

This electronic thesis or dissertation has been downloaded from the King's Research Portal at <https://kclpure.kcl.ac.uk/portal/>



The underground forest frontier in Mexico's Quintana Roo competing discourse and materialities surrounding caves and cenotes

Melo Zurita, Maria

Awarding institution:
King's College London

The copyright of this thesis rests with the author and no quotation from it or information derived from it may be published without proper acknowledgement.

END USER LICENCE AGREEMENT



Unless another licence is stated on the immediately following page this work is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International licence. <https://creativecommons.org/licenses/by-nc-nd/4.0/>

You are free to copy, distribute and transmit the work

Under the following conditions:

- Attribution: You must attribute the work in the manner specified by the author (but not in any way that suggests that they endorse you or your use of the work).
- Non Commercial: You may not use this work for commercial purposes.
- No Derivative Works - You may not alter, transform, or build upon this work.

Any of these conditions can be waived if you receive permission from the author. Your fair dealings and other rights are in no way affected by the above.

Take down policy

If you believe that this document breaches copyright please contact librarypure@kcl.ac.uk providing details, and we will remove access to the work immediately and investigate your claim.

This electronic theses or dissertation has been downloaded from the King's Research Portal at <https://kclpure.kcl.ac.uk/portal/>

Title:The underground forest frontier in Mexico's Quintana Roo
competing discourse and materialities surrounding caves and cenotes

Author:Maria Melo Zurita

The copyright of this thesis rests with the author and no quotation from it or information derived from it may be published without proper acknowledgement.

END USER LICENSE AGREEMENT



This work is licensed under a Creative Commons Attribution-NonCommercial-NoDerivs 3.0 Unported License. <http://creativecommons.org/licenses/by-nc-nd/3.0/>

You are free to:

- Share: to copy, distribute and transmit the work

Under the following conditions:

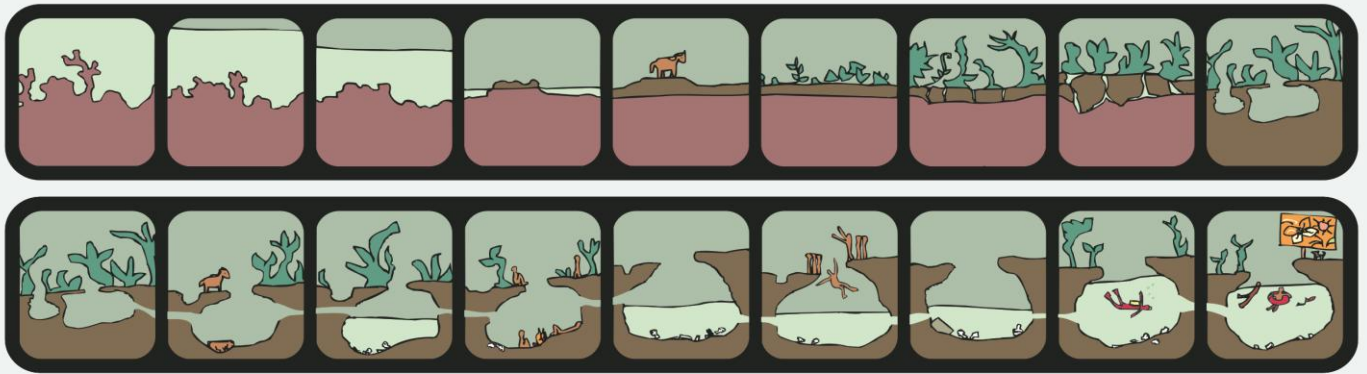
- Attribution: You must attribute the work in the manner specified by the author (but not in any way that suggests that they endorse you or your use of the work).
- Non Commercial: You may not use this work for commercial purposes.
- No Derivative Works - You may not alter, transform, or build upon this work.

Any of these conditions can be waived if you receive permission from the author. Your fair dealings and other rights are in no way affected by the above.

Take down policy

If you believe that this document breaches copyright please contact librarypure@kcl.ac.uk providing details, and we will remove access to the work immediately and investigate your claim.

The Underground Forest Frontier in Mexico's Quintana Roo: competing discourses and materialities surrounding caves and cenotes



A thesis submitted to King's College London
in accordance with the requirements for the
degree of Doctor of Philosophy in Geography

By María de Lourdes Melo Zurita

2012

Department of Geography, King's College London

Abstract

The Mexican state of Quintana Roo is home to a complex ecosystem. Beneath the state's surface is a riddle of flooded caves which form part of the world's most extensive aquifer, above the surface is a vast tropical dry forest, while along the coast line there is one of the world's longest coral reefs. These systems are directly linked by dispersed water sinkholes, known as cenotes, which pierce through the surface of the land and ocean floor. The state is also home to some of the fastest growing urban centres in the world, driven by mass tourism, the state's main economic activity. The intersection of these different complex processes and landscape has the focus of this thesis. In particular the research is interested in the appropriation of cenotes, how humans have related towards the underground systems, making use of them, controlling them, enclosing them and transforming them. The thesis draws upon the theoretical notion that commodifying nature has being a determinant way of how humans relate with nature. However these relations are ultimately shaped in different ways, according to each individual's position and function in the social system. Cenotes, for humans, have been and still are places to perform sacred and religious rituals, places to hide, places to deposit material goods, places to study, places to explore and places to be regulated. This thesis unpacks these relations, critically examining the main drivers of different socio-environmental outcomes in this underground forest frontier.

Acknowledgments

This thesis has counted on the support of many people. I will always be indebted to my lead supervisor, Mark Pelling, for the accurate and to the point advice. He is the one to be blamed for immersing me into the cenotes and caves world. I believe none of us was aware of the implications of choosing cenotes. I would also like to thank Michael Redclift, my second supervisor, for sharing his knowledge and experiences on Mexico and specifically on Quintana Roo. Both supervisors guided me in the most difficult times and provided insightful comments all along.

A big thank you goes to the Mexican Council for Science and Technology (CONACyT). Who has not only provided me with financial support throughout this PhD, but who has also helped to finance my previous studies in Mexico. CONACyT has heavily invested in me as an individual and I hope to repay them through future contributions from my personal, professional and academic life in relation to Mexico's unique environment.

Several organisations provided me with invaluable help and information during my fieldwork research. In Quintana Roo, I am grateful to the collaboration of Alejandra Serrano from Centro Mexicano de Derecho Ambiental; Alejandra Fregoso from Fundacion Amigos de Sian Ka'an; Paul Sanchez-Navarro, Edith Sosa and Alma Boada from Centro Ecologico Akumal; Mario Rebolledo from Centro de Estudios del Agua; Olmo Torres Talamante from ROZANATURA; and Carmen Rojas from INAH.

The ejidatarios of Quintana Roo, while they gave me a hard time, they also taught me that it does not matter how 'pretty' a methodological section looks on paper, when it comes to the field one needs to be creative. Thanks for the challenge! A special thanks go to Ejido Playa del Carmen, Ejido Jacinto Pat and Ejido Tulum. I would also like to especially thank Don Cleofas Pool (Playa del Carmen), Donato Castro (Jacinto Pat) and Gabriel Mason (Jacinto Pat) for sharing stories about a not so distant past and putting me in contact with 'others'.

I cannot mention here the names of all those belonging to the group of explorers that provided me with adventure, mystery and a lots of good times (as well as important data for this thesis). Nevertheless, I would specifically like to thank Daniel Riordan from Zero Gravity; Sam Meacham from CINDAQ; Luis Leal from Buceo Hecho en Mexico; Bill Phillips from Speleotech. I

am eternally indebted to Simon Richards and James Coke; they took this rocky researcher to the 'field in the field' and shared an absolute ton of information and time with me. James Coke and the material provided through the Quintana Roo Speleological Survey made this thesis far more interesting. While Simon Richards, provided hours and hours of his time 'cave-illuminating me', he actively participated in teaching me the intricacies of the hydrological system in Quintana Roo and filled this thesis with visual beauty through maps and pictures.

In Yucatan State, I would like to thank Carlos Evia from Universidad Autónoma de Yucatan; Raúl Manzanilla and Fátima Tec Poot from Grupo Ajau.

While writing this thesis, I have also counted on the friendship and advice of colleagues from multiple other universities and organisations. Many thanks to Ricardo Macip from Benemerita Universidad Autónoma de Puebla, Héctor Rodríguez from Universidad Nacional Autónoma de México and Lidija Mavra from Sock Mob (and King's College London).

Other friends that have been with me through my multiple theses and especially encouraged me through this one include: Letizia Silva, Ana Rosa Flores Soriano, Victoria Soriano, Ana Ramos Maurer, Donna Richards, Kat Richards, Emma Richards, Mary Henderson, Robbert Boyes, Elena Melo and Maria Tattaris.

My most special acknowledgment goes to my extended family, which have supported immensely during the last four years: Marilyn, Jim, Kylie and Rob.

My parents have always been my best source of knowledge and my strength through all my studies. If anyone is to blame for what I have written in the dissertation it is them! I must also thank my sisters and their families, who have been patient in the most difficult times especially when my presence was most needed.

On the 27th of September 2007 during student induction at the Geography Department at King's College London I met the person who has held my hand during this four (almost five!) years, Paul Munro. He has provided me with high doses of patience, optimism and critical feedback; I owe him more than I am able to publicly say. To my beautiful daughter Makena, she is the source of happiness that kept me going for the last two years, and a constant reminder of how easy it is to learn if we are willing to. I entirely dedicate this research to both of them.

Prologue

My own story about cenotes

When my supervisors, Mark Pelling and Michael Redclift, encouraged me to conduct my research on the cenotes and caves in Quintana Roo, I never thought that I would actually need to do some caving. Although, as a child, I had swum in cenotes and consumed lunch and drinks in nearby palapas, I never imagined what saying ‘yes’ to researching cenotes would entail.

The first cave I visited for my research was part of a cave system in the archaeological zone of Xel-Ha. Simon Richards and James (Jim) Coke, two resident cave explorers in Quintana Roo, invited me for a short visit to the system and some post-caving beers. Simon and I arrived at the archaeological zone and showed a letter to the guards, which granted us permission to enter the zone. When we arrived at the site, Jim’s truck was parked close to the cave entrance; he was already inside the cave and we were supposed to meet him in one of the passages. Simon joked about how people organise meetings with Jim. If someone wanted to meet with him, Jim would tell them: “meet me inside *this* cave in a dry passage that leads to the north entrance at 10 am sharp.” I laughed, but it was the honest truth.

I was completely unprepared for such a trip. As a social scientist, if someone invites you to be involved in something related to your research, you never say no. Luckily, Simon was equipped to accommodate my presence, bearing an extra helmet, lights and a double ration of insect repellent. Somehow deep inside me I thought:

I am Mexican. I do not need insect repellent, I am used to mosquitoes; I will not need sunscreen, I do not get sunburnt that easily; and I have been in the jungle. What could happen to me?

As it turned out, it didn’t matter how Mexican I was! I needed the repellent, the sunscreen and my courage in the jungle and it doesn’t matter how many times you’ve been in the jungle - you always need water. The Yucatan Peninsula sun is scorching, and the mosquitoes mean business. We walked along the track towards one of the cave entrances and, machete in hand, Simon cleared a path while pointing out different plants and trees in the area. He mentioned something about a rattle snake but I preferred not to think much of it.

We left everything that wasn't waterproof at the entrance and crawled into the cave. Simon was taking pictures and I was lost in thought, wondering why I had decided to write a PhD about caves and cenotes and questioning, on my hands and knees, crawling into the earth, whether or not I would be able to write anything theoretically or empirically relevant about caves. Just then, a bat breezed by my head. I felt the wind from its wings in my ear. Startled, I screamed. It landed in a formation and I watched the hairy creature that had, a few seconds earlier, made me scream and I was filled with admiration. We walked through different passages and, as we explored deeper, I tried to memorise as much as possible the path we were taking: where we turned right, where we had to swim with water up to our mouths, as well as the cave formations hanging from the roof scratching our helmets. After walking, crawling and swimming, it was time to find Jim. Simon had followed Jim's instructions accurately to the meeting point and we finally came to an open room where Jim was sitting, half his body underwater, pen and paper in hand, drawing fractures, formations, heights and entrances to more passages. That was the place where we remained for the next hour. During this time, Jim talked about cave fractures, Simon talked about hydrology and I kept thinking that if they left me there alone, I would not have a clue how to get out of the cave. At this point my research was seeming less and less relevant. Nevertheless, I still paid attention to the explanations about soil dissolution, the formation of certain cave features and, obviously, what time we were going to get dinner. It was an enlightening conversation, which made me aware of how unprepared I was to make interviews and 'explore' cenotes. We then headed back to the cave entrance. The mosquitoes gave me no respite, so I had to run back to the truck. I realized, again, how unprepared I was. Jim and Simon had a spare set of dry clothes but I did not. So I went to have dinner wearing the same muddy wet clothes I had worn in the cave.

Having post-caving food and drinks while discussing the day of exploration is part of the process and so, following tradition, we went to a nearby restaurant. After considering all the 'danger' I had been subjected to while visiting the cave, I thought that it would be safe to pat a Siberian-Husky dog that belonged to the restaurant's owner. It might have been my wet and muddy clothes or my self-reassurance of being safely above ground that made the dog suddenly bite my right hand, so concluding my exploration day in a hospital in Playa del Carmen.

After a couple of days I was cc-d in an email that Simon Richards sent to another hydrologist who specialises in the Yucatan's aquifer, saying: "I have met an anthropologist/geographer that has done 'proper caving' and she is doing research not from the desk but in the field!"

After that day I started visiting cenotes and caves every day, even using the verb: cenoting (*cenoteando*).

The belief that everyday experiences of nature socially construct our perception and influence our actions was a basic apotheosis of this study. My particular personal story of cenotes leads and influences the following analysis.

Acronyms

CALICA	Calizas Industriales del Carmen
CAPA	Comisión de Agua Potable y Alcantarillado Commision for Water and Sewage
CEDAM	Club de Exploración y Deportes Acuáticos Explorations and Watersports Club
CINDAQ	Centro Investigador del Sistema Acuífero de Quintana Roo Research Centre for the Quintana Roo's Aquifer
CONAGUA	Comisión Nacional del Agua National Water Commission
CONANP	Comisión Nacional de Áreas Naturales Protegidas National Commission of Natural Protected Areas
DOF	Diario Oficial de la Nación Official Gazzete of the Federation
EIA	Evaluación de Impacto Ambiental Environmental Impact Assessment
FIDECARIBE	Fideicomiso Caleta Xel-Ha y del Caribe
FONATUR	Fondo Nacional del Fomento al Turismo National Trust Fund for Tourism Development
FIPP	Fomento a la Inversión Pública y Privada Programme for Public and Private Investment in Rural Property
INAH	Instituto Nacional de Antropología e Historia Anthropology and History Federal Institute
LGAH	Ley General de Asentamientos Humanos Human Settlements Act
NPA	National Protected Areas

PA	Procuraduría Agraria Federal Attorney of Agriculture
PDU	Plan de Desarrollo Urbano Urban Development Plan
PROCEDE	Programa Nacional de Certificación de Derechos Ejidales y Titulación de Solares. Land Rights Certification Programme.
PROFEPA	Procuraduría Federal de Protección al Ambiente Attorney General for Environmental Protection
QRSS	Quintana Roo Speleological Survey
REPDA	Registro Público de Derechos de Agua Public Records of Water Rights
SAVE	Salvamento Akumal de Vida Ecológica Society of Akumal's Vital Ecology
SEDUMA	Secretaría de Medio Ambiente y Desarrollo Urbano Ministry of Environment and Urban Development
SEMARNAT	Secretaría del Medio Ambiente y Recursos Naturales Mexico's Ministry of Environment and Natural Resources
SRA	Secretaría de la Reforma Agraria Ministry of the Agrarian Reform

Table of Contents

Abstract.....	1
Acknowledgments.....	2
Prologue.....	4
Acronyms	7
Part 1. Introduction.....	16
1. Introduction: The cenotes of Mexico’s Quintana Roo.	17
1.1 The premise of nature’s commodification in Quintana Roo	19
1.2 Hypothesis and Contribution	20
1.3 Primary research location: Quintana Roo State.....	22
1.4 So... what is a cenote?	26
1.4.1 <i>Origin of the word ‘cenote’</i>	27
1.4.2 <i>Types of Cenotes</i>	29
1.4.3 <i>Caves</i>	32
1.4.4 <i>Cenote formation</i>	36
1.4.5 <i>Cliche Cenotes</i>	37
1.4.6 <i>Geographic distribution of Cenotes in the Peninsula</i>	39
1.5 The Underwaterscape	41
1.6 Understanding the underground forest frontier?	43
1.7 Thesis Structure	44
Part 2. Research Context.....	47
2. Literature Review: Nature as a Commodity.....	48
2.1 Capitalist commodification: is it just about the money?	50
2.1.1 <i>Privatisation or accumulation by dispossession</i>	51
2.1.2 <i>Economic valuation: the problem is the solution, and the solution is the problem</i>	53
2.1.3 <i>Alienability, Individuation, Abstraction and Displacement</i>	54
2.2 Institutions.....	57
2.3 Institutions and Natural Resources	60
2.4 Institutions and everyday life	62
3. Research Methodology.....	66
3.1 Reconnaissance trip: identifying research participants	67
3.2 Interviews: who to talk with, when and where.....	71
3.2.1 <i>Semi-structured Interviews</i>	72
3.3 Secondary data analysis	74
3.4 Constructing histories.....	74
3.5 Assuring rigour.....	76

3.6	The language and culture frontier	76
3.7	Fieldwork and analytic diary	77
3.8	The Analysis: coding data.....	77
3.9	Ethical and Moral Issues.....	79
3.10	Methodological development: challenges and changes	80
3.11	Observing the groups: the new methodological tool for this research	87
4.	An Environmental History of Cenotes	89
4.1	Pre-Hispanic cenote appropriation	89
4.2	The Spanish colonists and the rebellious Maya	93
4.3	Commercialisation and cenotes	99
4.4	Conclusions	105
Part 3.	Empirical Review: The deep view.....	107
5.	Cenotes: the Public View	108
5.1	Land	109
5.1.1	<i>Ejido creation.....</i>	<i>110</i>
5.1.2	<i>Ejido structure and cenotes.....</i>	<i>112</i>
5.1.3	<i>Ejido privatisation.....</i>	<i>118</i>
5.1.4	<i>Ejido and natural resources.....</i>	<i>121</i>
5.2	Groundwater regulation?	125
5.2.1	<i>CONAGUA and water abundance.....</i>	<i>126</i>
5.2.2	<i>Water bans</i>	<i>129</i>
5.2.3	<i>Water Pollution</i>	<i>130</i>
5.3	Cenotes.....	134
5.4	Environmental instruments.....	139
5.5	Archaeology.....	144
5.6	Institutions.....	146
6.	Cenotes: the Private View	150
6.1	Manufacturing the private sector: the Tourist Integral Centre Project of Cancun	152
6.2	The environmental impacts of commodification processes	156
6.3	The masterminds behind cenotes as commodities.....	158
6.4	The social construction of property and material enclosure	168
6.5	The division between landowners and private investors in commodifying nature	179
6.6	Conclusions.....	182
7.	The Explorers' Gaze	184
7.1	What do cenotes mean to explorers?	186
7.2	The History of cave and cenote exploration	187
7.3	Contemporary explorers of the underground forest frontier	193
7.4	Aquanauts in Maya-land: the Star Trek syndrome.....	195

7.5 Narrating nature: the importance of reporting for exploration.....	198
7.6 The commodification of exploration	202
7.7 Maps: let me show you what is underground.....	210
7.8 Explorers and the public sector: who knows what we got?	219
7.9 The impacts of exploration: tell me a story about cenotes.....	220
7.10 Campaigning for the cenotes	223
7.11 Cenoting: the act of relating to cenotes.....	225
8. Conclusion	227
8.1 Introduction.....	227
8.2 Thesis synopsis	227
8.3 Research questions: research answers	229
8.4 Summary of findings.....	231
8.5 Sectorial interaction	234
8.6 Pertinence and relevance: the underground forest frontier outside Quintana Roo ..	240
9. Reference List.....	242
Glossary	265
Appendix 1: Interview templates	268
Appendix 2: Coding example	270
Appendix 3: Analytical diary example	271
Appendix 4: Transcribed interview example.....	273
Appendix 5: List of Research Activities.....	277
Appendix 6: Ethical Approval Letter	284
Appendix 7: SAVE’s letter to President Felipe Calderon	285
Appendix 8: SAVE’s map Underground Rivers	289

List of Figures

Figure 0.1 The Underground Forest Frontier	16
Figure 1.1 Billboards of Mexican Cenotes.....	18
Figure 1.2 Quintana Roo’s Forest.....	24
Figure 1.3 Hall’s (1936) four types of cenotes diagram	29
Figure 1.4 Hall’s type A cenote.....	30
Figure 1.5 Hall’s type B cenote.....	30
Figure 1.6 Hall’s type C cenote.....	31
Figure 1.7 Hall’s type D cenote	31
Figure 1.8 Profile of cenote Humon Dzonot	33
Figure 1.9 Cavern and Cave diagram.....	34
Figure 1.10 Caves and Caverns.....	35
Figure 1.11 Cave diver prepares to dive.....	35
Figure 1.12 Breakdown pile in Cenote Angelita.....	37
Figure 1.13 Sump at Aktun Chen cave	38
Figure 1.14 Rebajadas, Derrumbes and Pozos.....	39
Figure 1.15 Aquifer’s diagram	42
Figure 0.2 Caves of Xtacumbilxuna’an	47
Figure 2.1 Producing a cenote.....	48
Figure 4.1 Cenote History timeline	91
Figure 0.3 The Deep View	107
Figure 5.1 Official INAH logo and reinterpretation	146
Figure 5.2 Institutional architecture of cenote management.....	148
Figure 6.1 Cenote Chac Mool	161
Figure 6.2 Jacinto Pat Children back in the 1980s.....	162

Figure 6.3 Cenote Nohoch Nah Chich	163
Figure 6.4 Cenote Chanolandia	172
Figure 6.5 Extracted pieces from cenote	173
Figure 6.6 Cenote Aktun Chen	174
Figure 6.7 Maya-like ceremony in a cave.....	176
Figure 7.1 Photograph of Thompson	190
Figure 7.2 The Well of Death.....	191
Figure 7.3 Aerial view of the Sacred Cenote at Chichen Itza	192
Figure 7.4 Tulum Municipality Emblem	200
Figure 7.5 A journey to Sian Ka'an	201
Figure 7.6 Loco gringo underground brochure	203
Figure 7.7 Experience the new frontier brochure.....	204
Figure 7.8 Without exception everybody pays	207
Figure 7.9 QRSS survey data contributors.....	213
Figure 7.10 Aguas con los cenotes	223
Figure 8.1 Institutional Interactions in the Underground Forest Frontier	238

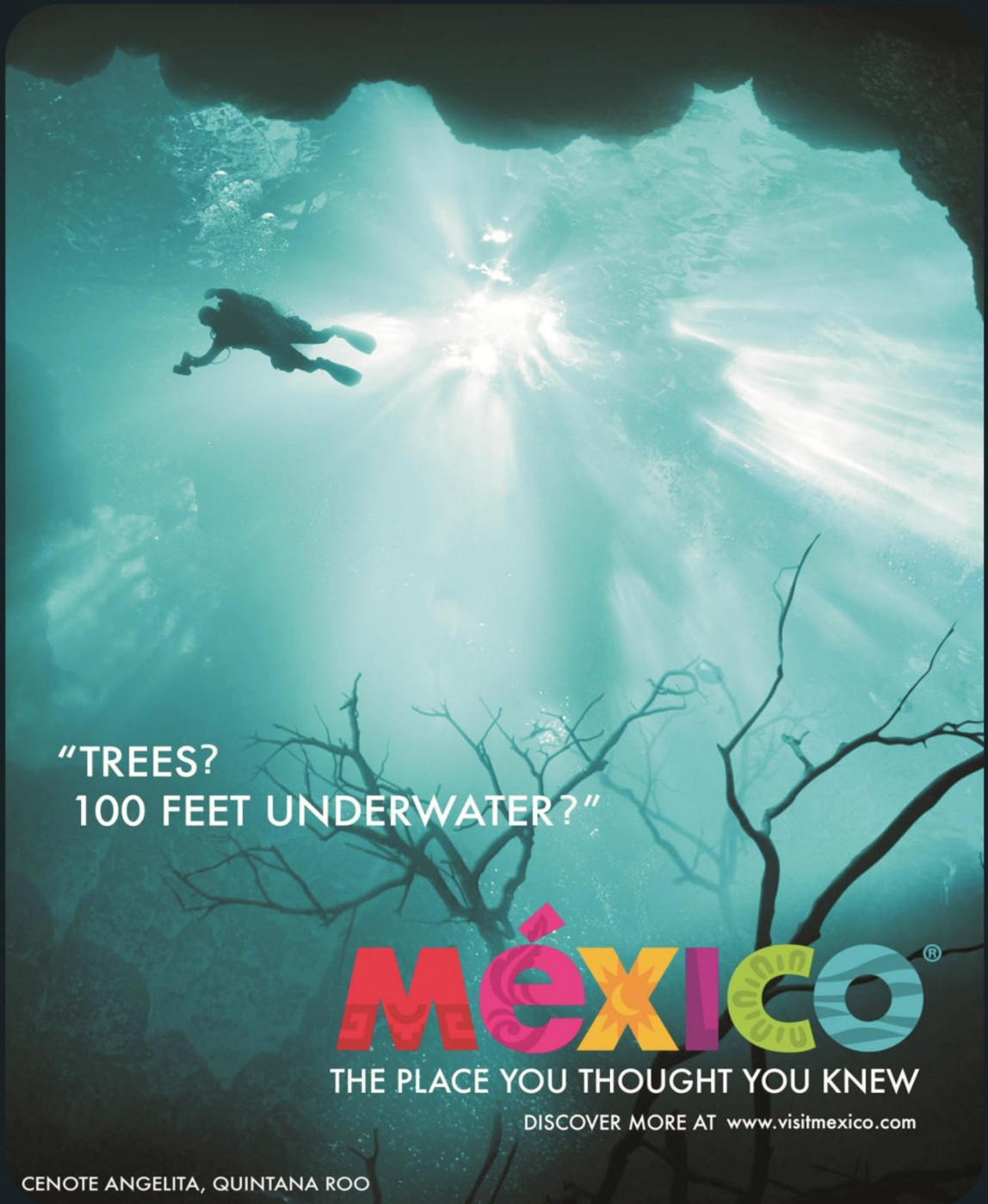
List of Tables

Table 3.1 Ejido Playa del Carmen cenotes visited during the field research period	81
Table 3.2 Ejido Jacinto Pat cenotes visited during the field research period	83
Table 3.3 Private land cenotes visited during the field research period.	85
Table 3.4 Cenotes located in National lands visited during field research	87
Table 3.5 Field trips attended during the field research period	88
Table 5.1 Waters of the ejido	122
Table 5.2 Responsibilities of Mexico's Water Catchment Authorities	126
Table 5.3 Concessions for utilizing groundwater	138
Table 5.4 Legal Frameworks.....	141
Table 6.1 A good cenote for tourist exploitation	177

List of Maps

Map 1.1 Map of Research Area.....	23
Map 1.2 Elevation and gross geological features of the Yucatan Peninsula.....	40
Map 3.1 Map of Case Study Area.....	68
Map 4.1 Maps of the Yucatan Peninsula.....	95
Map 4.2 A 1936 map of Henequen and Chicle on the Yucatan Peninsula.....	100
Map 5.1 Ejido Distribution in Quintana Roo	113
Map 5.2 Quintana Roo Municipalities.....	124
Map 5.3 Map of Water ban areas	130
Map 7.1 Sac Actun.....	211
Map 7.2 Bubbles.....	214
Map 7.3 Tulum and Playa del Carmen exploration process	216
Map 7.4 Tulum historical exploration shown in five year clusters	218

PART ONE INTRODUCTION

An underwater photograph of a cenote. A diver is silhouetted against a bright light source at the surface, creating a starburst effect. The water is a deep teal color. In the foreground, the skeletal remains of dead trees are visible, their branches reaching upwards. The overall atmosphere is mysterious and ethereal.

"TREES?
100 FEET UNDERWATER?"

México[®]

THE PLACE YOU THOUGHT YOU KNEW

DISCOVER MORE AT www.visitmexico.com

CENOTE ANGELITA, QUINTANA ROO

Figure 0.1 – 'The Underground Forest Frontier' Advertisement produced by Visit Mexico

Chapter One

Introduction: The cenotes of Mexico's Quintana Roo.

The image (Figure 0.1) on the previous page shows an underwater shot of Cenote Angelita located in the Mexican state of Quintana Roo. Cenotes are water sinkholes and are located across the Yucatan Peninsula in which Quintana Roo is situated. They operate as entrances to the Peninsula's extensive aquifer, which is considered to be the most extensive aquifer in the world with flooded caves systems up to 215 kilometres long. The importance of this aquifer is emphasised by the near absence of superficial water systems (rivers, lakes) on the 138,017 square kilometre Peninsula, meaning that all potable water for the Peninsula's inhabitants comes from this aquifer.

But the image also shows something else: the 'subtle' commodification of cenotes as places to be visited, discovered, explored and, ultimately, consumed. The image has been part of a Mexican tourism campaign in the United States, where large posters of it were strewn across billboards in different cities (Figure 1.1). In the context of Quintana Roo state's recent rapid tourism development, cenotes have increasingly come to the fore in public and private sector discourses and activities as natural spaces to profit from, to manage, and to explore. It is on this interaction of discourses and development that this thesis will be focused. Specifically, its main goal will be to critically examine the commodification of cenotes (i.e., nature) and its related social and ecological outcomes in the Mexican state of Quintana Roo.

During the last 30 years in Quintana Roo, in the heart of Mexico's neoliberal era, nature has been reconfigured: new values, new markets, new commodities, and new consumption processes have emerged as a result of a complex confluence of eco-managerial bureaucratic interests in the context of a relatively young organised civil society, communal land ownership systems and a debilitated government presence. This study's objectives are therefore to examine the social constructions of the underground in Quintana Roo, exposing how different identity groups relate to objects of nature according to their values and then to explore how such values are transformed into materialities in a complex political scenario.

One concept created for and utilised throughout this thesis is that of the ‘underground forest frontier’. The concept is an attempt to reflect the natural and human complexity of the geographical place which is the focus of this study. The phrase ‘underground forest frontier’ makes reference to the vast water aquifer that is situated under the Yucatan Peninsula’s forested area, as well as to the multiple social constructions surrounding the aquifer. In this case, the ‘frontier’ corresponds to the social concept of a liminal space separating two socially constructed ‘worlds’, but at the same time it is also a material space unifying the aboveground and the underground. The physicality of such a frontier also imposes certain social and natural dynamics, which will be discussed within this thesis.

The underground forest frontier is not just the aquifer, but also makes reference to the forest that has been subjected to urban development and other types of transformation, making land, soil and forest objects of mercantilisation. To probe these complexities, this thesis will focus on one object of nature that forms an integral part of the underground forest frontier: the cenotes. In doing so, the intention is both to reflect upon and analyse the social relations and political structures that forge the construction and management of nature. Thus, the underground forest frontier concept references both a physical and socially constructed space of cenotes and the aquifer they provide entrances to, recognising that our understanding of nature is ultimately a product of both material and discursive processes.

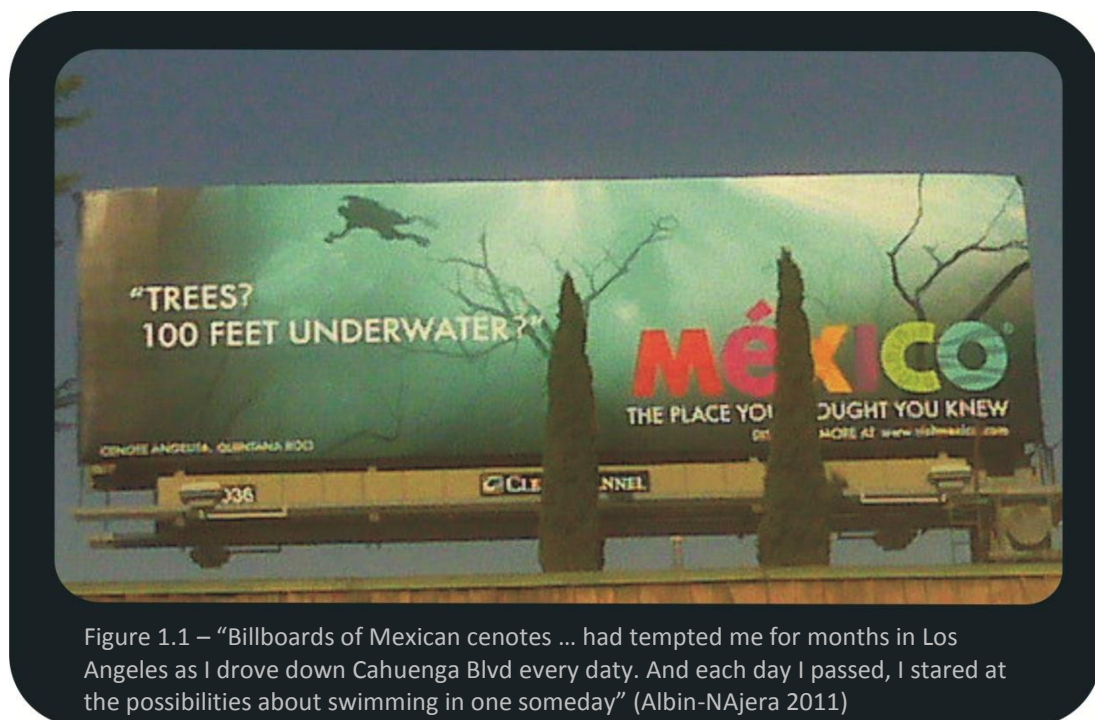


Figure 1.1 – “Billboards of Mexican cenotes ... had tempted me for months in Los Angeles as I drove down Cahuenga Blvd every day. And each day I passed, I stared at the possibilities about swimming in one someday” (Albin-NAjera 2011)

The approach of this study is to capture and analyse the perspectives of the collectives of actors (groups) who interact with the underground forest frontier and the subsequent material consequences that unfold as a result of their perspectives. The participants are grouped into broad 'identity groups': the public sector, private sector, and explorers. Doing so makes it possible to examine their discourses as well as to observe and describe their actions, both as members of their respective groups and as individuals sharing a certain identity.

Such cluster-type organisations also allow for the mapping of the social construction of Quintana Roo's underground forest frontier. Identifying the extent to which actors champion different values in this context, the study conceives that these values are ultimately transformed into actions: privatisation, enclosure of nature, exclusivity, and dispossession. They are also transformed into awareness of the nonhuman by 'local' actors, including businesses, government regulators and local residents, as well as by transitory actors such as researchers and tourists.

1.1 The premise of nature's commodification in Quintana Roo

As it has been discussed at the theoretical level by academics such as Castree (2000, 2001, 2003), Mansfield (2003, 2004, 2007) and Bakker (2005, 2007), there are various factors driving commodification processes, like in the case of Quintana Roo. A central factor is that government agencies have chosen not to actively engage with the underground forest frontier; instead, a set of informal institutions and environmental markets have shaped the use of the land, the aquifer and the cenotes marking its gateways. Thus, the underground in Quintana Roo represents a physical frontier that had been left unaddressed by formal institutions until this research started in 2007, with some early efforts of management first observed in 2009 (Chapter 5). There have been groups of explorers developing maps, measurements and discussions about the underground forest frontier (Chapter 7), but thus far no direct formal regulations have been proposed. Meanwhile, private investors (Chapter 6) have proven active in 'owning' resources that have not been formally privately 'owned' before. It can therefore be argued that it is these investors along with tourism developers who control the neoliberal environment in Quintana Roo, and therefore are openly promoting an economic commodification of cenotes.

This thesis analyses the development of different commodification processes of nature, using the cenotes of Quintana Roo as the case study and taking into account how remnants of previous social systems, such as communal ownership of natural resources, have influenced

the development of the present ones. It is contended that the vague definition that has been given to some natural features at the institutional level, such as the word 'cenote' itself, has ultimately favoured the creation of environmental markets and informal processes such as the production of enclosures. In light of this, the thesis will examine the implicit role of the Mexican Government as a silent promoter of informal mechanisms of privatising natural resources, as well as promoting intensive practices of use and appropriation, the profits from which have become important contributors to local livelihoods and international businesses in Quintana Roo.

In examining commodification processes in this way, this research also tracks the historical processes and pressures through which different values have been ascribed to the natural environment. A historical perspective is therefore taken in combination with primary data collection. Both are interwoven with theoretical discussions to draw meaning from observations where, very often, multiple interpretations can be made from singular material objects of nature like cenotes.

1.2 Hypothesis and Contribution

The overarching hypothesis of this thesis is that cenotes, in their current state, are the result of social constructions of nature, with nature's self-transformation processes occurring at very slow rates. Therefore, discursively – oral or written – and through actions, the nature we observe, experience, consume and commodify is the result of a continuous social and political process of humans constructing nature. As will be argued, these constructions of nature operate in a field of power and, as such, some constructions dominate and influence others. As this study will show, those inclined towards promoting economic profit tend to particularly dominate.

One of the contributions of this thesis will therefore be to build on existing literature about nature's commodification. A lot has been discussed, theoretically, about nature and its objects as commodities, but rarely have the processes been described and analysed. In this sense this thesis tracks values given to cenotes and caves through time, recovering narratives made by different actors in different historical moments and the actions evidencing their relation with nature.

To this end, the research will address the following questions:

1. What types of commodification do we see in Quintana Roo regarding caves and cenotes and with what social and material outcomes?
2. Has the underground forest frontier in Quintana Roo – comprising cenotes, caves, water, archaeological artefacts, geology, flora and fauna – been perceived and promoted predominantly as a set of capitalist commodities and, if so, through what processes and by who?
3. Can nature – cenotes and caves – be privatised? Can they be accumulated?

Although elsewhere it has been theoretically asserted that markets tend to homogenise formal responses to nature's management and therefore the involvement of the public and private sectors, this thesis argues that a vast range of definitions and values (social constructions) are given to objects of nature and such multiplicity creates a more than 'economist capitalist' way to manage nature. Studying the role of institutions therefore becomes a key strategy in the understanding of the local process of dealing with nature, posing the question of:

4. What is the institutional role of the different actors participating in the underground forest frontier?

One immediate empirical goal of the thesis is to respond to the lack of contemporary studies in Quintana Roo about the social and political dynamics taking place in the underground forest frontier. This will stand in contrast to the abundance of studies focusing mainly on the environmental management of the state's coastla environs. The research presented here will initially reconstruct the history of how cenotes have been depicted, experienced and socially constructed since the first 'outsiders' to the Peninsula started to talk about the water sinkholes. Existing research on the cenotes in Quintana Roo has mainly been in the realm of natural sciences, where hydrologists have examined water flows and water quality (Perry *et al.* 1995, 2009; Beddows 2007), geologists have examined cave formations (Smart *et al.* 2006), biologists have examined flora and fauna (MacSwiney *et al.* 2007, 2009; Moravec 1995), and palaeontologists have examined pre-historical human and animal remains (Gonzalez *et al.* 2008). Important ancient Maya artefacts are found in cenotes, which has meant that considerable attention has been paid to archaeological studies (Rojas *et al.* 2008). The absence of previous studies regarding the social dynamics and the use of the underground forest frontier seem to be obscured by the presence of natural science studies of the area. Therefore, the pertinence of this research lies in its contribution to the discipline of human geography, as it presents an in-depth case study that explores the relationship between social groups and

their natural environment (i.e. the underground forest frontier). It also contributes to the studies of underground systems from a social perspective.

There has been very little research on cenotes and the underground aquifer from a social scientific perspective. Existing anthropological studies have almost exclusively focused on the role of cenotes in Maya mythology (Rissolo 2005), with critical studies on the contemporary social-environmental aspects of cenotes essentially non-existent. There have been a handful of publications examining cenotes in a few specific historical contexts (Andrews and Corletta 1995; Martos 2008; Ruiz 1999), but prior to this research project no one has conducted an in-depth social scientific analysis of cenotes in the contemporary or extended historical context.

So far, literature on the underground has generally focused on the extraction of minerals or other resources in complex socio-political contexts (*cf.* Bridge and Fredriksen 2012; Bridge 2004a, 2004b; Bebbington *et al.* 2008; Keeling and Sandlos 2009), commonly exposed as the intense utilisation, extraction and commercialisation of natural resources. Human geography and anthropological studies of caves around the world have examined and analysed the cultural meanings of these places for different groups and, in a more recent fashion, have described the embodiment process where individuals, most of the time explorers, describe their experiences of the underground. The innovative element of the current study is its joining of two perspectives – one of utilisation and the other of embodiment – to explain social processes occurring in the underground forest frontier. Ontologically, this study favours a constructionist position where materialities (the physicality of nature) and subjectivities (meanings ascribed to it) interact in a constant process of adding multiple values to nature with material and discursive outcomes.

The research and analysis for this thesis was conducted between 2007 and 2011, with an extensive field research period between 2008 and 2010 in the Mexican states of Yucatan and Quintana Roo. It involved semi-structured interviews with a broad diversity of relevant actors, in-depth participant observation, and the analysis of a variety of historical and contemporary literature. A full scholarship was provided by the Mexican National Council on Science and Technology (CONACyT) for the PhD research period.

1.3 Primary research location: Quintana Roo State

The state of Quintana Roo, located in the south-east of Mexico, is one of three states that make up the Yucatan Peninsula. It is the youngest state in Mexico, having been demarcated out of Yucatan State in 1902 as an independent territory, before being awarded state status in

1974. The state covers an area of about 42,000 km² (specific state boundary lines are yet to be fully defined) and has some 900 kilometres of coastline, much of which includes beaches.



Map 1.1 – Map of research study area. Produced using data from INEGI, Google Earth and NASA/JPL-Caltech with assistance from Jim Coke at QRSS and Miriam Reza at Amigos de Sian Ka’an (Simon Richards 2011).

The ecosystem of Quintana Roo includes tropical forests, mangrove forests and coral reefs. The forests of Quintana Roo are classified as a tropical deciduous forest, with an annual rainfall of 1,000–1,300mm per year (Bray *et al.* 2004). It is one of Mexico’s few remaining tracts of lowland tropical forest (See Figure 1.2). The mangroves of Quintana Roo are part of a coastal formation that also includes estuaries, coastal dunes, and coral reefs (SEMARNAP, 1996). These are particularly important ornithological sites, with approximately 200 different species of birds nesting within the mangrove corridor (López-Ornat 1992). The Mesoamerica Barrier Reef System traces the entire length of the Quintana Roo coast and continues southwards to

Honduras. It is the second longest barrier reef in the world and is home to important populations of fish, turtles and manatees.



Figure 1.2 – Quintana Roo’s Forest. Sian Ka’an Biosphere Reserve.

Quintana Roo is perhaps best known internationally for its resort town Cancun. Established in the 1970s, it has become one of the premier ‘sun and sand’ package tour destinations in the world. The success of Cancun and the subsequent ‘Riviera Maya’ tourist area, which has developed to the south of Cancun, have caused a dramatic change in the social and political make-up of the state. Prior to the 1970s, Quintana Roo was a sparsely populated territory, with an estimated population of 26,967 inhabitants in 1950. This number dramatically rose to 1,325,578 permanent inhabitants in 2010 (INEGI), a growth rate that has largely been driven by the migration of people from other parts of Mexico to fulfil the service needs of the booming tourism industry. The state was estimated to have received 7,518,458 tourists in 2010, along with an additional 3,616,097 tourists from passing cruise ships (SEDETUR 2010). In a short period of time, Quintana Roo was transformed from a largely uninhabited territory to a state with a newly immigrant and highly transient population.

This dramatic demographic change has caused remarkable transformations in social relations and interactions with cenotes and the aquifer, both materially – i.e. how cenotes are used – and discursively – i.e. how cenotes are defined.

Prior to the tourism boom, the population of Quintana Roo was predominantly made up of the Maya ethnic group, who had been the dominant civilisation in the region for over 1,500 years, prior to the arrival of the Spanish in 1511. In Maya cosmology, the aquifer was a sacred place, which represented a mythical underworld where *chaaks* (rain gods) dwelt, and which could only be accessed via sacred cenotes. The offering of objects into certain sacred cenotes was a frequent practice across the Peninsula; this even included human sacrificial offerings in some locations (Martos 2008). Similar cosmological beliefs are still in existence among many of the contemporary Maya in Quintana Roo, sometimes in the form of syncretised Maya-Christian belief systems, a by-product of the Spanish evangelisation process (such as the Cult of the Talking Cross – see Chapter 4 for more details).

However, the Maya population in the state is now a distinct minority. By 2000, this population had been reduced to 18.7% of the state's demographic (INEGI 2005), and by 2005 it was 13.7% (INEGI 2009). This trend is likely to have been continuing until the present. In the tourism corridor of Quintana Roo, where the bulk of the state's immigration has occurred, the percentage of Maya is almost certainly even lower.

With the arrival of Quintana Roo's new immigrants and large tourist population, new relationships with the underground forest frontier have been established. The majority of tourists in Quintana Roo come to visit the state's famous beaches and perhaps snorkel or dive in the renowned Mesoamerican reef. For most of the tourists, the relationship with the Peninsula's aquifer is somewhat disconnected, with it being limited to the role of providing potable water and receiving generated waste. This was especially the case during the 1970s and 1980s when the role of cenotes in the urban and tourism development of the Peninsula had little or no prominence in government discourse. However, in the last couple decades, questions surrounding the underground forest frontier have gradually become prominent in tourism, private sector and public sector discourses.

This seems to have occurred due to three interrelated processes. The first of these is the increasing prominence of cave diving on the Peninsula. The Peninsula's intricate and mostly unexplored flooded cave systems have attracted a variety of cave divers who have been intrigued, among other things, by the thrill of exploring 'virgin' cave passages, the potential of

discovering Maya artefacts, and the opportunity to make new scientific discoveries. The eclectic members of this cave diving community have gradually brought to the surface, albeit in a fragmented fashion, more and more information about the underground forest frontier.

Second and partially buoyed by the pioneer cave divers' discoveries, cenotes have increasingly become valued sites for tourism, with visitors to the Yucatan Peninsula paying to swim, snorkel and dive in their fresh waters. Interestingly, with this new and increasing use of cenotes, there has been a (re)promotion of the notion of cenotes as entrances to the Maya underworld – now packaged in a sanitised form to add an extra mystique to the tourist experience of visiting a cenote (this argument will be discussed in depth in chapters 6 and 7). This has also had an impact on the broad tourism market, with many operators looking to purchase, rent or even 'construct' their own cenotes.

Finally, there have been growing discourses at government level about the need to find ways to manage and protect the aquifer. This has been brought to the fore due to increasing information and concerns surrounding the pollution of the system by the rapid urban growth of the state, and by the increasing transformation of cenotes for tourist consumption.

It is the convergence of these three factors that this thesis takes as key to the subsequent analysis; that is, the interrelated roles that the explorers, private sector, and the public sector actors play in socially constructing new meanings and producing outcomes around the underground forest frontier.

The following section will elaborate on the explanations of the underground forest frontier physical processes of formation and transformation. The main intention of the next section is therefore to provide a general understanding of the physicality of the systems in Quintana Roo as a stage where discourses and action take place.

1.4 So... what is a cenote?

A fundamental element of this thesis is for the reader to have a good understanding of what a cenote is and the complexities and unknowns of the underground forest frontier. Therefore, this section provides a relatively detailed hydrological and geological account of how cenotes are formed and their relationship to the Yucatan Peninsula's underground aquifer. While the analysis of cenotes in this thesis is a work of human geography, the development of 'transactional expertise' was an important element of the research project. Subsequently, this chapter involves a discussion of what cenotes are in terms of their physicality. This is highly

relevant, as it is the limited knowledge of such physicality that is having significant implications for the development and shaping of outcomes.

1.4.1 *Origin of the word 'cenote'*

The word 'cenote' comes from the Spanish transformation of the Maya term *dzono'ot*, which roughly translates as 'water-filled cavity'. It has now entered the English vocabulary and has been used to describe similar sinkhole formations in karst landscapes around the world (cf. Jaume *et al.* 2001; Webb *et al.* 2010; Marker 1976; Grimes 1994; Gomes 1985; Beck 1986; Dasher and Boyer 1997; Brook *et al.* 1998).¹ 'Karst' itself is another example of word migration, referring to a geological formation that has been shaped by the dissolution of layers of soluble bedrock, of which the Yucatan Peninsula is a classic example. Karst is a Germanicisation of the Slovene name *Kras* for the region in Slovenia and Italy where the first scientific research of a karst topography was conducted (see Cvijić 1893).

The word cenote has perhaps had greater resonance in English in recent times due to the term travelling globally as a result of the promotion of cenotes as sites of tourist consumption. When the word cenote is used in scientific contexts it is rarely contextualised in its etymological and geographical origins, as with most of the migrant words integrated into foreign languages. In this sense, karst from the Germanicisation of *Kras* and cenotes from the Spanishisation of the Maya *dzono'ot* are two concepts that will be constantly used in this study. It is important to take into consideration that the adoption of words by other languages is not a random event; rather, it is evidence of the usefulness of a concept whose application in foreign spaces may be valuable.

Regular usage of the word cenote has been recorded from the early colonial period (i.e. de Landa [1566] 2001; although he spelt them as *zenotes*; see Chapter 4), and scientific studies dating from the late 19th century and early 20th century also provided descriptions that commonly use the word. This included early attempts by researchers to describe and classify cenotes (cf. Mercer [1896] 2005; Thompson 1897; Charnay [1882], 1992; 1888; Casares 1902; Cole 1907, 1910; Hall 1936; Pearse *et al.* 1936). In the introduction to the 1936 edited collection *The Cenotes of the Yucatan - a Zoological and Hydrographic Survey*, Pearse *et al.* describe the usage of the word by local populations as follows:

¹ 'Doline' and, particularly in the US, 'sinkhole' are also used.

[The word cenote] is somewhat loosely used in Yucatan to refer to various types of bodies of water contained in cavities in the limestone ... In the interior of the peninsula a typical cenote is a deep, well-like hole in which the water level is some distance below the surface of the ground. Yucatecans distinguish *aguadas*, or shallow water-holes, and water-containing *cavernas*, or caves, from cenotes, but the three types grade into one another and, as said, there is a tendency to use cenote in a general way to include all limited, inland, freshwater environments (Pearse *et al.* 1936:4).²

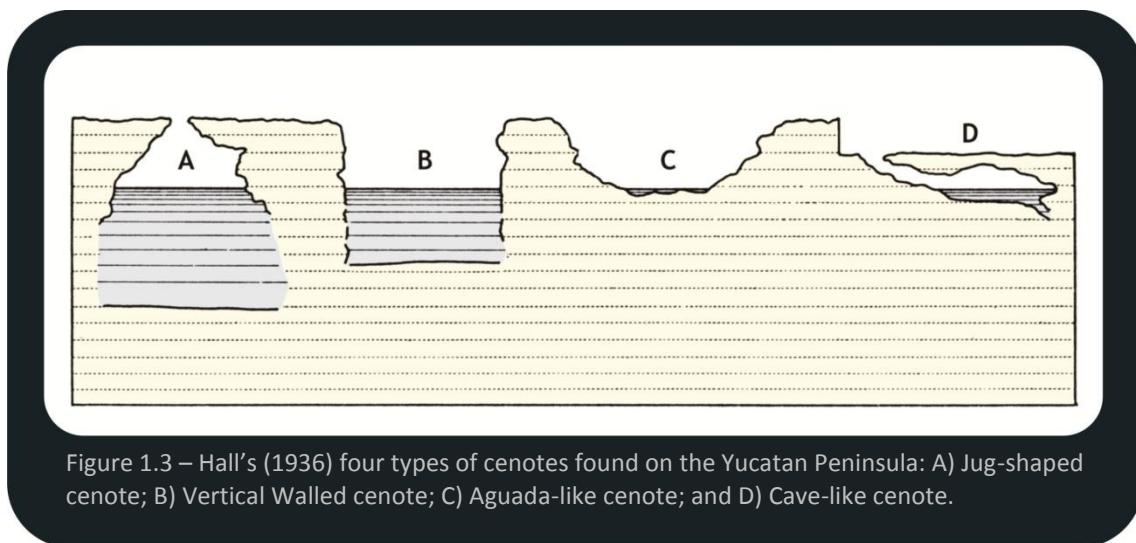
In the prominent geological text *A Glossary of Karst Terminology*, a cenote is defined as a 'steep walled natural well that extends below the water table; generally caused by the collapse of a cave roof' (Monroe 1970: 7). The current usage of cenote and *aguada* by researchers is largely based on local usage, and does not depart noticeably from what Pearse *et al.* used in *The Cenotes of the Yucatan*. However, US speleologists and cavers commonly describe deep voids with near-vertical walls as 'pits' (Monroe 1970), and some speleologists therefore use the term 'pit cenote' to describe deep steep-walled cenotes, or 'covered pit cenote' where the cenote ceiling is largely intact (*cf.* Beddows *et al.* 2007; Stoessell *et al.* 2002).

As a result of research and tourism, the word cenote has also been integrated into the political discourse and vocabulary of certain actors in the public and private sectors of Quintana Roo, and also at the federal level of the Mexican Government. The relevance of this, from the academic point of view, is the association between a word and its meaning and image. This study pays close attention to the definitions and meanings that different research participants provided of cenotes and similar ecosystems, as well as the value of having a Maya-origin word integrated within national and international scientific projects. This also helps to reflect on the importance of these systems in different geographical contexts, especially in terms of environmental management of similar landscapes around the world. The intentions of protecting karst ecosystems and their underground aquifers are globally shared. As such, using concepts like cenote in different geographical contexts helps to homogenise understandings of karst systems around the world and reflects a social process where science acts as a means of transportation. Nevertheless, the uses of the word cenote, including those developed in this study, have failed to pay credit to 'non-outsiders' knowledge of cenotes, including other Maya words to describe similar systems, but that according to local Maya knowledge fall under another classification.

² Interestingly while Pearse *et al.*, used italics for all Maya and Spanish terms in the edited collection, the word cenote is always non-italicised, suggesting a possible early acceptance of cenote as an English word.

1.4.2 Types of Cenotes

There is no agreed formal classification of cenote types in the scientific realm. However a study by Frank Hall in 1936 is often used as a departure point for more recent discussion about cenotes (*cf.* Alcocer *et al.* 1998; Hevly 1974; Schmitter-Soto *et al.* 2002). In his study, Hall examined a sample of 30 cenotes, describing how cenotes varied in morphology. While he reported that intermediate types of cenotes may exist, most of his sample could be classified into four main types, which he illustrated in a cross section morphology profile, a diagram that has been extensively used in cenote studies almost without modification (see Figures 1.3-1.7).



Hall's types A and B cenotes are both steep walled voids with an opening at the top and water at the bottom. The difference is that type B has near-vertical walls, while type A has a smaller surface opening and widening with the depth. Hall's type C cenote is distinguished by less steep walls and shallow water, while the type D cenote shows an offset between the surface opening and the water surface.

The following sections offer alternative descriptions of the material features of the underground forest frontier, along with photographs provided by Simon Richards, a hydrologist based in Quintana Roo. Such photographs offer an efficient method for the explaining and describing of different features of the Peninsula's aquifer system.

The first set of photographs corresponds to Hall's type A cenotes. The ceiling is pierced by a number of dissolution holes that led to the fresh water aquifer. Photographs in Figure 1.4 show the entrance from above and below; beneath it there is a void of 30 to 40 metres in diameter. These types of cenotes are also often referred to as 'pit cenotes.'



Figure 1.4 – Hall's type A cenote. Cenote near Coba (Photos taken by Simon Richards).

Comparatively, type B cenotes have a wider entrance, sometimes with residual overhang from the ceiling collapse (see Figure 1.5). Cenote images, like the ones below, have travelled around the world and captured people's imagination with the 'beautiful natural pools' that pierce the Yucatan Peninsula landscape. Types A and B cenotes are commonly found further inland in the Peninsula, although their appearance in the coastal side of Quintana Roo is not unusual and, therefore, highly valued by explorers interested in deep-diving techniques.

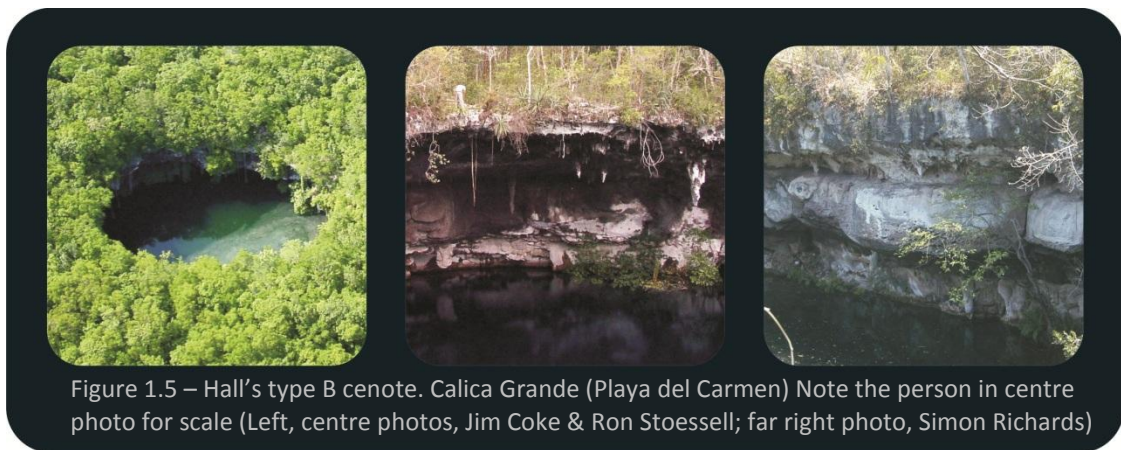


Figure 1.5 – Hall's type B cenote. Calica Grande (Playa del Carmen) Note the person in centre photo for scale (Left, centre photos, Jim Coke & Ron Stoessell; far right photo, Simon Richards)

The images in Figure 1.6 show what could be classified by the 'local' population as an aguada or a temporal body of water. The image to the extreme left shows a shallow temporal aguada at X'cacel. Water level monitoring by Simon Richards during 2010-2011 has shown that this 'aguada' is not hydraulically connected to the underlying principal aquifer. The central image shows an aguada-like cenote (Hall's type C), named Ak'al Che', which is connected to the longest recorded underground flooded cave system in the world, the Ox-Bel Ha cave system. In appearance, the first and second images are very similar, except that at the centre of Ak'al Che' there is a tube leading down to the aquifer system. The photograph to the far right shows another aguada-like cenote located in X'cacel; although in the picture it is possible to discern signs of rock breakdown, suggestive of a physical collapse during cenote formation,

hydrological studies in the area also suggest no direct connection with the aquifer (126/ May2009).

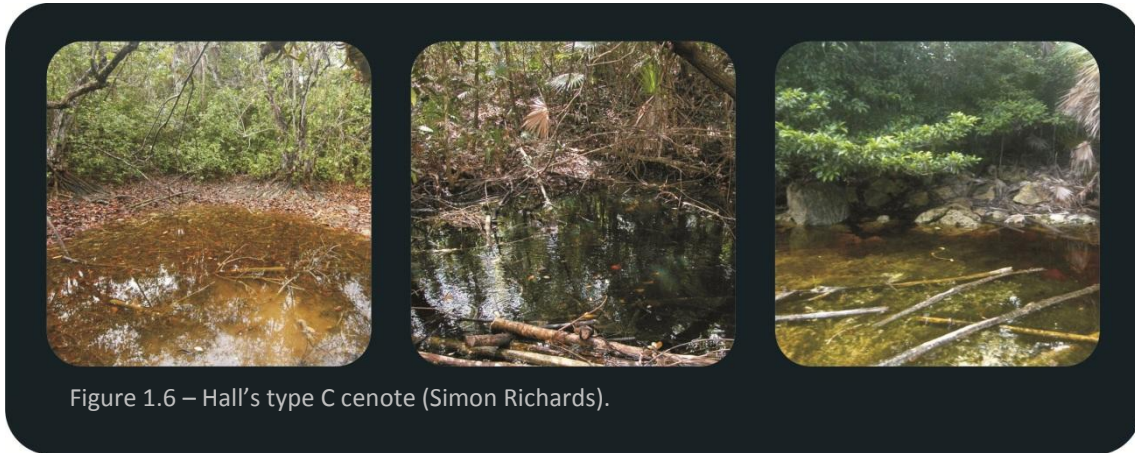


Figure 1.6 – Hall's type C cenote (Simon Richards).

Finally, cave-like cenotes, or Hall's type D cenotes, are frequently found in the Quintana Roo area and recently have been the object of tourism development due to their 'easier' accessibility, allowing for the development of walking, swimming and/or snorkelling tours in them. Photographs shown in Figure 1.7 are of cenote Ev at Xel-Ha archaeological zone located between Playa del Carmen and Tulum. To the left it is possible to see the entrance to the system, with James Coke, renowned explorer of the area, acting as a model for scale. The centre image shows the breakdown room (where the collapse occurred) and the far right image shows the water entrance connecting with one of the most popular cave systems in the area, the Dos Ojos underwater cave.

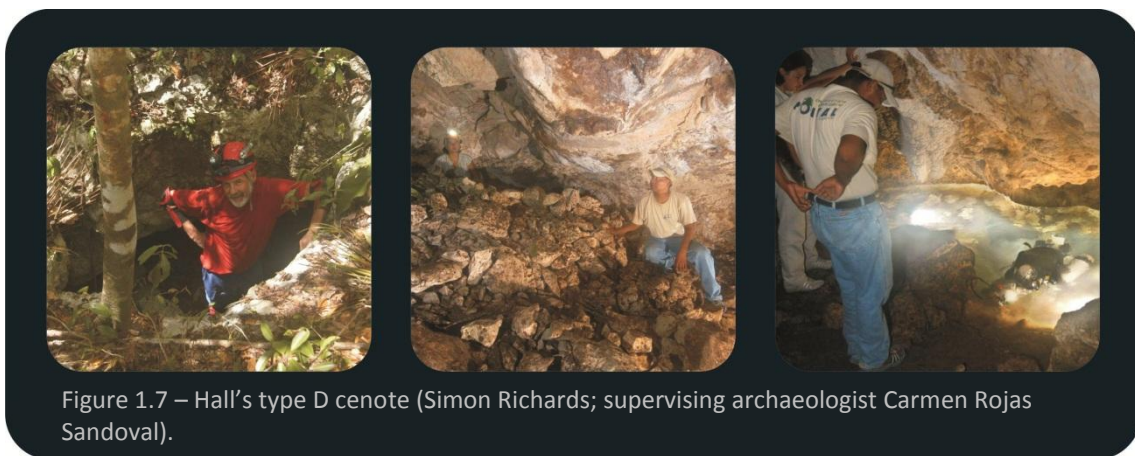


Figure 1.7 – Hall's type D cenote (Simon Richards; supervising archaeologist Carmen Rojas Sandoval).

Hall's 1936 classification of cenotes has greatly aided human understanding of the underground forest frontier in Quintana Roo. While recognising that this classification also assists the general understanding of a very complex and intricate environment, it is also important to appreciate that it is limited to geomorphological-type formations. Alongside this

classification, it is also necessary to consider types of land-ownership, land uses, urban pressures, livelihoods and the present flora and fauna, in constructing definitions of cenotes. This is because while cenote classifications such as Hall's have proven useful in mainly geo-hydrological studies, these typologies have, so far, not been mobilised by any public sector decision-maker for management or conservation purposes.

1.4.3 Caves

Hall's classification of cenotes does not include caves. As this study also considers caves as an important part of the underground forest frontier these are also discussed in detail. Caves are commonly defined, anthropocentrically, as underground voids large enough for a person to pass through (see Monroe 1970). Rane Curl (1964, 1966) distinguishes between 'proper caves' which have one or more human-passable entrances, and 'entranceless caves' which exist but have no natural entrances and therefore are not accessible to humans without modification. Subsequently he developed a statistical method for estimating the number of entranceless caves in an area, based on the number of 'proper caves' for that same area (Curl 1964, 1966). This definition is an essential starting point for providing a characterisation of these systems and the understanding of them. As will be discussed in the subsequent empirical chapters, the management and control of caves and cenotes relies on the limited existent knowledge of them, and the anthropogenic restrictions imposed by the physicality of caves. This has proven to be one of the main arguments for the lack of formal regulations regarding caves in Quintana Roo.

Pearse *et al.* (1936) mention *cavernas* in their study, describing them as 'underground chambers which may be nearly dry or may contain pools, but are never completely filled with water, as the lower parts of cenotes are' (Pearse *et al.* 1936: 6). Recent exploration by scuba divers has shown that some of the water pools in these cavernas often lead to underwater caves, and also that it is common for cenotes to 'bell out' (widen significantly) beneath the water surface, which may also subsequently connect laterally to underwater caves. The profile of the Humun Dzonot (Figure 1.8) is a good example of how cenotes and caves can unfold into unexpected underwater landscapes. To the left, it is possible to see a type A cenote entrance that 'soon enough' connects with a wider and major Type B cenote. At the bottom of the diagram it is possible to note the talus pile formed by the rock breakdown when the ceiling collapse formed the entrance to the cenote.

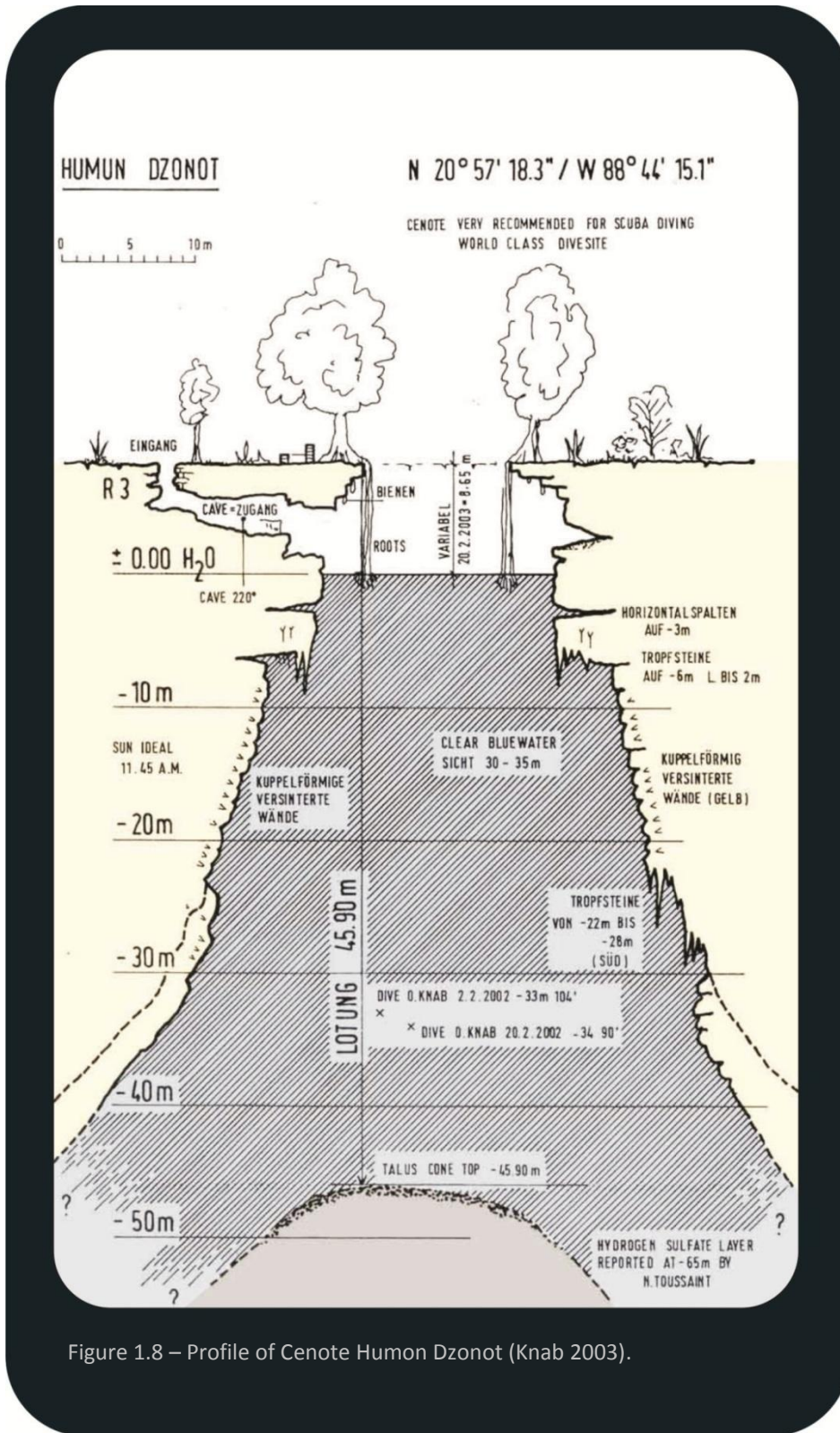
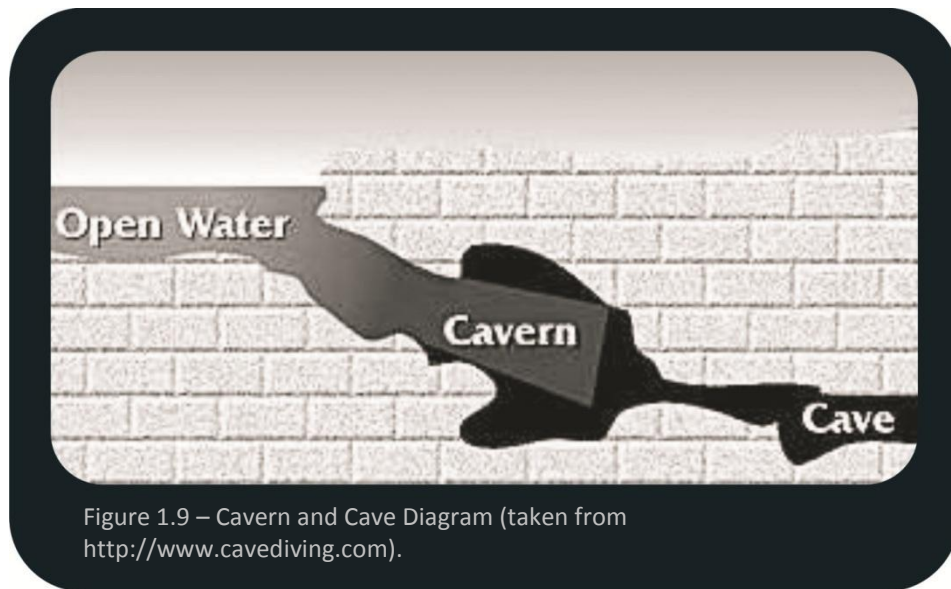


Figure 1.8 – Profile of Cenote Humon Dznot (Knab 2003).

The word cavern may be used interchangeably with the word cave, although in a technical sense 'cavern' is used to define a zone within a cave that is within direct daylight and/or within

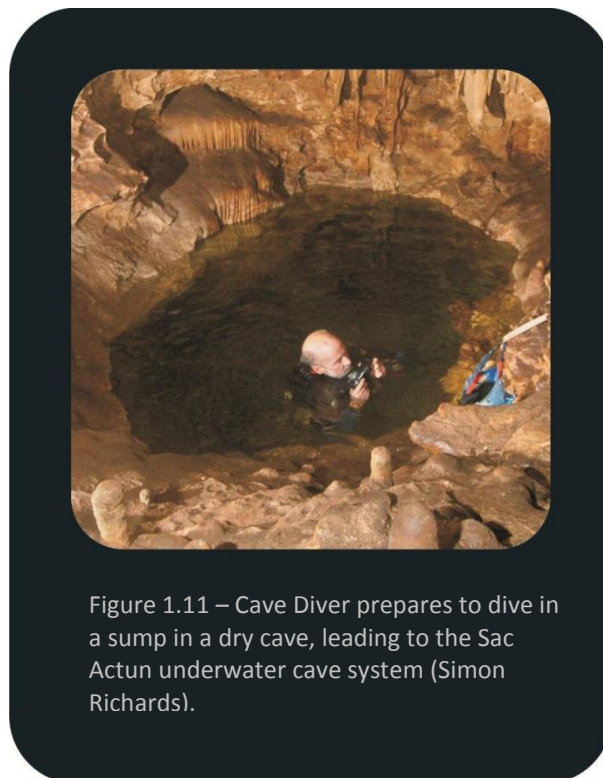
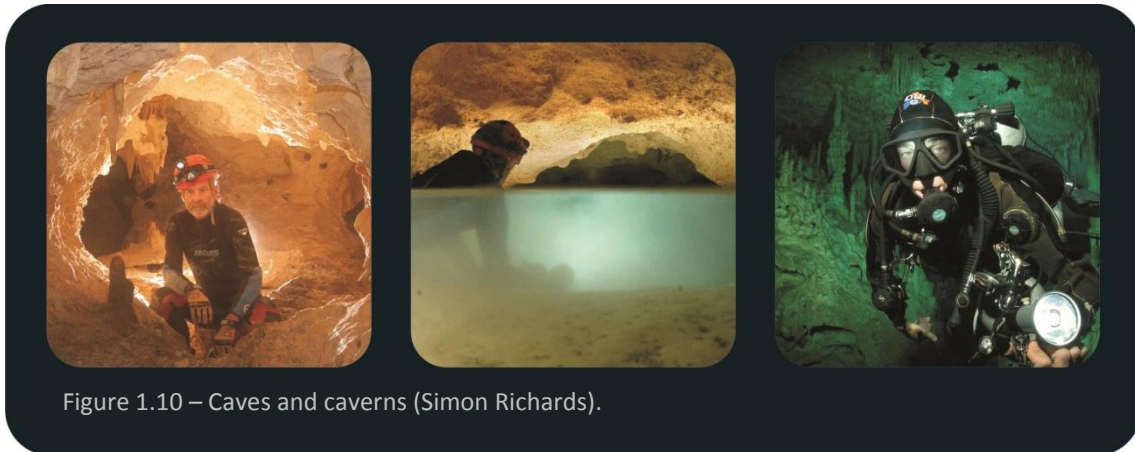
a specified distance of an entrance (see Figure 1.9). Such definitions are important for establishing cave diving training/safety standards (*cf.* Zumrick *et al* 1988; Prosser and Grey 1992). However, the use of the word cavern in other contexts is often ambiguous and sometimes irrelevant for scientific purposes.



Caves are subdivided into dry caves and underwater caves, according to whether or not underwater breathing equipment is required to pass through them (Prosser and Grey 1992). Within this definition, 'dry' caves may contain some water. This is generally the case in Quintana Roo, as dry caves are always close to the water table due to the region's low elevation. The area where a dry cave terminates in a pool of water, or the transition from dry cave to underwater cave, is generally described as a 'sump', 'siphon', or a 'duck' if it leads on to a further dry cave passage (see Figure 1.11 below). In Figure 1.10 below, the photograph on the left shows a dry cave passage in Quintana Roo. The photograph in the centre shows the same cave with a passage that contains some water, but that can still be passed through without using any underwater breathing equipment; thus it is still classified as a dry cave. Finally, the photo on the far right shows a cave passage with no surface area and thus is classified as an underwater cave.

In terms of technical definitions, there is no discrete distinction between cenotes, 'cave-like cenotes' and caves containing water. For example, Hall's 'cave-like cenote' (type D) can be distinguished from his other types of cenotes by the fact that the water surface is overhung by rock. Such a cenote could also be classified as a cave. Thus a speleological description of Hall's type D diagram could be evaluated as: an entrance (surface opening), leading to a dry cave

(the dry or partly water-filled void), leading to a sump (the water area beyond which one cannot proceed without underwater breathing equipment), and possibly onto an underwater cave (hinted at by the possible cave continuation shown at the far right of the diagram).



As this section has highlighted, the classifications of cenotes can be ambiguous and interchangeable, depending on who is describing them and for what purposes, but it also

shows the complexities of the underground forest frontier giving extensive material for the construction of multiple meanings, giving several names and relate to them in various ways.

1.4.4 Cenote formation

The formation of cenotes involves the groundwater dissolving the Peninsula's soluble karstic rock. This in turn creates underground voids (known as dissolution voids), which can subsequently become cenotes if the ceiling above them collapses, thus exposing the void to the surface. The collapse of ceilings is common in Quintana Roo's long lateral underwater caves, with ceiling breakdown blocks clearly visible in piles on the floor (Smart *et al.* 2006). Some newly collapsed blocks are occasionally reported as fallen on top of cave diving lifelines placed by divers (see Chapter 7). In shallower cenotes, the ceiling breakdown blocks are often visible and readily identifiable as originating from the superficial rock bed (for example Figure 1.12). In some cenotes, these rock piles may also accumulate more material from the surface such as soil and sediments, trees (Figure 1.14), animals (bones and skeletons), and human artefacts. These are known as talus, breakdown or debris piles. When they extend to the surface, or sufficiently close to the surface, talus piles may function as a substrate for surface or aquatic plants.

Talus piles may partially or completely block the cenote bottom, preventing access to the void and the determination of the cenote's true depth. Sediment cores extracted from talus piles in Quintana Roo have been important for the study of palaeoclimate changes (Van Hengstum 2008), while some talus piles have been excavated for archaeological studies (Rissolo 2003). Thus the 'cleaning' of cenotes' talus piles and related sediments during their development for tourism has the potential to damage or destroy important archaeological and palaeoclimate records. This is a more than common practice among land-owners interested in opening up their caves and cenotes for tourist visitors (See Chapter 6). The conscious extraction of archaeological and paleontological evidence does occur (the most recent event occurred in April 2012 when a 10,000 years old skeleton was subtracted from Cenote Chan Hol in Quintana Roo), but most of the time it is the removal of sediments that affects the material evidence of past times and activities located in the talus pile.



Figure 1.12 – Breakdown pile in Cenote Angelita is topped at a water depth of about 30 metres by sediments and other material entering from the surface, including trees. The white clouds are bacteria and is just a layer that needs to be crossed on the way down to the bottom (Aude & Muricio Domenge).

1.4.5 *Cliche Cenotes*

The cenotes are to the Yucatan Peninsula what the Alps are to Switzerland, or what the outback is to Australia; the cenotes are the unique geographical identifier to this region (140/June 2009).

During the fieldwork period in this study, it was found that non-explorer participants tended almost exclusively to identify Hall's type A and B cenotes as 'proper cenotes', while Hall's type C and D cenotes were described with a variety of additional names such as aguadas, cave entrances and caves. Indeed, an online image search of the word 'cenote' virtually brings up only photos of types A and B cenotes. These types of cenotes ultimately feed into popular perceptions of what a 'proper cenote' looks like. This has had consequences both for how the term 'cenote' is used and, crucially, for how the landscape has been modified to meet tourist expectations; for example, whether a tourist location is presented as a cenote (for snorkelling) or as a cave (for a guided adventure trip). The Aktun Chen tourist park in the Riviera Maya describes its dry cave as the following:

[Aktun Chen] is a spectacular cave of more than 5 million years old with a great variety of stalactites, stalagmites and columns. This cave is more than 640 yards long, has magnificent vaults, discreet illumination and fixed ways for a

comfortable walk, without risking the natural state of the grotto, inside the cave you will also be able to appreciate a beautiful crystal clear water cenote of 12 mts depth.³



The use of the word cenote in the previous quote, instead of the technically correct word ‘sump’, is most likely influenced by the marketability of the word cenote. The term cenote is already embedded in tourism discourse and requires no technical explanation other than reaffirmation that they are ‘beautiful’ and have ‘crystal clear water’. More dramatic than the strategic labelling of water features, some tourist operators are deliberately changing the physical karst environment to create a cenote. As the CEO of one of the largest tourism development groups matter-of-factly stated, ‘if I don’t find a cenote, I make one.’ (158/ September 2009). Thus it is not uncommon to find cenotes that have been created using dynamite and machinery to remove overhangs (i.e. Hall’s type D cenote) or even to expose un-collapsed dolines or sinkholes in order to create Hall’s type A and B cenotes (also see Figures 1.4 and 1.5). These types are almost exclusively identified as cenotes on the Yucatan Peninsula, due to popular perspectives of ‘what a cenote should look like.’

The non-cenotes or other karst features in Quintana Roo are also relevant as water supply places, although commonly confused with cenotes to the amateur eye. Shallow depressions

³ www.aktunchen.com/CAVE_ing.htm last accessed September 2011

containing water which are not in communication with the aquifer are more commonly referred to as *aguadas* (hence Hall's type C cenote). Shallow depressions without water may be known as *rebajadas*, while steeper depressions with breakdown blocks visible may be known as *derrumbes*. Natural dissolution tubes may be called *huecos* (generally if dry), and natural dissolution tubes or dug wells leading to water in communication with the aquifer may be called *pozos* (wells). These elements add another level of complexity to the landscape and waterscape of the area (see Figure 1.14).

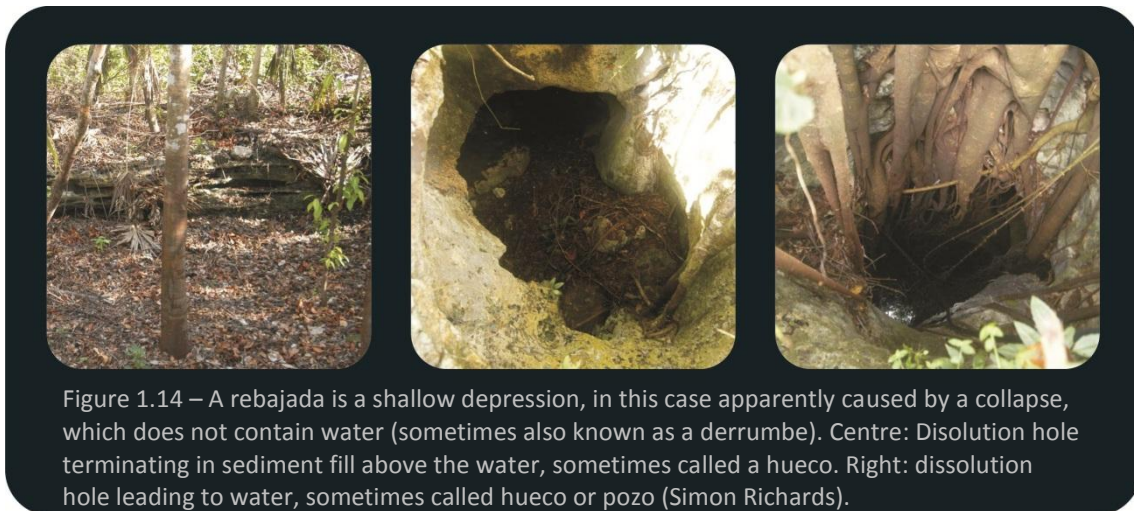


Figure 1.14 – A rebajada is a shallow depression, in this case apparently caused by a collapse, which does not contain water (sometimes also known as a derrumbe). Centre: Disolution hole terminating in sediment fill above the water, sometimes called a hueco. Right: dissolution hole leading to water, sometimes called hueco or pozo (Simon Richards).

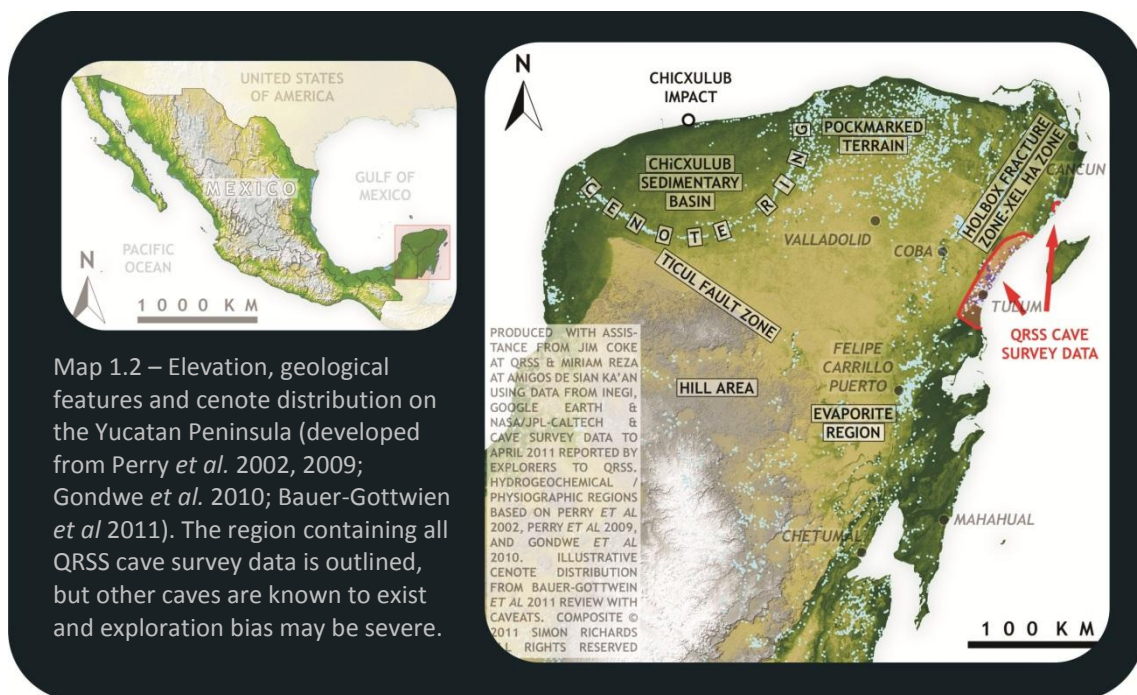
1.4.6 Geographic distribution of Cenotes in the Peninsula

All the Yucatan Peninsula's rock is technically soluble in water, meaning that cenotes, as well as other karst features described in this chapter, could potentially occur anywhere in the region. However there appear to be higher densities of cenotes in certain locations. Theories developed over the last few decades suggest that these concentrations of cenotes have been caused by the distribution of different types of rock, the chemical properties of different types of groundwater interacting with the rock, and the concentration of groundwater flows, and hence dissolution in faults and fractures (*cf.* Mylroie and Mylroie 2007; López 1975; Bauer-Gottwein *et al.* 2011).

The Peninsula itself is the presently exposed section of the Yucatan Platform, a large sedimentary platform composed of carbonate and other rocks predominantly deposited in a marine environment from the shells, skeletons, excreta and other hard parts of marine fauna and flora over more than 100 million years. As sea level has varied over a geological time-frame, exposure, water depth and environmental conditions have gradually changed, creating a sequence of different rock strata recording the geological history (see Figure 1.15 far right).

These strata have been interrupted in places, including by uplift or subsidence from tectonic movements, which raised or lowered parts of the Platform and introduced faults and fractures into the rock, and by marine and surface erosion processes (Ward *et al.* 1985).

There is no research grade data on the distribution of cenotes and other karst features over the Peninsula. Map 1.2 shows an *illustrative* distribution of cenotes identified from satellite imagery (Bauer-Gottwein *et al.* 2011). It is important to note that there may be some bias in the data, as smaller and partially covered cenotes (i.e. Hall's types A and D), particularly in areas where vegetation is more dense, are less likely to show up in the images. In addition, some aguadas may be misidentified as cenotes.



The semi-circular system of faults in the north-west of the Peninsula is described as the Ring of Cenotes, and it appears to constitute a zone of high permeability, channelling groundwater (Perry *et al.* 1995). These cenotes follow the outline of an asteroid impact, offshore of the current Peninsula near Chicxulub, about 65 million years ago. The impact of this has been linked by some scientists to the extinction of the dinosaurs (*cf.* Schultz and D'Hondt 1996; Pope *et al.* 1997; Vazquez-Dominguez and Arita 2010; Schulte *et al.* 2010). The asteroid created an impact crater approximately 180 km in diameter, extending up to 30 km below the present land surface, and ejected previously deposited minerals from the area over much of the Peninsula, known as an 'ejecta blanket' (see Perry *et al.* 2009). Perhaps due to misunderstanding of this event, it is not uncommon for tourists to believe that cenotes are the

result of multiple asteroid impacts in the region, obscuring the fact that karst formations are the result of millions of years of geo-chemical processes.

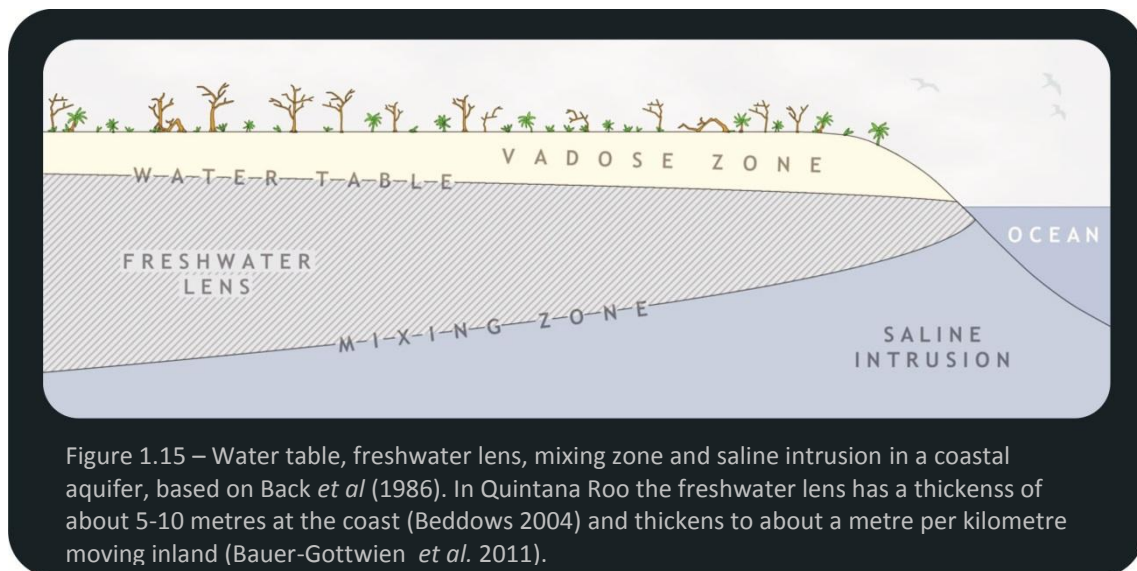
The broad region in north central Yucatan is described as Pockmarked Terrain, due to it having an exceptional abundance of cenotes in relatively mature karst. Karstification is assumed to have resulted from dissolution of ejecta blanket during times of lower sea levels, perhaps enhanced by proximity to the coast and block faulting/higher fracture density (Urrutia-Fucugauchi *et al.* 2008). Meanwhile, the Evaporite Zone in the south-east tends to have a lower permeability region than the northern part of the Peninsula, with some transient surface water flows. Groundwater quality varies, but in all cases the region has high dissolved sulphates and relatively low chloride content (from saline water intrusion and mixing) (Perry *et al.* 2002), making it somewhat distinct from other regions on the Peninsula.

The Holbox Fracture Zone is a region that runs roughly parallel to the faulted east coast. It is probably related to tectonic activity in the Caribbean during the Eocene epoch (between 56 and 34 million years ago). The zone is manifested at surface level by elongated cenotes often connected by broad swales (low areas close to water table), some up to 100 km long (Perry *et al.* 2002). The outlined area on the map labelled as QRSS cave survey data contains all cave survey data held by Quintana Roo Speleology Survey (QRSS) up until April 2011, totalling close to 1,000 km of cave passages. Many other caves are known to exist outside this area. However, this survey data has not been reported to QRSS. There is no comprehensive theory to explain the apparent concentration of caves in this region, although fresh/saline water mixing dissolution has been suggested as a possible factor. But water is not important just in the cenotes formation process, the underground aquifer that runs under the Peninsula has been the main focussed of institutional management in the Peninsula (see Chapter 5) and it is discussed in the following section.

1.5 The Underwaterscape

An aquifer is a wet subterranean layer of permeable rock or unconsolidated materials from which groundwater can be usefully extracted. Frequently an economic component is included in the definition of aquifers. For example 'a rock formation is regarded to be an aquifer when it can store, transmit and yield economically significant amounts of water' (Ford and Williams 2007: 103). In practice, all definitions require the structure to be large enough and have high transmissivity (horizontal water flows). The Yucatan Peninsula's groundwater aquifer consists

of a shallow lens of fresh water floating on top of saline water that originated from the ocean. The lens thickness reflects the rate of fresh water recharge (i.e. rainfall) and the rate of flow of this water out to the ocean. Its position also reflects sea levels, which have varied over geological time. The top of the freshwater lens is known as the water table, and the interface between fresh water and saline water as the halocline or mixing zone (Figure 1.15; Back *et al.* 1986).



The transmissivity (horizontal water flows) of the Peninsula’s aquifer is complex and so far only partially understood. Water bodies are described as being in hydraulic communication if water can flow between them. Exploration of underwater caves in near-coast Quintana Roo has shown that many cenotes are connected by underwater caves (See Chapter 7). Sistema Ox Bel Ha, the longest underwater cave in the world, is reported to be connected to 136 cenotes, and Sistema Sac Actun, the second longest underwater cave in the world, to approximately 162 cenotes (QRSS 2011). If a diver can move between these interconnected cenotes then so can water, and they are therefore seen to be in hydraulic communication. However, cave passages cannot always be found in cenotes, and other methods must be used to infer connectivity.

A number of studies of the Peninsula using water level measurements and monitoring have identified what appear to be continuous aquifers, including the identification of a high transmissivity and very high transmissivity in the area corresponding to the long caves known to the Quintana Roo Speleological Society (Bauer-Gottwein *et al.* 2011). Perry *et al.* (2009) also identify a high transmissivity route along the Ticul fracture by geochemical mapping. In addition, unpublished data by Simon Richards (2011) from water level recorders placed in

cenotes showed a progressive trend in tidal and rainfall response consistent with a model response for a highly transmissive aquifer. The inference from this is that either (i) the cenotes studied are connected to a common regional aquifer, and water level fluctuations in the cenotes represent water level fluctuations in that common aquifer; or, (ii) that there exist a number of dominant flow paths (the cave systems), which connect with the cenotes and act as local aquifers running from the coast to inland, and that these have very similar hydrological parameters, presumably because they developed under similar conditions and constraints.

Different actors in Quintana Roo have proposed the creation of Hydrological Protected areas for the Peninsula, arguing that protecting cenotes entrances would not be enough to impact favourably the ecosystems, and therefore the protection of the aquifer as a system is essential. The establishment of such areas, however, is connected more with above-the-ground geopolitical divisions and land-uses, than with the complexity of the system. Therefore, the understanding of the aquifer(s) is essential in the regulation and protection of the underground forest frontier, as water extraction may be the most intensive relationship between humans and the underground in Quintana Roo.

1.6 Understanding the underground forest frontier?

At the most elementary level of natural science, this section has highlighted the complexity of the Yucatan Peninsula aquifer and karst system. This complexity has meant that the land and waterscapes are still partially understood, with hydrological and geological knowledge of the system being limited, with that knowledge still very much in its infancy (particularly in comparison with research relating to aquifers in Europe). Thus we might conclude that the underground forest frontier of the Yucatan Peninsula is a complex geological system and that knowledge of it is incomplete and continuously changing. The gathered empirical information for this research suggests that the idea of 'not knowing' what is below our feet may limit the decision making and implementation processes relating to these waterscapes, although it does not stop certain commodification processes.

At the conceptual level, this is relevant because it is related to the social construction of nature. It is possible to perceive and construct something that we do not know or fully understand, and yet the implications of doing so at an institutional level are very important. Environmental sciences operate in this manner. It can be argued that the 'not knowing' drives us to a forced consensus that deals with the quite often unpredictable character of natural

phenomena. If we add to that a 'multi-knowledge' reality we have a complex social reality that 'intends' to manage a partially known environment.

The questions surrounding the underground forest frontier are becoming increasingly important. The tourism boom in Quintana Roo and the subsequent rapid urbanisation have greatly increased anthropogenic pressures on the underground aquifer. The exact nature and extent of these impacts are for the most part also unknown. At the level of the aquifer which interconnects the cenotes and forms the groundwater flow system, there are potential concerns which include over-extraction and salinisation of freshwater, as well as the contamination of the aquifer waters by solid and liquid waste. Both of these may affect not only cenotes and the supply of drinking water, but also the coral reef which receives fresh water from the aquifer in the form of submarine groundwater discharges. Bauer-Gottwein *et al.* (2011) reviewed the information relating to the Peninsula's aquifer and concluded that water extraction is presently only a small proportion of the recharge issue – the problem of managing solid and liquid waste represents the major challenge. Some other recent studies have also found faecal and pharmaceutical contaminants in cenotes and the aquifer (Leal-Bautista *et al.* 2011; Metcalfe *et al.* 2011). The Peninsula's overall lack of sewerage disposal infrastructure is a major concern in relation to the current and potential future impacts of human liquid waste (discussed more in Chapter 5). At the individual level, cenotes are managed accordingly with their location, land-ownership status and developed economic activity.

This thesis thus seeks to answer some of the questions posed and ultimately explore how a complex environment like the one exposed above is filled with socially constructed meanings and transformed by human actions. After a short elaboration of the contents of the dissertation, the following chapter will present the theoretical frame upon which the empirical data will be presented and analysed.

1.7 Thesis Structure

This thesis is organised into four main sections. The first section is this introduction which has provided the background to the research aims and objectives. It has also outlined the reasons behind the use of cenotes in Quintana Roo as a relevant case study to explain the complexities of the underground forest frontier, as well as briefly explaining the cenote formation process and the physical complexities of the underground in Quintana Roo.

The second section is the research context of the present study and consists of three contextual chapters (Chapters 2, 3 and 4). Chapter two provides a theoretical framework for this research, focussing in the existent literature about nature's commodification. Current debates have been focused on the theorisation of natures' commodification as something possible or not. This section analyses theoretical arguments in this topic area and discusses the pertinence of such arguments in a highly transformed environment. It also argues that the main limitation of the existent literature is the lack of empirical studies that show commodification processes. Therefore, the literature review developed in Chapter 2, draws the path to a 'commodification of nature' approach, and seeks for a more practical perspective that links processes of social valuation of nature to material actions. For that reason the chapter develops a discussion around the theoretical framework of institutions posing that such approach will be helpful in the analysis of process of commodifying nature.

Chapter 3 details the methodology used for this study. Drawing upon the qualitative tradition this chapter describes the methods utilised to obtain empirical data but also extensively discusses the challenges and goals imposed during the collection of research material. It also explains how historical information was obtained to elaborate the contents of the following chapter (Chapter 4), An Environmental History of Cenotes. This chapter provides a historical context of cenotes on the Yucatan Peninsula, with a particular emphasis on how they have been appropriated and utilised through different epochs, and their overall role in influencing societal outcomes.

The third section of this study is titled 'The deep view' and comprises the empirical and analytical review of the underground forest frontier (Chapters 5, 6 and 7), following the division of sectors: public, private and explorers. Chapter 5 discusses the roles that the Public Sector has had in the 'formal' management of the underground, but also shows how the public sector formal discourses of nature (i.e. cenotes) sometimes contradict more personal and individual constructions of these systems. It also elaborates on the idea of possessing technical knowledge of the land and waterscape in order to have a 'proper' and controlled relationship towards nature.

Chapter 6 analyses the perspectives of the Private Sector participation in the underground forest frontier in Quintana Roo. This chapter shows a vast heterogeneity of members involved in the privatisation and enclosure of the Underground Forest Frontier. The processes of land enclosure, landscape transformation, and market competition will be revealed and analysed.

Land ownership and nature's management are two highly interrelated factors within this chapter.

Chapter 7 breaks with private-public sector dichotomy and shows a third group of actors actively participating in the underground forest frontier: the explorers. This chapter analyses how this group of actors have played a protagonist role in constructing the current perceptions of the underground forest frontier as well as what is known about it.

The final section deliberates on the outcomes of the conducted study placing in an interactive mode the multiple relationships elucidated through the collection of empirical data occurring in the underground forest frontier. This chapter returns to the broader themes of the dissertation and addresses the hypothesis and questions posed in this introductory chapter. While the specificity of the case study makes challenging the generalisation process to other contexts, the last section will talk about possible avenues for further studies in the area and/or on similar environments.

PART TWO RESEARCH CONTEXT



Figure 0.2 – Caves of Xtacumbilxuna'an as drawn by Catherwood (Stephens 1843: 99)

Chapter Two

Literature Review: Nature as a Commodity

The objective of this chapter is to develop a theoretical framework to help in the understanding of how both social actors and nature in Quintana Roo shape social geographies and define the social institutions that constrain their everyday being. Important for this analysis is the consideration of the impacts of physically transforming nature for mainly human purposes, and the subsequent outcomes, environmental and social, of such actions. To start, this chapter will engage with the notion of ‘commodifying nature’ (Castree 2000), which has been discussed from various theoretical perspectives, particularly Marxist ones.



Figure 2.1 – Producing a cenote. Playa del Carmen, Quintana Roo
(Anonymous)

The photograph in Figure 2.1 shows what used to be a small cave near the coast between the Quintana Roo coastal urban centres of Playa del Carmen and Tulum. The landowner had previously decided to survey his large land property, with the intention of developing a cave system for tourist activities. After some months of surveying he decided to enlarge the entrance of the cave, removing the ceiling and creating a cenote. The extracted stone from this process can be seen at the top of the image, as well as a worker employing a pump to keep the water clean. This latter activity had become a necessity as the physical modification of the cave had disabled natural hydrological cleaning processes, causing the formation of murky waters.

This visualisation of extreme physical transformation is an example of the multiple processes taking place in the underground forest frontier in Quintana Roo. This chapter attempts to bring together theory in a way that allows for the understanding of social actors' role in nature, focusing on cenotes as a specific 'object' of nature. This will be done alongside addressing questions about the ways in which different actors view or manipulate the environment, reinforcing or conflicting grounds of legitimation and tension of their actions towards nature. This will be done by considering their positionality in the social system and their perspectives over a specific time-period. At first glance, a commodification perspective seems to highlight only market rationale and its logic, but there are other relevant discourses present, including those relating to cultural artefact protection, the conservation of nature, and scientific research and knowledge production, all of which also play a role in nature's commodification.

Nature is and has been constantly modified by humans. Historically, the exchange of natural goods in the marketplace was present in pre-capitalist societies, a phenomenon that took clear prominence in Europe's phase known as mercantilism (16th to 18th centuries). What is specific to the current capitalist mode of production is the propensity or compulsion to turn almost anything (everything) into a commodity. And it is this 'almost' that promotes conceptual uncertainty and ambiguity. It is here where the conceptual debate of the present study is situated. Defying the old tendency to define nature's goods as separable and portable things, this thesis will discuss the possibility of producing new and different commodities: not just the cenotes, but the experiences of them. Experiences that are structured and reified in the activities performed and the type of exposure that the agents suffered when relating with nature. Therefore nature's commodification imposes limitations and requires a careful theoretical discussion. Considering that the social relations of production between land (natural resources), labour and capital were transformed in the neoliberal context, this thesis

will aim to present empirical evidence supporting the argument that, although incomplete and diverse, the underground forest frontier in Quintana Roo has been diversely commodified.

The term 'commodity' has had multiple conceptual definitions, especially in the context of environmental studies, presented with well-developed and contested arguments by different groups of academics. Noel Castree, a theorist in this conceptual area, argues that among the multiple differences in defining 'commodification' there is one factor that Marxist theorists agree on: 'the status of a thing, object, idea, creature, person or what-have-you is not intrinsic to it but, rather, assigned' (Castree 2003: 277).

However, this statement does not reveal a lot about how nature could and has been commodified, through which processes, with what intentions and with what social and ecological outcomes (Castree and Braun 2001). The epistemological relevance of the concept for this research is that it allows us to think about (historical) processes. When considering a 'commodity' as a researcher, it is possible to question the process of transformation, its previous uses, if any, and the action of acquiring or accessing it. 'The commodification thematic thus draws our attention to the process, and therefore the propriety, of certain ontologically and categorically distinct things being seriously altered because of their potential, temporary, permanent or indeed "denied" commodity status' (Castree 2003: 278). In the context of this research project, the question is whether or not the underground forest frontier – comprising cenotes, caves, water, archaeological artefacts, geology, flora and fauna – has been perceived and promoted as a set of commodities and, if so, through what processes?

2.1 Capitalist commodification: is it just about the money?

In general, the main characteristic of a capitalist commodification process is the presence of monetary transactions. This narrow understanding can be studied from a simplistic market point of view – supply and demand. Somewhat in contrast, Noel Castree, recalling Marxist literature, argues that, instead of an isolated single characteristic, capitalism is a set of six explanatory elements (privatisation, alienability, individuation, abstraction, valuation and displacement) that gives a 'capitalist colouration' to the commodification process of nature (Castree 2003: 279-283). Such explanatory elements will be developed in the following sections, establishing links with the case study of cenotes. However, rather than trying to make the case study fit in this set of explanatory elements, the focus will be to try and develop the

necessary research tools for the analysis of empirical information. From quirky anecdotes to almost appalling narratives, the multiple processes of nature's commodification will be discussed. More than providing evidence to sustain or support Castree's contribution to the study of nature, this chapter will demonstrate a complex social map that does not exactly tick the boxes of 'the perfect commodity' requirement list but, rather, adds another example to the complexities of the topic and the ways in which nature and its social constructions can be understood. The two following sections will discuss privatisation and valuation, leaving the remaining four characteristics for the third section.

2.1.1 Privatisation or accumulation by dispossession

Erik Swyngedouw argues that accumulation by dispossession, or its more common term privatisation, is:

a process through which activities, resources and the like, which had not been formally privately owned, managed or organised, are taken away from whoever or whatever owned them before to a new property configuration that is based on some form of 'private' ownership or control. Privatisation is therefore nothing else than legally and institutionally condoned transfer of entitlements (Swyngedouw 2007: 51).

Privatisation as the transference of property rights is highly relevant to this research, as is the effect on nature of current forms of privatisation. In Mexico, land ownership has been dominated by the *ejido* system. This system consists of a communal property regime, inherited from a revolutionary process where large property holdings were expropriated and later on distributed among dispossessed groups throughout Mexico. Once the *ejido* was established as the formal way of providing land in Mexico, the specific process of assigning land took different forms across the country. In Quintana Roo, in particular, long extensions of land with apparently no livelihood opportunities (i.e. agricultural, forestry) were assigned to people coming from the northern part of the Mexico and some 'local' fishing families, ultimately creating a somewhat diverse ethnic mix in the state (see Chapter 5).

In 1992 the Mexican Constitution was changed and, in theory at least, the *ejido* members were able to become 'full owners' of their land, with the possibility of selling, transferring or renting the land to a third party. Legally, land can now be sold but the activities developed by the third party have to be economically, socially and environmentally equitable to those assigned by the

land use permits (Secretaría de la Reforma Agraria 1992). Land-use permits can be formally modified through a series of legal processes and by obtaining the corresponding permits.⁴

Historically, in Mexico, land ownership has been institutionalised, defining specific rights over natural resources, such as a plot of land, and the produce extracted from agricultural or forestry activities. However, when referring to other kinds of resources such as superficial or underground water or other underground resources like minerals, a big gap in the existing formal social institutions is evident. It was established in Article 27 of the Mexican Constitution that all superficial and underground water belongs to the Nation, along with other underground resources (discussed in Chapter 5). In this sense, the State holds the right to define the uses and destinies of the underground. Common property institutions such as the *ejido* and private individual owners cannot claim private rights to it, even though they hold property rights overland. In this sense, cenotes can be seen as existing in a hybrid zone. As a result, we can observe hybrid ongoing processes such as shifting productive ranches to 'amenities' where land is purchased or rented by wealthy out-of-state buyers (Robbins and Luginbuhl 2007: 28), while water system ownership remains uncertain and unmanaged. This has ultimately meant that a formal commodification of land has occurred in parallel to informal privatisation processes of the underground.

In Quintana Roo, property rights can take numerous forms, with most of them revolving around a concern with economic rationality and enclosure processes (Mansfield 2007: 71). The enclosure of cenotes has taken the form of informal individual and collective privatisation processes, but has been formally promoted through the tourism boom. Interestingly, such privatisation has occurred through land ownership and, as we will see, this has had repercussions at the environmental regulation and managerial levels (see Chapter 5). According to Castree (2001), the first step in any commodification process would be to privatise and accumulate. But can nature, cenotes, be privatised? How do we accumulate nature? This is one of the major conundrums in the study of nature's commodification. This research will hopefully shed some light on this topic through an exploration of two different processes: the commodification of nature, and nature's physical appropriation. This thesis argues that these are two different things, and their understanding will help highlight the difference between commodifying nature and owning it. It is argued here that one of them is a

⁴ Law instruments like the Urban Development Plans 'zone' specific areas according to their potential, meaning that *ejido* land parcels that have been sold and are located in a zone classified as 'for commercial use' can have their status changed after obtaining the correct permits. Otherwise, land-owners can change the land use status prior to the selling transaction and sell the land for a more lucrative rate with a commercial land use permit.

complete process (legal ownership), whereas the other (commodification) relates more to nature's physical transformation and less to its appropriation.

2.1.2 Economic valuation: the problem is the solution, and the solution is the problem

Every group, as Arturo Escobar (1996) has noted, orders the 'real' in specific ways, through particular categories, classifications and relations. As the natural environment (including cenotes, ocean, and forest) has provided sustenance to humans, so the natural world has had an intimate presence in the cultural imagination of any group. In the contemporary world, as part of groups' particular classification systems, nature is intimately related with privatisation and economic valuation meta-discourses. An example of this is environmental economics proposals, which seek to incorporate environmental considerations into both economic theory and the practice of environmental management and regulation.

According to Castree (2000), environmental economics assumes two things – first, that the economic system is an important cause of contemporary environmental problems when it is left unchecked. For example, it has been argued that some environmental problems have arisen from the absence of well-defined property rights with regard to environmental assets (mostly in 'developing' countries (see Heltberg 2002)); this has been described as the 'tragedy of commons'. Second, it has been argued that this branch of economics can help to ameliorate environmental problems (Castree 2000: 217). Environmental economics is built on the belief that if we apply economics to environmental issues, then we should 'expect to obtain some insights into the desirability of improving the environment further, taking the social objective of increasing people's overall satisfaction (or welfare) as given' (Pearce and Markandya 1991: 51). From this point of view, any kind of intervention to improve the environment, from expropriation to exclusion, would be justified, with rational objectives.

In the context of Mexico, a good example of this is the advocacy of markets for ecosystem services, an idea that is now embedded in the wider ideology of market environmentalism, which has become prominent since the late 1980s (Corbera 2005). Market environmentalism promotes the pricing of nature's services, the assignation of property rights and the expansion of commodity markets into the realm of nature's services. At the 1992 United Nations' conference in Rio de Janeiro, one of the central recommendations for all countries was to use these economic instruments as a complement to the regulatory measures for the conservation and preservation of the environment. The member countries of the Organisation for Economic

Cooperation and Development (OECD) have taken into account such suggestions and have applied some economic instruments as a complement to their developmental strategies, particularly in the promoting of their implementation developing countries. However the majority of these initiatives, at least in Mexico, have been brought forward by the State apparatus, thus challenging the 'pure' essence of these market mechanisms.

An example of this is the case of Payment for Environmental Services in Mexico, where landowners with natural resources in their properties are paid for the conservation of these resources. It has been suggested that these environmental services carried out by landowners are susceptible to appropriation, enclosure, exclusion and privatisation, creating the 'ideal' market. The extreme end of this position assumes the renunciation of the State as a participant in this process, leaving the market in control of nature. In this sense, an appropriation process is taking place as the incorporation of new resources, people, activities and lands (Harvey, 2003) becomes part of commodification processes.

In Quintana Roo, individuals and organised groups are negotiating the terms of land-use that has natural resources, including cenotes. The process for internalising an economical valuation of caves and cenote systems will be discussed in subsequent chapters of this thesis (Chapters 6 and 7). What is interesting to note here is that this economic valuation might not have been a direct outcome of the global tendency of promoting conservation through economic incentives but, rather, the outcome of a historical process where nature has been widely used and valued differently at different times. Therefore in Quintana Roo the economic valuation of caves and cenotes has been silently promoted as an eco-friendly livelihood that provides sustenance to families while promoting a less intensive 'use' of nature. Although on the other hand, environmental and social issues have emerged as a result of such practices creating the problem and the solution. In the next sections the particularities of the underground forest frontier will be discussed in the theoretical contextualisation of nature's commodification provided by Castree.

2.1.3 Alienability, Individuation, Abstraction and Displacement

This section will discuss the remaining four of the six characteristics of the commodification process, seen through the lenses of cenotes. The first of these is alienability. This 'refers to the capacity of a given object, to be physically and morally separated from their sellers' (Castree

2003: 279). If we go back to Figure 2.1 and think about cenotes, we can see that this is a contested arena. Cenotes have been priced and sold and, although legally they cannot be owned, it can be argued that they have been enclosed to those that do not provide or pay an entry fee. This is because, physically, cenotes are part of the forest, residential areas, hotel resorts, golf courses and/or archaeological zones. That is, they are still attached to the physical landscape in spite of the multiple anthropomorphic physical transformations that some of them have undergone. It can be argued that a physical separation has occurred through the creation of physical enclosures, such as the construction of fences to show boundaries and make the idea of privatisation evident. Thinking of cenotes as property of the Nation, the processes of privatisation and enclosure in the cenotes of Quintana Roo 'shifts the flow of value from public goods to the private pockets' (Robbins and Luginbuhl 2007: 30), alienating former uses, their meanings and spaces.

Individuation, another characteristic of commodification, can be understood as the 'physical act of separating a specific thing or entity from its supporting context' (Castree 2003: 280). Cenotes cannot be bought as discrete entities of a production chain. The individuation process around cenotes in Quintana Roo occurs, like in the service sector, when the client obtains a personal experience from their visit to the cenotes, thus attaching a monetary price to these experiences. In this kind of complex ecosystem, what is being individuated is not the natural resource in itself but the service provided to experience it. Can nature be commodified through the provision of a service? (See Chapters 6 and 7).

The third element of commodification, abstraction, is the process through which a 'thing' (in this case, a cenote), is inserted into a category where similar things are enclosed, that is, the cenotes' universe. These characteristics can be identified through a process of homogenisation. Castree (2003), following Robertson (2000), identifies two different kinds of abstractions. The first one is functional and seeks classifiable similarities among similar entities. The second is spatial and means that an entity located in one place will be treated similarly to one located elsewhere which has the same characteristics. In terms of eco-tourism or extreme tourism it is interesting to note that the activities developed in the cenotes (i.e. snorkelling, diving and rappelling) have been homogenised, subsuming the place to its practices. In this way, the intrinsic beauty of the natural feature is complemented or even substituted with built infrastructure such as lighting, stairs, and flying foxes. In other words, visitors are sold the activities to be carried out rather than the intrinsic and special characteristics of each individual cenote. Thus a process of abstraction has occurred. In this

sense, tourists can be seen as being exposed to 'controlled' circumstances when consuming nature in Quintana Roo. Even when cenotes are located in very different communities, sometimes from Maya area to urban centres, tourists can still consume the same version of this space – nature homogenised (see Chapter Six for further discussion). Therefore, the classification of cenotes presented in Chapter 1 somehow becomes irrelevant for this type of consumer; what is relevant to them about nature in this context is the experience.

Finally, displacement has been argued to be the spacio-temporal separation between the production and the consumption of the commodity. As may be deduced, this is not possible in the case of cenotes in Quintana Roo because the two processes, production and consumption, take place at the same moment in the same place. However, in this case it is the experience that is offered of the cenote that travels and, even when the object is not displaced, the experience is.

As was posed in the previous chapter, can a cenote be a capitalist commodity? David Harvey (1996) argues that there is something inherently anti-ecological about capitalist commodification that impedes a complete commodification of nature – not everything can be transformed into a commodity. 'Some natures resist complete commodification (physically and morally), while others are readily subsumed' (Castree 2003: 289). As we saw in Figure 2.1, there exist certain mechanisms of nature's resistance, such as towards the opening of a cave – fresh water becomes polluted with the organisms of the surrounded vegetation and flow patterns are modified. The manifestations of nature withstanding transformation in this way and its (re)actions to commodification processes thus become visible. These hybrid physical conditions of the over-underground delimit a physical and symbolic frontier in Mexico's Quintana Roo that imposes limits not only on the success of a commodification process, but also on the economic value given to cenotes and their potential uses. Nevertheless, 'something' is still commodified.

In some sense, the six 'ideal' explanatory elements based on Marxist literature and proposed by Castree (2003) cannot be fully applied to the study of cenotes as commodities. Nevertheless, it could be argued that new and different commodification processes enacted upon nature in the neoliberal context are taking place; these may corroborate Harvey's (1996) thesis that what we observe is a partial commodification of nature (proxy commodification).

It is undeniable that a strong material transformation of the space has occurred in Quintana Roo with 'physical and moral consequences for humans and non-humans' (Castree 2003: 283). It is the intention of the framework discussed here to study those transformations and help explain such processes. The following section builds on this by utilising a more grounded approach in the understanding of nature's commodification and thinking about the best way to empirically approach the topic, the study of institutions appears to be the best framework.

2.2 Institutions

When trying to understand the process through which cenotes have become commodified, an institutional framework can reveal 'how we know and organise the world we live in and how we know and organise this world differently' (McKittrick and Peake 2005: 52). Thus it is necessary to progress to the normative part of the analysis: 'how and by what means and through what institutions is the production of nature to be organised?' (Castree 2001: 203).

Institutions can be understood as socialised ways for allowing or constraining human action, offering a potential empirical window through which to examine culture and, in this case, the social constructions of nature. In the context of cenotes in Quintana Roo, such an instrument can be utilised to broaden our understanding of how the cenotes operate as a place. Important to developing this empirical tool is an engagement with the body of literature and theories surrounding institutions, such as the ones developed by Douglass North, Anthony Giddens and Elinor Ostrom. This engagement is important for the development of a framework from which to examine the role of institutions in the creation and reconfiguration of cenotes. The underlying objective here is to elicit the ways in which the varied relationships that people and organisations have with cenotes are maintained, challenged and re-made. To do this, it is necessary to go beyond the realm of theory and ultimately engage with the social realm.

Institutional forms have been defined in several ways:

Institutions are composed of formal rules (status law, common law, and regulations), informal constraints (conventions, norms of behaviour and self-imposed codes of conduct) and the enforcement characteristics of both (North 1997: 23).

A common definition in the case of environmental conditions has been the following:

Institutions [are] sets of formal and informal rules and norms that shape interaction of humans with others and nature (Agrawal and Gibson 1999: 637).

There is also the definition offered by rational common-property theorists:

[Institutions are] the harmony of interests' leading to 'collective actions in control of individual action (Commons 1934:8).

A political ecology perspective would argue that institutions are remade through resistance and reinterpretation by individual agents that are embedded in a larger political economy, where the disempowered are often deprived of crucial resources in the daily struggle over property rights (Robbins 1998). Resistance and reinterpretation are vital for the analysis of institutions as devices in a historical interactive process. However, this is not necessarily the case in Mexico where land ownership does not automatically translate into access to the land's resources. This becomes clear in the case of cenotes, where landowners might be able to open their cenotes for exploitation, but an external actor may ultimately control the process and the profits. The principal focus then is not on land tenure itself, but on the social and political structures that promote or control land and water uses. Thus, this study moves from seeing institutions as resistance mechanisms to a conceptualisation of institutions as creative and dynamic entities shaping nature, its materialities and the discourses surrounding it.

Each institutional form receives different responses from diverse groups of actors. Their responses can be translated into everyday informal activities that contradict the formal institutionalisation of a process. It, the institutional form, also can take the form of discourses against the 'authorities' or can be translated into more material manifestations, such as in the context of forests, with the logging of trees and hunting of protected species. Each institutional form leads to a land-use pattern that differentiates the landscape in physical terms. For example, the different scales on which the cenotes are exploited for tourism purposes can produce major tourist attractions or less commercialised niche activities. As Paul Robbins argues: 'rule systems, social and cultural norms, and legal frameworks are increasingly used as sites for intervention and platforms for action in cases ranging from fish and tree stocks to carbon and chlorofluorocarbon emissions' (1998:410).

The political ecology perspective on institutions is framed under the idea of a political economy structure that shapes uneven relations regarding the use, consumption and ownership of natural resources. An interesting point to note in political ecology is the notion of resistance and reinterpretation as means of agency. The study of the mechanisms of resistance and reinterpretations within formal and informal institutions can offer a potential access the study and understanding of outcomes. The weakness of this proposal is that it overly focuses on the disempowered, not fully taking into account the role of more empowered actors (i.e.

tourists). It is necessary to reinforce the idea that resistance is not exclusive to social processes. As has been shown in this section, there are natural resistance processes that should also be taken into account. Furthermore, it is necessary to note that organised social resistance to the commodification of nature in Quintana Roo has not been found.

Another way to approach the concept of institutions is from a weak social constructivism perspective, which posits that a 'real' material world exists but our categorisation and classification of it is ultimately biased and tainted. Social institutional constructivism argues that 'wrong' ideas about nature are a product of the social character of relevant scientific communities (Robbins 2004), or empowered actors. Therefore, the only way to approach 'real reality' is when these subjective constructions of the world are demonstrated to be inaccurate. Scientific knowledge is thus incorporated into the body of norms and other codes, which are then transformed into practices mediated by constructions of reality. It can therefore be understood that there are multiple competing knowledges derived imperfectly from the realm of reality.

This would have major impacts when trying to regulate and manage nature (see Chapter 5), for various reasons. First, there is the need for a constant supply of scientific knowledge to be presented in a digestible way, so formal institutional agents can understand them and produce formal means of control. Second, it would be necessary for formal institutions to name, categorise and classify the physical world in order to exert control over it. Finally, the formal discourses about nature's management must deal with livelihoods and everyday practices. These issues combined mean that a formal institutionalisation of scientific knowledge must take into account pre-existing sets of institutions, as well as informal social institution. This is extremely relevant in the context of the thesis because it is the 'availability' of knowledge and the production of it that actors consider as the main reasons, obstacles and motifs related with the underground forest frontier. This elucidates a type of commodification that neither Castree nor Neil Smith develop in-depth in their studies.

Numerous definitions of institutions acknowledge the separation between sets of informal norms and formal rules (North 1997; Ostrom 1990, 1998; Leach *et al.* 1999). As Jordan and O'Riordan note:

Analysts differ enormously as to whether institutions are actual structures, or more ephemeral association of values and shared belief, rules, or even more vague patterns of information flow between individuals and groups both to

sanction a spirit of a group consciousness or to permit social order to operate with the minimum of formal regulation (Jordan and O'Riordan 1996: 2).

Despite their discussion, Jordan and O'Riordan unfortunately do not expose their own position. This research will utilise a more middle ground approach, in which the social machinery reinforces the interaction and reaction of both formal and informal institutions.

The understanding of informal and formal social institutions in the field proved to be a very useful analytical tool in the mapping of different social constructions of nature and the decisions taken about it. Although sometimes such drastic classification was difficult to explain, especially when the formal spectrum relied on the products of the informal sector in order to implement formal responses to a problem. Particularly in the context of knowledge production (see Chapters 5 and 7). The following section discusses the institutional approach in the context of natural resource management and utilisation.

2.3 Institutions and Natural Resources

According to Ostrom and Tucker (2005) there are two principal approaches and methods for forestry institutional analysis. Both approaches and their methods study the outcomes of institutional processes more than analysing the actual institutions themselves, and have a rational choice basis. The first one, Institutional Analysis and Development (IAD) framework, focuses on the action situation, 'which is composed of participants, positions and actions that respond to information and relate to potential outcomes, and the costs and benefits associated with actions and outcomes' (Ostrom and Tucker 2005: 87). This framework recognises that each action is mediated by the physical world, human communities and a set of rules; however, it does not explain the origins of the studied institutions.

The second approach is the International Forestry Institutions and Resources Research Program (IFRI) which 'integrates principles of the IAD frame with approaches from the natural and social sciences to facilitate analysis of the interrelationships among the many variables that shape forest conditions and institutional arrangements' (Ostrom and Tucker 2005: 87). The IFRI methodology has incorporated ten protocols⁵ with the objective of obtaining 'reliable and representative data' about different forests. Ostrom (1990: 33) argues that an 'individual's choice of behaviour depends on how the individual learns about views and weights, the

⁵ The ten protocols are: 1) forest form, 2) forest plot form, 3) settlement form, 4) user group form, 5) forest-user group relationship form, 6) forest product form, 7) forest association form, 8) non-harvesting organisation form, 9) organisational and inventory form, 10) site overview form (Ostrom 1998: 89).

benefits and costs of actions and their perceived linkage to outcomes that also involve a mixture of benefits and costs.’ The individual calculates what is in their best interest and acts accordingly. The connection between ‘what is best for an individual’ and the corresponding ‘actions’ is far from linear. In the context of the underground forest frontier, this is the kind of information that the empirical chapters will help to develop.

IFRI can offer an interesting methodological approach to the study of institutions-actions in relation to Quintana Roo. However, the studies that have resulted from this approach have severe limitations (*cf.* Moran 2005). The ten protocols proposed, and the use of GIS systems, have provided an overview of the actual conditions of forest ecosystems around the world. The consistency of data that this system can produce would be interesting in comparative terms and for a general mapping of the forest conditions globally. Conversely, if the research question concerns the ways in which institutions at different levels create and reconfigure the socio-nature space, then IFRI needs to be complemented with other approaches. In particular, case studies like the one presented here, are often the way to obtain more detailed grounded information about the social process of dealing with, in this case, forests and the underground.

In the context of the underground forest frontier, it is important to follow the actions and outcomes of the institutional framework. A central part of the analysis is to understand the processes through which actions influence the creation of new institutions or the transformation of existing ones. In this sense, the question of ‘which institutions are involved?’ is the beginning of the analysis of how and why those institutions are selected to constrain or permit human action in the underground forest frontier. In Mexico, each successive legal system imposed over the years has resulted in a mixing of institutional forms. As Paul Robbins notes, this creates conditions of legal pluralism under which lands are governed today (Robbins 1998: 415).

An institutional history of the underground forest frontier in Quintana Roo is ultimately needed in order to formulate an understanding of how the aquifer system operates. This is further explored in Chapter 5.

Changes in the use of cenotes, from sacred meanings to tourist utilisation (discussed in Chapter 4), not only illustrate the groups of individuals’ conceptual world but also the ways they derive a living from them, and how they have adapted to different types of ownership, markets and new demands. In Mexico’s Quintana Roo, local institutions should guide the use

of natural resources (Gibson *et al.* 2000), because, in theory, they are designated to cope with the local context. Nevertheless, and as illustrated in Chapter 5, one of the major problems in the underground forest frontier is the implementation of bodies of regulation that do not correspond with the local physical geography described in Chapter 1.

Therefore, the study of local institutions in relation to cenotes will delineate the study of actions associated with these places through history. However, an existing connection between 'local' and 'non-local' institutions needs to be acknowledged, where imported schemes of nature's management are implemented. Institutional tools like the recognition of cenotes in Mexican legislation, the creation of underground reserves or the prohibition of modifying vegetation within 50 metres of cenotes (Chapter 5) are just some examples of the current formal perceptions about these systems. As discussed in the introductory chapter, the formal delimitation of the first underground hydrological reserve in Mexico is a good example of how the creation of institutions and the actual composition of the ecosystem does not necessarily correspond one with the other, but creates a social feeling that nature is 'formally' under a certain type of control. In this sense, the mere study of such intentionality shows that the aquifer is perceived as graspable, measurable and, most of all, controlled. How do institutions deal with uncertainty, flows, changes and an almost chaotic nature? The answer may be also found through the use of an institutional framework.

2.4 Institutions and everyday life

The set of rules that constrains or allows the day to day actions relating to cenotes is only one side of the story. There is another set of codes that also shape everyday actions – the informal institutions. The combination of both the formal and informal in everyday life is manifested into multiple relations, actions and the transformation of spaces. The first step in the research of social processes is the recognition of the existence of 'rules' (formal) and 'norms' (informal) in a particular context. The study of the transitions from values and perceptions into actions is the next step, filtered by the institutional apparatus. Anthony Giddens, through Structuration Theory (ST), has proposed a way to approach to these transitions. This section discusses ST and other contributions from Pierre Bourdieu to shape the framework for the present study, and how these notions can be applied to answer through what institutions is the commodification of nature organised in Quintana Roo when it comes to cenotes.

In the study of human social activities, social institutions and the interrelation between action and institutions, Anthony Giddens proposes ST as an ontological framework to explain such

relations. This framework shows how 'social structures are both constituted by human agency, and yet at the same time are the very medium of this constitution' (Bryant and Jary 1991: 7). Within this framework, the term structure is related with the production of 'rules' and 'resources'. When humans want to understand each other, under some particular circumstances, they access techniques or generalise procedures to establish contact. These techniques or procedures are known as rules and are the property of communities or collectives, not of individual actors. On the other hand, resources are related to the idea of individual actors having advantages or influence over other actors. This structure creates procedures known as rules, at the same time as it produces resources. ST differentiates structure from social systems, understanding the latter as the surface of actions. In a social system, then, the outcome of rules and resources is observable.

Social systems have 'structural properties, including that of the institutional fixity' (Giddens 1991: 204). According to Giddens, institutions have some degree of permanence and are relatively stable (Jordan and O'Riordan 1996: 5); they are the more enduring features of social life (Giddens 1984). Conversely, this research argues that institutions are in a continuous negotiating process and new institutions are created to respond to the new needs of the system; for example, the institutionalisation of markets for environmental services. As Giddens emphasises, 'institutions' can also be seen as a group of practices that are attached to time and space, and whose transformation is a very slow process.

What is understood from ST is that structure and the social systems are a duality. Structure is composed by rules and resources that somehow produce and are reproduced in the social system. 'All processes of the structuration (production and reproduction) in systems of social interaction involve three elements: the communication of meaning, the exercise of power and the evaluation and judgment of conduct' (Giddens 1977, cited in Bryant and Jary 1991: 9). ST is also organised into three different modules. The first one is a preoccupation with the semantic process to transmit knowledges or ideas, this communication process occurs in collectives and responds to communal 'rules'. In the second module, the communication process is submitted to a game of power and uneven relations are recognised. Finally, the third element is composed of 'sanctions', i.e. how the uneven relations are translated into judgments of behaviour. The intention of this ontological approach is to create multiple analytical categories to explain the existence and permanence of institutions. These three elements of the structuration process in the social system (communication of meaning, the exercise of power

and the evaluation and judgment of conduct) are a starting point from which to understand actions.

The duality of structure and social systems can be questioned in terms of the analytical complexity that can add to any social study. Giddens' concern with the coordination of day to day behaviour has contributed importantly to the study of human social activities. In spite of the complexity provided by multiple schemas and classifications to explain the production and reproduction of structure, the framework proposed for studying levels or layers of consciousness can be an open door to the implementation of interesting methodologies in the study of the interaction between institutions and actions. The general structuration process, consisting of the communication process, the exercise of power and the evaluation of conduct, according to the presence of different actors, could be a useful methodological tool in responding to how cenotes have been commodified in Quintana Roo. However this thesis, although finding the ST schematic useful in the classification of social process, prefers a more chaotic approach that recognises individuals' ability to play different roles according to their circumstances.

In a less complex proposal, Pierre Bourdieu connects action with culture, structure and power (Swartz 1997) with the study of social institutions. The main concepts driving Bourdieu's approach are habitus and field. He defines habitus as a structural mechanism that operates from inside the agents, which does not fully determine human conduct:

Habitus is the principle generator of strategies that allow agents to solve uncertain and non-preview situations [...] a system of durable dispositions that integrated with past experiences works as a matrix of perceptions and actions and permits a number of infinite tasks to take place (Bourdieu and Wacquant 2005: 45).

Habitus and field are connected; the habitus reacts to the field's demands in a coherent and systematic way. Habitus structures the bounds of possible actions but also generates 'perceptions, aspirations, and practices that correspond to the structuring properties of earlier socialization' (Swartz 1997).

Bourdieu defines the field as:

A network, or configuration of objective relations between positions. These positions are objectively defined, in their existence and in the determinations they imposed upon their occupants, agents or institutions, by their present and potential situation (*situs*) in the structure of the distribution of species of power (or capital) whose possession commands access to the specific profits that are at stake in the *field*, as well as by their

objective relation to other positions (domination, subordination, homologation, etc.)
(Bourdieu and Wacquant 1992: 97)

The field is, therefore, a space of conflict and competence where participants compete for control over cultural and economic capital. The dominant or subordinate position between actors in the *field* depends on the amount of economic and cultural capital they can control. It is in the field that the formal and informal institutionalised relationships are captured. Bourdieu's approach also provides the opportunity of historically showing the changes in institutions as part of the habitus which human manifestation are empirically graspable in an analysis sense in the field. While the idea of permanence and stability reflected in ST falls short in the very dynamic social reality reflected in Quintana Roo in the present study.

In general, Bourdieu, as Giddens does to a certain extent, sees action resulting from a set of dispositions that informs common sense (*le sens pratique*). Strategies, in this sense, do not derive from calculated rational or even conscious choices but, rather, from pre-reflective tendencies (Swartz 1997). Social actors construct institutions that govern human behaviour in a specific field, these institutions change over time, through complete replacement of one set for another, or through a more subtle process in which established institutions are refashioned. In the broadest sense, institutions work as the bridge between culture (structure/habitus) and human action in socio-nature. To a certain extent, the 'institution' is an explicative concept that follows the outcomes of human action and perception.

Community land and cenote management in Quintana Roo has become a polyglot mix of premodern, modern and postmodern vocabularies. The outcome of this variety is a visible mixture of different isolated rules trying to organise an interconnected and dynamic ecosystem. This syncretism inevitably poses the question: 'what is the set of social institutions that are organising nature(s) in contemporary Quintana Roo?' Prior to engaging with this, the next chapter will focus on the operationalisation of the previous theoretical approaches for data collection. It will detail the research methodology used for this study, with an explanation of the relevance of each set of specific methods to the research goals.

Chapter Three

Research Methodology

The first empirical goal of this study is to characterise what the underground forest frontier is, identifying different discourses it and its components, how it has been used, and the transformational processes it has undergone. To achieve these aims, the study utilised a variety of qualitative methods, recounting the ways in which cenotes in Quintana Roo have been appropriated, transformed and produced. Specifically, this involved extensive field-based, semi-structured interviews in order to gather the perspectives of different participants on cave and cenote uses in Quintana Roo, eliciting their values, actions and institutional arrangements. Interviews were carried out with 73 participants in different sectors at the local and federal level (government officials, academics, landowners, tourism developers/business proprietors, and explorers). The primary objective was to understand how these social actors produce knowledge and associate different meanings with cenotes, while also influencing the uses and material practices related with the cave and cenote systems.

The particularities of this research may not allow the study to be used as an example of generalised processes in other contexts without similar geological formations; however, the common ground with human geography is found in the institutional apparatus that this study analyses, which influences everyday decisions in relation to natural resources, the intensive processes of nature's commodification, and landscape transformation. The absence of previous studies regarding the social dynamics and the use of the underground forest frontier seem to be obscured by the presence of natural science studies of the area, as previously discussed. Therefore, the pertinence of this research lies in its contribution to the discipline of human geography, as it presents an in-depth case study that explores the relationship between social groups of actors and their natural environment (i.e. the cenotes).

Epistemologically, and as Bourdieu and Wacquant (2005: 61) note, 'a good methodology will not fill the empty space of a theoretical gap.' This study thus epistemologically follows a post-structuralist perspective of societal phenomena, a theoretical position that allows for a generally clear understanding of the discursive mediations occurring in a multileveled society; that is, a society where discursive formations (i.e. different constructions of the same object) are constituted by culture, tradition and different kinds of capital(s). What post-structuralism

does is to highlight the relationship between the event and the narrative of the event, exploring different knowledges and the ways in which they materialise. As disclosed in the literature review, different groups construct what is real to them through a variety of classifications and relationships. These constructions are not arrived at in historical isolation; on the contrary, they 'occur' in accordance with the historical moment and situation. To address such historical relevance, this study also analysed documents from different research epochs with the intention of finding reference to the underground forest frontier. This aided in the understanding of current valorisations of the underground in Quintana Roo and the multiple voices that, through time, have helped in the social construction of the underground forest frontier.

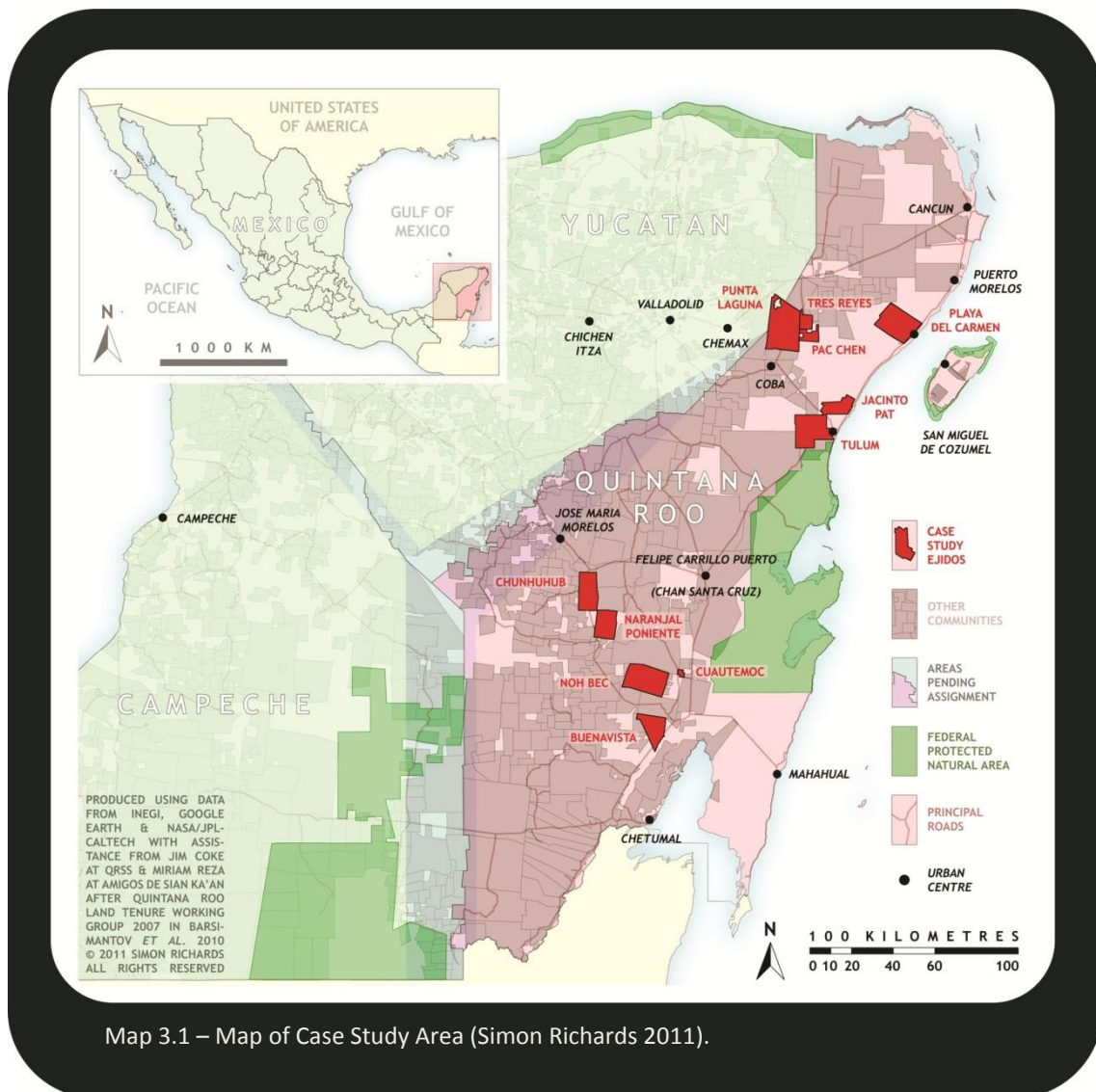
In light of this, it is important to recognise that the social production of nature is not just 'mediated' by hegemonic ideologies. At the local level, nature is produced and constructed at every turn. The syncretism of beliefs is part of historical and sociocultural processes. In Quintana Roo, for example, the idea of a cenote as something sacred has been resignified through time. And, although discursively the sacred meaning is still added in some narratives, other more evident discourses are occupying the social arena as protagonists, specifically those related with the processes of nature's economic commodification. The privatisation of cenotes and the transformation of this natural space as places of recreation for visitors, illustrates the intimate presence of multiple natures in the cultural imaginary.

The following sections detail the research design. It is important to keep in mind that this is not a process of evolutionary steps but, rather, interrelated methods that construct a coherent corpus, sensitive enough to be aware of new categories of drivers. For this reason, a constant and permanent reflexivity over the data was maintained. The focus of the current analysis is not merely on collecting a 'decent' amount of data for a PhD but, rather, on organising all the ideas produced for the analysis in a way that reflects those of the research participants.

3.1 Reconnaissance trip: identifying research participants

As detailed in previous chapters, the cenote realm involves a variety of stakeholders across all levels of environmental governance. To understand their role and to document as accurately as possible the contemporary situation and the position of the different participants, it is essential to engage with them in a meaningful and informed way. In order to identify such actors for this research, it was first necessary to establish contact with different

knowledgeable individuals and institutes, known through policy documents, newspapers or publications. This group of individuals was contacted via email, with the research goal and aims briefly explained (April-August 2008). Subsequently, a ‘reconnaissance trip’ was organised to establish personal contact with these actors, as well as to travel through Quintana Roo state to identify cenotes and their governance regimes (October-November 2008). When establishing personal contact with actors, polite requests were made to identify other individuals and organisations with a stake in the development of activities related to caves and cenotes. Contact was also made with private landowners, actors involved in regulatory processes, scientists, explorers and tourism promoters.



Map 3.1 – Map of Case Study Area (Simon Richards 2011).

During the reconnaissance trip, the main goal was to visualise the dynamics within the space. The geomorphology of the Yucatan Peninsula and especially of Quintana Roo demonstrates a

great diversity of cenotes not only in terms of shapes and types as discussed in Chapter 1 but also in terms of ways in which they have been used and the processes of transformation that they have undergone. For this purpose, numerous caves and cenotes were visited and different regimes of utilisation were identified. Some cenotes and caves are located along the Cancun-Tulum road and are generally open to the public, with entrance fees ranging from US\$5 to US\$100 per person. Others, located along this road, although in a minority, are not directly open to the general public; instead, it is necessary to contact the tourism operator that has signed an exclusivity contract with the owner(s). Thus the visitation process is different, with the company being in charge of transportation to the place and the provision of the necessary equipment for snorkelling and/or caving, in contrast to visitors needing to provide their own resources at other sites.

Another set of caves and cenotes were visited along the Tulum-Coba road. These have also been opened for tourist activity and they are mainly run by landowners, visitors arrive directly at the location to gain entrance. Even though these cenotes are inside ejido lands, the ownership regime of the cenote can differ and therefore their use and exploitation processes can vary. A number of different landownership regimes were identified in this area: communal private, individual private, public and loan-making, demonstrating a diverse panorama, especially in terms of institutional arrangements (discussed further in Chapter 6).

Also some caves and cenotes were visited in the Maya area of Quintana Roo that borders the state of Yucatan. While these places were also under the management of tourism operators, the main difference was that these cenotes are part of Maya communities, meaning that the Maya presence ultimately added a performative value to their current set of valorations. The majority of cenotes in this area are under an exclusivity contract with some tourism companies. These contracts consist of the companies paying a monthly rent to the Maya communities living near the cenotes and that legally own the land; honouring the obligation to provide the entire infrastructure for visitors: roads, boats, life-vests, food and transportation. In exchange, the companies have a 'real Maya community with Maya speakers' working for them in a 'pristine' context (study area is shown in Map 3.1).

Finally, a collection of caves and cenotes located throughout the state, and not opened to tourism, were visited. The main use of these spaces is for exploration, research and mapping. The lack of tourist activity in some cases is caused by their inaccessibility and the risks

associated with visiting them. These include factors such as fauna, air conditions and water level, which 'must' be taken into account if the space is to be exposed to tourism activity. To explore and study these caves and cenotes it is necessary to obtain the landowner's permission and, if the area is protected by any government body such as the National Anthropology and Historical Institute (INAH), a formal request to visit the area is required – another kind of exclusivity. For every visit, an accompanying speleologist was necessary.

Another group of cenotes is found within the Sian Ka'an biosphere reserve.⁶ The status of these cenotes is 'protected' and the activities surrounding them are mainly for the study of water quality, although the communities inhabiting the borders of the reserve are permitted to make use of them for personal consumption, such as fishing.

In terms of accessibility, the lack of an official survey of cenotes meant that access tended to be gained to those cenotes that are more exposed to tourism, since they are more visible. In cases where cenotes form part of residential areas as dumps or as grey water deposits it was more difficult to obtain access. There are also cases where buildings have been constructed on top of these underground systems, or they have been filled with concrete to strengthen the foundation of large-scale constructions such as big resorts and adjacent golf courses, making it equally difficult to access them. From the discussion developed in Chapter 1, it can be said that cenotes are not difficult to find amid the geography of Quintana Roo; however, due to property regimes it was difficult in some cases to contact the owner or manager of the system, making the publicly accessible cenotes easier for establishing contact.

Although no formal interviews were conducted during the two month long reconnaissance trip, it facilitated the initial important contact with stakeholders and, moreover, showed their openness and interest in the presented research. The trip also means that relevant information was obtained which proved useful in drafting the project's research design. Thus the trip laid down important foundations for the intensive field research period, which started a few months later, and the qualitative methods displayed to gather empirical information as shown below.

3.2 Interviews: who to talk with, when and where

⁶ The Sian Ka'an biosphere reserve is located in Quintana Roo and conserves 528,000 hectares of forest and marine ecosystems.

Why are intensive methods, such as semi-structured interviews, appropriate for exploring rationalities, implications and meanings (Hoggart *et al.* 2002) in the social construction of nature? Interviews allow people to talk about their own experiences and about the complexity of certain situations. Other methods, such as closed-question surveys, are arguably too restrictive since it is almost impossible for the respondent to answer with what they specifically want to say. In contrast, in-depth interviews ultimately allow the respondent to elaborate, theorise and even transform the questions (Valentine, 2005).

Interviewing was therefore a central method of this research and was organised according to a set of topics and questions derived from the reconnaissance trip and the conceptual framework. Key stakeholders, including government, NGOs, cave divers, academics, project managers, project investors and members of local communities were interviewed. They were identified through document analysis and a snowballing strategy, additionally aided by the researcher's attendance at a number of workshops and seminars.

The interview structure permitted a dialogue to take place between the researcher and the interviewee, with the purpose of conducting the conversation around the general topic of interest. According to May (2001), there are three different necessary conditions for a successful interview: accessibility, cognition and motivation; the three of them relating to the interviewee's 'status' more than the interviewer's. Cognition refers to the interviewee's knowledge of their role in the research. Motivation, on the other hand, refers to the importance of making known to the interviewee that the answers provided are extremely important for the research. It was important at all times to explain the research goals and let the informant transmit their knowledge and share experiences.

During the reconnaissance trip and through informal talks with different actors, it was noticed that, when discussing cenotes, a learned discourse about tourism and the problem of low and peak tourist season was a frequent conversation starter. Following this, the discussion could then take different directions, from the history of the cenotes to the different divers that have 'explored' the area. Accessibility in this sense was experienced by the researcher. It is also interesting that an important number of the researchers in the area have a natural science background, as mentioned before, and the methods employed to obtain information (i.e. taking water samples, soil samples, photographing and measuring) are now part of the general knowledge of communities and landowners. When this research project was explained to potential participants, there was ultimately an expectation that one of these 'known' methods

would be utilised. In this sense, an open interview was not viewed as a formal instrument when compared with taking water samples. Nevertheless, among all the sectors (government, NGOs, academics, cave divers, project managers, project investors and members of local communities), motivation to talk about the caves and cenotes was high. Different conflicts and tensions were identified during interviews between members of different groups (for example between divers, archaeologists, research institutes) but this tended to provide stimulation for them to keep discussing the topic.

Therefore, through the use of qualitative methods such as semi-structured interviews, it was possible to identify and show the different epistemologies of the actors related with caves and cenotes. Ambiguity in the role of the actors is translated in different and contradictory discourses, but the intention is that the analysis was permitted to highlight them.

However, interviewing as a research method also has the potential disadvantage, as Bourdieu and Wacquant (1992) note, of converting something ephemeral, like a dialogue, into something lasting. Nonetheless, interviews are arguably the optimum qualitative method that allows us to study different perspectives of a concept, and to establish the differences between the concept and its meaning. Through otherness intervention (my presence as a researcher asking questions of something 'common' in the interviewees' everyday life), the critique and the dialogic of something, the interviewee is forced to think and react to others' thoughts as they verbally materialise in the interview process (Bourdieu and Wacquant 1992). This dialogue was encouraged in every field interview.

3.2.1 Semi-structured Interviews

For this research, structured methods were not suitable, as forcing respondents to restrict their experiences and complexities of everyday life would not have assisted in answering the research questions. What this research was looking for was to develop conversations with purpose (Eyles 1988) and some structure. Therefore, in order to explore respondents' complexities and subjectivities, a semi-structured method was the preferred procedure.

Semi-structured interviews can also be thought of as an opportunity for the participants to teach the researcher a different knowledge, point of view or life style. When applying a qualitative method, the majority of researchers are worried about rigour and objectivity. Conversely, this research was not only concerned with extracting the 'important information'

to answer the research questions, but also with paying attention to open conversations that show the researcher what the proper way to ask questions is and also what the important questions to be asked are. In this sense, one additional characteristic of this method is the likelihood that the respondent might raise questions that have not been anticipated (Silverman 1993). Semi-structured interviews are thus a good tool to use in order to gain insight into what the interviewee sees as relevant and important (Brymant, 2004). In other words, the interview permits an interactive process of rethinking the proposed question guide.

The interviews were divided into a variety of themes, with a set of questions allocated within each. The process, order and shape of each interview depended on the interviewee. Due to the variety of actors interviewed, it was necessary to contextualise the research problem in different ways. For example, when conducting interviews with government officials, NGOs, academics, project managers and project investors, the context was first established by discussing their definitions about caves and cenotes. In contrast, interviews conducted with land and cenote owners were carried out differently. In the latter cases, the main interest of the interview centred on the stories around the cenotes and the different commodification processes that historically have been experienced in the state of Quintana Roo. The perspective here was to gather information about how their lives around caves and cenotes have been transformed by the different commodification moments. The landowners were asked about their views on cenote uses and property rights, as well as their opinions about the actual conditions of the cenotes and the aspects they would change or improve.

‘The interview guide is more like a list of memory prompts of areas to be covered’ (Brymant 2004: 324). The guide should be flexible enough to allow the interviewees to show their cosmologies, world views and the order they give to different experiences. Nevertheless, the guide should have some kind of order and coherence. The interviewer should be prepared, as much as possible, for a range of possible responses depending on the interviewee’s position in the field. The guide establishes a formal process and order of the questions by topics, helping the interviewer to look fluent and confident about the language and vocabulary to be used (Hoggart *et al.* 2002).

3.3 Secondary data analysis

Secondary data analysis had two purposes in this research. The first was to provide a context for the primary data. Second, it informed the quotidian changes related to the topic and the area. Secondary data is not static, as new sources are created and older ones destroyed (Clark 2005). In this sense, it was necessary (and still is) to keep a constant and informed process of new evidence for the case study. More specifically, the secondary data analysis in this research looked for information to assess the commodification processes in caves and cenotes in Quintana Roo, such as new discoveries, maps of caves and cenotes, environmental impacts, group conflicts, scientific controversies and the impacts of new tourist developments. Local newspapers (*Por esto de Quintana Roo*, *Novedades de Quintana Roo*) and documentaries (*Cenotes*, *Secrets of the Maya Underworld*, *Spirit of Nature*) were referred to as part of this process. Attention was also paid to the aims and attitudes of the consulted sources, with acknowledgement that their production has not been impartial.

In the case of Quintana Roo, documentaries are an important means of obtaining funding for exploration. Although this research does not aim specifically to examine the power of films in contemporary culture, it is important to recognise that through documentaries, the Maya underworld has been visually experienced by a wide range of actors and in some way commoditised through wonderful stories of discovery and disclosure in a capitalist world (Aitken and Craine 2005). Documentaries in this case are visually producing a kind of nature that has been experienced by a select number of people, reinforcing the 'exclusive' access to these spaces.

3.4 Constructing histories

An important component of this research was to (re)construct histories surrounding cenotes on the Yucatan Peninsula. In particular, this focused on how the underground forest frontier has undergone different historical processes of commodification, and the broader context of how it has been a prominent feature in influencing the Peninsula's social history. This involved extensive library and archival research.

The starting point for this historical data collection was in the United Kingdom. This phase involved online searches through electronic academic databases for articles relevant to cenote history. For most databases a simple search of "cenotes" or "caves" AND "Yucatan" was entered, and a subsequent methodical process of looking through every entry relating to the theme was conducted. Although this approach involved many extra hours (potentially even

days) of searching in comparison to more focused searches, it proved effective for finding relevant materials that would not have been found with pre-conceived Boolean operators. Furthermore, the relatively region-centric words of “cenote” and “Yucatan” made this feasible approached. From the above searches a large expanse of relevant materials to cenote and cave history on the Yucatan Peninsula were gathered in electronic form.

The next research step was to examine the reference lists of these articles, identifying other potentially relevant materials which were added to a ‘to read wish list.’ Searches for these specific materials, along with Boolean operator searches along the above lines, were effected in potentially relevant library catalogues (university and public), multi-library search engines (e.g., Trove, WorldCat, Bonus+, Copac), and specific archival websites (e.g., www.archive.org). Any relevant materials situated in the United Kingdom were tracked down to their relevant library; this included many libraries across London (British Library by-far having the greater collection), as well as consulting a specialist caving library located in the Peak District in the north of the UK. The next stage of the research was based on the Yucatan Peninsula; where numerous relevant materials were sourced. Three libraries of the Universidad Autónoma de Yucatán (UADY) - Ciencias Antropológicas library, Central Library, and the Arquitectura, Arte Y Diseño Library – along with the Yucatan State Public Library, and the Yucatan State Archival Office, were heavily consulted. During this period, many of the research respondents also loaned or provided relevant materials from their own personal collections.

A variety of different historical materials on cenotes were found and analysed during these searches. These included old journal articles, memoirs, photographs, newspaper articles and maps. These were then organised into historical epochs (i.e., pre-colonial, early colonial, post-colonial, post-revolution, contemporary), as well as into thematic areas (i.e., Maya, colonial exploitation, Henequen, Chicle, Caste War, Exploration, Tourism). These two approaches provided opportunities to analyse the data from different perspectives, with the history of cenotes presented in Chapter 4 and the starting sections of the three empirical chapters being a reflection of these two thematic approaches. Overall, this variety of historical materials provided a strong contextual foundation from which to analyse the contemporary milieu surrounding perspectives and interactions with cenotes.

3.5 Assuring rigour

As Bradshaw and Stratford (2005: 74) state, 'it is not a frivolous thing to share, interpret, and represent others' experiences'. Trustworthiness in the research can only be achieved through two different processes; first, a descriptive detailed explanation of decisions taken during the course of the research (described in the following sections); and second, submitting the research to evaluation by different communities, participants and the academic community. In other words, to earn credibility it is necessary to make the research accessible to be read, and to provide the space for it to be questioned. In light of this, the results obtained during the research process will be submitted to the scrutiny of research participants and the academy. In particular, large sections of Chapter 4 have already been published in an academic journal (Munro and Melo 2011) and subjected to a peer-review process, while Chapter 7 has been presented to a group of explorers for evaluation and feedback. Similar processes will occur upon completion of the thesis.

3.6 The language and culture frontier

For this research, the development of a 'transactional expertise' (Collins and Evans 2002) was necessary in two different ways. The first related to the Maya cosmology of the world, in response to the idea that the Maya Culture, at discursive level, was contained in different conversations among research participants. The second related to the technical details of the underground water and cave systems, given that most studies concerning cenotes have been conducted from a hydrological, speleological and even an archaeological point of view. To access to this information and to be able to interview the actors involved in the production of this 'scientific knowledge', it was therefore necessary to discuss the technical details.

In the case of interviewing hydrologists and speleologists, knowledge of basic and general concepts was necessary. To be informed of processes of water fluctuation, water layers, salinity, and water intrusion, for example, entailed the understanding of some of the outcomes of human activity and the effects of different uses and practices in cenotes and caves. Regarding Maya cosmology about the Xibalbá, it was necessary to read classic Maya Literature like the *Chilam Balam* or the *Popol Vuh* which have been sources of information and inspiration for many archaeologists, anthropologist and specialists in the Maya world.⁷ Although it was not necessary to conduct interviews in Maya, understanding the symbolic meaning of some narratives was essential.

⁷ *Chilam Balam* and the *Popol Vuh* are the two pieces of Maya Literature that narrate the creation of the world.

3.7 Fieldwork and analytic diary

A fieldwork diary and field notes containing observations, conversations and contact details of potential new participants were also kept. This helped to reflect upon the daily process of research during the fieldwork period. This diary was written at the end of each journey when possible, describing situations, contexts, anecdotes and places.

An analytical diary was also kept. It was used to record 'thoughts and ideas about the research process, its social context and the researcher's role in it' (Dowling 2005:32). This enabled a reflexive posture to be maintained. There are several other advantages to keeping this diary instrument. For example, it makes it possible to read the researcher's thinking process about the topic in question, while at the same time allowing one to map the link between theory and conceptual ideas with quotidian activities like interviewing. This continuous critical reflexivity does not seek an everyday radical transformation; on the contrary, the constant reflection can help to continuously think about the research processes, support it and modify it when necessary. Being reflexive also implies analysing the best way to present the information and communicate results. Moreover, acknowledging a personal social position in the research process via the analytical diary further allowed for the understanding of field data. The analytical diary also helped in the construction of codes to organise the data obtained through interviewing.

The following section details this subsequent coding process, as an essential part in the empirical data analysis.

3.8 The Analysis: coding data

The interviews conducted as part of this research were recorded and transcribed. Although transcription can result in hours of tedious work, it is ideal to transcribe the interviews as soon as possible. In this way, the process of analysis was started soon after the first interview had been completed and transcribed. While transcribing and listening, it was then possible to re-evaluate the interview question guide and work in information about new themes to be explored, or others to be avoided.

Open codification consists of the breakdown of data into discrete sections in order to carry out a meticulous analysis, and/or subsequently the further breakdown of events and actions that can be considered conceptually similar. For this research, open codification comprised the first

stage of analysis. Major themes were identified and followed by a list of codes, created by the current researcher to construct a clear panorama of the content and nuanced information. Every code was defined in such a way as to create the parameter to be identified within the text, to enable more in-depth analysis. This first codification stage consisted of identifying the 'general' topics along the interview. Such topics coincided with the general organisation of the interview guide (See Appendix 1) that, for this research project, were: a) caves and cenotes (physicality, values, uses, affectation, public-private); b) land (enclosures, privatisation, appropriation); c) exploration (history, experiences) , d) regulation (legal status of cenotes and caves); and e) personal experiences about caves and cenotes (tell a story).

During this initial codification process, the codes were also placed in line with the major conceptual interests of the research project. The first of them related to the historical references to uses and knowledge of and about cenotes (environmental history perspective). The second, and main conceptual framework used for the thesis, was that of nature's commodification processes (privatisation, alienability, individuation, abstraction, valuation and displacement). The final approach was that of institutions (the role of informal and formal social institutions, and their historical transformation in relation to the uses and management of the above-the-ground and the underground). This initial codification process helped to develop a broad comprehension of large segments of transcribed interviews, establishing clear links between the information contained in the interviews and the thesis' general topics. For example, a landowner talking about the construction of a fence to delimit his property would be selected under the category, among others, of commodification.

After the initial codification stage the interviews were classified into sectors, this was based on the content of the interviews as most participants openly stated the sector they 'belong to' (i.e., private, public or explorers). When more than one sector was identified, this was also marked as relevant to the analysis. After classifying the interviews by sector a 'fine codification' process took place (Castro 2000: 485). The fine codification process occurred as a result of multiple readings of the interviews and therefore subtopics started to become evident. For example, in relation to the major code of land, fine codes like: land extension, land property, land concessions and economic value of land were located and coded. An example of the map of codes created for this research is present in Appendix 2, as well as an example of the analytical diary kept during the different research stages (Appendix 3).

The dividing of the empirical chapters along the categorisation of public, private and explorers was developed as the most illuminating method for analysis. Various other ways of presenting the analysis were contemplated. For example, it was considered to develop a chronological division of chapters where the use of cenotes was marked by historical epochs (Pre-Hispanic times, Spanish settlements, Cast war, Chicle, Henequen and Tourism). This historical approach, although attractive due to the historical depth that it adds to the study, would not allow for a deeper understanding of the current social constructions and materialities of the Underground Forest Frontier. As a result of this, a map of the 'relevant' actors that could be classified among sectors was a more suitable approach. In this sense, the participants' professional ascriptions and their own personal interests were taken into account for the development of the classification system (i.e. public sector, private sector and explorers). It was assumed, however, as with any classificatory process, that overlaps between the members of each sector occur and that the participants' positionalities can be variable and flexible.

3.9 Ethical and Moral Issues

If research is considered a social process, then it seems necessary to present some ethical considerations when conducting a study that involves human and non-human participants. Ethics, in the research world, are about the researchers, their attitudes, responsibilities and obligations to those involved in the process. The latter includes sponsors, participants and readers (Dowling, 2005). This research followed the requirements of King's College London Research Ethic Sub-committee for Humanities, Law and Social Science and Public Policy (RESC) (see Appendix 5). Participants' informed consent was obtained, even taking into account that, due to cultural differences, asking a member of a Maya community to sign a letter, whose content may seem banal, could be offensive and even affect the outcome of the information gathering processes. The current researcher prefers to think that the ethical commitment towards the different participants lies principally in informing participants about the research goals and the important role their information will play in the study, and not solely in obtaining a signature, which somewhat substantiates unequal power relations.

Participants' confidentiality and anonymity were maintained when solicited. There are various ways of ensuring informants' anonymity; including the use of pseudonyms and masking other characteristics like occupation and location. However, as Robin Dowling (2005) remarks, sometimes it is difficult and not desirable to maintain public figures' anonymity due the

importance of the role they play in the public sphere. Thus, for this research, the participants' anonymity was ensured with the exception of those participants who agreed to be named in the research, in particular members of the public sector. The interviews have been assigned a classification number (i.e. I58) followed by the date when the interview took place (September 2009). An example of a transcribed interview is provided in Appendix 4. Although most of the interviews were conducted in Spanish, some were conducted in English by the researcher. The interviews were transcribed in their original language and when necessary translated for their use as part of the present document. The translation was made by the researcher trying to maintain as much as possible the original sense and intentionality of the participants' narratives.

3.10 Methodological development: challenges and changes

The fieldwork for this research started at the beginning of March 2009. Initially the intention was to contact landowners who possess one or various cenotes on their land. Yet it became apparent that landowners in Quintana Roo do not form a homogeneous group that can easily be approached through conventional methods, such as knocking on doors, introducing oneself and one's research, and asking questions. For example, it was found that a number of cenotes are located within large ranches on ejido lands whose owners often live outside of the ejido, while access to ejido lands is not public. To illustrate this, the ejido Playa del Carmen has four different guard posts monitoring entry into the ejido and a permit is necessary to gain any form of access. This permit has to be obtained by the ejido authority through the Committee in charge of surveillance and, in order to acquire it, it is necessary to go to the ejido office and explain the main purpose of the visit.

Name	Land Status	Use	Access
Chaac Tun	Communal ownership of the cenote. Currently rented to an eco-tourist operator.	Tourism.	Tourist operator pays for the use of the road.
Cenote el Tobi	Private parcel within ejido land. The cenote is located in two parcels with different owners; both have built entrances in different sides of the cenote.	Infrastructure built for tourist purposes (stairs, road, palapa, and road) but the cenote is not currently use for tourism.	Uses 6 kilometres of communal road. One of the owners built part of the road to get access to the cenote.
Cenote Chanolandia	Private parcel within ejido land.	Infrastructure built for tourist purposes (palapas, pyramids, bathrooms) but it is not open for tourism due to the contamination of the cenote	Use of the public road. The access to the cenote is closed.
Sistema Pool Tunich	Private parcel within ejido land. Cave system located in two parcels. A part of the system (Rio Secreto) is rented to an eco-tourist operator. The other part has been explored, but not opened for tourism.	Partially for tourism.	Uses private and communal roads to get access. The eco-tourism company pays for access and use the roads.
Cenote Coati	Private parcel within ejido land.	Not in private use. Some construction workers shower in the cenote.	Use private and communal roads to get access.
Cenote Hipolito	Private parcel within ejido land. The Ranch has more than one cenote. Only one of them has a ladder installed.	Water extraction.	Use private and communal roads.

Table 3.1 – Ejido Playa del Carmen cenotes visited during the field research period.

Access to ejido lands was subsequently gained through two distinct methods. The first was by gaining appropriate permission from the corresponding Committee. In most cases, the Committee agreed to give access, but only on condition that each visit was accompanied by someone from the Committee. During these visits, a variety of cenotes were seen (see Table 3.1 for more information). These same members of the vigilance committee have cenotes in their parcels of land and mentioned that they were ‘cleaning’ their lands to make the cenotes accessible in order to be exploited for tourism in the near future. Cleaning is an activity that landowners and their families can perform during weekends. Conversely, major investment in infrastructure such as road building requires more planning and time, as some cenotes are located at a considerable distance from the main highways. When this information was casually provided, a note was made in the field diary for future reference.

Another way of gaining access to these lands was through tourist companies that have activities in ejido lands (i.e. jungle treks, four-wheel drive adventures, and speleo-tourism) and that need to pay a fee in order to have access to, and use of, the ejido roads. ‘Access prices’

vary depending on the number of tourists that visit every day, on the ejido charging the amount, and/or informal partnerships. In every case, the amount is agreed through the ejido constitutional process but not formally supported by any formal institution outside the ejido realm. Through these tourism companies it was, therefore, possible to arrange visits to the cenotes within ejido land as a guest. On several occasions, a copy of the permit extended to the company itself was used to visit other cenotes within the ejido as part of the attempt to contact the land owners.

Another restriction in contacting landowners was the existence of exclusivity agreements between the landowners and the tourist companies. In these cases, tourism companies were effectively the mediators who facilitated contact with the landowner, organising a meeting with them or providing their details. However, some of these companies felt that protecting the owner's identity was the correct thing to do and no information was obtained. The exclusivity agreement gives power to the operator to take decisions about infrastructure, prices and visitors. To visit the cenote, a proper permit is required and this is generally obtained by explaining the research purpose. An interesting aspect of this process, as was mentioned earlier, is that most of the landowners expected the research to focus on taking water samples from the cenote, as this is their experience of what researchers do when 'researching' cenotes. In order to maintain a professional relationship with the participants when obtaining entrance to any cenote, efforts were made to avoid swimming or snorkelling in the cenote, focusing instead on viewing the cenote and asking questions about infrastructure, years of operation, and problems experienced. However, in some cases, the participants argued that interviews could not be conducted unless the interviewer 'knows' the cenote by swimming, snorkelling or diving in it. In such cases a 'proper' visit to the cenote was conducted.

In the case of Dos Ojos cenote, located in the ejido Jacinto Pat, contact was established with the ejido members who work as snorkel guides in the 'cavern tour'. The researcher was asked to come back to talk with 'someone who knows about cenotes'. It was interesting to note that a recent promotion campaign done by the ejido to promote the Dos Ojos cenote shows a picture of 20 boys at the entrance of the cenote. The children in that picture are now 40 years old and work in the cenote every day as snorkel guides and sometimes as cave divers. So, even though these snorkel guides had grown up near the cenote and had witnessed the processes of exploration and its opening up for tourism, they denied having any knowledge of the system and seemed reluctant to talk about it.

Name	Land Status	Use	Access
Dos Ojos	Communal and it is operated by the Ejido Jacinto Pat.	Tourism. Swimming/Snorkeling/ Cave and Cavern Diving	Ejido Roads
Dos Ojitos/Mil columnas	Private parcel within ejido Land.	Small scale tourism. Speleo tourism.	Ejido Roads
Pit	Private parcel within ejido land.	Tourism. Cave Diving. For sale	Ejido Roads
Murcielagos	Private parcel within ejido land. The cavern is connected to Dos Ojos. Some tourist companies pay entrance to the owner.	Tourism. Swimming/Snorkelling	Ejido and Private Roads.
Hidden Worlds	Private parcel within ejido lands. Rented to a tourist operator.	Tourism. Swimming/Snorkelling/Sky cycle/ Fly fox. Diving is banned in this system.	Private Roads
Nohoch Nah Chich	Private parcel within ejido lands. Exclusivity contract with Alltournative.	Tourism. Swimming/Snorkelling/Cave and Cavern Diving.	Private Roads
Luna y Sombras	Private parcel within ejido lands.	For sale (1 million pesos)	Unfinished private road.
Labna Ha	Private parcel within ejido lands. Exclusivity contract.	Tourism. Swimming/Snorkelling/ Cave and Cavern Diving	Private roads.
Caracol	Private parcel within ejido lands.	Not in use	Private roads.
Yaaxmul	Private parcel within ejido lands. Exclusivity contract with Alltournative.	Not in use. The contract still holds.	Private roads.
Cenote Temazcal	Private parcel within ejido lands.	Use for the performance of purification rituals called temazcales.	Ejido roads.
Cenote Xunaan Ha	Private parcel within ejido lands	Tourism Swimming/Snorkelling/ Cave and Cavern Diving	Ejido and Private roads.

Table 3.2 – Ejido Jacinto Pat cenotes visited during the field research period

Currently Dos Ojos is a cenote completely managed by the ejido. The tourist activities performed there provide around 4,000 pesos (US\$400) every month for each ejido member. Jacinto Pat is formed by 180 ejido members, some of whom own a private cenote as well as participating and profiting from Dos Ojos. The ejido has been offered money by the private sector on different occasions to sell the cenote. However, as one ejido member stated in an interview ‘they’ (major private investors in the area) now ‘know the value of the cenote, but we [the ejido] refused to sell it’ (I19/April 2009).

After several attempts at interviewing members from the Jacinto Pat ejido, a cave diver who had worked within the ejido for ten years offered to take the researcher diving in cenote Dos Ojos, saying: ‘we cannot talk about it if you have not been there’ (I46/ April 2009). In spite of

not being a trained cave diver, a basic dive was conducted into the cenote. Interestingly, the wearing of diving gear allowed for the crossing of some frontiers with the ejido members; afterwards, they appeared to identify the researcher as a more familiar character (i.e. as a diver, rather than a social science researcher asking questions), who was then easier for them to talk to. From this point onwards, it was possible to start interviewing ejido members from Jacinto Pat and visit the ejidos various cenotes (see Table 3.2).

Generally, cenotes used for tourism that are located on both sides of Federal Highway 307 and that are not on ejido land, are privately owned. These lands used to be *tierras nacionales* (i.e. owned by the Nation) but through different processes people have been able to obtain full ownership of the land. Contacting these owners proved to be almost the job of a private detective. Usually, pay booths are located at the cenotes' entrances to charge visitors. Information about number of visitors per day and costs was gathered from short conversations with the person in charge of the booth; however, talking with the owner was the main intention. Quite often, when requesting information about the owner, the people in charge of the booth preferred to abstain from giving it; on other occasions, after repeated visits were paid, they starting sharing some information. Soon it became obvious that the cenote owners were running other businesses too – the profits made from exploiting cenotes were subsequently invested in a variety of other ventures such as restaurants, grocery stores, dive shops and hotels. Until this point, the idea of the cenote as a generator of funds to support other businesses had not been considered in the research (see Chapter 6).

Given this situation, some interviews were conducted in these 'other businesses'. Once contact was established with the owners, they were generally participative and interested in the research. In the case of Xcaret and Xplor, as the two major eco parks in the area (Xplor being a cave park), access to the parks was given after several visits. In Xcaret, interviews with some of the oldest workers who remembered the cenote before the construction of the park were completed, and two 'formal' visits through the parks were organised. During one such visit, the cenotes located within the park but that have not yet been opened for tourism were shown. An Interview was also conducted with a former member of the Grupo RICO⁸ (current director of Rio Secreto, Delphinus and the Flamingo Hotel), helping the researcher to uncover part of the history of the park and the idea behind Xcaret. After almost three months of constant visits to Xcaret Park, Miguel Quintana Pali, founder and CEO of Xcaret, agreed to be

⁸ Consortium owner of Xcaret, Xplor and holds the concession for Xel-ha.

interviewed for this research. During the interview he mentioned that he was conducting exploration into new areas in Quintana Roo and Yucatan to buy more cenotes.

Name	Land Status	Use	Access
Cenote Aktun-Chi	Private	Cenotes Park	Private road
Cenote Chac Mool	Private	Tourism Swimming/snorkelling/cave and cavern diving.	Private road
Cenote El Eden or Ponderosa	Private	Tourism Swimming/snorkelling/cave and cavern diving.	Private road
Aktun Chen	Private	Tourism Jungle trek and observation	Private road/ share roads with the Gran Bahia Principe Golf Courses
Cenote San Remo	Private	Not in use. The owner opened the cenote with machinery and the water is polluted as consequence	Public Road
Xcaret	Private	Thematic Park	Private roads
Xplor	Private	Caves Park	Private roads
Cenote Manati/ Xpuha Palace Hotel	Private	3 cenotes for recreation and cenote manati for swimming, snorkelling and observing the white manatees that enter to this cenote from the ocean through the caves	Private roads
Casa Cenote	Private, although a rumour exists that the cenote is located in Protected Federal Zone (Zona Federal Maritima) and the public access to the cenote should be granted.	Tourism Swimming, snorkelling and openwater and cavern diving.	Public roads

Table 3.3 – Private land cenotes visited during the field research period.

Attempts at obtaining interviews from the owners of large resorts along the coast of the Riviera Maya produced mixed results. On some occasions, efforts to visit cenotes inside resorts were prevented by the hotels; with them generally arguing that access cannot be given for research purposes and that the information is private. An example of this is the Maya Coba Hotel that has been publically criticised for removing karstic roofs to uncover the ‘underground rivers’ and construct a ‘navigation canal’, as well as for using other cenotes within the resort area as part of the Spa. Efforts were made to interview them but access was never approved. In the case of the Gran Bahia Principe Hotel the ECO Bahia foundation, an environmental

organisation funded by the same hotel, gave an interview stating that there are no cenotes within the resort. However, in the months preceding the interview, SEMARNAT (Mexican Environmental Agency) had stopped the transformation of cenotes for decorative purposes as a part of their golf courses located within the Hotel complex. In the XPUHA-Palace Hotel, a full visit was organised and information was willingly given in an interview with the biologist in charge of the conservation programme and environmental management of the hotel.

In the case of Xel-Ha, it was necessary to contact the current concessionaire of the park. Xel-Ha was originally run by a state trust called FIDECARIBE and in 1996 Grupo Xcaret was given the concession to manage the park. Today, it continues to be a state concession of Grupo Xcaret, with 14 hectares of water, 7.8 hectares of built infrastructure and 64 hectares of forest (144/ May 2009). An interview with the Director of the Sustainable Development Office in the park was conducted; when asked how many cenotes there are in the park, he said: 'we do not have cenotes, what we have is bodies of superficial water but no cenotes' (149/June 2009). It is interesting that these formations were not identified as cenotes even though in the park itself these water bodies are identified by signboards as cenotes and a brief description of them is shown. In addition, part of the park attractions is the 'Mayan Cave' connecting the cave with an underground river. Also, interestingly, the former President of Xel-Ha Park likewise claimed that Xel-Ha did not have cenotes.

These denials about the existence of cenotes in Xel-Ha and Gran Bahia Principe Hotel, despite obvious contrary evidence, exist for three possible reasons and are relevant here given the difficulties they posed in obtaining the empirical data. The first is that cenotes within their complexes do not look like a 'cliché cenote'; that is, perfectly round and very deep (see Chapter 1), and therefore the participants' understanding is that they are not 'true' cenotes. The second reason is perhaps because they have not directly exploited their cenotes for snorkelling and diving activities and therefore do not fully appreciate their existence (i.e. a cenote cannot properly exist unless it has been directly commoditised - see Jim Coke's definition of what is a cenote in Chapter 7). Finally, because the landscape has been highly transformed, it is difficult to differentiate what is 'natural' from what has been manufactured. Other operators in the area advertise their cenotes and the experience of entering them with big signs and media campaigns, clearly demarcating their existence. Xel-Ha and Gran Bahia Principe Hotel do not do this; instead their cenotes are either a side attraction to a superficial water body or the recipients of golf balls. In both cases, the cenotes appear not to be sufficiently commodified to properly exist. A list of the cenotes on private land during the

research can be seen in Table 3.3. Other visited cenotes along this stretch of highway, that were visited during the research are listed in Table 3.4.

Understanding land status and accessibility to the cenotes was another challenge of this research. Even now, some parts of the land tenure history in Quintana Roo and how the cenotes fit in that scheme seem obscure (see Chapter 5). Land tenure systems have proved to be a methodological challenge in this research that pushed for new and somehow innovative qualitative research methods, as this section has demonstrated.

Name	Land Status	Use	Access
Xel-Ha	Xcaret group was given a concession from the Cozumel municipality to manage the Park.	Thematic Park/ Archaeological zone.	Private Road
Xcacel-Xcacelito	Turtle sanctuary and Protected natural area. A concession of the land was given to the University of Quintana Roo. Currently a project to develop the project Punta Carey (resorts) is threatening the protection of the area. The Environmental Impact Assessment for such development describes plans to open 'canals' and expose the existing underground rivers.	Currently it is a public beach with two 'small' cenotes. A donation is asked at the entrance.	Public Road
Boca Paila/ Biosphere reserve Sian Ka'an	Biosphere Reserve. Cenotes and fresh water rivers feeding the lagoon.	Research/ angling/ and low impact tourism	Public Road / No road

Table 3.4 – Cenotes located on national lands visited during the field research period

3.11 Observing the groups: the new methodological tool for this research

As shown, interviewing as the main qualitative tool for the present research generated certain difficulties. Cenote owners were an especially complicated group to be interviewed for the reasons discussed above. However, other participants were very open to the interview process (particularly speleologists and divers) and it was helpful to apply an observation approach when different groups invited the researcher on 'field trips' to caves and cenotes. This method was useful not only in witnessing different groups relating to cenotes *in situ*, but also as a way of becoming a 'friendly face' for different participants in the research.

Group	Sector	Project	Place	Field trip characteristics
CICY-CEA	Academia	Monitoring the water quality in tourist cenotes	Cancun, Puerto Morelos, Playa del Camen, Puerto Aventuras, Akumal	Group of 4 researchers: two biologists, one phycologist and one oceanographer. Visit the cenotes showing a letter in the pay booth/guard explaining the purpose of the project. Once in the cenotes they took different water, algae and rock samples. In total ten different cenotes were visited, but on none of these occasions was it possible to hold a conversation with the person in charge.
Zero Gravity	Private exploration	Exploring the underground rivers located in Boca Paila within the Biosphere Reserve Limits. The objective is to provide a map of the existing underground rivers, showing their dimensions and orientation. This information will be combined with the Urban development plans proposed for the state in order to inform planning processes.	Boca Paila	A group of cave divers explored 12 km of inland underground rivers over 6 hours, departing from the Boca Paila lagoon.
Buceo hecho en Mexico	Private exploration	Exploration of the cenote Luna y Sombras in the Nohoch-Nah-Chich system. Purpose of the exploration to sell the 1 hectare of land and the cenote.	Ejido Jacinto Pat	The land owner contacted the cave divers to make an exploration of the cenote with the cavern, and to make an economic valuation of the cenote with a hectare of land.
Quintana Roo Speleological Survey	Private exploration	The pursuit is to encourage cartographic representations of caves.	Ejido Jacinto Pat	Visit to the 'dry' cave Tichi Kuna, where a fragment of the cave was mapped.
Potable water and sewage commission	Government	To provide potable water and sewer system to the State of Quintana Roo.	Cenote Chemuyil	Visit to the installations located in Cenote Chemuyil that provides potable water for urban consumption.

Table 3.5 – Field trips attended during the research period

This chapter, instead of providing a list of methods and their pros and cons, has opted for openly discussing the challenges of implementing a methodology once in the field. It has explained the methods used to gather data, to analyse it and to present the information gained through this research. The discussion has also shown that cenotes have been subjected to processes of enclosure where even researchers with no 'ludic' intentions are perceived as consumers, and therefore 'buyers', of the nature that is being sold. On the other hand, the group of explorers and scientists in the area were inviting and happy to share experiences, knowledge and contacts. The main challenge posed by this group consisted of saying no to the multiple 'gatherings' in bars after exploration trips. The public sector was also open to this research and in most cases showed an appreciation of the research topic.

Before proceeding to the analysis of empirical information the following chapter presents the historical understanding of how the attitudes shown and discussed above are the result of historical relations with natural resources, land and institutions. With that intention a very wide historical epoch is covered with cenotes as the central actor in this history.

Chapter Four

An Environmental History of Cenotes

In order to examine the contemporary commodification of cenotes on the Yucatan Peninsula, it is important to develop a contextual understanding of how this process has developed. Thus the objective of this chapter is to provide an in-depth historical context for the subsequent empirical chapters. In the introductory chapter of this thesis, the (pre-human) physical and geomorphological historical formation of cenotes was introduced; this chapter now seeks to analyse the historical interaction between human actors and the underground forest frontier.

This chapter adopts an environmental history approach for its analysis of the role and significance of cenotes during the Yucatan Peninsula's social history. The eclectic field of environmental history does not adhere to any specific theoretical position; rather, it is a broad field of study that seeks to incorporate nature as an actor in the historical narrative (Endfield 2009). It attempts to correct the historical discipline that has generally viewed social actors as ontologically separate from the natural world. Over the past 40 years, environmental history has grown into a prominent sub-discipline of history. However, similar analyses have considerably older roots in the field of historical geography and other fields of study (Grove 2001). The supposition of using an environmental history approach is not based on the notion that it provides a more truthful or accurate account of history, but rather that it offers us a different lens through which to view the past. It provides us with new perspectives through which to engage in historical and contemporary debates. This environmental history of cenotes, while still providing a broad overview of human-cenote historical interactions, will have a specific focus on cenotes and their historical commoditisation. It will examine the historical (human) appropriation of cenote spaces and its relevance to social, economic and political contexts. This will enable a more nuanced understanding of the contemporary dynamics surrounding cenotes in Quintana Roo to emerge.

4.1 Pre-Hispanic cenote appropriation

Non-humans were the first to arrive in the Yucatan Peninsula, with evidence of marine and land megafauna in the underground flooded cave systems of the Peninsula dating back to the Pleistocene Epoch (2.5 million BCE to 10,000BCE). This has included the discovery of camel,

llama, tapir, horse, giant sloth and mammoth skeletons (Rojas and Gonzalez 2009). The archaeological and paleontological research of these sites suggests that animals were active in using the then-dry caves as shelter (Martos 2008). It is thought that these megafauna existed as early as one million years ago and that their extinction was brought about by the later arrival of humans (Rojas and Gonzalez 2009; Folan *et al.* 2000).

Human habitation on the Yucatan Peninsula is known to date back at least to the late-Pleistocene/early-Holocene period (between 13,000 to 10,000 years ago), thanks to the discovery of three intact human skeletons preserved in cenote water in the Tulum area of Quintana Roo State (Gonzalez *et al.* 2008; Rojas and Gonzalez 2009). During this particular stage of the late Pleistocene Epoch, the sea level is estimated to have been 65 meters lower than in contemporary times (Blanchon and Shaw 1995), meaning that the skeletons would originally have been buried in dry caves that would later be flooded by subsequent sea level rises. The style in which these skeletons were found has been cited as the first possible evidence of ritual burial in the Americas (Gonzalez *et al.* 2008; Rojas and Gonzalez 2009; Gonzalez *et al.* 2006). The skeletons were from pre-ceramic hunting and gathering societies who would later settle in coastal areas where large quantities of food were available. As early as 5,500 years ago, these populations began to supplement their diets with domesticated edible plants such as corn and, over the next thousand years or so, would gradually develop into what would be known as the Mesoamerican Maya civilisation (Folan *et al.* 2000).

The karstic landscape, with all potable water predominantly supplied by cenotes, meant that, for the Maya to flourish on the terrain, they had to effectively and efficiently utilise all their water resources. Thus, as George Veni (1990) notes, the Maya life, whether urban or rural, peasant or elite, religious or secular, was often a function of groundwater exploitation and surface water development. It is therefore not surprising that cenotes functioned not just as a source of water, but were also seen as entrances to the mythical underworld where *chaaks* (rain gods) dwelt (Brady and Prufer, 2005; Villa Rojas, 1945). As Mexico's Institute of Anthropology and History (INAH) has noted:

Caves and *Cenotes* are interesting places because sacred and profane things coexist. We found domestic life as well as constructive material extraction vestiges, but their main role in Maya culture was as sacred gates that connected cosmic dimensions (INAH 2008).

For the Classical (and still many contemporary) Maya, caves are symbolic paths between the terrestrial world and the underworld. Caves and cenotes play an important role in the Maya cosmology. On one hand, they are entrances to the *Xibalbá*, the world of the dead, while on the other they are *Subuy ha*, fertile places where life begins (MacLeod and Puleston 1979; Rojas *et al.* 2008).



Figure 4.1 – Cenote History Timeline (key events mentioned within Chapter 4 alongside major Mexican and international events).

Different theories about human intervention in cenotes have been documented in archaeological and anthropological studies of the ancient Maya. One of them relates to the sacred character of these spaces; the evidence of religious artefacts and the pictographic representations of cenotes in contact with deities are evidence of this sacred meaning (Evia

2007; Uc and Evia 1991). Ethnographic studies in caves and cenotes have also documented rain-making rites and purification ceremonies (Bassie-Sweet 1991; Bonor 1989), while further archaeological evidence indicates their use as ritual burial sites (Rojas *et al.* 2008).

Other theories relate to the appropriation of meaning. Human intervention in cenotes that modifies the physical appearance of the space, such as mural paintings and architectural modifications (Stone 1989), indicates property marks that show and reaffirm that the space was taken. For example, in Santa Rita, a collection of caves and cenotes found near the city of Valladolid in Yucatan State, numerous paintings of hands can be found within the system. Archaeologists have argued that such paintings can be 'symbolic boundaries' or space demarcations that were made by elite community members, not only to control the community's water utilisation, but especially as a restriction to external visitors (Evia 2005a, 2005b).

The arrival of the Spanish did not, of course, cause a complete end to Maya ritual practices. Early colonialists, such as Diego de Landa and the Cabildo of Valladolid, in their writings offer elaborate descriptions of Maya ceremonies surrounding cenotes (de Landa [1566] 2001; de la Garza and Izquierdo 1983), while cave diver and researcher Guillermo de Anda Alanis offers us a more recent description of Maya cenote rituals:

In 1959, Romualdo Hoil, a *J'men* (Maya priest) of the people of **Xcalacop**, near Chichen Itza, held the last *ceremonia de desagravio* (ceremony of sorrow) that was documented in the cave [of Balankaché]. The ritual lasted 20 hours and witnesses described that Hoil consumed *balché* (Maya "holy wine") at all times, bringing him to what they described as a "hypnotic state. (Alanis 2010: 41; bold in original)

Such Maya beliefs and ceremonies have continued to the present day. However, the rise of tourism has seen a commodification of these Maya ceremonies for visitors' viewing pleasure. This has created an ambiguity in the 'authenticity' of these practices, with the (re)interpretation of Maya ceremonies to align more neatly with tourism discourses, subsequently causing changes and adding new meanings to these ceremonies (Cohen 1988; also see Chapter 6).

The *ceremonia de desagravio* recounted above was not the last to be performed in the Chichen Itza area. In 2010, singer Elton John gave a controversial performance at the site in front of the Kukulcan Pyramid in Chichen Itza. Three days before the concert, the main stage collapsed, injuring three workers. Local Maya groups, already in opposition to the concert, suggested that the accident could have been the work of *aluxes* (mythical Maya spirits that inhabit caves), who were upset because their gods' permission for the concert was lacking. A

ceremonia de desagravio was subsequently conducted by these groups as part of the continued protest against the concert and to help placate the aluxes (Olivares 2010).

The location of cenotes was also a principal factor in determining Maya population centres, due to their important role of supplying potable water (Sharer and Morley 1947; Fedick and Morrison 2004). For example, many toponyms of villages, among the Maya territory in the state of Yucatan, were named after the cenotes around which they settled (i.e. Xcalakdzonot, Chikindzonot, Dzonotcauich), demonstrating the importance of cenotes not just as a source of drinking water but also as a territorial demarcation and a form of ownership (Evia 2002b). Some studies conclude that the social stratification of the pre-Columbian Maya is a result of the accessibility to basic resources and especially water. This suggestion was developed when archaeologists began analysing the political development of Maya settlements and the emphasis given to cenotes in the Maya archaeology (Kurjack 1977). However, it has also been noted that the Maya, to a certain extent, were able to 'control' their surrounding nature with the development of *chultunes* (cisterns) to trap rainwater, allowing for the development of larger settlements and cities (Gallareta 2007; Scarborough 1998).

While the 'decline' of the Maya civilisation is debated and highly contested, the potential roles of water, access to water, and quality of water is often cited. One popular thesis comes from evidence of climate change producing an extended drought from 300 to 1,080CE, which coincided closely with the decline of the Maya after their societal peak in 550CE (Hodell *et al.* 1995; Curtis *et al.* 1996; Haug *et al.* 2003; Gill *et al.* 2007; Pringle 2009). The use of *chultunes* in cities as a substitute for obtaining water would have been most affected, and the move from cities to villages around cenotes would have been a natural societal response to such climate change (Curtis *et al.* 1996). This meant that the Maya lost a certain form of control over 'their' nature, needing to revert to a more traditional supply of potable water. Whatever the exact cause, by the 1500s the population of the Maya had changed from a partly urbanised culture to one that was sparsely spread across the Peninsula in villages situated in close proximity to cenotes.

4.2 The Spanish colonists and the rebellious Maya: control and exploitation of cenotes

The Spanish first landed on the Yucatan Peninsula in 1511; fifteen years later they started a campaign of conquest against the Maya. However, the Maya population proved resistant and the Spanish were not able to bring the Yucatan Peninsula under their control until 1546. The

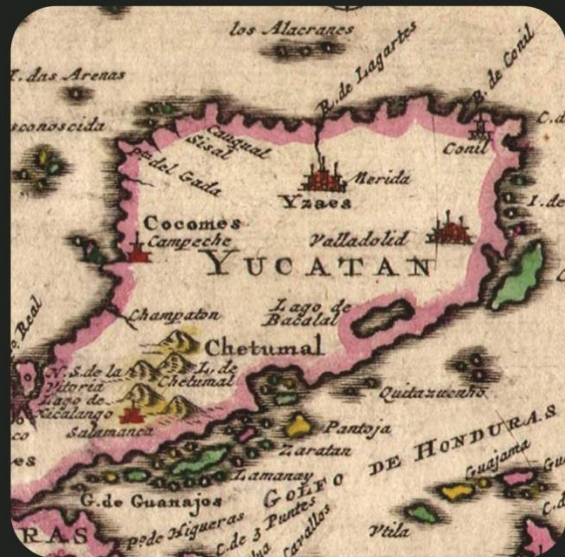
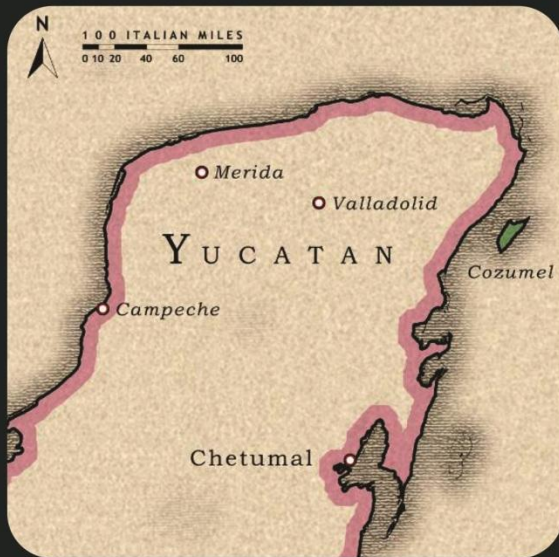
Spanish colonial settlement was concentrated in the north-west of the Peninsula, in what is now Yucatan State, with the region currently covering Quintana Roo largely perceived as too wild to bring under any kind of formal control. This wild land in the south-east of the Peninsula would subsequently become an important space for the rebelling Maya during the Caste War of the 1800s. Cenotes played an important role throughout these contestations between the Spanish and the Maya and ultimately helped to shape and influence the colonisation process.

With the arrival and settlement of the Spanish came a new perspective of the landscape, with a particular curiosity directed towards the apparent lack of rivers, the presence of cenotes and the underground water system. The cenotes, which were seen as the mythical underworld to Maya, were now being viewed by the Spanish from a European biological and 'scientific' perspective, with questions being asked about the depth of the cenotes, the fish species that lived in them and the possible existence of underground rivers (de la Garza and Izquierdo 1983). Diego de Landa, a controversial Roman Catholic Priest sent to convert the Maya to Catholicism, presents us with one of the earliest written Spanish descriptions of the Yucatan landscape's water features:

The work of nature in this land with regard to rivers and water sources is very different; while in most of the world the rivers run above the ground, in this land they run through secret passages beneath the earth (de Landa [1566] 2001: 133).

The geography of water supply on the Peninsula had a great impact on the nature and speed at which the Spanish colonised the region (Back 1999). Colonial conquests in other parts of the world relied on navigable waterways as strategic natural features via which to control a territory, as they offered a steady source of potable water, natural supply channels to the centre of territories and an important tactical natural feature to control. Cenotes, too, were an important natural feature to control. However, their irregular, scattered nature meant that the Spanish had no obvious route to penetrate and control the centre of the Peninsula. As Herman Konrad (1991) notes, the Spanish had a desire to penetrate toward the centre of the region but did not have the means.

This lack of control would have been no small insult to the then global Spanish colonial power. Their solution was simple: they created maps that deliberately distorted the geography by placing Merida in the centre of the Peninsula and Valladolid near the eastern coast (Reed 2001), and all but squeezing the southern interior out of existence. Visually, at least, they were able to diminish the territory outside of their control almost out of existence (see Map 2).



Map 4.1 – Maps of the Yucatan Peninsula, showing the actual location of towns (left) and the distortion by Spanish colonial powers (right), deliberately shifting the location of Merida and Valladolid and shrinking the southern interior to mask the true size of the territory outside their control. The left hand map was created by Simon Richards (2011); the right hand map, titled *Las Ybueras*, was created by Pieter van der Aa in 1706.

While the Spanish were able to navigate around the coast, they were unable to adapt such naval powers to the Peninsula's unique interior waterscape. Even when Mexico gained independence in 1810, three centuries after the Spanish first arrived; the majority of the Yucatan was still not under any type of formal government control. The 'unappealing' nature of the terrain no doubt lowered the motivation of the Spanish, with the scrubby bush land and soil of low fertility making it unviable for European methods of agriculture.

In the 1570s, the King of Spain demanded Spanish *encomenderos*⁹ in the Yucatan to give historical and geographical accounts of the newly conquered land, offering an interesting catalogued source of early descriptions of the Yucatan environment. Following Diego de Landa, the *encomenderos* recount a land lacking in aboveground rivers, but with subterranean rivers instead that offered an excellent source of water. The cenotes received particular mention in these communications, with different descriptive metaphors utilised to explain the phenomena to the monarch. These included cenotes being described as: 'eyes of water', 'mouths of water', 'ponds of water', 'caves of water', and 'natural wells', as well as 'eyes of rivers that pass below to the sea' (de la Garza and Izquierdo, 1983). A number of these historical commentators remarked on the abundance of delicious cenote fish, while others

⁹Encomenderos were Spanish nobility in the Yucatan that had been granted by the Spanish crown control over lands and Maya labourers.

described them as water sources created by the 'grace of god' (de la Garza and Izquierdo, 1983).

The Spanish colonial administration in the Yucatan and the closely associated religious authorities were soon to recognise and exploit the importance of subterranean water in Maya mythology. Churches, convents and colonial administrative buildings were constructed in close proximity to cenotes as part of an important strategy for controlling and converting the populace (Santiago and Bates 1991). As Samuel Edgerton (2001) notes, the Catholic Church's purpose in this was to encourage the indigenous population to make connections between the church and former sacred spaces and shrines, in order to place a Christian belief over the Maya cosmology. The result, however, was the creation of syncretised Maya-Christian beliefs among the Maya (Edgerton 2001), the most famous example of these perhaps being the Cult of the Talking Cross, which was established during the Caste War of the 1800s, which will be shortly discussed.

Resistance by the Maya during the oppressive colonial and post-colonial eras was common, with various rebellions and revolts. However, the most successful and famous of these was the Caste War. It lasted for over half a century (1847-1901) and has widely been considered to be the most successful indigenous rebellion in Latin America (Alexander 2004; Reed 1997; Montes 2009; Joseph 1985). Important to the success of the rebellion were cenotes, both due to their physical locations and their spiritual importance in Maya cosmology, which helped to create the social and political conditions for the Maya uprising to prosper. Three centuries of patrimonial and often brutal rule over the Maya by the Spanish and *Yucatecos* (Spanish descendants living on the Peninsula), including inequitable taxes and physical cruelty, had created extensive discontent among the Maya, helping to fuel the rebellion. In the 19th century, further discontent amid the Maya had arisen during the *Yucatecos'* efforts to break away from the Mexican National Union. The *Yucatecos* managed to obtain Maya army conscripts for their battles against the Mexican nationals by making post-war promises of greater equality and the elimination of unfair taxes. When these promises were not honoured, the Maya were left with a combination of very recent grievances and military training – important components for the instigation of a rebellion. Maya elites, who had previously been co-opted into assisting the *Yucatecos* in controlling and restraining the broader Maya populace, suddenly broke ties with the *Yucatecos* (Rugeley 1996), paving the way for the start of the conflict in 1847.

The revolt was swift, with the Maya rebels succeeding in taking over the majority of the Peninsula in a short amount of time. In 1848 the Maya overthrew Valladolid, the second largest city on the Peninsula, and came close to taking the capital of Merida (Reed 2001). The majority of residents of Valladolid subsequently fled the city, apparently discarding rifles, a canon and a variety of other items into a cenote located in the centre of city to prevent them from falling into the hands of the rebel Maya (see Gonzalez and Rojas 2007). Such an activity had a precedent – in 1843 weapons confiscated from rebel Maya were thrown into a cenote near Peto in the south of what is now Yucatan State (see Rugeley 2009: 54-55).

The *Yucatecos* eventually managed to repel the Maya army, reclaiming cities and villages back one at a time; by 1850 it looked as if the Maya rebellion was about to be quashed. But a revival, more permanent than the initial uprising, was to soon come. It was fuelled by three key factors: first, the Maya were able to utilise the south-east of the Peninsula, as yet unsettled by the Spanish and their descendants, as a secure base from which to continue their rebellion; second, a new found belief within the Maya had arisen with the creation of a new religion; and third the Maya were newly able to source weapons from the British through British Honduras (modern day Belize) (Reed 1997). The role of cenotes was particularly important with these first two aspects.

While the Spanish, and later the *Yucatecos*, were able to use their control over cenotes in the north-west of the Peninsula to assist their political and economic dominance, the lack of colonial infiltration and jurisdiction in the forested region, south-east of their settlement in what is now known as Quintana Roo state, permitted a space of retreat and resistance for the Maya.¹⁰ We see here the importance of cenotes, whereby the Maya retreated into the forests and created hideouts built around cenotes and inside caves (Evia 2005; Reed 2001; Montes 2009). These areas, considered as ‘wilderness’ by the *Yucatecos*, were familiar to the Maya, filled with knowledge of caves and cenotes (Reed 2001). Knowledge of and retreat to cenotes acted as an important conflict and disaster coping mechanism during colonial times (Farriss 1984). The Maya were now able to exploit this to their advantage during the Caste War, attacking exposed Yucateco patrols venturing towards the south-east of the Peninsula, who had little knowledge of the terrain and its water supplies. The rebels also closed up wells in towns to help restrict Yucateco water access, and it was not uncommon for Yucateco soldiers patrolling at night to be killed by accidentally falling into a cenote (Rugeley 2009). The Maya

¹⁰ Robert Patch (1991) notes how the forest hinterland just outside of the Henequen Zone (see next section) was often heavily populated with Maya – probably escapees of indentured labour.

reportedly even utilised a form of biological warfare, polluting cenotes which were used by the Yucateco patrols with clothes of the cholera victims, subsequently causing disease outbreaks (Reed 2001). Through their knowledge and subsequent control over these cenotes in the south-east of the Peninsula, the Maya were able to create a strategic military advantage to aid their resistance.

Water also had an important symbolic role during the Caste War, helping to fuel the creation of a new Maya religion, the Talking Cross (*la Cruz parlante*), that contained the self-belief that the Maya would eventually conquer the white population on the Peninsula. Based on a prophetic Talking Cross, the religion paved the way for a new military and spiritual movement which gave the Maya a new drive to continue fighting (Zimmerman 1965). The story is as follows: in 1850 the Maya rebel leader Jose Maria Berra had been driven deep into the forest of south-east Yucatan and came across a small cenote, where he discovered a small cross a few inches long, lightly carved in a mahogany tree (Reed 2001). A Maya priest travelling with Berra claimed to hear the voice of God coming from the tree, with the cross subsequently becoming *santo*, the Santo Jesucristo, an intermediary with God. This event of the Talking Cross was later to be replicated at cenotes across different parts of the Peninsula (Dumond 1985). The Talking Cross predicted the downfall of the Yucatecos and the revival of the Maya, and supplied inspiration that provoked a Maya resurgence. A church was constructed next to the original cross and cenote, which subsequently grew into the town of Chan Santa Cruz (modern day Felipe Carrillo Puerto). From this position the rebel Maya were able to fend off and make substantial counter attacks against the *Yucatecos* over the next half-century. They created a de-facto independent region that was recognised by the British, who stocked them with armaments from the nearby British Honduras (now Belize). These followers of the Talking Cross came to be known as the *Cruzob* and generated an influence over a wide area, which incited fear among outsiders:

It is currently believed that no white man, except at extreme risk to his life, can penetrate into the interior [of Quintana Roo] either from the west or from the north (Heilprin 1891: 137).

The Cult of the Talking Cross represented a syncretism of Christian and Maya belief systems, stemming from early colonisation and Christianisation on the Peninsula. The discovery of a cross was influenced by Christian beliefs, its location on a tree next to a cenote influenced by Maya beliefs (Reed 1997). It also shows the importance of the underground for the Maya spiritual world. The fact that the cross was found in the proximity of a cenote evokes the cosmological world that used to permeate everyday life. It arguably also conveys the

importance of their group identity as belonging to a natural space that, for its part, recognised and legitimised their right to remain there via the sacred sign.

The Cruzob, with their knowledge of the waterscape and self-belief driven by the Talking Cross, were able to fight off the Yucatecos for the next half century. However, by the end of the 19th century their downfall began when the British signed a treaty with the Mexican government. Subsequently, an army from Merida, equipped with modernised weaponry, was able to slowly but effectively siege its way to Chan Santa Cruz, the Maya 'capital.' The Cruzob escaped complete domination thanks to the Mexican revolution in 1910, with the new revolutionary government halting the siege and taking a more reconciliatory approach towards the Maya.

4.3 Commercialisation and Cenotes

Prior to the advent of mass tourism from the 1970s onwards, the Yucatan Peninsula had two important commercial exports: henequen and chicle. These two commodities were harvested in different parts of the Peninsula and each underwent peak production during different eras. Nevertheless, cenotes were important for different reasons for the production of both of these commodities.

During the 19th century and early 20th century, henequen (*agave fourcroydes*) production prospered in the north-west of the Yucatan Peninsula around the city of Merida. Henequen is an agave plant that produces a fibre that is used for rope and twine.¹¹ It had previously been cultivated by the Maya for centuries for use in making hammocks, ropes and baskets (Barke 1984). At its commercial peak, henequen was being cultivated under the hacienda system,¹² with both this system and the control of the water supply ultimately determining the success of henequen production on the Yucatan Peninsula.

Known locally as *el oro verde* (green gold), henequen paved the way for the rapid transformation of the north-west of the Peninsula and its main city of Merida. Henequen at the beginning of the 20th century was the main product used in ropes all around the world; by 1915 an estimated 90% of the binder twine used in the ropes of the United States was coming from the Yucatan Peninsula (Evans 2007). The impact of this boom was massive, transforming

¹¹ A second very similar agave plant known as Sisal (*Agave sisalana*) was also harvested as a part of this production. The terms Henequen and Sisal are often used interchangeably by commentators, but they are technically different. The principal port during the Henequen boom was named Sisal after this second agave plant.

¹² The Mexican hacienda system was similar to the European feudal system. In Yucatan, the haciendas stemmed from the 16th century when land grants were given to aforementioned *encomenderos*, landowners who controlled large estates with large populations of indentured labour.

Yucatan from one of the poorest states in Mexico to the most prosperous, with Merida being the first city in the country to have grid electricity installed and a horse-drawn tram service (Barke 1984). This prosperity is often noted as the reason why the Mexican revolutionary movement was almost non-existent in the Yucatan, as one commentator has noted: ‘while the rest of the Republic [of Mexico] made war, Yucatán made money’ (Joseph 1982: 6).



Map 4.2 – A 1936 map of Henequen and Chicle on the Yucatan Peninsula (Redclift 2006).

As with almost all industrial production, water was an important element for the henequen production process. This was particularly the case on the Yucatan Peninsula’s aquifer, where it was used in the steam driven fibre-processing factories and for washing away the waste parts of the leaf (Chardon 1961). During this period, water was pumped from wells using windmills

or accessed through cenotes.¹³ The haciendas controlled these cenotes, with their main houses being typically located near or right on top of a cenote (Alston *et al.* 2009). The economic success of a henequen producer thus lay in their ability to access and control water.

More importantly, command over water was imperative in controlling the indentured labour arrangement that underpinned the hacienda system and hence henequen production. As Arnold Strickon noted:

The Maya obtained their water from the wells or cisterns of the hacienda. In return for the use of the water and debts incurred by the Indian [Maya] to the hacendado, the Indians [Maya] had to perform work on the land (Strickon 1965: 46).

Such control was further accentuated with the removal of water rights access and protection during the 1840s:

Throughout the 1830s the all-important water rights had been protected. In 1841 this protection was removed, and a cenote that had served an area from time immemorial suddenly became private property to be exploited by private gain [subsequently] the Maya would pay dearly to drink what had been free (Reed 2001: 10-11).

This facilitated the monopolisation of cenotes and water resources in the north-west of the Peninsula (Rugeley 1996). In the past, during crises such as famines, epidemics or political troubles, the Maya population would travel to a nearby cenote to camp out and weather the crisis (Farriss 1984; Back 1995). However, for the Maya population situated in the focal point of henequen production and hacienda control in the north-west of Yucatan, this crisis management technique was no longer possible, meaning, as Alston *et al.* (2009: 111) note, subsequent 'droughts and locust plagues left [the Maya] with the choice of starvation or moving to a hacienda.' Therefore, the Maya population in this region of the Peninsula ultimately became incorporated into the indentured labour system of the haciendas and were disenfranchised from both land and water (Alexander 2008). While land ownership has been the focus of the hacienda and subsequent land ownership regimes in Mexico, it is ultimately control over the natural resources, in this case cenote water, which had (and still has) the most significant implications (Melo 2012). Particularly in Yucatan, with a terrain characterised by aridity and drought, the monopolisation of water was an extremely important political and economic resource (Rugeley 1996). Control over the resource, therefore, translated into control over the population and the economy.

¹³ By 1930 there were over 20,000 windmills in Merida, causing the city to be dubbed 'the city of windmills' (Back 1999).

The henequen boom also coincided with the rule of the Mexican dictator Porfirio Díaz (1876–1911), whose emphasis on capitalist production and foreign exports was underpinned by the hacienda/indentured labour system. Working conditions on the Yucatan haciendas were infamously bad and were subsequently made internationally notorious through the descriptive and somewhat sensationalist accounts published by the US journalist John Kenneth Turner. Mortality rates were high and torture was common, while the indentured system was designed in such a way that a labourer would never be able to repay their debt – Turner described these conditions and system as nothing short of slavery (Turner [1910] 1990). As Arnold and Frost (1909), two travellers visiting the Peninsula during this period, noted, the hacienda owners' control of the cenotes and thus the water supply, made escape from the hacienda system near impossible, given the high temperatures and droughts that characterised life on the Peninsula. The US explorer, John Lloyd Stephens had also made a similar observation in the same region some fifty years earlier:

All the enterprise and wealth of the landed proprietors [hacienda owners] therefore are exerted in the procuring supplies of water [this] creates a relation with the Indian [Maya] population which places the proprietor somewhat in the position of a lord under the old feudal system (Stephens 1842: 404).

Control of water might have been important for the henequen production process, but it proved to be even more important for controlling the indentured labour population, on which the success of the production heavily relied.

Henequen production and exports from the Yucatan Peninsula started to decline from the 1920s onwards due to a number of reasons. First, the introduction of synthetics meant that henequen fibres no longer had a near monopoly on rope production. Second, during the 1930s importers began look to towards East Africa for henequen supplies, as the region was considered to be producing a cleaner form of henequen; this was mainly due to a water shortage occurring on the Yucatan Peninsula which ultimately undermined the steam fibre cleaning process (Evans 2007). Finally, the industry was further dissipated with the break-up of the hacienda system after the Mexican Revolution and the installation of an ejido (communal) land system in 1937 (Alston *et al.* 2009). In a short period, the control over the natural resource of water was destabilised by climatic and land tenure changes, undermining the existing political and economic power system on the Yucatan Peninsula.

While henequen production was in decline, a new commodity export was arising in the south-east of the Peninsula: chicle. During this period, chicle (the resin of the *chicozapote* tree) was the main base ingredient for chewing gum. It had started to develop into a commercially

successful activity in the Yucatan during the 1890s (Konrad 1991). Dubbed *el oro blanco* (white gold) by harvesters (Schwartz 1989), the production of chicle boomed during the early part of the 20th century, transforming economically, socially and politically the Maya populace in the region. Again, the presence of water was important and a major influence on chicle production; this combination also helped shape contemporary geographies as the location and use of cenotes during chicle production left a legacy long after chicle commerce dissipated, as shortly discussed. This also occurred in the former henequen zone of the Peninsula, where the old small-gauge henequen railways are being used to transport tourists to cenotes (Valdez 2006). The impact of historical economic industries on the Peninsula ultimately goes well beyond their periods of rise and decline.

The commercial production of chicle on the Yucatan Peninsula was based around the Maya city of Chan Santa Cruz (modern day Felipe Carrillo Puerto). Chan Santa Cruz, as previously noted, was also the base of the Cruzob Maya of Caste War fame. After the conquest of the city by the Mexican army, the Maya looked towards the commercialisation of chicle as a potential form of income with which to finance their rebellion (Forero and Redclift 2005, 2006; Redclift 2004). However, as Konrad notes, harvesting chicle and guerrilla fighting were virtually mutually exclusive undertakings. Gradually, the Maya chiefs found themselves 'with hoards of coins, no army of forest warriors, and no good reason to purchase great quantities of armaments' (Konrad 1991: 165). Thus by 1930, much of the rebel Maya had been integrated in the broader chicle sector, which included the US company Wrigley that negotiated direct contracts with the Maya population (Diaz 1999). At the time, Chicle had helped to transform Quintana Roo into a region that was safe for non-Maya to travel through (Bennett 1930).

An important figure in this transformation was the Maya rebel leader Francisco May, who negotiated the first chicle concession with entrepreneurs in 1919. He would later meet the Mexican President Venustiano Carranza de la Garza, become a General of the Mexican army, and ultimately was put in charge of pacifying the Maya (Avila 1974; Redclift 2006). Chicle exports from the Yucatan flourished during the 1920s and again in the 1940s due to the US entry into the two World Wars, with chicle an essential part of the general infantry's rations (Redclift 2003, 2004; Landon 1935; Konrad 1991), aided by savvy advertisers who were persuading the US population that chewing gum was an excellent way to reduce tensions (Schwartz 1989). However, like henequen, chicle production was to fall victim to synthetics and the international market. From the 1960s, cheaper synthetic alternatives were increasingly being used for chewing gum, causing a swift decline in the chicle trade.

Chicle extraction differed markedly from the hacienda controlled henequen production as it was conducted by *campamentos* (camps) of chicle tappers. Initially these groups of *chicleros* would be funded (and subsequently indebted) to foreign contractors, but in 1935 the government became a driving force in creating workers' cooperatives, with the goal of improving working conditions (Forero and Redclift 2005, 2006; Redclift 2004). These *campamentos* would usually be based around cenotes, due to their importance for water supply for human consumption.¹⁴ Many of them would be transformed into permanent settlements that are now the villages of today.

Many former *chicleros* are still living in the ex-*campamentos*. Here, elders of Pac Chen and Punta Laguna recount the founding of their villages:

Forty four years ago we went to find chicle and we walked from Chemax to this area to find it. One day we came back from working in the chicle and Don Valerio told us: we have found a cenote, a hole with water, and we saw the jaguar coming out of it. They saw the Alamo; a tree that finds water with its roots. Where Don Valerio and the others found the Alamo they knew that water was there. We are all from Chemax and one day we decided to build some houses and then our families started coming to live here. In the beginning we were 26 people without families and then the families decided to come, and here we are now (I70/August-2009).

Our parents arrived in Punta Laguna with the chicle extraction. They came to work here every year and then we all liked it and came to live here. At first it was just two families in 1958. It started as a camp and then we built houses. When we arrived we took water from the cenote; we did not know that there were archaeological remains in it, until a diver arrived and discovered the skulls, but before that, we obtained water from there to survive (I71/August-2009).

The former chicle *campamentos* at Pac Chen and Punta Laguna (located near Coba), now exploit their cenotes for tourism through tours organised by the Playa del Carmen based tourist company *Alltournative*. The cenotes are popular sites to swim and snorkel in for many tourists, with cave diving for the more adventurous. Jennifer Matthews, in her recent research about Chicle, has also witnessed a similar phenomenon further north, near Cancun, on the Peninsula at Central Vallarta, Santa Matilde, Santa Apolonia and the Marin Botanical Gardens in Puertos Morelos. All these former chicle *campamentos* are now towns that are developing their cenotes for tourism; Santa Matilde and Santa Apolonia are even reviving the old small-gauge railways that were used to transport chicle produce, as a part of their cenote tour

¹⁴ Everton Macduff (1991) in his account of a *chiclero* family talks about how often it was the children's job to collect water from the nearby cenote.

(Mathews 2009; Mathews and Lizama-Rogers 2005). Similarly, further south, past Felipe Carrillo Puerto, the former chicle campamento of Chacchoben, was being developed as a theme park (known as *pueblo chiclero*), focusing on the Peninsula's chicle history (Forero and Redclift 2007; Redclift 2010), with the nearby cenotes also being developed as a part of the project.¹⁵

4.4 Conclusions

In different historical times humans have related to cenotes in multiple and varied ways. It could be argued that, beyond cenotes in and of themselves, the main human relationship with nature's commodification in the broader context here has been with the fresh-water aquifer; cenotes were merely entrances to this valuable resource. Nevertheless, it is also possible to argue that it was not only water but cenotes themselves that did influence, and still do, the human geography of the Peninsula. With the rise of the chicle and more importantly the henequen industry, we saw the beginning of new values being ascribed to cenotes. Cenotes were not just strategic physical places, but also began to have an economic value attached to them. They were integrated into broader commodification processes, which would soon accelerate with the advent of mass tourism on the Peninsula from the 1970s onwards.

Three broad themes can be derived from this analysis of Maya interaction with cenotes, which still have strong pertinence in contemporary cenote appropriation. The first is that cenotes have had a distinct influence on the human geography of the Peninsula. In particular, they have influenced the location of settlements and subsequently became a central feature, culturally and politically, in Maya society. Cenote location and ownership continues to be important in contemporary times, although with the advent of wells and water pumps, the reasons for appropriation has changed. Today, cenotes are more important as a tourism commodity. While the Maya mythology surrounding them continues, to a certain extent it, too, has been commercialised, helping to form a cultural mystique to enhance the tourist cenote experience.

The second broad theme that can be derived relates to the strong links between water and power. Identifying links between potable water and power is not a novel notion (Swyngedouw 2004; Gandy 2004; Strang 2006). However, cenotes on the Yucatan Peninsula causing potable water to be distributed unsystematically, provided different avenues of control. Maya elites were able, to an extent, to circumvent restrictions presented by cenote access through

¹⁵ A fire in May 2010 destroyed this tourist development.

relevant technologies such as the construction of *chultunes*. Similarly, today, elite actors are able to 'create' their own cenotes with dynamite and excavation equipment.

Finally, throughout the colonisation of the Yucatan Peninsula until the end of the Caste War, the importance of cenotes is apparent. In particular, knowledge about and acquisition of cenotes was an important attribute of political power. The Spanish, despite evident frustrations regarding the new terrain, utilised control over cenotes as a method to subdue and integrate the Maya populace. However, such a strategy had its limitations, with the Maya's local knowledge of the terrain and cenotes being an important factor during the Caste War. Knowledge about and acquisition of cenotes continues to be important in contemporary times on the Peninsula, particularly for tourism operators and cave divers.

Historically, one of the main conclusions is that different means of control were created and implemented by the various groups, especially of those in power. What is remarkable from this history is the fact that no cenote management plans were proposed in the different epochs, a situation that has continued in contemporary times. This is not a minor issue, especially if we relate the theoretical questions of the present study with the kind of nature that has been produced and its outcomes in the underground forest frontier in Quintana Roo. The value of developing an environmental history approach is that we have better perspectives on human productions of nature and the outcomes regarding cenotes. As demonstrated, control over individual cenotes and their entrances has been the historical tendency, but not of the system as a whole. This then evokes the question: does this terrain and its unique features allow for the management of water resources? The following chapter sheds some light on these ideas from a contemporary institutional perspective, discussing and analysing the participation of the public sector in the underground forest frontier.

PART THREE

EMPIRICAL REVIEW

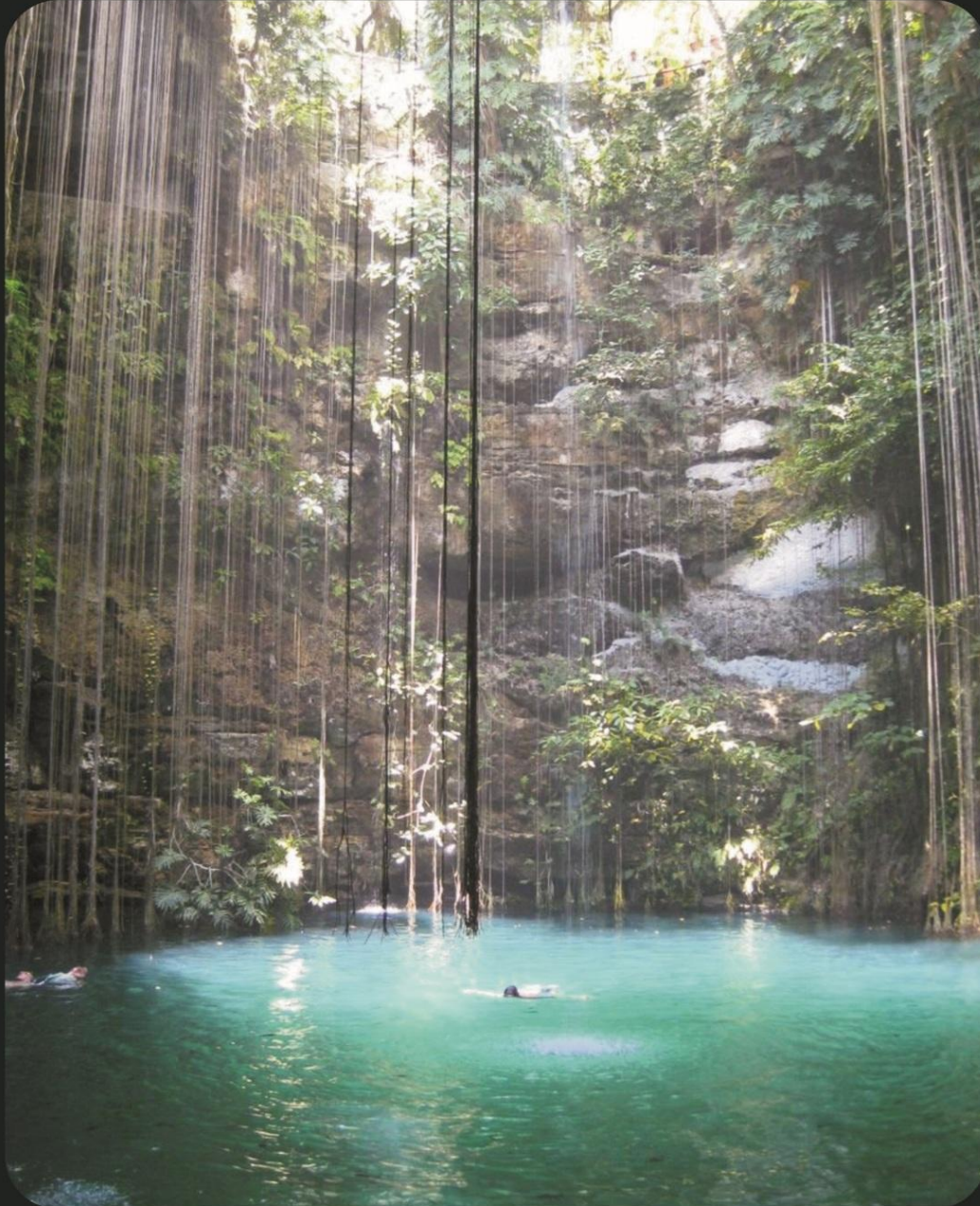


Figure 0.3 – The Deep View (Photographer unknown)

Chapter Five

Cenotes: the public view

This chapter examines the discourses about the underground forest frontier in the context of land, water and historical patrimony, from the perspective of the public sector in Quintana Roo. Cenotes have occupied an ambiguous position in the changing dynamics of land and the related public sector regulations. Due to their geological characteristics, geographical distribution and physical contents, cenotes have fallen into several areas of federal regulation: water, land, archaeological evidence protection, as well as a collection of existent environmental regulations that include forests, flora and fauna. Moreover, at the state and municipal level, cenotes have also been considered part of the urban development plans promoted by Quintana Roo's state government. This chapter will provide a systematic description of these different federal and local instruments, structured along existing divisions: land, water, archaeology, tourism and environment. In each section, empirical information relevant to each of these topics will be shown and discussed, followed by a final section that will draw the insights together, attempting to create a more unified vision of the public sector view about the underground forest frontier. This will be done by mapping and analysing the interactions between the different public sector bodies and their 'intention' to regulate caves, cenotes and the aquifer in Quintana Roo.

As was seen in the previous chapter, the history of the Yucatan Peninsula since pre-Hispanic times has been one of appropriation, demarcation of limits and, more recently, one of enclosures. During the Classical Maya era, land limits were established through military power where territorial conquests, political impositions and taxation worked as a means for territorial control. After the arrival of the Spanish, indigenous groups were gradually dispossessed of their lands and although this dispossession was, for a period, localised in the north of the Peninsula, a big socio-political reorganisation process occurred among the Maya groups. Their lands were turned into speculative objects where water and the availability of other natural resources were influential in the establishment of land-uses and livelihoods. This was further facilitated with the establishment of private rights over land and natural resource control, which ultimately meant that new values were added to the land.

These shifts ultimately created a widespread shared feeling of dispossession in Mexico, which came to the fore during the Mexican Revolutionary movement, paving the way for the returning of ancestral lands. This post-revolutionary land redistribution at the beginning of the 20th century returned territories to original inhabitants, but at the same time allocated new populations to new territories. This was particularly the case in Quintana Roo, with the establishment of communal and individual private property rights. The state both moved towards and accelerated the enclosure process, with the practice of allocating land in ejido plots, the selling of 'national lands' to private investors, and the subsequent changing of laws.

Historically, land management in Mexico has been overseen by a well-established bureaucratic apparatus which has acted as regulator, owner, realtor and broker of land extensions throughout the country. A booming tourist economy has prospered over the last few decades in Quintana Roo and has provided the country with one of its most important economic activities. During the 1970s in Quintana Roo, large parcels of land with no clear use were identified by private investors and massive parcels sold to develop one of the biggest tourist destinations in the world, Cancun. As a result, there has been an on-going shift in land ownership from 'agricultural' and 'livestock' self-consumption practices to amenity ownership, where land is bought by wealthy out-of-state buyers who are interested in 'partially' developed landscapes, nature-like views and extreme adventure activities. Land prices have risen in an essentially free market economy, with a degree of formal governmental encouragement. The accelerated selling of land to 'outsiders' has coincided with massive immigration into Quintana Roo from overseas and other parts of Mexico. The political economy of the state witnessed a rapid change, influencing the whole country towards a tourist economy as a consequence.

5.1 Land

The land tenure system in Mexico has been formed through a complex historical process of rights, autonomy and identity. Attempted here is not a broad analysis of land tenure and land reform in Mexico, as this has been done elsewhere (DeWatt *et al.* 1994; Randall 1996; de Janvry *et al.* 1997; Cornelius and Myhre 1998; Assies 2008). Rather, in this section, land and land tenure will be analysed in relation to the underground forest frontier in the context of Quintana Roo over the past 100 years. Particular attention is paid to how the current institutional situation influences, limits and encourages certain material practices and

discourses within the public sector towards cenotes. The first part of this section will cover examples that show the everyday management, control and marketisation of land.

While this tendency might seem to be out of context when talking about the public sector *view*, it sets the context to show a 'double process' of State intervention: 1) the State's retreat from natural resource management involvement; and 2) the State's concurrent active role in allocating land, promoting land speculation and establishing land limits. Thus in a sense the State is both retreating from regulation and advancing towards a more neoliberal approach in land management regimes at the same time.

5.1.1 *Ejido Creation*

The majority of the land in Quintana Roo is administered under what is known as the *ejido* system. This is a system of communal land ownership where land is divided among peasant communities called ejidos (Muñoz-Piña *et al.* 2003). While this system existed in Spain's agrarian social structure during the 13th and 14th centuries, and also to a certain extent in pre-Columbia Mexican societies, its contemporary incarnation in Mexico was a direct result of the early 20th century Mexican Revolution (1910-1920). Prior to the revolution, the majority of Mexico was under the hacienda system, a relic of the colonial period *encomienda* land system where land ownership was held in the hands of a small minority while the majority of the population worked the land as indentured labour, as discussed in Chapter 4 (Lockhart 1969). This concentration of minority landholding increased during the long authoritarian rule of the Mexican dictator General Porfirio Díaz (the *Porfiriato* 1877-1910) (Assies 2008), which subsequently fuelled discontent, helping to provide impetus for the Revolution. The importance of land is reflected in the famous revolutionary war-cry of '*tierra y libertad*' ('land and liberty'), with the Revolution's success eventually leading to the reform of the country's constitution. Most notably, this entailed an amendment to Article 27 of the 1917 constitution, which explicitly recognised community based land tenure rights and forbade commercial companies from acquiring, holding or administering rural properties (Barnes 2008).

As Barnes (2008) notes, this was the first time since Spanish colonisation that Mexico's land was viewed as having a social purpose, rather than just being seen as factor in economic production. Chowdury and Turner give a good summary of the internal organisation of ejidos:

Under Mexico's ejido structure a group of smallholders register as ejido members (*ejidatarios*) retain formal rights to a certain proportion of their community's land area and hold the legal title delineating that right. Most (but not all) ejidos in the region [of

the Yucatan Peninsula] have distributed these land rights to ejidatarios in the form of parcels that are managed individually by the ejidatario households [However these could not be privately sold until after the change in the law in 1992]. The remaining land area in the ejido is considered to be collectively owned by the community (Chowdury and Turner 2006: 304).

While the legal basis for the ejido was established in 1917, its widespread implementation did not occur until the 1930s with the rise of President Lázaro Cárdenas (1934-1940). President Cárdenas transformed the reformist policies of the revolution into permanent structures, redistributing close to 19 million hectares of Mexican land to ejido groups (Assie 2008). The first ten ejidos in Quintana Roo were established around the chicle extraction region, with most of the remainder of the state's ejidos being established in the 1960s and 1970s (Bray *et al.* 2004). These were largely granted to migrants from the state of Yucatan and other parts of Mexico as part of an early effort to populate Quintana Roo.¹⁶ This redistribution of land continued across Mexico with varying degrees of speed until 1992, when Article 27 of the Constitution was amended by President Carlos Salinas de Gortari, ending the process of ejido creation and fundamentally changing the laws governing ejido administration, land rights and natural resource management.

Perceptions about land in Mexico and its different organisational cells are the product of historical social mobilisations like the Mexican Revolution. Thus a feeling of belonging and appropriation, and the right to 'own land' – at least the feeling of it – is observable and audible throughout the country. Discourses such as this is the 'land of my ancestors' can be heard within different states and come from the political fight against dictatorial regimes that existed prior to the Revolution. In Quintana Roo two important processes can be identified. First, there is not a strong sentiment for the revolutionary past, mainly influenced by the fact that land was given to 'outsiders' by the Mexican Government to populate the area.

Second, and most importantly, land and natural resources are not the same. The allocation of big extensions of land to small groups of farmers and fishermen might have influenced the relationship with land and territory, but not with natural resources themselves. The latter have come to the fore more recently, especially after the fall of the chicle industry when a 'new' natural resource, not a new product of nature, needed to be exploited and a new livelihood was necessary. It might be argued that land in itself has been a commercial commodity for a long time, but not until recently has the idea of nature, rather than a good from nature, as

¹⁶ Until 1974 Quintana Roo was still considered to be a Territory as it had not reached the requirements to become a State, which included an 80,000 inhabitant threshold.

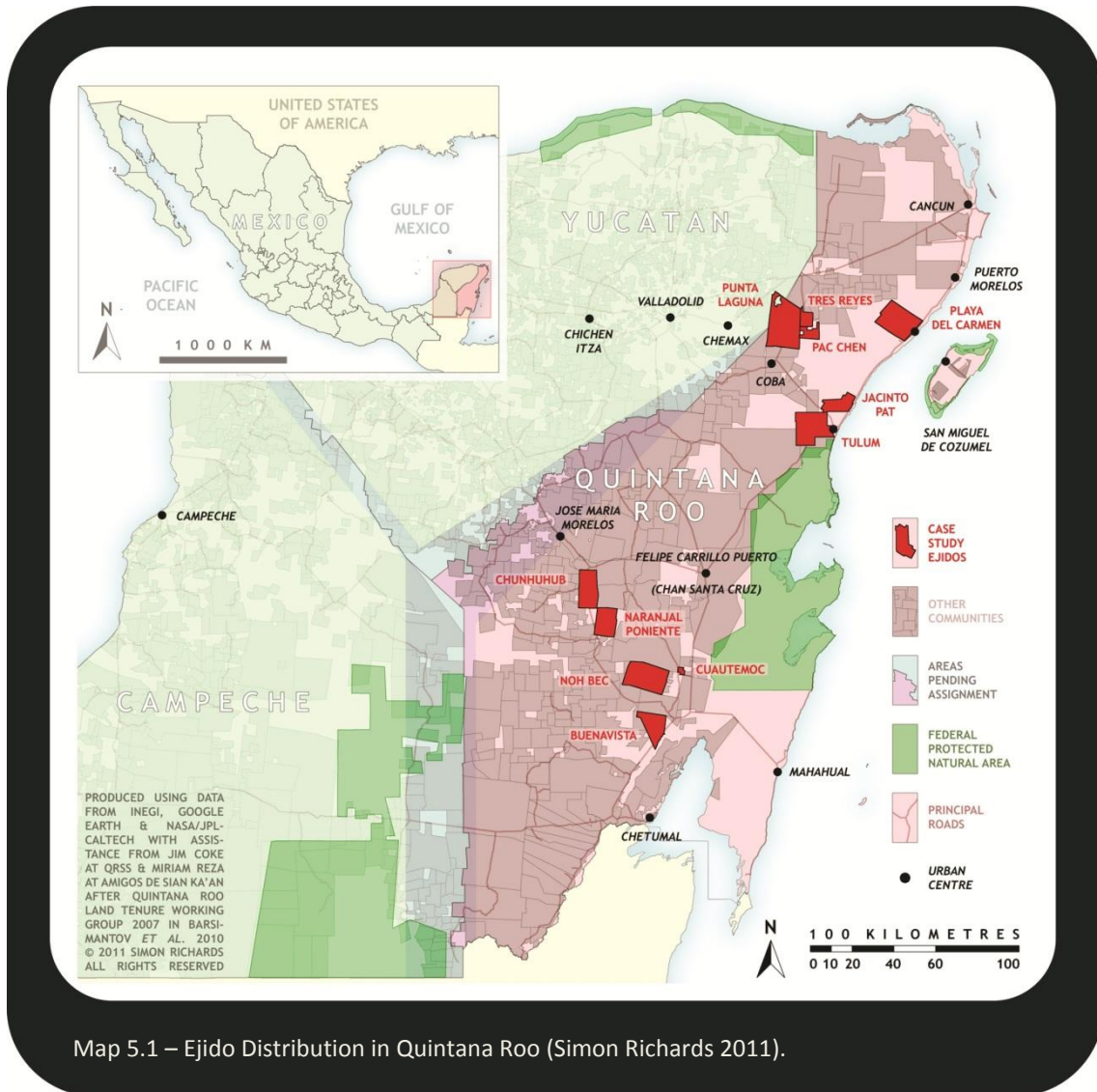
something to be owned and commodified been entered into ejido discourses in Quintana Roo. Before, they were workers in the chicle and henequen extraction industries, now they 'own' the resources and manage them. In this sense, natural resource extraction acquires a secondary role, while selling and renting the land has become the main approach to managing natural resources in the area. The products of working with nature, like henequen or chicle, can be sold because they are transformed into individual commodities. With cenotes and other natural resources such as water a different process has occurred. As will be further explained within this chapter, the study of formal institutions and governmental organisations also applies to this 'natural' division where land and water can be regulated, but as separate entities. Perhaps this perception is about to change among the public sector with new attempts to regulate the underground forest frontier and where natural resources (see Chapter 7) – rather than the products of their exploitation – can be seen as commodities and something to develop discourses and material practices around.

The ejido structure is discussed below, not because the ejido is part of the public sector. If anything it would be considered part of the private sector, as ejido members privately own land. Nevertheless it will be discussed in the following section to map out the perception that the public sector has constructed of land and land uses. Thus this following section helps to contextualise the role of the public sector in the underground forest frontier.

5.1.2 Ejido Structure and cenotes

There are currently 215 ejidos in Quintana Roo, spread across the state's ten municipalities (INEGI 2009). The ejidos along the state's northern section of the coastline have become the most rapidly exposed to tourism, with the latter's influence gradually and more recently spreading inland. This research takes into account both of these areas, focusing on the coastal ejidos of Jacinto Pat, Playa del Carmen and Tulum, and the inland (and former chicle) ejidos of Valladolid,¹⁷ Pac Chen and Tres Reyes. These were the main ejidos where cenote exploitation for tourist activities was occurring during the fieldwork period of this study (see Map 4).

¹⁷ Ejido Valladolid is politically ascribed to the Yucatan State, although part of the ejido land is located with Quintana Roo's political limits.



Map 5.1 – Ejido Distribution in Quintana Roo (Simon Richards 2011).

The ejido governance structure contains three primary bodies: the General Assembly (*Asamblea Ejidal*), the Commission (*Comisariado*), and the Surveillance Council (*Consejo de Vigilancia*). The General Assembly is the main authority of the ejido in which all *ejidatarios* (members of the ejido) have the right to vote, with decisions reached by majority vote. The Commission is the executive arm of the ejido and is formed by three members (President, Secretary and Treasurer) who are in charge of organising meetings, implementing agreements made by the General Assembly, and, most importantly, legally representing each ejido before the State. The Surveillance Council closely follows the Commission’s actions and also surveys the ejido land in order to monitor activities and control land uses. As mentioned in the research methodology (Chapter 3) the Surveillance Council were, in every ejido, the gatekeepers of ejido land and provided permission to survey the cenote landscape. The representatives of the Commission and Surveillance Councils hold power for three years, after

which new representatives are ‘democratically’ elected through a vote in the General Assembly.

The General Assembly meets at least once every six months, during which several topics can be developed regarding the internal regulation of each ejido. An example of one such meeting, and specifically in regard to cenotes, was when the Ejido Jacinto Pat discussed the possibility of independently managing cenotes located in individually assigned parcels, without sharing the profits with the rest of the ejido:

I have 100 hectares [254 acres] of land and so far I have found six big cenotes. Just two of them are earning me some money. I have an exclusivity contract with Alltournative¹⁸ and they pay me around US\$7,000 every month. When the General Assembly realised this, they asked me for some money. But I have some political power in the Ejido’s Assembly and you know that we need the majority of votes to approve a petition, so the Assembly passed a resolution in my favour, you know, with family support [also ejido members]. And now we can profit from the cenotes that we have in our land parcels, although Cenote Dos Ojos is another story (I19/ April 2009).

Cenote Dos Ojos was also part of a parcel of land assigned to an ejido members, but a different process from the one recounted above occurred. Prior to the tourism boom in Quintana Roo, Cenote Dos Ojos had gained the attention of many explorers, especially cave divers. Soon the ejido members working that parcel became used to seeing foreign visitors wearing ‘funny outfits’ and immersing themselves in one of the ‘eyes’ of the cenote.¹⁹ However, during the late 1980s Cenote Dos Ojos started to capture the attention of different groups, including other ejido members:

In the 1980s a small band of adventurous and environmentally active divers led by Thomas "Buddy" Quattlebaum followed up on the tales of these secret spaces [cenotes], told to them by Mayan friends who spoke of a vast network of sparkling caverns and lakes hidden deep beneath the jungle floor (Hidden World’s Cenote Park 2008).

Some explorers including Thomas ‘Buddy’ Quattlebaum and Marcus Rotzinger wanted to buy the parcel of land where Cenote Dos Ojos is located, but the ejido assembly found out and decided that the ejido member, previously the tenant of the parcel, should be reallocated to another piece of land and that the cenote’s management should remain in the Assembly’s hands.

¹⁸ Alltournative is a tourist company in Quintana Roo that specializes in ‘adventure’ and ‘nature’ tourism (see www.alltournative.com).

¹⁹ ‘Dos Ojos’ literally translates as ‘two eyes’ which refer directly to the two cenote entrances into the flooded cave system.

In 1979 an ejidatario owned it [Cenote Dos Ojos], he was from Chemax²⁰, and in one assembly we were told that he was going to sell the cenote for 5,000 pesos [US\$500] so we told him that the right to the land was given but the cenote was different...it is understood that it belongs to all of us. Dos Ojos was for everybody and we told him [the previous owner] that he could take water from the cenote but that was it, and we, as an ejido, have been in charge of its management ever since (I19/ April 2009).

Ejido Playa del Carmen and Ejido Jacinto Pat currently work under a similar regime of not sharing profits with the ejido when the cenote is located in an individual parcel but, rather, shares profits from common ones. This has led to discontent among some ejido members that have been removed from their parcel of land by the Assembly so that it can take control of the cenote.

Roberto Canche has a large underwater cave system on his ranch, five cenotes are connected into a quite a large cave [8,400m²] called Dos Pisos and a couple of cave divers wanted to get things settled with the ejido to use it for tourist purposes, but the landowner told them: get the cave map out of your mind, there is no way you are going to show this to the Ejido Assembly, don't you dare to show this to ejido or they will take the land away from of me (I59/ July 2009).

There is an evident tension between the cenotes and the land; where public (in the context of the ejido) knowledge of a cenote can cause a change in internal ejido land tenure. This has meant that in some ejidos there is a strong desire for cenotes to remain unseen, to be exploited in private or secret, although positions of power within the ejido structure can be useful for maintaining the individual management of cenotes. This reinforces the idea that even in a 'democratic' social institution like the ejido, power positions delineate the use and destiny of natural resources and land, making us question the effectiveness of the internal organisation of the ejido and its different administrative bodies. In most cases such internal functioning remains, with the ejido boundaries limiting the possibility of formal regulation of the social institutions, as discussed in Chapter 2.

The constitution of the ejido and the subsequent creation of their internal regulations preceded the caves and cenote tourism boom. Nevertheless, the resilient approach of the ejido system allows ejido members to take decisions depending on factors such as urban pressure, economic crisis, environmental issues and, of course, new tourist demands.

In parallel to the ejido constitutions and the opening of cenotes as tourist attractions, some cenotes (e.g. Ponderosa, Azul, Chaac Mol, and Xcaret) that had also captured the attention of different groups of divers, explorers and developers, were under different kinds of land property. Some of them were located in what used to be national land and then privatised

²⁰ Chemax is a municipality in the State of Yucatan.

through a process called 'pacific occupation of land' or usucaption (the acquisition of property through the uninterrupted possession of it for a certain term prescribed by law). Different systems coexist in adjacent pieces of land, making the understanding of this topic challenging. While some landowners obtained their land through ejidos, others claimed to own the land through a process of usucaption. In Quintana Roo, one can be considered a usucapient if they have occupied the land and worked on it for more than three years. However, claiming such land titles through the Agrarian Tribunal is a long and expensive process. Therefore, in prime tourist locations, the process is often funded by 'outside' business interests, in collaboration with the local land occupier. Xcaret is an example of such a process (described more in Chapter 6).

An important obligation of the Ejido Assembly is to keep minutes of the points discussed at meetings. Unfortunately, access to minutes was denied to the researcher, so the information developed here relies predominantly on semi-structured interviews. What is most important to note is that neither the federal body in charge of agriculture nor any other government body have kept any records of the evolution and changing roles of cenote and cave management in the economy, natural resource use or land use changes in the region. This has influenced the participation of the different agencies in the control and regulation of cenotes. Although developed in the next section, the lack of knowledge regarding internal ejido agreements about cenotes by the federal land agency has undermined its position, enabling state and federal water regulation bodies to occupy the leading role. This has had implications for the empirical data gathered in this study, given the difficulties in accessing public sector perceptions of the underground forest frontier from the land sector.

Comparatively speaking, how are cenotes different from other natural resources under ejido land property? Like forestry or agriculture, individual parcels that profit from their activities do not have to share such profits with the rest of the ejido. However, when one practices an activity that causes a change of land use, it is necessary to discuss and obtain approval from the rest of the ejido. Cenotes located in the ejido common land are managed like any other common resource, and the profits obtained for managing them are distributed among the ejido members, usually once a year. As one ejido member commented in an interview:

From Cenote Chaac Tun, the 200 ejidatarios of Playa del Carmen Ejido gain every year 600 pesos [US\$60] each, it is not bad, and we [ejidatarios] do not have to do anything [to get that money]. The cenote is just there (13/ March 2009).

The 600 pesos given to the 200 ejido members is just from the rental payment obtained from a tourist company called 'Explora Caribe Tours' since 1992. The annual 120,000 pesos [US\$12,000] rental fee was established during an assembly meeting; it allows the leaseholder the entrance to the land and the use of the cave and cenotes for tourist and recreational purposes. Such a contract exempts the ejido from building any necessary infrastructure (such as toilets, stairs, and lighting). Any other use of the ejido infrastructure, like roads, need to be paid for under other agreements with the Ejido Commission. Such payments are also discussed and agreed in Assembly meetings. 'Land' as the analysed concept in this section therefore becomes much more complex when natural resources management and the commodification of natural resources enter the equation.

Each ejido, depending on its historical conformation, location and activities, responds to different dynamics. In Quintana Roo, some of the ejidos were formed from the communities of fishermen living along the coast of the territory, while others were formed with people migrating from the neighbouring state of Yucatan and from the north of the country. Early on, this migration was driven by opportunities offered within the chicle industry; more recently it has been driven by the tourism boom. These varied processes have influenced contemporary internal ejido relations, but also relations with other ejidos in the State.

Playa del Carmen had requested since 1928 the granting of ejido land and it was on the 15th of December 1937 that 54 peasants were given definitive possession of the ejido. In the corresponding resolution it is said that the requesters were mainly farmers and landless people and in order to satisfy their needs they required land. It is specified that a farmer in the region during the annual season requires 84 hectares to extract gum supply sufficient to produce the subsistence for his family, needing to give the land a five year period break... a minimum of 420 hectares per family are needed in order to extract the basic for family subsistence (DOF 4th august 1941, 5th resolution).

Ejido land in Quintana Roo was originally distributed to the few inhabitants of the state and people of other states through invitation. Through this process, 'almost' everybody with an interest in obtaining land was favoured with the ejido system. Once the ejidos were established in Quintana Roo, ejido members could then invite a blood relative or legal partner to be part of the ejido. In this sense ejido membership can come with birth right but ultimately it is the decision of the Assembly to let new members enter. Recently a market for 'ejido membership' has been developed in Quintana Roo. In the ejidos in the Riviera Maya this is a political and money game. Some of the most well-known hotel owners and investors have become ejido members after multiple negotiations (and the proper payments). In ejidos located in more 'remote' lands, some members are willing to sell their *numero de ejidatario*

(ejido member's number) and the prices vary depending on the ejido and the number of hectares allocated to each of them. This is a 'formal' process that the Procuraduria Agraria (Federal Agriculture Attorney) supports through legal procedures. The transaction has to be done in the office of the PA and the amount processed through the transaction is printed on the documents, although this amount is informally agreed between the parties.

In some cases, where land is available, the size of the ejido depends on the requirements made by the requester, if these requirements do not exceed the limit established for the small property regime found in land law.²¹ Such limits are established with reference to the economic activity developed. Tourist activities are not considered in agrarian law to be an economic activity that could limit property sizes; as land in Quintana Roo was classified for chicle extraction livelihoods rather than tourism, big extensions of land were allocated. This status has not changed, even with tourism now as the main economic activity in the state and the almost complete absence of chicle extraction. This proved to be a major issue with the change of the constitution in 1992.

5.1.3 *Ejido 'Privatisation'*

In 1992, Article 27 of the Constitution was reformed, allowing ejidos to divide communal property into individual parcels that could be purchased, sold, rented, or used as collateral (Taylor and Zabin 2000). To facilitate this process, ejido members have been able to obtain individual title deeds to their land parcels if their ejido agrees to participate in a government property certification program known as PROCEDE (*Programa de Certificación de Derechos Ejidales y Titulación de Solares*) (Cornelius and Myhre 1998). The impetus for this reform arose during the mid-1980s, after the country had suffered from repeated financial crises, and the Mexican Government began to introduce structural reforms modelled on the Washington Consensus²² (Barismantov *et al.* 2010). The restructuring of Constitutional Ejido law was part and parcel of this process, which involved State withdrawal and trade liberalisation (Assie 2008). Influenced heavily by neoliberalist philosophy and the pending ratification of the North American Free Trade Agreement (NAFTA), the Mexican government perceived the communal

²¹ This limit changes according to the ejido activities. In the case of agriculture it is 100 hectares, 150 if it is cotton harvest, 300 for banana, sugarcane, coffee, sisal, rubber, palm, vine, olives, vanilla, cocoa, agave, tender cactuses or fruit trees, and 800 for forested areas (DOF Ley Agraria 17/04/2008 art. 117-119).

²² The term Washington Consensus refers to economic policy prescriptions that are often constituted in the "standard" reform package promoted to developing countries in economic crises. These policies have been advocated by International Monetary Fund (IMF), the World Bank, and the US Treasury Department (all based in Washington DC). The policies focused on areas such as macroeconomic stabilization, economic opening with respect to both trade and investment, and the expansion of market forces within the domestic economy.

land-tenure system to be inefficient, with the private market viewed as the prime mechanism to improve efficiency within the agrarian sector. As Barsminatov *et al.* (2010: 297) note:

In effect, the 1992 Reform weakened the social contract between the state and peasants by decreasing the responsibilities of both parties. The state withdrew its responsibility to provide more land for the creation of ejidos, while simultaneously lifting restrictions on *ejidatarios* (legal members of the ejido) to buy and sell ejido lands and to use those lands as collateral.

Individual parcels and common areas now could be sold to third parties, although the activities to be developed in the common areas needed to be 'economically and socially equitable, as well as environmentally sound' (Corbera 2005: 84; DOF, Ley Agraria, 1992). It could be argued that due to such a reform, government intervention in the control and management of land had ended. However, a new bureaucratic apparatus was created to support and attend to the new demand for private land. Successful private land enclosure ultimately requires changes 'in the institutional structure of the distribution and transfer of access rights at the state level' (Robbins and Luginbuhl 2007: 29). Formal enclosures surged with the modification of Article 27 of the Constitution; in that sense, the 'double movement', as discussed first by Polanyi (1957) and recently by Bakker (2005) and Mansfield (2004), took place. The State retreated in the sense that they gave away 'national land property' and allowed ejido members to 'sell' their resources. However, at the same time the establishment of a new bureaucratic apparatus was necessary, so the PROCEDE office was created to regulate land titles and to provide training programmes to help explain to ejido members and public servants the nuances of the new system.

Against popular expectations, the rapid privatisation of ejidos did not and has not occurred in Quintana Roo (Barsimantov *et al.* 2010). According to the 2007 Agrarian census in Mexico, out of the total 2,886,520 hectares of ejido land in Quintana Roo, just 277,251 hectares have been sold in the last ten years (INEGI 2007). The above data does not provide enough information about the impact of the Land Law reform since 1992, but can shed some light over later perspectives about the processes occurring along the Riviera Maya, after the initial development of tourism in the region. As an agrarian lawyer in Quintana Roo explains:

[Carlos] Salinas [de Gortari]²³ made the amendment to Article 27 of the Constitution and this affected Quintana Roo terribly, because now they have been able to sell the commons. With the value acquired by the land, all the wealth accumulated by families for generations has been given away for nothing. Today the same pieces of land have been re-sold for the fifth or sixth time, including cenotes (136/ June 2009)

²³ President of Mexico from 1988 to 1994.

Or as an ejidatario of Playa del Carmen ejido notes:

No, we do not sell the land like in Cancun, as we have learned. I have, in Ejido Playa del Carmen, around 30 hectares and I sell every hectare for a million pesos (US\$50 per metre squared), but if it is close to the federal road it is more expensive. I do not sell this land with the cenote, it is better for me to rent it (13/ March 2009).

Land acquired increasing economic value since the development of tourism in Cancun. Ejido members suddenly became aware that the assigned piece of forest, where no chicle or any other intensive extractive activity was possible, had increased its economic value. Selling seemed a good option at the beginning but through a gradual learning process they realised that every year the value of the land was increasing, and they started renting the land. With the liberalisation process instigated by the amendment of Article 27, there was the intention of creating new markets and investment in the area. However, the institutionalisation of a land market created a 'retard effect' whereby landlords are now holding their lands and renting out the right for the exploitation of the natural resources contained on those lands. This has actually slowed the land market (selling/buying) process by creating incentives to retain land which then becomes available for 'others' through renting mechanisms (Bridge 2007). As Barismantov *et al.* (2010) have observed, ejido members in the Buenavista ejido, soon after the 1992 law change, sold their coastal lots for US\$600/ha, while now they are currently valued at US\$140,000/ha. The early sales known above probably reflect the number of hectares sold to third parties reported by the last agrarian census and show part of the process where a 'new social and political construction of land', and later of natural resources, had started.

Interestingly, this was not the first attempt by the Mexican Government to privatise land on the Yucatan Peninsula. During the 1870s the government attempted to privatise any remaining communal lands in the henequen region around Merida. However, the process was stymied due to limited state resources, conflicting interests and different cultural perspectives (Rugeley 2009). The metaphor that historian Terry Rugeley used to describe the consequence of these interventions is particularly apt for this thesis:

[The continuation of] a land where issues of property and land tenure remained cenote murky (Rugeley 2009: 277).

While the impacts of these early privatisation efforts were very limited, it does show that ideas surrounding privatisation are not necessary, new or novel for the region.

For example, Ejido Playa del Carmen has, since 1937, had full possession of the ejido land and, although communal land remains the majority, it has been parcelled and some free-land ownership has been allowed. This has had social, economic and environmental implications. An example of this is the building of roads to access the parcels assigned by the Assembly to different ejido members. In the interior of the ejido are 'ejido roads' built with the ejido communal funds, but there are also private roads built by individual landowners to access their plots of lands. This has resulted in the proliferation of roads without any formal control. Private roads are an individual investment, although in some cases multiple ejido members work together to build a road that favours access for all of them. With the cave and cenote tourist boom it has become common to see new roads leading to cenotes located in the forest. For the construction of such roads an Environmental Impact Assessment is not necessary and, although the Assembly should be informed of any land use modification, the building of a 'necessary road' will not be stopped. In this sense, the emergence of multiple paths and the environmental impacts of such unregulated activity are not mentioned by the ejido authorities or any relevant government organisations as something to be formalised. Ejido land, thus, enjoys a certain amount of autonomy compared to other land tenure regimes, including other private property regimes, but due to the land extension under ejido property, the impact on natural resources management could be something to study meticulously in future.

To access a cenote via communal or private roads in the ejido, a payment needs to be given to the Ejido Commission or to the private owners. These rents are not formal and most of the rental agreements occur at the individual level between the interested parties. The Land Law does not contemplate these kinds of agreements where no land transactions or extractive activities occur (at least not physical ones). Thus since 1992 a straightforward process of land privatisation has not occurred in Quintana Roo; rather, this has involved complicated mosaic of private and public land, utilising both informal and formal rental systems.

5.1.4 Ejidos and natural resources

Understanding the Ejido system helps to the further understanding of natural resource management in Mexico and in Quintana Roo. A historical point of view shows us how such formal property regimes shaped current perceptions and relations with nature. Cenotes in the ejido land context are not considered formally in the law, but are somehow integrated in the water section of the Agrarian Act. Land Laws leave the internal management of their water bodies to the ejido, allowing individuals to have usufruct rights over them (rights to use land to derive profit, but it belongs to a third party). However, the water law specifies that all the

underground and above ground water belongs to the nation and therefore its management is the imperative of the federal government:

Second Section Of the Waters of the Ejido
<p>Article 52. – The use or exploitation of ejido waters will correspond to the ejidos and to the ejido members, when it is in the case of common and parcelled land.</p>
<p>Article 53. – The distribution, use and access, maintenance, taxes, fees, transfer rights and other aspects relating to the use of water volumes of the ejidos are governed by the relevant laws and regulations.</p>
<p>Article 54. – Ejidos which benefit from the irrigation, distribution or other systems of water supply are obliged to pay the applicable tariffs.</p>
<p>Article 55. – The water bodies inside the ejido lands, if they have not been legally assigned individually, will be of common use and its exploitation will correspond with the available internal ejido regulation. In the absence of such internal regulation, the agreements will be taken in accordance with the tradition of each ejido, when it does not contravene the relevant water law and regulation.</p>

Table 5.1 Waters of the Ejido

The law does recognise the power of the internal organisation of the ejido to decide about the management and control of the waters of the ejido. Nevertheless, such power is subjected to the corresponding Water Law and the public servants in charge of its implementation. Landowner fee payments for water consumption are also subjected to the National Waters Act. In regards to Article 55 it is not clear how the water body can be legally assigned when it comes to cenotes, as it is not known of a cenote/cave that has been legally assigned to someone. If that were the case more than 4,000 assignments would be necessary in order to 'legalise' cenotes and caves statuses.

Another interesting issue is the lack of definitions for the cenote/cave systems in the Land Act, or any other law. At the legal level when a contract is signed between a land owner and a lessee interested in developing amenity activities (i.e. scuba diving, snorkelling), the words cave and cenotes are used frequently in the contracts, making us question the formalities of the process, in case State intervention is needed to protect any of the parties.

The lessee through its legal representative declares that it has received a permit for the use of ecological areas and for the aquatic exploitation of the cenotes located within the aforementioned plot of land ... The cenotes and caves that are found inside the parcel, reason of this contract, will be used exclusively for scuba diving and ecological

trekking (Legal contract established between a land and cenote owner with a tourist developer, June 2004).

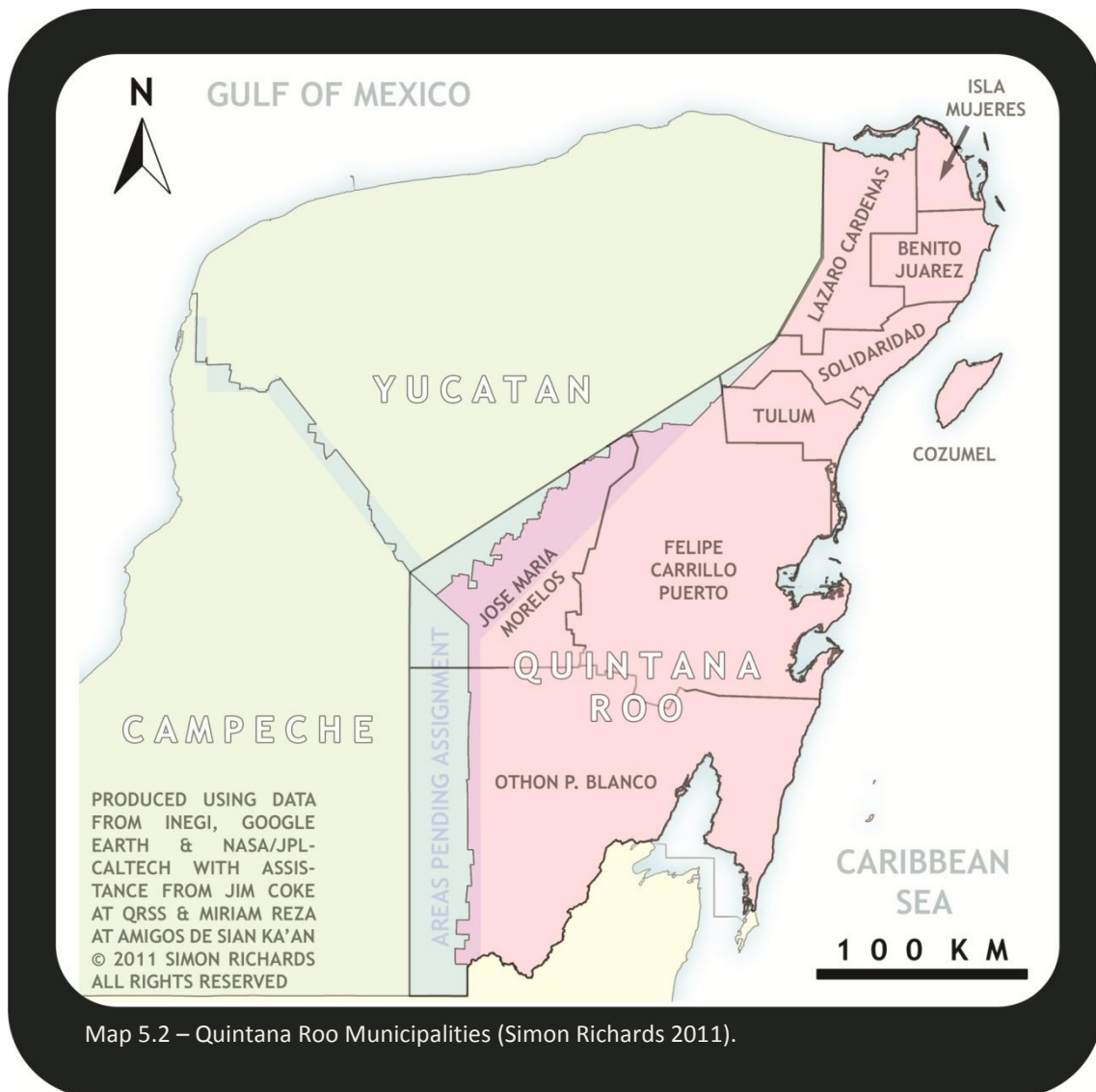
If a conflict emerges between the parties the existence of a contract has proven to be irrelevant and in the majority of cases an informal agreement is settled leaving as a last resource the State involvement in ejido issues. Land and cenote owners form lease agreements in different ways. Sometimes the landowner, as in the above case, prefers to receive a percentage for each tourist entering the cave or cenote but also they might request the applicant for a rental payment regarding the use of roads. In other occasions these rental agreements are fixed rental payments plus payment for use of roads. Some ejido members have argued that this is the best system, because the fixed rental system does not get affected by seasonal fluctuations of tourism or crises such as hurricanes and the 2009 swine flu outbreak.

The governmental body in charge of enforcing land regulation in Mexico is the Secretary of the Agrarian Reform (SRA), but the body in charge of proposing, implementing and following up programmes and budgets intended for agrarian purposes in Mexico is the National Agrarian Attorney (PA). The PA in Quintana Roo, under a strategy of 'promoting ejido land' (I58/ September 2009) implemented in July 2008 a programme called: Agrarian Development Programme for Public and Private Investment in Rural Property (FIPP). Through this programme the PA tries to find alliances with the private sector to develop rural projects.

The objective of the institution [PA] with this programme is to create links between land owners and private investors, ensuring legal certainty to both of them, based on the legislation. It is important to establish every possible association to transform Mexico's rural reality. Let us place our responsibility as a link in these programmes to improve the living conditions of peasants and to improve the country's development (Speech given by Rocendo Gonzales Patino, Agrarian Procurator, Dirección General de Comunicación Social 2010).

In an interview with one of the PA agrarian lawyers (I58/ September 2009) working in the Municipality of Felipe Carrillo Puerto (see Map 5.2) it was highlighted that the programme is interested in supporting and promoting projects for the development of cenotes for tourism. The Agrarian governmental bodies are acting as the 'link' between landowners with cenotes in their land parcels and the private sector investors. A position that has been influenced by the rapidly increasing tourist activity and the already occurring transformation process in the cenotes located in the Solidaridad and Tulum Municipalities that have had a level of success with this activity. The 'new' role of the Agrarian authorities as intermediaries in developing tourism projects contrasts with the absence of the land governmental agencies in the recent

attempts to regulate caves and cenotes. As will be developed in the next section, governmental water bodies have been more active in proposing types of regulation for caves and cenotes and organising relevant events (Forums, Conferences and Meetings). For the events that took place during 2009, none of the agrarian sector stakeholders were invited to participate and more interestingly no ejido members or private landowners with cenotes were invited as well.



It is interesting to note that the actual land has become of lesser importance in terms of renting ‘any plot of land,’ instead the presence of cenotes is viewed as being most vital. Yet in legal terms cenotes are not formally recognised and thus for rental agreements, land has been the necessary transaction and agreement point of departure. Under the ejido regime it is possible to rent land in communal areas or in individual parcels. In the case of individual plots

of land almost everything occurs between the landowner and the applicant, although real estate companies, land-cenote brokers and the PA intervene in the process. The participation of realtors in the process has added a touch of 'pristine romanticism' to an obviously new market where cenotes are traded: "Beautiful cenote ready to be developed, for sale."²⁴

The omission of cenotes in land regulatory instrument permits economic land transactions without direct restrictions over the activities to be there developed. In the state of Quintana Roo cenotes are mainly located in private land; either under ejido or individual property regimes. The question then is: Can the underground be considered within the same scheme of private land ownership? It seems clear that the creation of the ejido system was directed entirely towards agrarian issues, leaving aside questions concerning natural resources and the development of 'other' extractive activities. The process of enclosing the underground and its related resources is a much slower process. As Gavin Bridge notes: "The 'resource space' must be nurtured as a site into and through which capital can flow, via knowledge claims which establish (and make legible)" the [...] content "of the underground, and by instituting property relations to the underground that enable its enclosure and the appropriation of values" (Bridge 2007: 74). According to Article 27 of the Constitution, some underground resources (water, petroleum and minerals) belong to the Nation but this specification does not limit the private ownership of the underground. In this sense, the owner of a property that has cenotes on it could also be the owner of the space underneath it (Rodriguez 2009), regarding land jurisdictions. To complement this idea, water regulation under the National Water Act, will be analysed in the following section.

5.2 Ground Water Regulation?

As in the case of land, Article 27 of the Mexican Constitution devotes a section to national waters, including specific references to underground water. The pertinent constitutional Article specifies that all water belongs to the nation and its regulation lies in Federal hands; relative to underground water that same article states that:

Ground water can be brought to the surface through artificial works by the landowner, but when the public interest demands it or other uses may be affected, the federal executive will regulate its uses and extraction, and even establish water ban areas. All other waters, not covered by the listed above (See art. 27) are considered and integral part of the land through which they flow or are deposited but if they are located in two or more properties, the use of these waters is considered of public interest and it is subject to the regulations established at the state level (DOF February 1917).

²⁴ www.ownacenote.com

Although it might be argued from the above paragraph that groundwater could be privatised if located under private land, it is actually referring to the use and exploitation and not to the right to own water (Paredes 2004: 70). Articles 1, 5, 7 and 9 of the Federal Water Act establish that ground water belongs to the nation and that it is ruled by the principles of inalienability (cannot be sold, transferred or mortgaged, nor can they have any real rights over it like transference of domain) and indefeasibility (individuals cannot take possession of the water that is not derived from a permit lawfully issued allowing its exploitation, use or benefit) (Semanario Judicial de la Federacion 1989: 221). Article 27 states the same, but also notes that underground water, being a natural resource, its use and exploitation can take place with the proper federal concessions. This need for a federal concession has ultimately created some contentious outcomes at the local level in Quintana Roo. The geomorphologic characteristics of the Yucatan Peninsula's underground forest frontier, particularly as it can be accessed through cenotes, creates some ambiguity of its status as superficial or underground body of water. Should cenotes be considered as superficial water or the opposite? Such diffuse jurisprudential status may affect the development of instruments to regulate these systems.

5.2.1 CONAGUA and water abundance

The governmental body in charge of administrating water in Mexico is the National Water Commission (CONAGUA) and has the objective 'of managing and preserving national waters and their inherent goods in order to achieve sustainable use, with joint responsibility of the three tiers of government (federal, state, and municipal) and the society as a whole' (CONAGUA 2011). CONAGUA is made up of

three main administrative pillars: the central office, the water catchment authorities and the regional offices. The central office establishes, in cooperation with the other two pillars, the hydrological policies and strategies to administrate resources at the national level, designates annual budgets and monitors its applications. The central office is also in charge of monitoring the policies on water rights and discharge permits; it coordinates changes in the National

Table 5.2 - Responsibilities of Mexico's Water Catchment Authorities

1. to determine water availability;
2. to guide the development of new development centres;
3. to achieve a sustainable use of water;
4. to ensure the preservation of aquifers;
5. to ensure the preservation of surface water;
6. to collect national water fees and its goods;
7. to solve conflicts over water;
8. to grant concessions, allowances and permits;
9. to promote a culture of good use and preservation of water;
10. to prevent risks and deal with flood damages;
11. to prevent risks and address the effect of water scarcity; and
12. to operate strategic infrastructure.

Water Act and supports its enforcement. The Commission also elaborates the formal institutional instrument called *normas mexicanas*, to regulate the hydrological sector.

The water catchment authorities are responsible of managing and preserving the national waters in each of the thirteen hydrologic-administrative regions that divide the country. The water catchment authority of the Yucatan Peninsula, which is based in the city of Merida, includes the states of Quintana Roo, Yucatan and Campeche. Classifying the Yucatan Peninsula as a catchment area is problematic, as it lacks mountain systems or land depressions that help to define a catchment area's boundaries. The peculiarities of the underground forest frontier, as this section shows, have subsequently had repercussions in the administration and management of water resources in the state. As the regional director states:

CONAGUA has the constitutional duty of preserving the national waters, monitoring their use and establishing the usage limits of the different aquifers. For these purposes we have different areas within the Commission, but for me the most important is the technical one, because that is the one producing the information that we need to manage everything. That is how we know how much water we have, where it is, how can we extract it and try to find the best ways to deliver water to everybody (14/ March 2009).

The Yucatan Peninsula Water Catchment Authority administers an extensive aquifer(s) that runs under the platform of land in the whole Peninsula (see Chapter 1); while Quintana Roo's local office is in charge of implementing the different instruments of CONAGUA within the state jurisdiction. The water catchment authority and the local office subsequently have to deal with cenotes as 'an integral part of the aquifer' (128/ May 2009). Cenotes are understood as a fundamental part of the ground water system in their offering of a physical way to access the aquifer; although, as the quote below illustrates, the main worries are related with water abundance and its treatments and disposal.

The Mexican law [Water Law Act] has been written for the whole country and thus an aquifer like this one is very different from the rest of the country, geologically speaking. The law was written for places where there is no water but here there is water in abundance. We have to distribute the water, but we also need to dispose of the used water and that is another problem. The technical aspects are covered by the technical section of the Authority and that is why I believe it is the most important body of this office. Think about it, if you waste water in the north of Mexico, it is like a sin, but here it is different [...] we have free and easy access to the water table. There is 4 billion metres cubed of water available to be used in Quintana Roo and of that total we end up using just 400 million (14/ March 2009).

Two notions emerge in relation to ground water management in this context: abundance of water and the iconic technical information and intervention. Among different governmental actors the idea of abundance pervades the decision making process. Numbers and statistics of

recharging rates and extraction concessions seem to be the perfect combination to help to maintain the health of the aquifer believing that the aquifer can provide more water than what is already being consumed. Thus compared to other water bureaucracies in Mexico, 'experts' in the Yucatan Peninsula do not plan multimillion dollar investments for project interventions in river systems. In Quintana Roo such enterprises are not considered to be necessary 'because water is very accessible' (14/ March 2009). Nevertheless it is believed that a considerable technical expertise is needed to address 'water issues' somehow isolated from the everyday users' practices and beliefs. Although the 'technical side' receives all the attention, the local offices and the catchment area authority have no experts on groundwater and on the Peninsula's karst aquifer. The technical expertise consists of engineers that drill wells and install pipes to provide water, mainly, to urban centres. This was made clear in the Cenote Forum (in March 2009), organised by CONAGUA and SEDUMA²⁵, for which they invited hydrologists from the United States to present and explain the nuances of the underground forest frontier. Such need for 'external' expertise brings into question how are the technical decisions taken by the hydrocracies in Quintana Roo.

Curiously, during the 1970s, CONAGUA's predecessor *Secretaría de Agricultura y Recursos Hidráulicos* (The Ministry of Agriculture and Water Resources) was involved in a joint US-Mexico funded major research project to better understand the hydrologic functioning of the Yucatan Peninsula (Weidie and Ward 1976). Research and publications arising from this project indicated sewerage disposal as a major problem for the Peninsula, particularly around urban areas, and the need to adopt specialised disposal techniques to prevent the aquifer contamination (Back and Lesser 1981). Despite the findings of the research, the Cancun project went ahead and no specialised sewerage techniques were adopted. In a sense this research has been both ignored and forgotten; making one wonder if the promotion of economic development project will be always put forward and the promotion of research projects are used as political tools, where knowledge is proof of the good intentions of the public sector regardless of the results or information presented. This point will be developed further in Chapter 7, with the involvement of explorers and the availability of information for public interest.

²⁵ *Secretaría de Desarrollo Urbano y Medio Ambiente* [Secretary of Urban Development and the Environment]

5.2.2 Water Bans

In spite of, and contradicting, the shared perception of ‘abundance,’ two water ban zones have been established in Quintana Roo. The first one delimited in the south of the state in 1964 (see Map 5.3), ten years before Quintana Roo was formally declared to be a state:

It is established for indefinite time a ban in the extraction of the underground waters in the area of Payo Obispo in the territory of Quintana Roo [considering that] the area has been experiencing excessive underground water extraction for domestic use, public services, agriculture and industrial purposes ... if these activities are not controlled the water levels of the aquifer will drop, affecting the future availability of the water resource (DOF 7 May 1964: 7)

While the second ban was established in 1981 in the tourist areas of Cancun and Playa del Carmen, at the very beginning of the tourism boom:

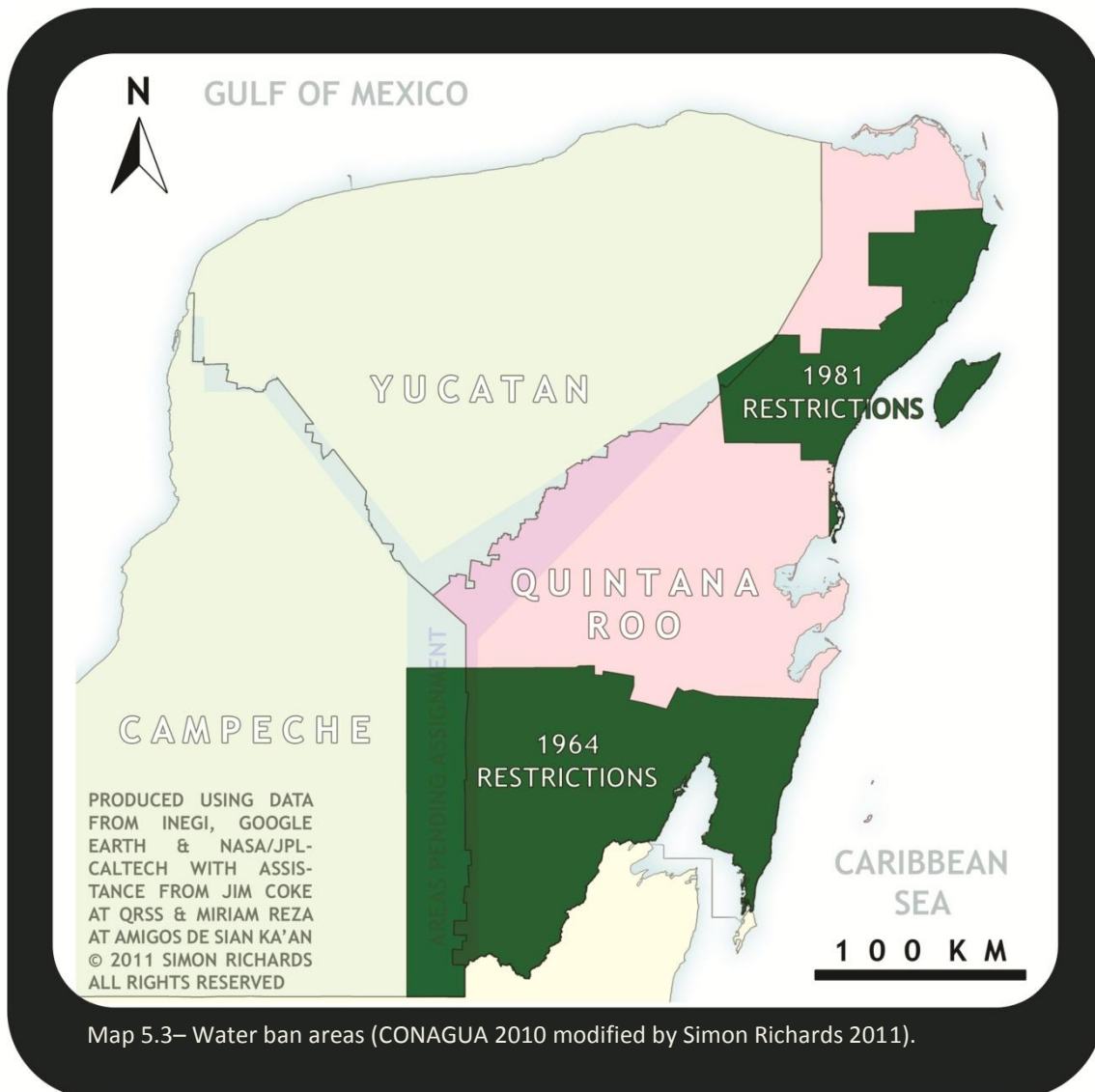
Considering that in the municipalities of Playa del Carmen and Cozumel in the state of Quintana Roo have been increasing the extraction, delivery and exploitation of the underground waters in a disorderly manner, and if this continues the current usages could get affected as well as exceeding the exploitable capacity of the aquifer, for which conservation and preservation are of general interest (DOF 23 March 1981: 27).

These ban areas consist of ‘zones where different water uses of those legally established in the law are forbidden. Therefore they are under specific regulatory instruments due to the quality of the available water’ (SEMARNAT 2008: 224).

Here in the Peninsula we have water ban zones like in Cancun and Playa del Carmen. The ban was a Presidential Decree that established guidelines to extract water from the aquifer and CONAGUA needs to give a concession²⁶ to users that want to exploit the aquifer such concessions have a cost that is related to the activity to be performed (14/ March 2009).

At the discursive level there seems to be the common belief that the aquifer under the Peninsula is extensive and healthy, providing abundant water resources which are needed for the different livelihoods. Nevertheless at the action level, the existence of two ban areas, even before the rapid urban growth phenomena started, contradicts this belief and almost in a “just in case” fashion two geographical territories control the quantity of water extracted without clear impacts or repercussions in the management of the aquifer.

²⁶ Concessions are given for different uses: agriculture, agro-industrial, domestic, aquaculture, services, industrial, livestock, public use, urban, multiple, power generation and trade.



5.2.3 Water Pollution

In Mexico 63% of the utilized water, comes from superficial sources (rivers, streams and lakes), the remaining 37% comes from underground sources or aquifers (SEMARNAT 2008: 54). Quintana Roo is one of the states in Mexico that is fully dependent on the underground water resources, with the 99.9% of the utilized water coming from the Peninsula's aquifer. Interestingly, water statistics in Mexico for 2007 show tables about the quality (classified as: very polluted, polluted, acceptable, good and excellent quality) of the available *superficial* water in the Nation, but no statistics are available for underground water quality (SEMARNAT 2008: 200). Subsequently, the regional office of CONAGUA for Quintana Roo offers one parameter relating to the terms of water quality in Quintana Roo, and it is saline intrusion (classifying them as: fresh water, slightly brackish, brackish and saline). The Mexican Norm (NOM-127) establishes limits for the water saline intrusion for human consumption

(SEMARNAT 2008: 51). Saline intrusion occurs when salt water from the ocean enters the land through the aquifers. This phenomenon can take place as a natural process or when the anthropogenic removal of fresh water leads to lowering the groundwater level below sea level, altering the natural dynamic balance between seawater and freshwater. For the Yucatan Peninsula it is also necessary to consider the natural layers of saline water form an essential part of the aquifer.

Other types of pollution, such as human waste, are not considered in the formal parameters of polluted water, in spite of the near non-existence of connected sewerage infrastructure in the state. Even when the infrastructure exists most of the houses are not connected to the main system. Therefore with constricted measures of CONAGUA, the Quintana Roo aquifer is formally considered to be in good condition. This is in spite of an evident sewerage disposal problem, due to the lack of connections between houses and the main system, as a member of the Water Supply and Sewerage Commission states:

As the State Government it is our duty with all users of Quintana Roo to provide water and sewerage. Our commitment is to provide the service to their doors but the connection inside of the house has to be done by the user (I14/ March 2009)

The national water statistics report for Quintana Roo shows that in 2005 more than 96% of the state population had access to potable water and that 89.5% should have had access to the sewerage system. While the report further estimated that 76.3% of the entire Yucatan Peninsula has access to a sewerage connection (CONAGUA 2010). However, these statistics are an obscuration of reality as they refer to *potential* connections, not actual connections. The entire Yucatan Peninsula only has one sewerage treatment centre with a capacity of 2.26m³ per second and an actual treatment flow of 1.73 m³ per second, the lowest of any region in Mexico (CONAGUA 2010).²⁷ This suggests, and has been confirmed through interviews, that very few households on the Yucatan Peninsula are connected to sewerage treatment networks. Furthermore the above also suggests that the region's treatment facilities currently do not have the capacity to handle a full influx of household sewerage connections.

Here in Playa del Carmen, in the Colosio neighbourhood, 95% of the 5,000 lots have the *option* of building the connection from their houses to the sewerage system that we at CAPA²⁸ have built, but they do not do it because there are very old houses that were built without the option of a sewerage system and the septic tank was built at the back of the house. If the inhabitants were interested in establishing a connection

²⁷ For example, Baja California, which has a smaller population than the Yucatan Peninsula has a sewerage treatment capacity of 8.19 m³ per second and an actual treatment flow of 6.11 m³ per second (CONAGUA 2010).

²⁸ *Comisión de Agua Potable y Alcantarillado* [Water supply and Sewerage Commission].

they would need to break all the floors inside their house to run the pipes from the back of the house to our system located outside along the main roads. In 2007 we applied a survey to 70% of the lots with a potential connection and 50% of them were not connected to our system yet. There is a big chance that all these houses have their septic tanks connected to the caverns and the underground aquifer due to the kind of terrain we have here. The surface here is like a Swiss cheese and it has multiple connections... that is the biggest worry because it is polluting the fresh water. But the state Government does not have the proficiency to build the intra-household connection, that is left to the users and many of them do not do it for lack of money (I14/ March 2009).

When governmental organisations report to the 'national statistics system' the percentage of built infrastructure they do not report that an important percentage of the 'growing' urban centres in Quintana Roo are not connected to the main sewerage system and that most of the individual houses are connected to septic tanks.²⁹ Septic tanks are designated to allow faecal solids to dissolve in liquid through a process of anaerobic digestion, with the subsequent effluent passing out into a drainage field. This drainage field should be in thick soil so the natural breakdown of nutrients and the killing off of hazardous bacteria may occur (Beddows 2002). However, the Peninsula's terrain is characterized with thin fragmented soils that would not stop the passing of bacteria and viruses to the aquifer. One of the mechanisms that would partially stop a process of water contamination would be to clean the septic tanks regularly (every six month to two years) (Beddows 2002), but as it was mentioned in an interview conducted with the sub-director of the organisation in charge of potable water and sewerage in the state, CAPA (*Comisión del Agua Potable y Alcantarillado*), most of these households have septic tanks systems that in most cases do not receive any kind of maintenance.

When we did the survey, we asked when the last time they had cleaned their septic tank was, and more often than not the answer was: my septic is in perfect conditions, I haven't had to clean it in years (I14/ March 2009).

In the city [of Tulum] there is a serious health hazard, 30% of the households are not connected to any drainage system, 66% have septic tanks and 4% are directly connected to pits or cracks. Although there are a considerable number of houses with septic tanks they are not properly constructed as they are placed in cracks and cenotes, without any system to prevent the aquifer's pollution (Solidaridad 2007: 86).

The absence of statistics about the underground water quality might be an example of the lack of knowledge about the aquifer system in Quintana Roo. Nevertheless, the above narratives show that despite the fact that urban centres (such as Playa del Carmen, Akumal, Chemuyil and Tulum) are not connected to the sewerage system; a consistent methodology to monitor levels of pollution by human waste in the aquifer does not exist. In contrast, official statistics

²⁹ Recent research in Yucatan State also suggests a similar situation there (See Naverrete 2008).

report that 'in Quintana Roo water is abundant and of good quality' (SEMARNAT 2008); notions that influence everyday perceptions of the aquifer, and the consequent decision making process. In this way the official discourse acknowledges, but avoids taking decisions about a problem and in doing so legitimises practices such as the lack of connections to the main system.

The technical body of CONAGUA reports that water is abundant and of good quality; while in a somewhat contradictory manner it still maintains two water ban areas in the state. However, what is more important to understand is how the public sector's discourses of abundance and quality could affect the decisions that ejido members, individual private landowners and private investors take every day regarding water management. As it is well known, tourism is the biggest economic sector in Quintana Roo. Resorts, hotels, restaurants and all the services derived from the more than 55,000 hotel room capacity (Manuel-Navarrete *et al.* 2009a: 8), require a controlled system to provide potable water but also to dispose waste. In this sense CONAGUA and CAPA have tried to impose some controls over the disposal of polluted (dark and grey) waters. Resorts, hotels and restaurants that hold a concession, given by CONAGUA, have to treat their own sewerage:

In terms of sanitation CAPA collects the sewage water and treats it. For example the holders of concessions, like big hotels, they have to treat the used water and we collect it. The law specifies some parameters and they have to respect them or pay more rights to pollute. How do we measure the quality of the treated water? Every three months the concession holders have to inform us, through a certified laboratory, about the quality of the discharged water (14/ March 2009)

Although it is difficult to know if the business sector reports every three months the conditions and functionality of the water treatment plants, the methodology to take such samples to be analysed has not been shown in any of the requirements given by CONAGUA to maintain a concession. Other practices like the use of fertilizers in extensive green areas, such as with golf courses, have not yet been taken into account by these organisations, as an agrarian lawyer states:

In every part of the world the aquifer is underground, the big difference here is the intense proliferation of underground rivers and that it is possible to find them less than three meters below the surface, and I am not even talking about the interconnectivity between them that makes this aquifer so special and totally different from others. The surface in the Yucatan Peninsula is very similar to a honeycomb that permits the infiltration through different layers of soil, but that makes it very vulnerable and everything you put in the soil here will go to the aquifer eventually. That is why, for example, it is so relevant to regulate golf courses. All the fertilizers used to keep the green grass in this arid weather are going to the aquifer and the underground rivers, with or without cenotes (136/ June 2009).

Vulnerability of the aquifer was also a common topic among the interviewees and the main topic of different workshops and seminars organised by the public sector. Recognition of such vulnerability and the discussion around it has not yet been translated into research studies by the public sector to evaluate the current conditions and to establish a baseline from which to depart for future studies and regulations. This is particularly interesting if we contrast narratives of 'vulnerability' with the ones about 'abundance of water' at the discursive and action level. While the second one seems a very developed topic at the institutional level, the vulnerability of the aquifer has not found translation into any formal regulation. It is almost completely agreed that the Peninsula's aquifer is a very complex system (I1, I4, I28, I22, I31, I36, I80), but water technicians and hydrologist in the public sector are in charge of developing techniques and infrastructure to provide water in quantity and quality, and their actions are directed towards such goals, leaving the 'vulnerability' at almost a political level. The subsequent chapters will explore 'vulnerability' from other sector perspectives and its possible impact in the current water public sector discourses, as a foreign hydrologist invited to one of the forum states:

But we are seeing things that are wrong, cocaine in the Tulum water system. How can you explain that? And it is not only cocaine, all the pharmaceuticals drugs... the turtles are under birth control and the coral reef is taking *Viagra*... this can't be good (I11/ March 2009)

As explained in Chapter 1, the underground forest frontier has numerous direct connections to the ocean. Such connections are not one sided; fresh water from the aquifer has several exits along the ocean that also feed the famous second longest barrier coral reef in the world. By polluting the fresh water with human waste (including the above mentioned substances, for more information see Metcalfe *et al.* 2011) through inadequate sewerage system infrastructure several ecosystems have been affected.

5.3 Cenotes

Chapter 4 showed us that these systems have been perceived and utilised differently by numerous actors across a range of historical periods. Since the Peninsula was geo-politically divided in three different states (Yucatan, Campeche and Quintana Roo) it could be argued that such a division has also influenced the current conceptualisation and relation between humans and nature, especially due to the different economic activities developed in each state. Although this study is territorially demarcated within the state of Quintana Roo, it is interesting to briefly compare how cenotes are approached by the public sector in each of the three entities, according to the catchment area representatives for the Peninsula:

It is very strange how one system has different perceptions in each region, when we were trying to organise the Cenotes Forum in every state we found very different things. In the state of Quintana Roo, the cenote looks like a business opportunity, as another form of exploitation of a property to earn an income, giving an economic value to a place that is the tourist vision of a place. It is a different system in Yucatan because we are thinking of the Maya community's centuries of rituals, traditions and beliefs. People settled down around these places. And finally, the state of Campeche, was very interesting, during the planning stage of the forums and when we first contacted them, they said: but we do not have cenotes. In Campeche there is no awareness of their cenotes, so the first reaction of Campeche when we asked how many cenotes are in the state? They told us: 'no, we do not have any here'. Then it is amazing how many different perspectives we can have in environments that are very similar (I28/ May 2009).

Yucatan, Quintana Roo and Campeche have experienced different processes when it comes to the cenotes and cave management. In the state of Yucatan, since 1996, a Programme of Cenotes and Caves (*Programa de Cenotes y Grutas de Yucatan*) was implemented. The programme had the objective to conduct a survey of the cenotes by municipality, locate them and classify them by shape. As a result of the programme 2,285 cenotes have been counted as well as 119 caves, with a total of 2,404 formations located along the 91 municipalities of the Yucatan (SEDUMA Yucatan 2009). The programme was conducted by the Yucatan State body the Agency for Urban Development and Environment (SEDUMA), and although a homologous organisation exists in Quintana Roo, similar studies have not been developed. The existent information about location, distribution and shape of caves and cenotes in Quintana Roo has been produced mainly by scuba divers and speleologists. Although recently some overseas research institutes, in collaboration with local NGOs, are conducting research projects in the area (see Chapter 7). Similarly, government bodies in the state of Campeche, as it was shown in the above quote, do not maintain a consistent programme towards these systems. This is likely because either the Public Sector is not aware of their existence or they know about them but their existence has not become an important part of their livelihoods, like in the states of Yucatan and Quintana Roo. However, this does not mean that the rural population in the state is not aware of the existence of cenotes.

Overall, the Yucatan State's public sector participation and management of cenotes and caves has been very active. Recently, in 2011, SEDUMA created the Department of Karstic Studies in charge of monitoring and studying the systems. In Quintana Roo state, on the other hand, the public sector talks, knows and develops discourses around caves and cenotes, but no formal actions, like the ones seen in Yucatan State have been brought forward. Making one question if the economic value and tourism uses of the cenotes have limited or restricted a more

evident participation of this sector, or if the public sector perceives their participation as unnecessary due to the already existent (informal) means of control.

In the previous section the idea of the need for a different water regulation for the Yucatan Peninsula catchment area was raised, nevertheless this catchment area is constituted by federal entities which perceive and have different knowledges about 'their' geography, including cenotes and the underground water system. For these purposes during March 2009 the Yucatan Peninsula water catchment area organisation, CONAGUA, and the SEDUMA of each state organised a Cenotes Forum in the three federal entities. During the forums 'experts' of CONAGUA presented technical information about the formation of the system, academics working with tourism outlined case studies of tourist caves and cenotes, hydrologist and limnologist talked about the complex hydrological system and the living organisms that inhabit them, biologists talked about flora and fauna, archaeologist talked about the pre-historical and historical material evidence and anthropologist talked about the ritual significance of the underground. However, ejido members, private owners or tourism developers were not invited and therefore did not participate in these events. Thus no one who 'owns' (or at least owns the land around) a cenote was in attendance. Afterwards in August 2009 a Regional Forum was organised with the intention of concentrating the 'lessons learned' from the previous forums and to propose a possible legal instrument to regulate them.

After the forums the situation became more diverse. We thought that something important was that the States and the Federal Government defined cenotes in the Federal Water Law, but now that is not enough. Defining is not enough; we need to establish uses and limits. What would be the federal, state and municipal competences? What would someone need to do to start using a cenote... it is very difficult...we, as the catchment area organisation cannot say: cenotes are water deposits and we have them in different shapes. That is not enough; I can't even tell what is going to emerge from all the very different opinions presented in the Forums (128/ May 2009).

Trying to define cenotes to include them in the law was one of the main purposes of the Forums. During the conducted interviews for this research one of the questions asked to respondents was: how would you define a cenote? When asked, the public sector employees offered an interesting rather vague variety of answers:

Cenotes are considered from a very technical farfetched point of view, not exactly like we would like it to be mentioned in the law and regulation, that is why we are trying to do it more precise, specifying carefully how cenotes are known in the general consensus and not from the public-populist point of view. We should do it well and not like something similar to a superficial lake or river, so there will be no doubt of what we want to regulate (180/ September 2009).

The cenote concept is well defined, well...among the technicians... the word cenote comes from the Maya language and means 'deposit' of water. But cenotes are normally associated with Chichen Itza, but technically all the karstic formations could be... although sometimes they are like the pit cenotes and sometimes look like caves (128/ May 2009).

Cenotes are not defined, a concrete definition does not exist, and some people say it is a collapse of the karstic roofs, others say that is a natural accident, but in legal terms there is no definition (14/ March 2009).

The technical side of public organisations in the water sector in Mexico seem to be not confused about what a cenote would be from the technical point of view, although they struggled to give a definition right away. Cenotes and caves become a more complicated topic when asking if they would belong to the underground water classification written in the law or to the superficial one. Superficial water in the regulation considers rivers, streams, lakes and lagoons, while underground water considers all the aquifers that run under the surface. But cenotes, as mentioned before, in some of their shapes provide immediate access to the water table and in some cases infrastructure needs to be built in order to extract water or access them. In a visit made to the central offices of CONAGUA in Mexico City, information about concession titles to utilised cenotes in Quintana Roo was requested to the Public Record of Water Rights (REPDA). The office is a department of CONAGUA and has the objective of making public and accessible the information available about national water. When information about cenotes was requested, to make a search in their system it was necessary to specify superficial or underground water. A lengthy debate subsequently arose between the office's employees about how it should be classified. Finally a search for underground water and cenotes was made. Overall, the implication of a vague definition of cenotes is more than a logistical problem in searching for information. In terms of regulation, superficial water is limited by a federal land zone, of variable size depending on the body of water (beach, river, lake), while aquifers do not. Under such definition cenotes have no protected federal zone around them, characterised by flora and fauna endemic to these systems. Therefore although the water of cenotes falls under the Water National Law, the land surrounding them belongs to the landowner where the cenote is located. CONAGUA in such terms has no authority to stop any construction or cenote modifications unrelated with water extraction.

Use		Number of Concessions	Annual Extraction Volume (m ³ /annual)
Agriculture		60	509,375
Domestic		1	150
Aquaculture		1	830
Services	Diving/snorkelling	4	0
	Restaurants	2	83
	Government	1	97
	Hotels	21	6,506,406
	Universities	3	15,618
	Eco-parks	3	7,012
	Country club	1	4,134
	Laundry	1	5,000
	Shopping center	1	10,171
	Airport	2	190,811
	Aviary	2	82,782
	Mineral Extraction	2	146,000
	Unknown	4	1,898,059
Total	47	8866173	
Industrial		4	1,828,332
livestock		14	3,590
Urban		6	1,866,298
Multiple		16	784,679
Total		149	13,859,427

Table 5.3. Concessions for utilising groundwater (described as cenotes), Quintana Roo.

Source: REPDA 2009

The National Water Act considers in Article 82 that any use or exploitation of the national water for tourism purposes requires adequate permission issued by CONAGUA. However, concessions for tourist use are not strongly represented from the record obtained at REPDA, 149 cases were listed in the obtained report and next to every case a brief description of the cenote and their uses were developed. From the 149 reported concessions to use cenotes as a source of water, just seven of them openly specified a tourist use. As it is observed in the above Table (5.3) the permit does not concede any kind of water extraction, when tourist activities are reported. This is interesting, considering the amount of cenotes exploited for tourism in the state. Such circumstance might have its origin in the fact that the user is not extracting the resource but using it *in situ*. A pertinent question for this is if CONAGUA just give

permits for water extraction, why does it extend concessions for tourist activities where water extraction is not taking place? As it was mentioned before, such types of concession should be requested to CONAGUA in water ban areas (see Map 5.3). Areas that do not belong to these banned polygons can extract, use or exploit the resource freely.

In this regard, CONAGUA as the federal authority on the subject has only taken actions towards the regularization of users performing productive activities. In the case of the state of Yucatan CONAGUA, together with SEDUMA of Yucatan, have conducted an inventory of cenotes, however, none of the three states of the Yucatan Peninsula has a state regulation for the management, use and exploitation of groundwater and the conservation and preservation of these systems. Attorneys specialized in this field (Paredes 2004; Rodriguez 2009) and CONAGUA officials (14, 180, 128) argue that the origin of this problem is related to the fact that the Peninsula should have its own regulatory instruments due to the peculiarities of the system. REPDA does not have an efficient record of cenotes and their uses. The inventory realized by SEDUMA Yucatan has been done through intensive fieldwork in the area, none of the CONAGUA instruments, so far, have helped in developing a census of these systems and their status. In reality the only way to access the information about cenotes, their location and uses is when the user-landowner reports that the water source is a cenote; otherwise not even that information would be available for analysis.

5.4 Environmental Instruments

Is it possible to say that the underground forest frontier is a by-product, a result of pre-human geological history (Watts 2004) and of human activity? The use of caves and cenotes for different purposes and by different actors undeniably has great historical depth. Different regulatory instruments have existed (formal and informal) to control their uses, access and pollution. Cultural anthropologist would argue that symbolic meanings are given to objects as a strategy to regulate utilisation:

A long time ago, near the place where now stands the cenote Chen Ja lived a marriage which had only one child. The son grew up and married a local woman. They built a house on the site where now is the cenote, a very rocky terrain. Over time the mother was widowed and had to rely on her son's help. The son started having very good harvests and thanks to this he and his wife lived very well. The mother, however, was very poor and had to go and ask her son for food. While he was eating good food, he refused to help her ... Annoyed by this attitude, the woman cursed her son: "Someday you will be swallowed by the earth." The place where the cenote is located today used to be the well from which the son and his wife drew water. Then one day, by the curse of the mother, the bottom fell out and turned into a cenote. The ungrateful son, his wife and the house disappeared. Even today if you go visiting the cenote you can see remains of the house (Evia 2003: 206).

And although myths often have worked as informal tools to regulate the use of natural resources, shaped by place and time (Watts 2004), nowadays a more formal approach needs to be taken. How different are cenote uses from the early Maya inhabitants to the current ones and what instruments are implemented nowadays to protect them as natural resources?

A natural resource is, then, a technical, symbolic and economic assessment or appraisal of the biophysical realm that is deployed in particular ways for particular purposes through particular practices (Harvey 1996: 147).

This entanglement of nature and human practices produces a set of ways to control human behaviour and nature at the same time. Along this section the contemporary Mexican instruments created to regulate the environment will be discussed in the context of the underground forest frontier. As was mentioned earlier, cenotes are not openly considered in any land or water regulation, nevertheless under the General Law for Ecological Equilibrium and Environmental Protection (LGEEPA) cenotes make their first appearance under the category of sanctuaries. The LGEEPA establishes the competences of the Environmental Authority in the following attributions, where cenotes, although not in an explicit way, may be included:

- a) planning and proposing environmental policies;
- b) establishing, regulation and monitoring national natural protected areas;
- c) proposing and implementing the ecological planning programs;
- d) evaluating the environmental impact assessments; and
- e) regulating the extraction of minerals and underground substances (DOF 1988, LGEEPA).

Although there is no specific regulation to the underground systems in Mexico, the LGEEPA entails protection to places that by their special characteristics are likely to be declared protected areas. Cenotes are classified as sanctuaries in this federal law and it is the federal state's responsibility to exercise the actions relating to their conservation and protection.

Sanctuaries are zones with a considerable richness of flora or fauna, or the presence of subspecies, species or habitats of limited distribution. These areas cover glens, meadows, relics, *caves*, *cenotes*, creeks, or other topographical or geographical units that need to be preserved or protected (DOF 1998, LGEEPA, art. 55; emphasis added).

The above quote is a very general characterization of what sanctuaries could be, including all the 'other' natural features unconsidered in the regulation. However, in the state of Quintana Roo there is not one cave or cenote declared as sanctuary.

The environmental office in charge of applying the LGEEPA summons specialised agencies when any of these features is affected. In the case of cenotes, and as it was mentioned before, CONAGUA is the governmental body 'more involved' in their management. Natural Protected Areas (NPA) are under the jurisdiction of the Natural Protected Areas Commission (CONANP), but cenotes that do not belong to any of the demarcated categories cannot be protected by this organisation. Some cenotes do belong to a NPA, such as those within the Sian Ka'an biosphere reserve and they do consider the cenotes identified in their territorial limits as part of their internal regulation. However this is not applicable to cenotes under urban, tourist or any type of other human pressure that do not belong to a NPA.

Year	Legislative Instruments
1917	Mexican Constitution (art. 27)
1972	Archaeological and Historical Monuments Federal Law
1983	Planification Law
1988	General Law for Ecological Equilibrium and Environmental Protection
1993	Human Settlements Act

Table 5.4 Legal Frameworks that could potentially affect cenote management

Thus at the federal level, cenotes are mentioned as part of a group of natural features to be protected and conserved. Nevertheless, like in the water section, the particular characteristics of urban development, economic activities and land property affect relations towards these natural resources and such particularities should be the responsibility of the state level government. In this sense Quintana Roo is concerned with the status of cenotes and caves, but more specifically with the karstic system they need to deal with every day, and for that reason cenotes are explicitly included in the 'new' urban development plans (PDU) of some of the municipalities of the state. These instruments, although concerned with environmental issues are not environmental policy instruments. The PDUs are detailed proposals of future developments taking into account: urban growth, economic activities, available resources and the environment, among others, and although conditioned by Federal Laws their regulatory spectrum is very limited. As the chief of Quintana Roo's SEDUMA agency states:

The new plans of urban development, like the one submitted for the Municipality of Solidaridad, include criteria that make specific reference to cenotes. In such plans it is established that active vegetation cannot be removed in a five hundred meters perimeter surrounding the cenotes. Some researchers have participated in the PDU proposals telling us the type of illumination that is advisable to put inside caves to avoid affecting wildlife. The issue also covers the construction of infrastructure: buildings, hotels and roads. Sometimes we do not have sufficient and necessary studies to tell if the new road or bridge will pass over the cave and they tend to break down and cause problems ... we are already incorporating these issues to the management plans, it doesn't matter if it is through a regulation or a norm, the important thing is

that we are already including the topic. Of course the urban development plans are for the future, we cannot do anything about what already happened (180/ September 2009).

Although other authorities and instruments have not proposed a definition of cenotes and their uses, which has been a given reason to not include the systems in the legislations, the Quintana Roo PDU in contrast has offered cenote definitions and characteristics:

Cenotes and dolines are karst manifestations typical of this part of the country, ranging in a diameter from a few meters to over 100 meters. Its origin corresponds to an intense phenomenon of vertical dissolution of carbonate rocks during glacial periods. These formations are concentrated along the systems of fractures and faults (SEDUMA 2002:94).

Each cenote is a refuge, and subsequently breeding and feeding for many endemic species of fish, mammals, birds and insects occurs in these sites. Therefore, they are very important places for conservation due to their function as biological corridors and as a source of propagules for other systems (SEDUMA 2002:128).

The Human Settlements Act (LGAH) empowers the federal entities to legislate urban aspects, at the state and municipal level. These powers are set out in the Urban Development Law of each state, which also identify the tools to conduct spatial planning and land uses through the: state urban development programmes (PDUs) and municipal programmes for urban development. The state of Quintana Roo has a state PDU and nine municipal PDUs, the most recent being for Tulum (although the first version of it was elaborated when Tulum was still part of the Solidaridad municipality) (SEDUMA, PDU Quintana Roo).³⁰

These programmes operate at the state level and are governed by the laws issued in the respective states. The state plans of urban development will be approved, executed, monitored, evaluated and modified by local authorities, with the formalities prescribed by the state law for urban development, and will be available for public consultation (DOF, 1993, Art. 15).

PDUs are the product of public consultations, where different members of society discuss 'future urban developments'. In such meetings, information about new hotels, new golf courses, new residential areas and new urban infrastructure are made public. The presence of members of different sectors somehow legitimises the process and opens a small window for suggestions about better practices, opposition to new developments or relevant scientific information that could be included in the document. As mentioned in the first quote of this section, cenotes and the karstic condition of the surface were included in the Playa del Carmen and Tulum PDU, not just as a description of the landscape, but as something to consider in future developments.

³⁰ In 2011 a tenth municipality was also established in the south of Quintana Roo, called Bacalar.

Existent vegetation within the urban area is not relevant, but the parts located to the east, northwest and southwest of the Playa del Carmen's town maybe suitable for exploitation of the landscape setting. In areas suitable for new urban development, relevant vegetation does exist and it would be important to incorporate it to the urban context. There are some caves and cenotes located to the west, which can influence the development of tourism and might influence the urbanization process in the area (Plan de Desarrollo Urbano de Solidaridad).

In Tulum special attention should be paid to the aquifer in areas where the geochemical processes have formed passages named: "underground rivers" that are the origin of caves and dolines; such systems run south and north of the area of study and are very vulnerable to pollution, for this reason it is necessary to apply the necessary precautions to conserve their natural conditions, especially due to their extraordinary environmental value and their extraordinary beauty as eco-tourist places, especially for scuba diving activities. Current conducted research points that Tulum's underground river system is one of the longest in the world. Currently two underground rivers that traverse the area of study have been identified as the longest Ox Bel Ha in the North and Sac Actun in the South (Plan de Desarrollo Urbano Tulum).

In an interview conducted with an NGO member and attendee to Playa del Carmen's PDU meetings it was mentioned that during the meeting it was agreed upon to form a 500 meters containment area around cenotes. However, when the PDU was published the point of agreement was removed from the report (18/ March 2009). In an interview with the Secretary of Urban Development and Environment for the state, the 500 meters contention zone was also mentioned as one of the taken resolutions (180/ September 2009), apparently ignoring this, the final version does not include such an agreement. In a similar vein, Tulum's PDU considers a protected radio of '50 meters around cenotes, dolines and caves' among other considerations (Gobierno Municipal de Solidaridad 2007: 144):

- It is forbidden to construct rural houses where high-tension cables exist, and in places like: caves, cenotes, fractures and natural wells.
- It is forbidden to log for tourist and commercial purposes; the physical and scenic modification of dolines, cenotes and caves; dredging, filling, digging and opening cenotes and the removal of vegetation [...]
- The permit to use caves and cenotes will be submitted to the elaboration of an environmental impact assessment and ecological studies that guarantee the maintenance of biodiversity, promoting, also, the correspondent authorization from CONAGUA.

At the federal level the peculiarities of the Peninsula's aquifer are not considered in the regulation and management of the institutional organisations. This was identified, by different state governmental actors, as part of the problem of the current management conditions of

the underground system in Quintana Roo. The competences of the three governmental levels allow for the regional and local authorities to take decisions about such 'peculiarities', if they do not contradict federal acts. In this sense, the state of Quintana Roo, through the Urban Development Plans, has explicitly included cenotes and the aquifer. Nevertheless, such inclusion is not coherent with the absence of 'other' instruments that would help in the implementation, control and monitoring of the system. The state of Yucatan, comparatively, has developed strategies to identify and classify cenotes and, as it was mentioned before, a caves and cenotes census has been in process. However, SEDUMA of Quintana Roo has not started the identifying and classifying process, leaving the mention in the PDUs as an isolated attempt of control.

5.5 Archaeology

Among the body of regulations hereby mentioned, there is another legal instrument that considers the underground systems and its content, the Federal Law for Monuments and Archaeological, Artistic and Historical Areas; and the organisation in charge of its application is the Anthropology and History Federal Institute (INAH). The law considers (Article 28) archaeological monuments and material evidence of past activities to be national property, in this sense paleontological and archaeological vestiges or remnants found in caves and cenotes are INAH's jurisdiction. INAH is in charge of declaring a certain area as a Historical and Archaeological Site in the country and in the cenotes and caves area of the Peninsula have formed different groups for the evaluation, monitoring and the consequent research of these sites. The Yucatan Peninsula has special attention due to the extensive existence of the aboveground archaeological areas but also for the underground evidence found there, which has included a variety of Maya (see Coggins 1992; Proskouriakoff 1974; Andrews 1960; Andrews and Corletta 1995; Luna 2008) and colonial artefacts (see Martos 2008; Gonzalez *et al.* 2007), as well as skeletal remains such as those discussed in Chapter 4.

Several projects have been developed by cave diving archaeologists to uncover more hidden material evidence contained in such systems. The Cenotes' Atlas and the Underground Mayan Graveyards are two of the main projects authorized by INAH, with different sponsors including the National Geographic Society. Through such projects a number of cenotes and flooded caves have been identified as sites of overriding importance for archaeological research in Mexico. Such cenotes are located in ejido private property and/or in private property, and in an important number of cases tourist activities are performed in them. The federal law recognizes that archaeological areas can be located in private premises (art. 6), but the

landowners must conserve and if necessary restore them with prior authorization and monitoring. That applies, in general, for above the ground archaeological zones but in the case of cenotes and flooded caves the material evidence could be extracted, removed and destroyed due to their 'easy' accessibility and the straightforwardness in moving and transporting the materials, but again the 'peculiarities' of the Peninsula are not considered in the federal law, leaving most to free interpretation, and to specific projects their study and protection.

There is an unrestrained interest in opening sites for public use. It could be called a vortex, adapting these sites [cenotes] and creating eco-parks for tourism. The economic interest makes the archaeological research one of rapid response. The Atlas Project sought cenotes in the shortest time possible. The reports of divers were treated immediately because there is always the threat that diving in caves and cenotes will jeopardize the evidence. There is also the feeling of wanting to keep a memory of a finding in a cave or cenote, something that we call 'ant looting'. If each diver collects a small piece from a specific place there will be nothing left of the site. So we have had to come up with a strategy against the accelerated race of tourism. Certainly, the best preservation of a cenote, both in archaeological and biological terms, would be no human impact at all, but that is unrealistic. That is the case of cenote Angelita, we made the recognisance dives, photography and mapping of the pre-Hispanic vessels but at that moment we did not have the infrastructure to collect the pieces. When we finally had the money and the necessary permits for the materials' collection nothing of the archaeological material was left on the site. Two processes occur here, one is a fear of INAH shutting down cenotes with archaeological evidence and the other is this 'ant looting'. The actions we take, as INAH authority, and to determine whether to make the collection of the evidence there found - if it is in danger of being lost, damage or stolen- or leave it there, but never to close to the cenotes for tourist activities (10/ March 2009).

Among landowners with cenotes where archaeological evidence is been found, there is legal uncertainty about the actions that INAH could take in order to protect the archaeological materials. It is a common belief that INAH could ban tourist activities from cenotes and caves with such characteristics and as a consequence most of these sites are rarely reported to the authorities. However INAH's authority does not include the closing or banning of certain activities, unless the area is declared a federal archaeological zone and an expropriation process occurs. This uncertainty influences landowner decisions about reporting archaeological materials found in their properties.

On the other hand, and with regards to the material evidence taken by INAH for research purposes, some of the communities and private landowners mentioned that INAH does not provide information obtained from the studies performed in relation to the materials extracted from 'their' cenotes. Such unconformity is added to the already existent fear that INAH will close their land. Interestingly enough is the fact that although a symbolic religious meaning is

given to these places by some groups and communities, an organised opposition to stop INAH from taking away the cultural inheritance from a Maya past was not found during fieldwork season for this research.



Figure 5.1– Official INAH logo (above); and reinterpretation of the INAH logo by a disgruntled cave diver (right).

5.6 Institutions

It is perfectly possible – and for a variety of reasons defensible, even necessary – to examine human–environment connectivities in ‘asymmetrical’ ways. For instance, physical geographers who are experts in river restoration may go about their work without having to know why certain social groups like restored rivers or why government planning regulations prohibit more restoration projects from occurring. Likewise, the ‘third world political ecologist’ can say important things about how and why peasant farmers use their land in the ways they do, without having to know all the biological intricacies of crop rotation, soil fertility and plant germination (Castree *et al.* 2009:6).

The public view of underground forest frontier in Quintana Roo is framed by the existent institutional apparatus and by the individual actors taking decisions about the underground system. The water sector has established a stronger connection with the destiny of cenotes and caves’ regulation compare to the other governmental agencies, but it is still very incipient. The sectorial approach towards nature, combined with the prevalence of technical

perspectives has obscured somehow the 'human-environment' connectivities and their outcomes. The water sector in Quintana Roo, but generally in the Peninsula, has the main intention of providing water in quantity and quality, and for that purpose the elaboration of technical studies seems sufficient. During a participant observation field trip conducted by the Water Studies Centre (October 2008), a group of researchers with different expertise (from botanists to limnologists) surveyed eight cenotes used for tourism that were located in the Solidaridad Municipality. It was observed that in every occasion, the technical team asked permission to take water samples from the cenotes but no questionnaire or dialogue was established with the landowners or managers. During the sampling of one of the cenotes, a conversation with the manager was developed with the author of this research, and 'relevant' information was provided about human wasting practices, death of fauna, dredging plans and vegetation removal. Unfortunately none of the members of the Centre listened to the ongoing conversation.

This partial approach –to nature- might be the result of the historical processes mentioned along the chapter. Land regulation at the beginning of the last century occupied an important part of the country's concerns and consequent actions were taken. Natural resource management and regulation started when petroleum became the main exploitable resource for the nation, but no environmental regulation was derived from it. It was not until very recently that these approaches were included in the National regulatory apparatus. Thus the sectorial approach might be a consequence of such history and the present research about cenotes is a good opportunity to highlight that such fragmentation becomes more obvious when the governance of complex systems is at hand.

The public sector claims that decisions cannot be taken unless a classification of nature exists that helps in delineating responsibilities, defines 'good' or 'bad' practices and provides a set of features that allow the decision making process. The attendance to the different Cenotes' Forums in the Peninsula showed this in a remarkable way. In this sense, natural scientists name, label and classify for 'scientific' purposes, but also inform the public sector domain who is willing to take the labelling and transform it into a regulatory instrument. Another identified process informing public sector view is the development of 'new' economic activities. Tourism in the state, as the main monetary source, has promoted the attention of the public sector towards cenotes. Thus the creation of concessions to use cenotes with tourist purposes is standard and remains as one of the main intentions to regulate this places. In both cases, the relevance of the topic has been brought to the attention of the public sector, scientists and

explorers (see Chapter 7); in most cases people from outside of Quintana Roo and Mexico, making one wonder about who is constructing what kind of nature and for what purposes in the underground forest frontier.

As we can see in Figure 5.2 part of the problem is the lack of both civil and administrative regulation. The former is due to the fact that the vast majority of cenotes and caves are located on private property (communal or individual). The lack of certainty about legal connections between cenotes and land, promotes that landowners do not report the presence of cenotes in their lands. On the administrative side, at the federal level, only the National Water Act regulates water extraction and wastewater discharges into bodies of water whose regime is considered national property, but there are no special federal regulations to consider their specific, legal and technical aspects. Meanwhile, at the state level there is no legislation that refers specifically to these formations, except the mentions made in the Urban Development Plans. Nevertheless state authority power is constrained by the same formal Federal apparatus that tries to regulate the environment, even from a sectorial perspective.

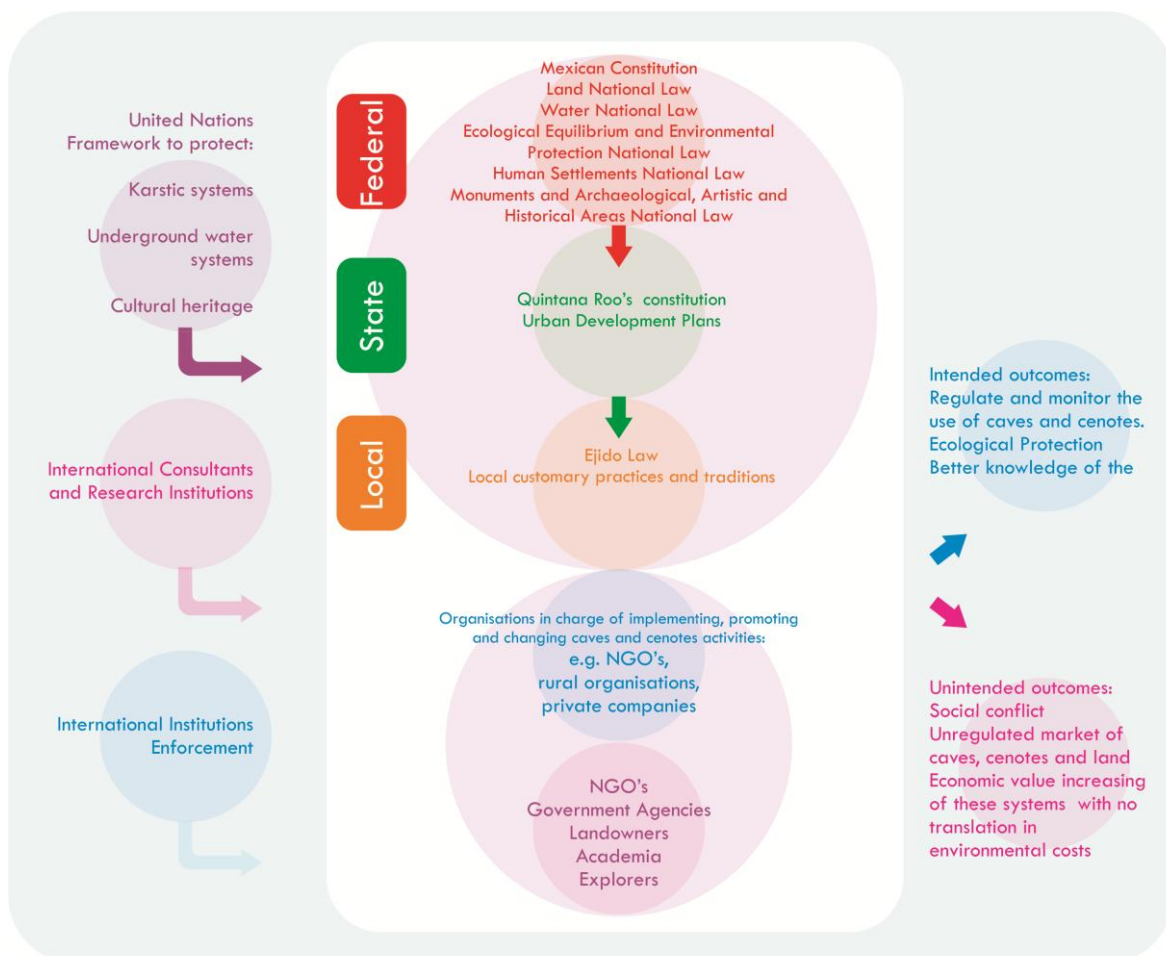


Figure 5.2 – Institutional architecture of cenote management. Based on Corbera's diagram for carbon forestry activities (2005).

Also remarkable is the fact that the public sector perspective and plans to formally regulate the underground are not involving landowners, private investors and explorers. It seems that the public sector is responding to the pressure of some key actors in the process, mainly NGOs and researchers, while there appears to be no formal competencies between governmental organisations to control cenotes.

One of the questions elaborated during the interviews was: how the public servants 'experience' cenotes. It was interesting to listen to responses such as: 'of course I have swum in the cenotes it is a part of the everyday life in the Peninsula'. A personal bonding exists towards cenotes: I 'learned to swim in the cenotes, we used to go every day after classes' (I80, I28, and I14). Including stories of different Mexican presidents cave diving in the 'underground rivers' in Quintana Roo (I59) or even the current Director of CONAGUA giving a public speech and embarrassing the Yucatan's present governor for never having scuba-dived in the cenotes (F6). A combination of some 'technical' knowledge and 'experiencing' the cenotes has shaped the public sector view of these systems, nevertheless at the action level both process work in isolation and just the technical knowledge is brought forward as relevant. The Cenotes' Forum and the Watershed Commission meetings demonstrate that there are some political intentions to 'formalise' the status of the underground forest frontier.

The next section will show how land, water, urban development and natural resource management in Quintana Roo have influenced certain processes of commodification of nature. The link between this chapter and the next one is the relation between public sector view and how it is influencing, constraining, allowing or even promoting behaviours towards nature among actors in the private sector. In this sense, the aim of the next chapter is to use the contextual knowledge acquired in the last two chapters to understand how caves and cenotes have been also commodified by this sector in Quintana Roo.

Chapter Six

Cenotes: the private view

This chapter will explore a wide range of informal perspectives and actions within the private sector relating to cenotes and their commodification. It will highlight the lack of a unified perspective of how nature has been commodified and unfold a scrambled set of actions and discourses, recognising the multiple ways in which nature can be and has been commodified by the private sector in Quintana Roo. With an understanding of commodification as a process of standardisation where economic goods are created and sold at a price determined through market exchange (Bakker 2007), the focus will be to understand if the market (with a capital M) could be the common factor that acts as the compass in this journey.

In recognising the contexts and the different processes involved in nature's commodification, this chapter will also highlight the physicality of the underground forest frontier and how this peculiar environment constrains or does not constrain private sector behaviour. Following Mansfield's argument that 'humans give meaning to "things" without removing their material properties' (Mansfield 2003: 177) it will be argued that the presence of the market as tool to manage natural resources in Quintana Roo is the result of a unique and peculiar geographical composition.

It is also necessary to consider the geopolitical distribution of land and the fact that by allocating big land extensions through the ejido system, the Mexican Federal Government distributed an important percentage of natural resources to a widespread but low number of landowners. Even though, as discussed in the previous chapter, underground resources and bodies of water belong to the Nation, land ownership and access to natural resources is controlled by the formally created ejido sector. Compared to the extraction of some mineral resources where the source of such minerals is located in a territorially limited area, cenotes are haphazardly scattered across the Peninsula, making their individual regulation even more complicated. Thus, by creating ejidos and later on by modifying Article 27 of the Constitution, access to the land is ultimately marketised as access to natural resources, and, in the case of Quintana Roo, access to the aquifer. The 'double movement' developed by Polanyi (1957) can be exemplified here in its first stage with the modification of Article 27. That is, the State took a step back and conceded to landowners the right to sell their lands; although a deregulation

process then occurred, a strong re-regulatory bureaucratic apparatus was created in order to 'reregulate' land tenure and to give individual private land titles away:

Such political involvement was a deliberate formal strategy of the State to create a private sector managing and using nature in Quintana Roo. However, it is important to note that, in spite of the region's fast economic growth (at 5% per annum in 2011) (INEGI 2011), not all private investors there have had the same economic and land capital. Thus, although this chapter presents the private sector discourses and material actions towards caves and cenotes, there are also a wide range of actors in terms of land ownership status, land size, land location and economic capital available for investment, among others.

Methodologically, proposing a classification in terms of the economic capital individuals possess will not add relevant information to the thesis, and accessing such data would have been challenging. Nevertheless some form of classification can provide a useful investigative tool with which to begin this analysis. It is also necessary in order to help clarify the relationships and interactions among different groups of actors. Furthermore, mapping the actors' spectrum from a social perspective engages with the main question of this research: what kinds of commodification do we see in Quintana Roo regarding caves and cenotes? And what are the outcomes of such commodification processes? The proposed hypothesis asserts that the types of ownership have affected commodification processes and influenced the type of relationship that the owners have with caves and cenotes. Conversely, the conclusion tends towards the assumption that the neoliberal tourist movement in the state of Quintana Roo has resulted in a homogenisation of activities regardless of ownership status, backgrounds, or the size of the enterprise. Such a conclusion would not be surprising if we believe in the power of capital(s) in local contexts. As Castree (2010: 43) notes: 'neoliberalism only 'works' if it is properly adapted to different contexts.' Thus relevant private sector actors will be categorised as the following:

- Land owners with cenotes who manage their own asset. This group has big internal disparities in terms of land size, number of cenotes and infrastructure.
- Land owners under different regimes of land-ownership that rent their land with cenotes to third parties (via contracts).
- Tenants renting a cenote or a group of cenotes who have invested money to build infrastructure (road ways, platforms, illumination, or have physically modified the caves and cenotes).

The following analysis will be organised using this typology and taking into account the subtleties of each group. As in any classification scheme, its members transgress boundaries; in this particular case study, all the individuals categorised can simultaneously act as tourist operators, land owners and major capital investors.

With this intention, and following the pattern established in previous chapters, this chapter starts with the historical role of the public sector in promoting the consolidation of a private sector in Quintana Roo. Taking into consideration the analysis from the previous chapter, this will help unveil the nuances and relevance of the legal characterisations of state-granted rights over natural public resources. By doing so, this chapter will address the idea of 'property' in relation to natural resources and land not just from the economic perspective of land and resources value, but from the legal perspective of property ownership. Empirical evidence will be integrated throughout.

6.1 Manufacturing the private sector: the Tourist Integral Centre project of Cancun

After three hundred years of Spanish settlement in Mexico, the majority of the Yucatan Peninsula was still not under any type of formal control. As recently as the 1840s, New Yorker and self-proclaimed explorer John Lloyd Stephens and his travelling companion Frederick Catherwood, were able to captivate audiences with descriptions and pictures of the wild frontiers of the Yucatan:

We were amid the wildest scenery we had yet found in Yucatan; and, besides the deep and exciting interest of the ruins [of Tulum] themselves, we had around us what we wanted at all the other places, the magnificence of nature. Clearing away the platform in front, we looked over an immense forest (Stephens 1848: 389).

The reader knows the difficulty we had in reaching this place from the interior. The whole triangular region from Valladolid to the Bay of Ascension on one side, and the port of Yalahao on the other [the region which now covers the north of Quintana Roo State], is not traversed by a single road, and the rancho of Molas is the only settlement along the coast. It is a region entirely unknown; no white man ever enters it (Stephens 1848: 407-8).

Tourism on the Yucatan Peninsula, particularly in the region of Quintana Roo, for 100 years or so after Stephens' visit remained the realm of 'explorer' tourists. As late as 1958, the then 21 year old French ethnologist, explorer and author Michel Peissel, while stranded on the coast of Quintana Roo, was able to walk 300 kilometres down the coast to Belize and discover no less than fourteen unrecorded Maya archaeological sites on his way. His perspective of the Peninsula is epitomised in the title of his 1963 publication: *The Lost World of Quintana Roo: An*

Adventurous Quest for Mayan Ruins on the Untamed Coast of Yucatan. Prior to the 1970s, mainstream tourism in Quintana Roo was largely limited to Cozumel Island, which in the 1960s was home to only two hotels and received visits from passing cruise ships (Isola 1987), while Quintana Roo, particularly the northern half of state, was still very much perceived as an uninhabited and ‘unconquered’ frontier.

In descriptions prior to the tourist boom, Quintana Roo was frequently described as the ‘wild forest’ or ‘isolated humid jungle’, thus constructing the perception of an area as one lacking the ‘necessary’ human factor and with a *need for transformation*. This perspective is neatly typified in the title of a US student’s Masters’ thesis during this period: *Quintana Roo: Mexico’s Empty Quarter* (Edwards 1957). In spite of the groups and communities of Maya living in the area and in spite of the archaeological evidence showing the development of ‘complex’ communities, the constructed perception of Quintana Roo before the 1970s is one of desolation and abandonment. Subsequently, the material actions that followed the imagery surrounding this ‘pristine space’ are ones related with intervention and transformation, necessary to ‘domesticate’ the last frontier. Quintana Roo *was nothing but forest*, with no natural resources or land, and ‘just forest’ needs something else – it ‘needs’ the human element. In this sense, a discourse of devaluation emerged, almost as a justification of the transformation to come:

The isolated tropical forest enclave of Quintana Roo [was] a virtual tropical prison for political exiles under President Porfirio Diaz and a refuge for Maya rebels (Torres 1997: 34).

Quintana Roo has been regarded as a sparsely populated ‘virgin’ region, the settlement and exploitation of which are overdue (Edwards 1986: 120).

When construction began in 1971, the Cancun site was essentially devoid of a local resident population—less than 200 persons. The surrounding countryside was also lightly settled. Still, for the planners this was not an unmitigated liability as it afforded *an opportunity to manipulate a virgin site and control from the beginning* each stage of development (Collins 1979: 356; emphasis added).

Tourism did not arrive in Quintana Roo casually or as a slow incremental process; although geographically the place offered enough ‘beauty’ to be exported, it was not enough. Federal Government policy makers pushed tourism through an open campaign (Clancy 2001) and in 1972 the Mexican Government, in conjunction with the Inter-American Development Bank, ‘created’ Cancun. The Cancun project was a quintessential example of mass-tourism style development popular during the period, with all-inclusive hotels designed specifically for the

geographically close United States tourist (Mowforth and Munt 1998; Torres 2002). In crude economic terms, the Cancun project has been an unbridled success for the Mexican Government, becoming one of the world's leading tourist destinations with millions of visitors every year, by far the lion's share of Mexico's tourist industry.

In the early stages of tourism development on the Peninsula, the role of cenotes and the aquifer was limited to providing potable water and receiving generated waste. This was perhaps most exemplified by the digging of twenty enormous holes to secure a supply of fresh water for the hotel area (Redclift 2005). From the 1990s onward, on the back of Cancun's commercial success, tourism has continued to grow in Quintana Roo, spreading south down the coast, passing the city of Playa del Carmen (then a small fishing village), and reaching most recently the town of Tulum (130km south of Cancun). This southward growth was once again facilitated by the Federal Government:

There was a federal trust here known as FIDEICARIBE that was a trust of the Ministry of Finance. This trust acted as the owner of one hundred and forty-two kilometres of beaches along the Riviera Maya. And not just the beach itself, but also the six hundred meters inland from it. You could say that this trust had in its hands the most important tourist wealth of the country (I14/ March 2009).

With this newer expansion south, while large all-inclusive resorts were (and still are) being built, tourism in Quintana Roo began to follow worldwide trends with a slow move away from fordist (mass) types of tourism to more post-fordist types (Torres 2002). Currently, there is a shift from the exclusives types of 'sun-and-sand' tourism to more niche forms such as nature, cultural and independent forms of tourisms – a slow movement away from beach tourism and towards jungle tourism. However, as Rosaleen Duffy asserts (2002), the ideological content behind such niche forms is also closely related with developmental strategies that impact on numerous actors' livelihoods, ranging from tourist operators to Maya ejido members and cenote managers.

As part of this process, there was also a commodification of Quintana Roo's nature where cenotes and the Maya indigenous culture have been integrated into tourism practices and discourses. The presence of both the ancient and contemporary Maya culture in Yucatan has been highly marketed to reinforce the multiple representations of Cancun as an exotic paradise (Torres, 2002). While cenotes have been marketed not only as natural features to visit, swim and dive in, they have also frequently been promoted as encounters with the Maya underworld. Redclift (2004) has noted how tourists are usually been presented with a sanitised

and unthreatening view of the Maya culture, with less romanticised histories such as the Caste War notably absent from these discourses. Instead, a mythical world of the Maya is presented, offering a spiritual discourse that complements physical activities like swimming or diving. The ethnic label 'Maya', along with environmental labels such as 'eco' and 'sustainable' are therefore subsumed into contemporary tourism discourses purporting to be more culturally and environmentally sensitive. In Quintana Roo, these cultural and ecological tourisms have been readily adapted for the mass market, with day coach trips to the forest and Maya ruins, or through the creation of nature theme parks such as Xcaret, an 'eco-archaeological Disneyland', which Torres (2002: 97) observes in many ways reflects a neo-fordist rather than a post-fordist tourist landscape.

With the economic investment made in an area and with a young (politically speaking) Mexican territory, it was necessary to push for the creation of a 'power elite.' Due to this, the Federal Government targeted tourism as the main economic activity and subsequently a close connection between political elites and tourism developers evolved (Manuel-Navarrete *et al.* 2009a, 2011). Then, the intentionality, resources and capability of transforming a plan into a long term project became real:

Because the new resorts were built from the ground up in lightly populated areas, the tourism bureaucracy in effect became the governing power within the area. [An example of this is that] the first Mayor of Cancun was previously director of FONATUR's [National Trust Fund for Tourism Development] community development office (Clancy 2001: 52-54).

Thus the political sector in possession of the economic resources and having the 'green light' to push tourism as an export commodity, started to expropriate land from the 'roughly 170 people living in the island [of Cancun] and surrounding area, cleaned the land, including some dredging of lagoons, and essentially erected a complete city,' from scratch (Bosselman, 1978). This was shown in the following advertisement disseminated by the Ministry of Tourism:

Puerto Cancun, [...] calls for the building of a wharf with 500 slips for yachts, a golf course, and luxury hotels and condominiums. The plan calls for a series of navigable canals, modelled somewhat like a residential Venice (SECTUR 1992).

Projects like the construction of canals and marinas were a proud product of the developmental plan for Cancun. It is interesting to note that such actions were not placed under scrutiny by environmental non-government organisations, or by the rest of the public sector. History shows us how different discourses, most of them nuanced with developmental tints, have changed through time. The project of developing a wharf for 500 yachts, with

serious environmental implications (i.e. removing karstic floors, changing flows and destroying mangroves), were part of the formal licit activities promoted by the same public sector. Nowadays these activities are regulated by federal acts and their promotion would not, officially, be part of a public document. However, that does not mean that it does not occur anymore. This would support the argument that an important part of the development of tourism in Quintana Roo was not the result of deregulatory processes, but an outcome of rapid contextual change, where capitalism was inserted in sectors 'never' imagined by the public sector, as was the case with the tourism in caves and cenotes.

6.2 The environmental impacts of commodification processes

The environmental impact of tourist development in the region has been substantial (Murray 2007). The population in Quintana Roo increased more than 1,500 percent between 1970 and 2010 (INEGI 2011), and civic planning and governance have struggled to keep pace (Manuel-Navarrete *et al.* 2009b). Numerous studies have documented widespread damage caused by tourism to the coastal coral reef, the beach strip and the inland flora and fauna (*cf.* Mutchler *et al.* 2007; Arrivillaga *et al.* 2004; Juarez 2002; Serio-Silva 2006; Zarate *et al.* 1999). In terms of the aquifer, there are currently around 500 hotels and 60,000 rooms in Cancun and the Riviera Maya, which are estimated to consume 1,000 to 2,000 litres of water, per room, per day. These, along with the 17 golf courses, restaurants, retail businesses, and urban settlements of those working in tourism sector rely almost completely on pumped water from the underground aquifer for potable water supplies.

In February 2010, likely in response to numerous criticisms, the President of Quintana Roo's Association of Golf Clubs declared that the state was seeking to become the first ecologically certified golf destination in the world, and that anybody who thinks of golf courses as something damaging to the environment is generally misinformed (Manuel-Navarrete *et al.* 2011: 255). The same Association has also argued that golf courses act as biological corridors. However, similar to overflowing septic tanks (discussed in Chapter 5), golf courses have major issues in terms of their environmental impact, notably fertilisers leaching into the aquifer. This has meant that golf courses are generally identified as being ill-suited for karstic areas as they generate high levels of pollutants in aquifer systems (Picher *et al.* 2008). This was reflected in a recent study in Quintana Roo, where chlorophenoxy herbicides were detected in aquifer at Puerto Aventuras,³¹ which were identified to have come from the nearby golf course (Metcalf *et al.* 2011). Thus, despite its ecological rhetoric, the Quintana Roo's Association of Golf Clubs

³¹ A gated community located between Tulum and Playa del Carmen.

appears to be falling well short of its lofty objective. Manuel-Navarrete *et al.* (2011: 255) describe this as an 'ecological modernisation double discourse,' whereby hegemonic actors in Quintana Roo incorporate strong environmental stances at the discursive level, which their actions often contradict at the material level.

The amendment to Article 27 of the Constitution in 1992 is a much-cited transition point where the destiny of land management and natural resources in the country changed direction. Following this modification, different bureaucratic apparatuses were developed and many regional offices were equipped to attend to the increasing demand for land-regulation services and land parcel certification. Although the constitutional modification took place and the tourist boom in Quintana Roo was highly promoted through projects and economic incentives, other Federal Acts (such as those relating to National Waters) were not modified. Instead, a multiplicity of offices was created to solve 'urgent' and practical issues like water supply. For example, the local Commission for Water and Sewage (CAPA), was created to supply water to the urban centres and, importantly, to the hotel clusters. In this way, 'unintentionally' the terrain for the development of markets for natural resources was being prepared.

Although recent literature about neoliberalism links privatisation with processes of re-regulation instead of deregulatory ones (Mansfield 2003, 2004; Bakker 2005; Castree 2010a, 2010b, 2011), it is argued here that historically in Quintana Roo the privatisation process occurred so rapidly that it caused the public sector to be caught 'out of place'. In this sense, an intentional deregulatory process had not been conducted by the time a commodification process occurred; due to the already regulatory absence, it was not necessary. Thus the rate at which cenotes and caves were privatised, marketised and commodified was faster than the development of a conscious and intentional deregulatory process.

With the rise of tourism on the Yucatan Peninsula, cenotes have been again used for commercial purposes with linkages to Europe and North America. However, these 'exports' are now markedly different to henequen or chicle – nature is now being consumed *in situ* by tourists and divers (Redclift, 2010). The 'empty space', the underground, is being 'rediscovered' and 'recreated' by tourists and tourism operators. However, there is not a complete discontinuity with the past, with symbolic and romanticised links with the ancient Maya and former explorers providing a thematic background to tourist consumption. John Lloyd Stephens' sentimentalised descriptions of cenotes would not be out of place in a contemporary Quintana Roo tourism discourses:

But first we resolved upon another bath in the cenote. My first impression of the beauty of this fancy bathing-place did not deceive me and the first glance satisfied me that I incurred no risk in introducing to it a stranger. A light cloud of almost imperceptible dust, ascribed to the dripping of the waters of the rainy season, or perhaps made visible by the rays of the midday sun, rested on the surface but underneath were the same crystal fluid and the same clear bottom. Very soon we were in the water, and before we came out, we resolved to postpone our journey till the next day, for the sake of an evening bath (Stephens 1843: 98).

I gasped in excitement when I saw with my own eyes, the 'entrance to the underworld'. The entrance was more or less a camouflaged hole in the ground, like a downward cave, but ultimately led to something miraculous looking. I carefully stepped down the narrow pathway, (about 60 steps or more) to the first cenote. In the mild, damp and echoing surroundings rested a sanctuary of glowing fresh water. When my body met the water, I felt like an angel floating in the mild, refreshing, crystal clear water. I had never experienced anything like it. It was very spiritual, in fact – even if there were dozens of other guests enjoying the same experience too (Albin-Najera 2011).

In cenotes there also exist physical links with the past through the discovery of preserved objects, which offer a focus of interest for many cave divers and researchers while also providing a potentially exciting side show for the visiting tourist. Cenotes in brochures are painted as the perfect commodity to be consumed. So now the question is: who commodifies the cenotes? The following section attempts to answer this.

6.3 The masterminds behind cenotes as commodities

After the big tourism push in the north of Quintana Roo, the 'use' of cenotes for recreational purposes surprisingly did not occur in Cancun. Cancun, as mentioned before, was visited mainly by the 'sun and sand tourists' keen for a Caribbean beach experience. But, during the 1970s and 1980s, to the south of Cancun where initially tourist infrastructure was nearly non-existent and the roads were not suitable for unadventurous visitors, a group of divers established their camps in the 'inhospitable jungle'. Their presence greatly influenced the future development of cenotes as places for tourist activities (see Chapter 7). As will shortly be discussed, the development of cenotes and caves took place outside the mainstream tourist remit because its origins were not of a 'proper' tourist activity; on the contrary, it was the activity conducted by a 'bunch of misfits living in tents' (I59/ July 2009). These more niche exploration activities were geographically located in what now is known as the Riviera Maya, although it is now possible to visit some tourist cenotes in the Cancun area (analysed in depth in Chapter 7).

This section also discusses private land owners who manage their own assets (caves and cenotes); with a view to questioning if caves and cenotes in Quintana Roo are partially or fully

privatised. If we believe that privatisation entails a change of 'ownership' from the public to the private sector (Bakker 2007), then it would be necessary to question if such a definition also applies to more informal processes where a drastic public-private division, like the previous one, is not very clear. For example, there have been cases where no formal opposition towards cenotes' privatisation practices have been shown, even though in technical terms privatisation processes should be subjected to the legal instruments mentioned in the previous chapter. Recalling the definition of cenotes as bodies of water under public-state property, it can be argued that cenotes have been partially privatised. As an ejido member from Jacinto Pat with a cenote argues:

Public cenotes are like the ones located in the Tulum ejido, Car-Wash and Cristal, those ones are public although they charge the entrance. Also Dos Ojos Cenote at the ejido Jacinto Pat is public. They are public because they are located in Communal Lands within the ejido. Private cenotes are those located in private plots of land. If I build a road to get to my cenote, I decide who uses it and who enters my property. If they [the government] say that cenotes are federal zones, it is perfect, they are in their right. But if they want to go to my cenote they need to grab a helicopter and go down exactly there. The road is a private investment and the land is mine (I19/April 2009).

According to this response, both types of cenotes (public and private) are located in private lands, the difference being that for this particular respondent argues that public cenotes are located in communal private land in ejidos, whereas private cenotes are individually owned. This is in spite of the fact that the ejido member formally recognises that all bodies of water are the property of the nation and therefore cannot be fully privatised. Thus it is possible to agree with Nick Blomley's (2007: 177) argument that the theorisation of property has so far failed to acknowledge 'the diverse, contradictory, and sometimes collectivised ways in which property can be put to work,' especially in local contexts. Privatisation and the *enclosing* of caves and cenotes on the Peninsula convey the existence of a wide range of deals, agreements and settlements that are not kept secret from the public sector but are not formally permitted either. As observed in the previous quote, a clear consciousness of 'ejido rights' or private rights over plots of lands influences the current state of natural resources in Quintana Roo. So, too, does the knowledge about the limitations and jurisdictions that the public sector has in controlling and monitoring the activities developed there. As one respondent, from his historical perspective of Quintana Roo as an agrarian lawyer and cave diver, stated:

In 1996 cenotes were like the ruins of Tulum, it was just something to go and see. At that moment, I thought cenotes were just springs where Mayans sacrificed virgins to appease the gods. But back then I had no idea that there were underground rivers that may be a hundred and fifty kilometres long and interconnected at the bottom of the

peninsula. Cenotes' exploitation was not commercial back then. Cenotes' owners, so to speak, or those who were in possession of land with cenotes, did not even remotely perceive them as something from which they could derive an income. After divers arrived and began to explore the cenotes everything changed, even the names. For example, Cenote Ponderosa got its name because it was the American family 'de Rosa' who began to dive in it; later on the cenote came to be known as Pond-de-Rosa (Ponderosa) (I36/ June 2009).

The use of cenotes for tourist purposes did not *just happen*; and it was not born out of a pre-existent demand, but as the result of a slow and mindful process where individuals added new values to the underground systems and started creating a supply. When asking landowners with cenotes in their properties how they discovered their cenotes and how they instigated tourist activities in them, the name Mike Madden, a scuba-diver and explorer, was constantly mentioned. As he describes himself in his website:

Mike Madden is credited with making the first exploration dive in the Nohoch Cave system in Mexico in 1986. For the next 14 years he organized and led teams of divers, exploring and filming the Nohoch system and establishing it as the world's longest underwater cave system [at the time]. Mike was recognized for his work in the caves by his induction into the prestigious New York Explorers Club 1991, the Guinness Book of World Records 1992 -1999 and a finalist in the Rolex Awards for Enterprise in 1996 (Nohoch Productions 2009).

Sometimes Mike Madden is described as a hero-like character that discovered the 'true essence' of cenotes. For others, having a flooded cave whose diving life-line was laid down by Mike Madden is a historical commodity in itself; he is '*the one*' that put a price on cenotes for the first time and showed the ejidos the economic value of these systems. A landowner with a cenote who currently manages her property, tells the story of how Cenote Chac Mool was discovered, explored and finally transformed into a tourist destination. Cenote Chac Mool is located in what used to be national lands and currently is private property. The owner and her family settled in the area in the 1970s and obtained the land titles in 1998, when they presented proof of pacific land occupation (i.e. usucaption). They named the cenote *Chac-Mool*, a Maya word that means red-tiger, due to the many *tigres* (jaguars) that used to live in the area.

Mike Madden came here when there was no road and he told us: 'the cenote is beautiful and it is full of stalactites.' At that time there was no tourism, there was no road, but when he came we took him to the cenote. The cenote is a kilometre away from the entrance; each one of us carried one of his tanks and all his gear. He is a gringo [a person from the US], so he does not carry his own things. Then he began putting the life-line in the cenote and we started building the road from the entrance to the cenote. Back then Mike Madden offered to open the road [from the entrance to the cenote] for us in exchange for him having the exclusivity of the cenote for ten years. He brought a contract stipulating that none of us could use the cenote, and

additionally the contract said that we had to clean the fields. I can't read, so when he showed me the contract, I said: I will not sign it, I will not be cheated, and I am not going to sign anything. And he told me: but it is good for you, sign it. When my daughters and sons-in-law read the contract we all realized that he believed that because we are poor and simple farmers he can come and take advantage of us. After that we [the family] worked for a whole year, with our bare hands, to open the road that takes you to the cenote. Back then it was possible to find cheaper materials to build the road, and we were charging 10 pesos [less than one dollar] per person for the entry. At the beginning not many people came, but six years ago people started coming and now the cenote is famous. This was the first cenote in the roadside and very close to Playa del Carmen, but the real story behind this cenote is daily hard work (I50/ June 2009).

This narrative conveys an approach towards nature that juxtaposes human labour with the perspective that nature is a provider. In this case in particular the owner conquers nature through hard-work and cleverness. Cenote Chac Mool was commodified through human effort and will, respecting nature as always being there, but also seeing nature as something to be worked on in order to make something out of it, thus legitimising the sense of commodification.

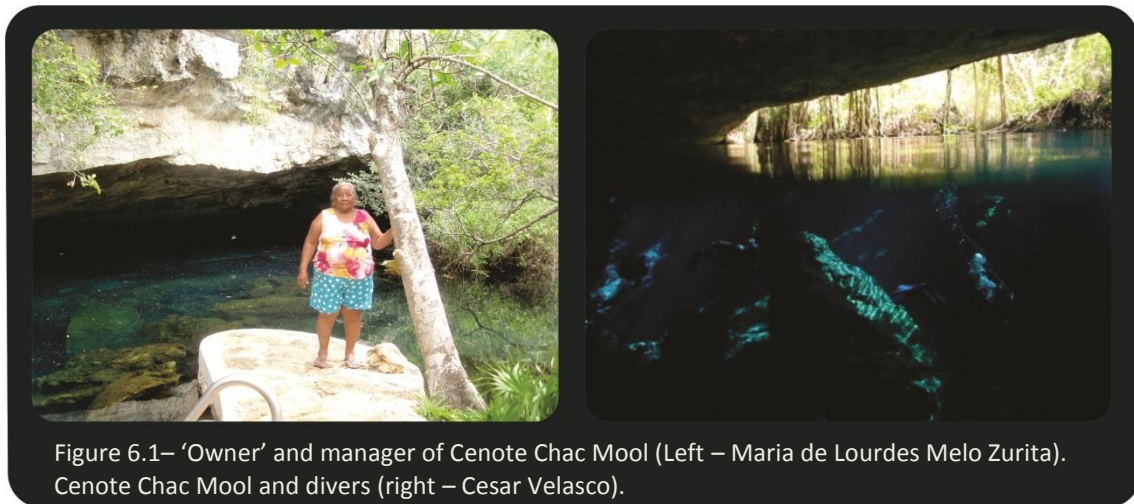


Figure 6.1– ‘Owner’ and manager of Cenote Chac Mool (Left – Maria de Lourdes Melo Zurita). Cenote Chac Mool and divers (right – Cesar Velasco).

Stories about scuba-divers visiting cenotes in the middle of the forest and ‘contracting’ landowners to take them to cenotes’ entrances are common narratives in the area. The use of horses, mules or donkeys to cross the forest with the required scuba-diving gear are also common descriptions of how cenotes became places of interest for different groups. Nowadays, land owners are more familiar with the divers’ vocabulary, and they refer to their gear, technical needs and characteristics of the karstic systems with acquired confidence. Interestingly, some land owners have never swum in their cenotes. Chac Mool’s manager explains that she is scared of swimming in the cenotes, and although she is the proprietor and manager, she believes that cenotes are dangerous places for women; but she also does not know how to swim.

How, then, do owners promote and sell a commodity that they do not get to know and experience like scuba-divers? At the very beginning, it was not the land owners offering the cenotes but the same divers that acted as marketers in promoting cenote consumption. That is why landowners rely on the knowledge produced by explorers who draw maps, take pictures or videos and describe their experiences. Newer generations of owners participate more in swimming, diving and caving experiences. Cenote Dos Ojos is a good example of the impact that scuba-divers have had in the ejidos' livelihoods where, as mentioned in the previous chapter, an important number of ejido members are currently working as snorkelling guides (see Figure 6.2).



Figure 6.2– Jacinto Pat children at the entrance of one of the cenotes back in the 1980s. In 2009 some of them were working as snorkelling guides in cenote Dos Ojos (Ejido Jacinto Pat 2009).

Mike Madden was not interested in buying the land from the land owners. He was primarily interested in organising cave-diving excursions for US citizens and most of his time was spent exploring cenotes that could satisfy the avid curiosity of cave divers, especially to Nohoch Nah Chich Cenote (see Figure 6.3). However, he introduced a concept that the majority of landowners came to know and use: exclusivity. The reason behind such exclusivity rights of access are various and in some cases related with the exploration thrill of seeing never-seen-before spaces. Mike Madden's intentions of exclusivity all of a sudden added an increasing economic value to cenotes. If the cenotes are exclusive, the entrance to them is both selective

and expensive. In that sense, the tours offered by Mike Madden would guarantee not just the accessibility but also the experience of a place that only a few have had the opportunity to visit. Contracts of exclusivity were signed between Mike Madden and other landowners in the area, and the idea is as powerful today as it was 20 years ago. For example, the tourist company Alltournative has exclusivity contracts not only with landowners in different cenotes located in the Cancun-Tulum highway but also with some of the cenotes located inland, in what is commonly described as the Maya Communities of Quintana Roo.



Figure 6.3– Sign found at the entrance of Cenote Nohoch Nah Chich (Maria de Lourdes Melo Zurita 2009).

At the time that the interviews for this research were conducted, Alltournative had signed contracts with at least six different landowners, including ejido members and individual private owners in ejido lands. Although each of the contracts had its specificities, the exclusivity clause in all stated that only Alltournative could take people into the cenote to practice any of the programmed recreational activities. In that sense, some of the cenotes located in communal lands within the ejido depend on the affluent tourists that Alltournative brings, varying during peak and low seasons. Alltournative also has exclusivity contracts in cenotes where future development plans are in sight. Cenote Yaaxmul is an example of the speculation process that

exclusivity contracts have created in the area. Donato Castro, owner of Rancho Yaaxmul and ejido member, narrates how Alltournative came to offer a deal:

No, I did not have the opportunity to exploit my cenotes as I wanted, because in my land there are very large and very beautiful systems. I did not have the chance because the big companies that are dedicated full-time to this started making offers. They came to tell me: 'sign a contract with me, you have the cenotes and I have the capital.' The first one to come was Mayan Adventure, they told me: 'we are going to build zip-lines [flying foxes].' They told me all their plans and left. But a week later Alltournative came and although I told them that I was committed to Mayan Adventure we signed a contract. They told me: 'did they give you money? Have you signed a contract? Here is the money and here is the contract, read it.' It was a 20 year contract but I told them that we would need to revise it every 5 years and if we are happy with the terms and conditions we would renew it. I also told them that if the contract was not fulfilled I would keep the built infrastructure, like the platforms. We signed the contract and since then I receive a monthly payment of seventy-seven thousand pesos [seven thousand dollars approximately], with increases each year, according to the contract revisions every five years (I19/ March2009).

Since 2002, the Yaaxmul Cenote landowner has had an exclusivity contract with Alltournative, even though the cenote is not open for tours and has not been visited by any tourists in a long time. The owner's explanation for this situation is that 'Alltournative is saving [the cenote] for the right moment' (I19/ March 2009). The speculation of cenote development is something that started happening with the 'cenote boom' that Alltournative created and has been fostering in the area since 2000, although this has recently declined somewhat due to the swine flu outbreak, the global financial crisis and the Mexican 'drug war.' A cenote, like the one in Rancho Yaaxmul, located close to the Tulum ruins, close to the main road, and with a perfect setting for adventure tourism sounded too good to be taken over by 'other' companies and thus Alltournative started a sort of monopoly over the 'perfect for tourism cenotes.' This demonstrates how renting the cenote and waiting for the opportune moment to exploit them did not stop the commodification of cenotes; rather it created a sort of 'natural resource' speculation.

Exclusivity contracts or exclusivity rights were the innovation that Mike Madden donated to the caves and cenotes community in Quintana Roo; compared with other investors, he was interested in selling the experience and not in buying the land. In contrast, Miguel Quintana Pali, current owner of the Xcaret and Xplor eco-parks arrived to the area for the first time in 1986 and his experience of swimming in the then 'unmodified' Xcaret cenote 'changed his life':

Miguel Quintana Pali arrived in Xcaret in 1986 by mere chance. He was simply accompanying a friend to a business meeting with Roman Rivera Torres³² in [Akumal] [...] while in route to the meeting the heat, curiosity and their guide's suggestion encouraged the two to stop and take a welcome swim in the Xcaret cenote. The impact the [cenote] made on Miguel Quintana that day can still be detected in his face and in his voice every time he strolls along, explaining the ingenious labyrinth of today's Xcaret park (Rodriguez 2000: 29).

After that life-changing experience, Miguel Quintana Pali, was interested in the land and asked his friend Roman Rivera Torres about it, who was then co-owner of the plot of land where the cenote Xcaret was located. The latter answered him: 'if you like it so much, I'll give you a piece of land so you can build your dream-house there' (Rodriguez 2000: 28).

Quintana Pali recounts in an interview: '[it] was the generosity of the new generation of entrepreneurs who would forge the future identity of Quintana Roo' (Rodriguez 2000: 29). The land with the cenote remained in hands of Roman Rivera Torres and his associates, the Constance brothers, who did not alter it because 'the group had yet to discover the true vocation of the land' (Rodriguez 2000: 30). After several visits and offers to the RICO group, Quintana Pali obtained the land and started developing it. Xcaret is now promoted as a 'glorious' story of an urban character, Miguel Quintana Pali, who *discovered* a cenote and with his 'bare hands transformed' a wild landscape in what today is one of the most visited theme parks in Mexico. In contrast to this romanticised narrative, the perspectives of the 'original' owners have disappeared from the oral history and they simply became the people who sold the land. As one ex-member of the RICO group recalled:

That [where cenote Xcaret is located] was really a place of pasture for livestock. Don Juan Delgado used to take cattle to the cenote. He entered into partnership with the Constance brothers and later on Quintana Pali came to the picture. The ones started everything there were the Constance brothers. They brought machinery that we had never seen before here in Quintana Roo, they knocked down trees and opened wells. But Quintana Pali was never here at the beginning. (I21/ March 2009)

So it is not only cenotes that have been transformed and materially produced, but the stories surrounding them have been accommodated and commodified too, sometimes to satisfy a 'shallow' curiosity from tourists, but other times to legitimise certain practices. With his 'bare hands' (Rodriguez 2000: 31), Quintana Pali started cleaning what seemed to be a lagoon and, soon enough, he decided to bring in the machinery to dredge the lagoon:

³² Roman Rivera Torres is the founder of RICO group, in a joint partnership with Oscar and Marcos Constance. They were pioneer entrepreneurs in the seventies and the Riviera Maya tourist development.

It was still 1986 and as soon as the machinery arrived on the land, the first protests appeared in the newspapers, with opposition especially expressed by the National Institute of Anthropology and History (INAH), always a firm defender of Mexico's heritage. The situation required immediate negotiation, and the newly created company Promotora Xcaret [...] signed an agreement with the Institute in which it agreed to finance an archaeological project on his land [...] all the expenses were covered by Xcaret and, to this day, the company pays the Institute a monthly fee justified by the presence of pyramids in the park and certain specialized studies of the zone (Rodríguez 2000: 31).

Similar agreements between INAH and the private sector regarding cenotes and caves have occurred in other parts in Quintana Roo. The company Calizas Industriales del Carmen (CALICA) which quarries white stone found in the area, known locally as *sascab*, discovered archaeological evidence in its mining zone. CALICA has often been criticised for having a closed approach towards external inquiries about the environmental impacts of their activities in the area, such as using explosive materials to remove the limestone and opening 'new' entrances to the aquifer. However, when it came to dealing with INAH they decided, as with Quintana Pali, to sign an agreement.

Archaeologists have registered three ceremonial spaces associated with caves and cenotes. Some of the evidence is located inside miniature temples and carved walls, even bones of animals that might have been part of offerings. This is the result of seventeen years of salvage archaeological work, research and conservation carried out in the land belonging to the company Calizas Industriales del Carmen (CALICA), located in the Municipality of Solidaridad. CALICA and INAH signed a contract in 1986 in an effort to safeguard the cultural heritage (Informador Periodico 2010).

During the fieldwork period, it became clear that these were the only types of formal agreements found in the area between the private and the public sector. As discussed in previous sections, INAH may be the one and only government body that influences, impacts and/or restricts landowners' actions in caves and cenotes. Landowners verbally manifest an open fear towards INAH's actions. Whereas a sanction-fee imposed by the Federal Environmental Attorney's office (PROFEPA) for environmental damage or pollution can be paid off, INAH could enforce major penalties for the destruction, misplacement or robbery of archaeological evidence. Perhaps that is why two of the major capital investors in the area decided to have business-like relations with INAH, where funding is provided to perform archaeological research while the economic activities meant to be realised in the area are not affected. Furthermore, the 'good image' sent to the general public by these entrepreneurs as being interested in conserving and protecting the cultural heritage of the area helps to legitimise their activities. This is an example of the same historical approaches that the public sector has had through time. While Mexico was recognised as a country with multiple ancient civilisations whose archaeological evidence must be protected, it was not until recently that

environmental discourses started being included in formal approaches. In this sense, it is not possible to offer financial compensation for 'missing' or 'lost' pieces of archaeological evidence; however, comparatively the state could request monetary compensation from business people, entrepreneurs or any person for chopping down 10 hectares of mangroves and removing karstic floors. In a worst case scenario, PROFEPA can close down the site where 'illegal' activities have been developed; however, as has been seen in the area, such measures are usually temporary.

There is only one known case in Quintana Roo (and perhaps Mexico) where a member of the private sector has been jailed for illegal activities towards the environment. This was Nancy de Rosa, a self-proclaimed 'environmental activist.' It resulted from her protests against the destruction of mangroves and other environmental damaging activities conducted by the Hotel Bahia Principe development, the largest hotel complex in Quintana Roo (also her neighbour) (SAVE 2008). Hotel Bahia Principe, in a seemingly cynical act of retaliation, promoted an indictment against Nancy de Rosa for mangrove destruction. She was subsequently deemed an 'offender to the Constitutional Act' and is currently facing trial (Noticaribe, 2008). Conversely, Hotel Bahia Principe has never been charged or investigated for its alleged mangrove destruction.

Thus the private sector, with its multiple variants, was created and promoted by a national policy favouring investments in the Quintana Roo State. Multiple processes have taken place since its inception, most of the time at a speed that has been difficult to follow and control. For a great number of the participants in this research, the change had occurred with such velocity that it was difficult for them to describe situations in a chronological order. However events, like the instigation of the highway, act as temporal markers of how and when 'development' arrived to the area. From the gathered narratives and discourses, it seems like there are causal explanations for the current status of caves and cenotes in the area, although the transformation of cenotes as part of this movement was not foreseen by the majority. Changes in the area occurred rapidly; as one business consultant in the area and hobby cave-diver notes:

The other day I met one of the owners of Cenote Nohoch and he is now a small entrepreneur. I saw him on the way to Playa del Carmen driving his new van, not a super expensive imported one, but a nice late-model pickup truck. He was formally dressed, wearing long trousers, and here in the region that is a symbol of formality. He had two mobile-phones, and it reminded me a bit of myself when I first came here [twenty years ago]. As if the roles were reversed, now I am wearing shorts and flip-flops that cost eleven pesos [less than one US dollar] in the market. So I thought

how life turns around right? He was looking at his watch constantly while we were talking. He looked busy and told me several times: You do not have to pay entrance to the cenote, go and see it, give us your opinion about how we are managing the business. He is already a small entrepreneur seeking professional advice and while talking I just kept thinking how fast the area and the people have changed (136/ June 2009).

Two main processes can be identified in the changing perceptions of the underground forest frontier. The first is the presence of what this study describes as 'the explorers' in the area (Chapter 7). Their practices and discoveries, literally, brought the underground forest frontier to light. This is not to deny previous knowledges of this frontier but, rather, to acknowledge that the explorers provided new means and ways to explore it so that it could be commodified. Through this process they also took advantage of previous knowledges, as we will see in the next chapter.

Second, the success shown by Xcaret and later on by Xel-Ha, as tourist venues utilising cenotes, became examples of possible enterprises that could be developed in the area, as one of the new enterprise models.

From family enterprises to big corporate projects, the underground forest frontier has been subjected to various processes of commodification. Although in each case different levels of difficulties had been experienced, this study mainly discusses the cenotes that have been 'successfully' commodified, in different ways. This then evokes the methodological question of which cenotes and caves have *not* been subjected to this process, and why.

6.4 The social construction of property and material enclosure: accommodating nature for human consumption

While it is considered almost luck to find a 'good' cenote on your parcel of land, this is not an uncommon occurrence in Quintana Roo. The main repartitions of land occurred at the time when cenotes were not seen as strategic investments and objects of tourist consumption, and therefore were not a major factor for land selection. Location, on the other hand, has been a major factor in deciding the value of land, in terms of proximity to the main roads and/or to the main urban developments. With the growing tendency in the area to ascribe new values to objects of property or natural resources, cenotes and their physical shapes became valuable features. As a result, facts like being the landowner where the longest flooded cave in the world is located have caught the attention of investors.

Private sector investments in the area vary according to the economic capital available, the limitations imposed by the terrain and the type of project to be developed. Xplor Cave and Cenotes Park is the quintessential example of a cave-cenote project in terms not only of the monetary investment made in the area but also in terms of the conceptualisation behind the material enclosure. As Miguel Quintana Pali, the CEO of Xcaret and Xplor recounts:

I already knew that the terrain was full of dry and wet caves, with lots of formations, stalactites and stalagmites. There are cenotes, there are flows, and it is part of the same network of rivers that flows from inland towards the ocean under the Peninsula. It is an important part of the underground river that runs under Xcaret. I have known this land for many years, but six years ago I made a trip to Costa Rica and I really liked the zip-lines [flying-foxes] and enjoyed what they were doing there. So I decided to do something similar in Quintana Roo. The only problem is that we do not have the magnificent rain-forest. But I do know what we have here, and we have our cenotes and caves. So I decided to insert the concept of zip lines entering caves and cenotes, not using trees because our trees are small, but building towers. This is the interesting part of this new park: 80% is underground. We passed the last five years opening entrances to the caves, making the rivers flow and connecting them, fixing the floors to equal heights so the people could walk safely. In terms of illumination we use low voltage lighting, three watts or five watts light bulbs. We have more than 20,000 bulbs installed in the caves. It has been a tough project. (158 Sep 2009, 66-100)

The homologation of nature, as Castree (2000) defines it, took place when trying to copy a project where nature was transformed in one place, to another, even though the environmental characteristic of the other place were not similar. Quintana Pali argues that such a project could not have been developed in any other part of the world. This is not just due to the rich cave and cenote landscapes found in Quintana Roo, as similar 'surfaces' and undergrounds can be found in other parts of the world. Rather, it is due to two other reasons:

First, labour is cheaper in Mexico compared to other parts of the world. Second and although here in Xplor we take care of our employees, it would have been impossible to get a permit to build a project like this one, where employees spend 8 hours underwater, anywhere else. We implemented the safest measures to protect our employees, but it is a very difficult job and only in a Latin-American country would this have been possible. (158/ September 2009).

The intricacies of Quintana Roo's landscape act more as challenges than hurdles to Miguel Quintana Pali, whose interest in finding nature's vocation is a life style (Rodriquez 2000). As he said when interviewed for this research: 'if I do not find a cenote I make one' (158/ September 2009), which indicates a perspective in which it is possible to fully manufacture nature. The concept of *Arquitectura al Llegue* (the spontaneous architect), a notion also forged by him, reflects this approach towards nature:

With this kind of architecture there is no master plan, there are no drawn-plans until the construction is completed. No one can honestly tell what is going to happen, not even the person in charge. It is necessary to follow the natural paths, to detect a possible collapse and then force it, to study the fresh-water flows to invent new ones or to expand the existent ones (Rodriquez 2000: 41).

Therefore homologation is possible, here in spite of nature, factors like the proper technology and labour become indispensable to the projects' success.

It would be interesting to study the compatibilities between an Environmental Impact Assessment's guidelines and the previous discourse. What Quintana Pali found in Mexico was a direct incentive to develop his projects – lax labour regulations and a lenient environmental apparatus. This suggests that more than nature was necessary for this project. Contrasting with other processes of commodification (i.e. Cenote Chac Mool), where hard work is the flag that owners and managers use to justify the success of their enterprise, with Xplor and Xcaret nature's commodification occurred thanks to lax social institutions. And although an Environmental Impact Assessment was presented to the relevant authorities (SEMARNAT) under the name of Xcaret, none was presented specifically for Xplor.³³ Therefore the project was not exposed to public opinion process or a process of consultation before the construction started.

When an Environmental Impact Assessment is presented to SEMARNAT, it has to be made accessible to the general public, by law (see LGEEPA art 28- 35). The EIA is then posted on SEMARNAT's webpage and any individual or organisation has the right to petition a public consultation for the project within twenty working days of the EIA's release. These public consultations take the form of events organised jointly by SEMARNAT and the people responsible for the project. The participants in the public consultation, including members of civil society, are 'free' to make observations regarding mainly environmental issues, but also any other social concerns they feel should be brought to light. The comments obtained during the meetings are incorporated into the EIA as a result of consultation process, where individuals of different backgrounds can democratically take part and influence the decisions made by the federal agencies. If a public consultation is not requested, the discussion about the feasibility and impacts of the project takes place privately within the experts' committee selected by SEMARNAT. Having assessed the EIA, the final resolution may be to approve, conditionally approve or deny the permits to execute the project.

³³ This may be due to the fact that legally Xplor is part of Xcaret eco-park and so the construction of Xplor appears as a modification of the existent park. In such cases an annex is sent to the former EIA.

What is interesting to note here is the fact that most of the time when public consultations and/or expert committees integrate comments in favour or against the viability of a certain project, they are mainly focused on minor technicalities of ecological impacts, rather than proving any outright opposition to the project due to its overall environmental impacts. As the following respondent from Río Secreto indicated:

Before opening Río Secreto we presented an EIA. SEMARNAT came to make an inspection but they did not even go inside the cave. They were just worried that the buildings would not be higher than the stipulated by law and things like that. [The cave] does not fall within their interests because there is no regulation, so they would not know what to do if they go inside. (I1, Mar 2009, 224-230)

Attendance at three different public consultations was part of the fieldwork process. Each one of them proposing physically modify cenotes and underground flows. During the meetings, discussions revolved around the use of accurate concepts to define fauna and flora, the territorial limits of federal zones, water flows and organic residues found in the aquifer, among others. However, no discussion took place about the overall regulation of the natural systems or even that of the workers' labour conditions. This is despite the fact that Mexican environmental regulation stipulates the social aspects of any EIA as one of the main areas to be covered by a project's developer. Nevertheless, while EIAs are regarded as administrative procedures and compulsory fulfilments by law, the social impacts of a project with strong effects on the environment might be masked under the label 'we are creating more employment' (I58/ September 2009). The EIA allows transformation where it should not be allowed, given not only its obvious impacts to the environment but also because the labour utilised to develop the projects, like the one mentioned above, is subjected to 'difficult' and dangerous working conditions.

Xplor, the cenote and cave park that is part of Xcaret is a US\$25 million project that hires over 200 employees, has the capacity to host 1,200 people, and covers an area of 49 hectares (Orea 2010: 46). In terms of monetary investment, hired personnel and land extension, Xplor is the biggest cave and cenote project in the area. Some of the participants in this research (I26 May-2009) argued that intense environmental exploitation and 'successful' projects, like Xcaret and Xplor, are in fact the best way to commodify and enclose natural resources, meaning that it is better to have one (or three) big projects whose intense transformation and modification would satisfy existing demand, instead of having hundreds of small projects whose minor impacts would exponentially multiply the 'opening of enclosures' and further environmental degradation (i.e. death by a thousand cuts). But what has been observed in the area is a

process where the 'big projects' are replicated at a smaller-scale several times – a phenomenon that has crossed political boundaries, and is also being experienced in neighbouring Yucatan State. This perspective of nature's commodification and enclosure arguably requires not only an active regulatory apparatus, but also a strategy where the public and private sectors work together as separate entities. The panorama in Quintana Roo tends not just to deregulate the private sector but, as mentioned earlier, sometimes a very thin line between both sectors is drawn. As the following account shows:

Marciano Toledo [known as Chano] was *regidor*³⁴ of the environment in the triennium 2002 - 2005, and just before leaving his post in the Municipality council, he began an informal building project around a cenote [located in his land] without the necessary environmental permits. When this was discovered, the media gave the place the symbolic name of 'Chanolandia'. The council closed Chanolandia down. According to a copy of the council's minutes, closing Chanolandia down was due to the construction of a perimeter fence around a cenote, the construction of two palapas, chopping down two hectares of jungle and dredging 600 meters of sediments in order to connect two cenotes (*Noticaribe* 2009).



Figure 6.4– Cenote Chanolandia, Playa del Carmen (Paul Munro 2009).

³⁴ Member of the environmental council in the Municipality of Solidaridad, where Playa del Carmen is located.

Cenote Chanolandia is not ‘yet’ open for tourism but it is not legally closed either. The building of pyramids imitating the ones found in the Yucatan Peninsula, along with some monumental statues representing Egyptian pharaohs, was still happening at the time of the research. As can be observed, in spite of the different positionalities of the actors in relation to caves and cenotes, the overriding tendency is to accommodate nature for consumption. Cases like this one are not unusual in the geographies of Quintana Roo, where public servants are also ‘entrepreneurs’ and/or ejido members, and their social roles are favoured by their positionalities.

Even when the ‘natural’ and pristine beauty of the cenotes is a constant topic of conversation, cenote managers argue that such beauty needs to be adapted for human consumption. The common argument behind modification actions is that in order to provide visitors with a safe and comfortable environment it is necessary to build staircases, ramps, platforms, illuminate the cenotes, add some background music and dredge the bottom of the cenotes. The need for such transformations has created a skilled-labour supply market where labour specialising in hydrology, lighting installations, and establishing safe routes for tourists, among other skills, is also for sale. Consultancies are offered too in order to develop tourist projects. Experts in dredging are hired by landowners to clean caves located in their lands and make them accessible for tourism,³⁵ while explorers are invited to map and film the underground.



Figure 6.5– Industrial pump brought to drag sediments from a cave located in Tulum (left). Tepalcates, bones and fossils extracted through the dredging process (right – anonymous photographer).

³⁵ This dredging takes a few hours, in contrast to the dredging of the Sacred Cenote in the 1960s, which took five months (see Chapter 7).

In this sense, a set of physical transformations take place depending on each cenote's characteristics, morphology and the proposed project. The differences between Chanolandia and Xplor might be more related with the outcomes than with the intentionality. It is possible to assume that in terms of economic capital Chanolandia, unlike Xplor, does not have a US\$25 million investment. Nevertheless dredging, building palapas and deforesting the forest still seem to be common practices there. Following the argument that intense exploitation should be allowed in a limited number of cases as a measure to control over-exploitation, it can be further argued that this might have the perverse effect of a proliferation of multiple projects trying to copy-cat the publicly recognised 'successful' ones. As mentioned before, Xcaret acted as a source of inspiration for land-owners whose cenotes had been explored and mapped by divers. The impacts of narratives like the one Quintana Pali has recreated about his discovery and transformation of the cenotes have been relevant in the area because they create an epic feeling of transforming things from scratch with bare hands or, as is often the case, with industrial pumps.

Physical Interventions in the underground forest frontier have different motifs; it is not rare to see four-wheel vehicles driving through the forest and visiting a safe but 'wild' enough cenote. It is also common to visit some cenotes arranged in a more 'family' vein, designed to receive families mainly during the weekends, which can enjoy a grass lawn, hammocks, and a pool-like cenote accessible and safe for swimming. One of the cenotes with such intentionality is the Aktun-Chen Cenote. The landowner has shown an interest in integrating statues that resemble mythical Maya entities, locating them inside the caves. He has also built a stone-stage underground where some Maya ceremonies are performed, as well as some concerts.

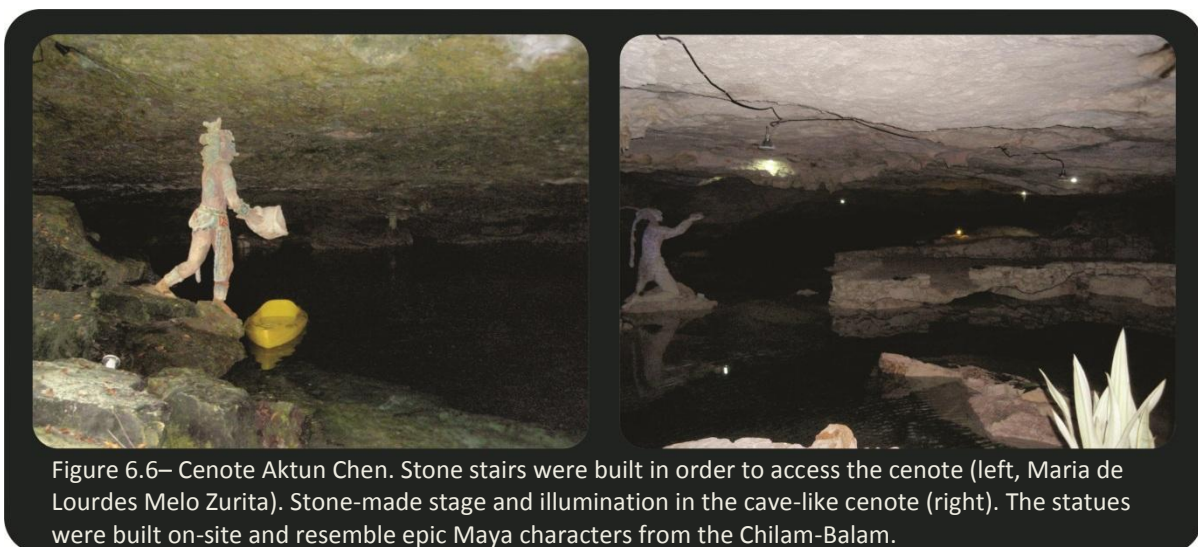


Figure 6.6– Cenote Aktun Chen. Stone stairs were built in order to access the cenote (left, Maria de Lourdes Melo Zurita). Stone-made stage and illumination in the cave-like cenote (right). The statues were built on-site and resemble epic Maya characters from the Chilam-Balam.

These links with a pre-Hispanic Maya presence can be seen in cenotes and caves opened for tourism. Tour guides usually start talking about the *Xibalbá* and the meaning of the underground for the Maya. In this sense, it is common to find that the above-ground archaeological evidence is utilised as a highlight of the tour, but in cases where such evidence is absent a physical re-creation of this past is manufactured. Contemporary pyramids imitating the 'original' ones (Chanolandia), statues of mythical characters (Aktun Chen, Chanolandia), families dressed up in traditional Maya costumes and cooking for visitors (Pac Chen), or even the creation of a Maya community next to a cenote (Punta Venado), are some of the practices observed during fieldwork. There is also a new-age fusion practice where *temazcales* are built inside caves or next to cenotes to perform cleaning-ceremonies. These rites usually take place during full-moon days and target a specific kind of public, whose consumption practices are more related with the mysticism of the place and the possible connections with a 'more' spiritual world.

The physical transformation of the place that also integrates Maya-like symbols associated with cenotes is a particularly interesting process. While interviewing landowners and tourist operators about practices, beliefs and values from the past and current Maya culture practices related with caves and cenotes, most of them claimed that everything has disappeared in Quintana Roo. Nevertheless, when asked directly if they perform any religious ceremony in their caves and cenotes, a range of responses emerged. For example:

When we ended up building the road and finished cleaning the cenote we held a ceremony. We closed everything for a week and no one could go in or out. The ceremony was done at night, so at 5pm we started making the wooden altar, with flowers and candles. The ceremony takes place where there is no contact with women, only men can participate. When all the men have arrived, they can no longer go out. We delimited a square perimeter where men should remain and pray. In every corner of the square we put a cup filled with Balche [a special brew prepared by Mayan priests with virgin water from a sacred cenote], we left candles burning and we build a wooden cross that will be placed in one of the corners of the perimeter. The cross will stay there for years until we have another ceremony. During the ceremony it is forbidden to touch the water of the cenote. After the ceremony, a promise to make another ceremony was made to the cenote. The promise should be fulfilled otherwise the Aluxes [cave and cenote guardians] could get angry and affect the affluence brought by visitors (150/ June 2009).

During fieldwork, it was interesting to note that the number of performed offering-ceremonies increased around May 2009 with the swine-flu crisis. During this period, the number of visitors in the area decreased dramatically, affecting the livelihoods of landowners and communities

dependent on tourism. Some communities decided to perform ceremonies as offerings to appease the caves' guardians and increase the number of visitors. The landowners of a cenote located in the Punta Laguna area explained that the cenote gods were displeased by 'bad' behaviour³⁶ and a ceremony was offered in order to ask forgiveness for any offense. Explanations of major phenomena occurring beyond the immediate community, such as the outbreak of swine flu, are connected with a present cosmology sometimes hidden behind the tourist maelstrom.

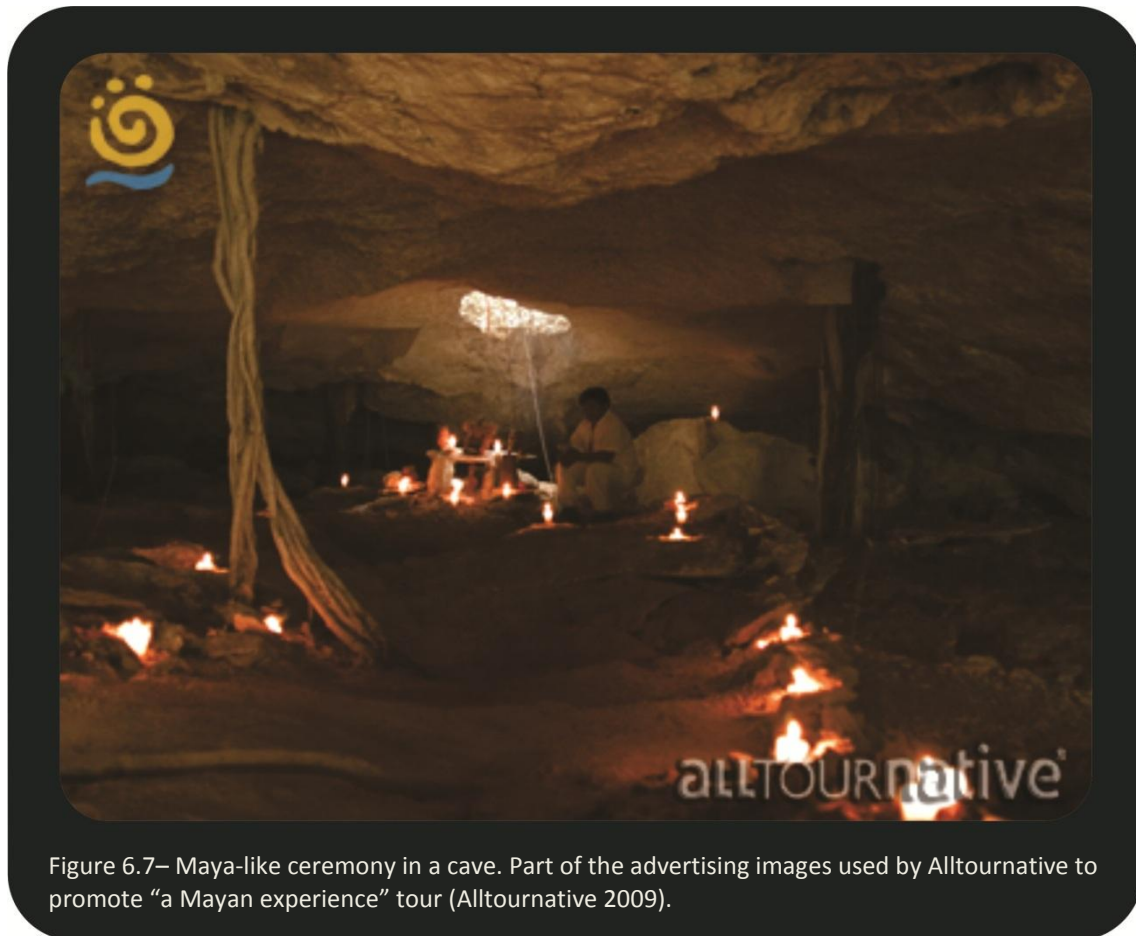


Figure 6.7– Maya-like ceremony in a cave. Part of the advertising images used by Alltournative to promote “a Mayan experience” tour (Alltournative 2009).

In parallel to these beliefs, tourist operators promote 'different' and more contemporary ceremonies. Such ceremonies are performed at the entrances of caves and cenotes and offered to visitors as part of a pre-paid tour. The ceremonies are conducted by shamans dressed in white speaking in *La Maya* [the Maya language] and burning incense. The term shaman or *chaman* is commonly used to describe an elderly member of the community who performs these rituals for tourists. In the communities, these shamans are different from the

³⁶ A couple was found having sexual intercourse in the cenote.

traditional Maya priests or *Hmens*, who are the contacts between the mythical guardians of the cenotes and the human world. This commodification of beliefs is an intrinsic part of the commodification of nature in Quintana Roo, where again natural beauty seems to be insufficient and so an addition is made to nature’s physical transformation – the mystical dimension.

As demonstrated, commodifying nature in the cenotes of Quintana Roo is often accompanied by the commodification of culture. Finding a cenote is just the beginning of a transformation process where nature is physically modified and culture is reproduced. Like any other market, competition is an essential part of the commodification process and the most original ideas of how to manage these spaces, what to show, what to add or what to transform are just some of the decisions that need to be taken in order to enclose nature in this context.

Maya Experience	Socio-cultural value
+	
The longest cave	Exploration value
+	
Unique organisms	Scientific value
+	
The oldest skeleton found in Latin America	Paleontological/ Archaeological value
+	
Morphology	Aesthetic value
=	
A good cenote for tourist exploitation	Economic value

Table 6.1 – A good cenote for tourist exploitation

Even though the private sector recognises that cenotes are not and will not be the main reason for tourism in Quintana Roo (I1, I36, I29), there are an increasing number of visitors to the Peninsula interested in cenotes as an addition to their trip. Cenote and cave tourism was not formally the result of a nation-state project to promote them (although currently it is, as shown in Figure 0.1 at the start of this thesis); therefore a set of informal actions and discourses were created in order to satisfy the demand.

These discourses first targeted scuba-divers with notions of ‘unexplored’ and pristine places that had a ‘need’ for discovery (see Chapter 7). As the demand kept growing and some cenotes landowners transformed cenotes for more ‘earthly’ or ordinary activities, a more general public was targeted. As these changes were taking place, approaches to tourism were

changing too, and instead of having people dressed in Maya costumes and selling hand-made crafts inside hotels, tourist promoters started showing the 'outside environment' to visitors. And so an informal eco-cultural tourism was created, where pristine environments (although conveniently modified), 'original' Mayas and controlled environments were offered. Reaffirming a contemporary Maya presence in Quintana Roo might have not been one of the original intentions of the major tourist project for the region, but tourist promoters clearly saw a value in it and somewhat insidiously induced members of Maya communities to embrace their culture (Lanfant 1995) and remain 'pure'.

The private tourist sector has played a major role in constructing an imagery of caves and cenotes at the international level. As an outcome of such constructions, the National Tourism Agency in Mexico is currently creating a marketing campaign that favours an already existent market (See Figures 0.1 and 1.1). The highlight in this process is that, as a result of a highly planned Quintana Roo tourism project, multiple unplanned outcomes are occurring, such as the cenotes boom, and the public sector is having to play catch-up. The double movement described by Polanyi (1957) and utilised by others (Heynen *et al.* 2007) to explain the commodification of nature proves to be useful in contexts of planned reregulation processes; however, when it is related with something that is already unregulated, a regulatory process seem to be more an outcome than an original part of the plan.

The privatisation of caves and cenotes in Quintana Roo has favoured a decontextualisation of nature and society, where the natural-resource-commodity is consumed in isolation from its context. Tourist excursions have the power to travel through urban spaces, the forest and the ocean without revealing the intrinsic dynamics and diversity of contexts. The private sector's objective in this sense is to mobilise people to a context of beauty and manufactured reality; that is, to a space that is socially and ecologically controlled. For example, when tourists from cruise ships visit cenotes in Playa del Carmen, the level of abstraction of reality gets to the point where tourists 'do not know that they are in the Peninsula and they believe they are on an island. That is why it is necessary to show them the map of Mexico' (I2/ February 2009). In this sense, the commodification of nature has been so successful that no involvement with the surrounding society is necessary.

6.5 The division between land owners and private investors in commodifying nature

The previous sections have discussed how various actors and actions, through time, have promoted the development of cenote and cave markets. The perspectives shown by tourist investors towards natural resources elucidate a certain practicality when it comes to the feasibility of different projects. The involvement of tourist companies with cenotes' landowners in the state has become well known. Today, tourist companies receive offers from landowners interested in developing their assets. Ten years ago the process was different and tourist companies, like Alltournative, used to go out in the field in search of caves and cenotes suitable for tourism. As one of Alltournative's founders commented:

I used to work in the communities as a facilitator; I was the link between the company and the communities. If I knew about a beautiful cenote, I had to go, evaluate it and decide if it has a tourist potential. Although, I have to say that just a very few cenotes have it (11/March 2009).

This starting point might have set the tendency for years to come, where cenotes' landowners pursue 'external' knowledge and investment in order to offer their properties as part of tourist activities. Over time, it is not just the strategy that has changed but also the cost – the prices to rent a cenote have increased. Where Mike Madden used to offer exclusivity contracts in exchange for five dollars per visitor, current payments range up to seven thousand dollars per month sealed with five-year exclusivity contract (e.g. Alltournative and Cenote Yaaxmul, Rio Secreto and Yok Ha Hanil System, Explora Caribe Tours and Chaac Tun). Compared with previous epochs, the need to develop a settlement near a cenote for water consumption has changed. The increased ability to drill for wells and the supply of piped water by government agencies has diminished the necessity of having a cenote as a source of fresh water, yet their increasing value as a tourism resource has caused new forms of cenote appropriation. This is clearly reflected in the Peninsula's real estate prices, particularly in Quintana Roo State, where a property is worth considerably more if it contains a cenote, with at least one company specialising in cenote sales:

This beautiful cenote lays untouched and has been rediscovered by our cenote staff scouts. With beautiful scenery and surroundings, this clear water cenote has the *best qualities* any cenote could offer: *perfect* height, perimeter and depth. Tropical paradisiac [sic] vegetation and above all, *easy access* to the water line... 'Paraiso Fernando' is now for sale! (Own a Cenote 2009)

Although some cenotes are for sale, some tourist operators claimed that renting the land was more affordable than buying the land as 'prices in the area have increased too much in the last years' (11/ March 2009). On the other hand, some landowners claimed that 'it is better renting

them than selling them' (I3/ March 2009, I19/ April 2009). If landowners hold the land and the cenotes, why do they need a third participant to develop their natural resources? As Alltournative's CEO explains when referring to their experience with the communities they have exclusivity contracts with:

They own nature but we know what to do with it, we know how to make a product from it but in exchange we need them to remain pure, we need them to conserve nature, and we need them to embrace the project. They own nature but they did not know what to do with it. That is when we start working with the communities and telling them what to do with their resources (I29/ August 2009).

Whether or not cenote tourism found in Quintana Roo can be labelled as community-managed tourism can certainly be contested; from the empirical information gained during this research, the answer would be no. Private investors perceive the management of natural resources by their proprietors (landowners) as absent of any experience and expertise. Thus the geography of tourism in Quintana Roo displays the intention to make 'them' part of a tourist project, rather than a tendency to empower landowners through the project development. Even cenotes that are managed by ejido landowners (Cenote Dos Ojos, Cenote Esmeralda, Cenote Profundo, Cenote Chaac Mol) manifest a strong dependency on corporate tourism.

The tourism project in Quintana Roo can thus be seen to have produced a strong private sector that is further bolstered by the absence of projects that empower 'locals' in the management and control of natural resources, even if part of the same promoted tourist activities. In this sense, enclosing nature around cenotes is not just a strategy to enable a handful of people to consume a 'well-protected' and 'conserved' environment, but the result of a government strategy that does not favour a community based management of natural resources and promoted a domesticated nature.

For their part, private sector perceptions about cenote management, in the absence of economic investment or enclosure, are of abandonment and misuse: 'If no one owns it, it becomes a public toilet' (I2/ March 2009). Some private investors also gave examples during this research of where cenotes had been used as dumps or sewerage by landowners: 'public cenotes are abandoned but if the owners get an interest in tourism then they would clean it and keep it that way' (I27/ May 2009). However, the bigger picture where populated urban areas inject sewerage into the system is overlooked, as discussed in Chapter 5. As the director and founder of the NGO Flora, Fauna y Cultura expressed:

It is part of the cenotes' culture to consider them as deposits. When we were building the park [La Ceiba Park] we found two cenotes that must be interconnected underground. We built a wall around them. We have little kids running around and their safety is first, so we had to block the cenotes to prevent any accident. One day that we were supervising the construction, we walked around the cenote and it occurred to me to take a look inside. It was horrifying. The workers had built a platform that functioned as a toilet for them. Imagine, a park that tries to send a message of environmental care and protection, and the workers were using the cenote as bathroom, even though the first thing we built in this park was a bathroom with a shower... That is the cenote culture in the area – cenotes are holes for waste. Sometimes I feel that cenotes are not sacred at all and that they have been seen as sewers (156 Jul-2009, 594-620).

Private sector perspectives about landowners and locals' management of natural resources are of destruction, compared with their intentionality of developing a project where nature is the main attraction and therefore an object of conservation or transformation. From this perspective, it can be argued that nature needs to be claimed and appropriated in order to protect its value and that this therefore justifies and legitimises the production of enclosures of nature. Among this sector, there seems to be a consensus about the ecological advantages of opening a cenote for tourism. As such, ideas of privatisation, enclosure and exclusion are viewed as conservation strategies to protect nature. Such a perspective is shared among tourist operators and supported somehow by the unregulated status of cenotes that has left to tourist operators and private investors the creation of an informal, but shared, set of norms to protect the systems. Nancy Lee Peluso (2007: 9) argues that a common trait of enclosures is that they inevitably involve some kind of 'public-private or state-capital alliance', although in this case such commonality is a 'non-intromission agreement'. As Otto von Bertrab, CEO of Rio Secreto elaborated:

We [tourist operators] have no relation with the public sector. There is no legislation to begin with, there is no clarity about cenotes, and we all know that all the bodies of water are federal. But in the case of the cenotes they are actually too small to be considered federal zones and most of them are located within private properties, therefore there is no regulation. If you want to be legal in the use of cenotes for tourism, you have to use laws that are made for rivers but there are no rivers in the Peninsula. If you obtain a permit, it will grant you the use of the waters and ten meters of shore-land on each side, but there are not ten meters on each side because it is underground. Maybe you would have to use the outside, but you cannot get to the outside anyway because it is private property. Cenotes are simply there, and all the available legislation is generic and not specific to this region. In the 15 years that cenotes have been used as tourist attractions, a set of informal rules have been established by tourist operators. Those rules might have begun with Xel-Ha and Xcaret who were the first ones to say that sunscreen or repellents could damage the aquifer system. They created a discourse for all persons operating cenotes. But this is more the guild of tour operators. The problem is that we do not even know if it is effective or not. We can tell to all our visitors that sunscreen damages the environment, but then it turns out that across the road passes there is a sewer drain that goes straight into my

cenote. So sometimes it sounds absurd, but that's what we do, these are pretty much the unwritten rules of management of the cenotes: try not to affect the water through the use of chemicals and protect the speleothems, no touching (March 2009).

When asking the private sector what kind of actions would be necessary for regulation to protect the network of underground rivers, a common response related to the management of above-the-ground activities, usually the management of sewerage in the state are mentioned. 'Other' kinds of activities like opening tunnels, pumping sediments out, collapsing walls, extracting materials (saascab) or chopping down vegetation associated with cenote ecosystems were not mentioned in the interviews as activities (which are mainly facilitated by private investors) that were damaging the aquifer system. Relating this with the public sector view in Chapter five, it is possible to observe that if any attempts have been made to regulate these systems, these are more likely to target landowners rather than private investors. Different perspectives of nature are at stake and, so far, public sector strategies to regulate caves and cenotes have not targeted the vast variety of actors participating in these systems. Thus, if the production of nature is to be formalised, different groups need to be considered in the panorama.

6.6 Conclusions

Cenotes as the focus of natural resource protection and regulation at the national level allows landowners and private investors to perform a wide range of activities. The government perception indicated that the relevance of water as the problem to be addressed by the formal authorities does not relate with the use (for tourist activities among others) of caves and cenotes. This detachment from the entrances, holes, orifices, channels, passages or any other definitions of caves and cenotes, means that the latter are not at risk of being related in any way with the main environmental discourse developed at national level. The discourses and materialities among the private sector are then homogenised in terms of a neoliberal perspective where the markets control and regulate the uses as well as the physical shapes and appearance of cenotes. In this case, the 'virgin' 'wild' nature that cenotes and caves provide is standardised and homogenised under the discourse as one of the 'last frontiers' at the same time that the physicality is transformed and standardised, becoming a new frontier, albeit an artificial one.

The cenotes and caves of the Maya groups in the Peninsula have changed meanings over time and new values have been added. From the *Xibalbá* to sources of water and currently sources of income, cenotes have been layered with new meanings. A new perspective of these places

as something to be studied and discovered has been added. The intricacies of these land and waterscapes captured the attention and the curiosity of new eyes. Through the exploitation of new resources, cenotes and caves have been renewed as places in need of investment. When the Peninsula was promoted as the new place to experience nature, again, the underground was re-signified.

Discursively there is a sense of knowledge of the complex karstic system that characterises the Peninsula. In practice, such knowledge is used, on the one hand, as a marketing tactic to make the underground cunning and exciting; but, on the other hand, this knowledge is something to defeat and conquer. It is not just that Paradise has been exported but, in order to achieve that, the landscape has been transformed. In the case of the underground forest as a manufactured frontier, nature has been transformed for consumption. In the next chapter, the origins of these discourses of 'unexplored', 'never-seen-before landscapes' and 'discovery experiences' will be discussed from the perspectives of the 'explorers' and their participation in the commodification of caves and cenotes in Quintana Roo.

Chapter Seven

The Explorers' Gaze

This chapter investigates how cenotes have captured the attention of one group of actors more than that of any of the other participants in this research: explorers. Historical chronicles have described early interests in caves and cenotes as driven by the aesthetic value of the underground forest frontier. However, as the story developed, 'more than beauty' was found, and the thrill for exploration, the conquering of space, and finally, the commodification of natural resources has now become prominent. Exploration and other concepts associated with it, such as discovery and conquest, have been discussed with a colonialist gaze. This is in part due to the fact that they tend to deny or undermine a pre-existing human presence, culture and institutions. As will be seen, contemporary explorers of the underground in Quintana Roo seek to find pristine places, as well as to gain prestige and recognition associated with such findings.

Recognising the Maya knowledge of the area and the 'exploration' processes involved in the establishment of pre-Hispanic, Colonial and post-Colonial Maya settlements is important and necessary. Nevertheless, this section mainly focuses on the kind of exploration that started in the Peninsula from the 1970s onwards. This is a chapter that discusses 'outsider' explorers, meaning migrants to Quintana Roo from different parts of Mexico and other parts of the world. This sampling may be the result of a methodological snow-balling process that forced this research to be focused mainly on contemporary scuba-divers and speleologists, but it is also such because the number of Quintana Roo 'locals' or 'natives' whose identity can be linked to an explorer one is limited. Therefore, the participants discussed in this chapter are mainly those who defined themselves as explorers and who described the practices they partake in as exploration.

Nowadays, being a explorer is a trade, which consists not, as one might think, in discovering hitherto unknown facts after years of study, but in covering a great many miles and assembling lantern-slides or motion pictures, preferably in colour, so as to fill a hall with an audience for several days in succession (Levi-Strauss 1992: 17-8).

As Levi-Strauss observes, exploration has become an act of presenting evidence and of exposing what has been seen and experienced, for leisure, competition or scientific purposes. More often than not, explorers in Quintana Roo mentioned that 'we', i.e. non-explorers,

'cannot understand what we do not know and what we have not seen' (140 Jul-2009), and that in order to gain such understanding it is necessary to explore. The idea of 'understanding nature' through touching, seeing or just by the simple act of being there, is an interesting one. We transform, produce and consume nature in multiple ways but the exploration process produces a narrated nature, a story about nature that will be secondary, consumed, decontextualised and with its own outcomes. The latter includes more explorers arriving to the Peninsula, a new dive-shop opening, new diving devices invented to aid in longer exploration trips, and so forth. In this sense, as Castree (2001) notes, natures (cenotes) are not materially abducted from their context but they still 'travel' in terms of how they are used, and it is in their travelling that they are consumed. Thus, this chapter will argue that one of the main characteristics of exploration is the dissemination process, from word of mouth to publications in peer-reviewed journals. Exploration depends on rumour, on the being told.

Exploration, as will be shown, is one of the triggers of jungle-tourism development in Quintana Roo and one of the types of nature consumption that can currently be witnessed along the coast. The group of pioneer explorers in the area produced a kind of nature, through their pictures and stories, whose outcomes for the underground forest frontier are remarkable. Pioneer exploration and scientific expeditions are two concepts that, over the next pages, to an extent merge into one: exploration. In the field it is not easy to distinguish a scientist from an explorer, even if they would like to be differentiated. As it will be seen, scientists (including the one writing this thesis), public servants, developers and investors in tourism have relied on the explorer's knowledge to perform their different actions. This is because explorers know the people, the sites and the underground: 'scientists have followed behind the efforts of the explorers' (Meacham 2004: 16). Explorations, discoveries and their experiences in this chapter will be analysed as processes that socially construct nature. The outcomes of such processes will also be discussed while acknowledging that members of this 'group' are political actors who, although formally have not been designated to perform a specific role, have become recognised as an essential part of the geography of Quintana Roo.

Considering the relevance of the landscape and the role of nature in capturing the imagination, interest and capital investment of many explorers through time, this chapter will be organised in a way that allows a chronological understanding of exploration in the area. This will start with a much debated and argued definition of what a cenote is and how explorers describe them, followed by historical development of exploration, and finally a discussion of explorers'

contemporary links and roles in the management of the underground systems in Quintana Roo will be developed.

7.1 What do cenotes mean to explorers?

A constant argument throughout this thesis is that there have been multiple definitions, descriptions and narratives developed to reflect and grasp the intricacies of the Yucatan Peninsula's complex underground forest frontier. At the public level, a legal definition does not exist. Such vagueness has invited different agencies to regulate what they think cenotes are, or the part of the system they believe necessary to manage according to their functions. At the natural scientific level, definitions are more related to geophysical, chemical or biological processes (see chapter one). Natural scientists do not seem to be at conflict about the more basic definition of cenotes as karst windows.

For their part, explorers seem to practice exploration without the need for a formal or unique definition. Nevertheless, classifying, describing and narrating the systems is a common practice among this group and their experiences of these systems have influenced a shared imaginary of the underground, almost like a marketing campaign. The range of explorers' descriptions starts with the very formal and technical, and extends to ones that use unusual referents, as the following illustrates:

What the hell is a cenote, anyway? Someone invariably asks. Cenotes (say no'tays) are fresh water wells scattered throughout the Yucatan Peninsula of Mexico like holes made by a shotgun from space. The openings to them may be anywhere from a few feet to a few hundred feet in diameter. From the surface a cenote may appear to be merely a lovely pond in the middle of the jungle. Natives and tourists alike often stop to escape the tropical heat by bathing or swimming in them. What is beneath the surface in each cenote is a mystery. Some dynamite diving awaits those who have the curiosity and sense of adventure to check them out (Chapman and Calkins 1995: 12).

The founder of Quintana Roo Speleological Survey (QRSS),³⁷ and a very well renowned explorer in the area, James Coke, offers a tongue-in-cheek definition:

Or better... cenotes are any watery entrance that is circular and has limestone, and that you have to pay 150 pesos [US\$15] to get into, an all-inclusive cenote. I like that definition! (James Coke, June 2009).

In contrast, Carmen Rojas, an underwater cave archaeologist and explorer, provides a rather different definition:

³⁷ The QRSS, founded in 1990 by James Coke, supports the safe exploration, survey and cartography of the underwater caves of Quintana Roo (Coke 2001: 95).

Cenotes are the physical geography of mythical spaces. The Maya organised or believed that the universe was divided in three levels, the above-the-earth world, the terrestrial world and the underworld. The underworld is formed by several worlds and one of those is the world of the dead, inhabited by the gods of Xibalbá. Xibalbá is the underworld where the dead arrive after spending time in several sacred geographies. Cenotes are the gateways to the underworld, the entrance to a mythical world so important for the Maya cosmology; it is the origin of life and death (I10/ March 2009).

If we consider that speech is the graspable part of human cosmologies, then the above definitions of cenotes elicit the types of understanding that the actors' contact with these systems have socially constructed. Exploration has multiple outcomes including maps (discussed below), photographs, and scientific descriptions of geological processes. In order to explain such outcomes in any context, a definition of cenotes to start with is always required, because invariably someone will ask, 'what the hell is a cenote?' The condition of exploration in caves and cenotes defies most of the human, physical and social, basic functions: breathing underwater, timeless space, total darkness, no natural orientation, floating, and no talking (efficiently). It is possible to say that such conditions help in the construction of narratives, sometimes with a romantic tone, that seem to be extracted from a science fiction novel, while other times less physical descriptions are provided and intangible beliefs and cultural values are described. It may be there where the explorers' attachment to cenotes comes from.

Following the previous chapters' organisation, a history of caves and cenote exploration will be developed, keeping in mind the vast range of actors and backgrounds that the group at hand, explorers, consists of. In Chapter 4, the commodification of cenote environs was explored in depth; Chapter 5 (Cenotes: The Public View) provided a historical context of ejido creation and relevant laws in relation to cenotes; while the start of Chapter 6 (Cenotes: Private View) examined the rapid development of tourism and its implications for cenote management in Quintana Roo. Likewise, the next section of this chapter provides a historical context of the exploration of cenotes, with a particular focus on the discourses and practices surrounding the need to explore and understanding the unknown. Although at first glance this seems to be a history of individuals, it is necessary to keep in mind that from the earliest to the latest expedition, exploration is an incremental process and relies on pre-existing information; therefore it is almost always the work of a team.

7.2 The History of Cave and Cenote Exploration

But why search caves? Why go underground? Why leave the daylight and all the beauty and wonder of the ruins to delve in damp, dark holes, where at most we proposed to find a few broken pieces of pottery, a few fragments of bone or chips of flint upon which the visitor at a museum might scarcely bestow a glance? (Mercer 1897: 354)

Henry Mercer posed the above question in his article 'Cave Hunting in Yucatan', which was presented at a lecture in 1896 at the Massachusetts Institute of Technology (MIT). For Mercer, the answer was clear. People searched caves in the name of science and discovery. Mercer himself was specifically interested in archaeology (also see Mercer [1896] 2005):

We were going to test the antiquity of the man [*sic*] that built the wonderful ruins, and gauge his [*sic*] original state of culture, not by the ruins themselves, but by the traces of his [*sic*] presence left by him [*sic*] in caves; and we were the more confident of success from the fact that the caves, abundant as they were in the region, had never before been searched. We were the first upon the field, the first to attempt to translate their hidden contents (Mercer 1897: 354-5).

Mercer certainly was not the first foreign explorer to enter the Yucatan Peninsula's caves. As discussed earlier, John Lloyd Stephens (1841, 1842, 1843, 1848) and his travelling companion Frederick Catherwood were perhaps the initial self-described explorers to visit (and write about) different caves across the Peninsula. However, with Mercer's approach to exploration there was a qualitative change, with a more conscientious effort to develop a greater understanding of the caves and especially what was in them. For Stephens and Catherwood, caves and cenotes were interesting features of a diverse Peninsula landscape. For Mercer, the Peninsula's caves were the main focus.

Along with Mercer, numerous other researchers developed 'professional' and 'semi-professional' scientific interests in the Yucatan Peninsula's cenotes and caves from the end of the 19th century. Angelo Heilprin, from the United States, was notably one of the earliest natural science researchers in the region, conducting a geological research expedition in the Yucatan in 1891 that focused on the biological and physical aspects of the Peninsula's aquifer system. He wrote about the cenotes briefly, noting the interesting relationship between cenote water and sea level rises (Heilprin 1891).³⁸ Numerous other international researchers, mainly from the United States, visited the Peninsula, making studies of cenotes and the broader physical environment (Casares 1906; Cole 1907; Huntington 1912). Leon Cole wrote an in-depth description dedicated to cenotes, and suppositions about the extent of the underground rivers:

In 1900 a domestic duck fell into a well (which opens into a subterranean cavern) at Izamal, and the following day was taken out of a well some one-fourth mile to the north. Izamal is probably situated over a great subterranean river; a line of important towns can be picked out which mark its course from the southern hills to the Gulf (Cole 1910: 333).

³⁸ The first few pages of Heilprin's 'Geological Researches in Yucatan' article are dedicated to discussing in detail the challenges and experiences on of conducting scientific exploration in the challenging environment of the Yucatan Peninsula.

A protagonist in this cenote history is the famous Sacred Cenote (*Cenote Sagrado*) located in the Maya ruins of Chichen Itza. It is the focus of many early and contemporary explorers' and scientists' interest. While most studies during the early period of exploration were restricted to the Peninsula's surface, Desire Charnay, an eccentric French explorer, and Edward Thompson the local US consul at Merida, attempted to penetrate the depths of the Sacred Cenote. As early as 1883, Charnay endeavoured to dredge the cenote for artefacts using a contraption he called the Toselli Sounder. However, he ultimately failed in his task due to irregularities in the cenote bed (Charnay [1882] 1992, 1888; also see Folan 1974). Thompson, like Mercer, had an early interest in the Maya use of caves (see Thompson 1897), yet he later became obsessed with the Sacred Cenote (Thompson 1932). Thompson purchased the Hacienda Chichen in 1894, which included the Sacred Cenote and the famous Chichen Itza ruins. Some twenty years after Charney's attempts, Thompson managed to retrieve a variety of Maya artefacts by dredging the Sacred Cenote. Then, inspired by this early success, Thompson turned to diving in the 'sacred well' and, in 1909 along with a hired diver, who is known simply as 'the Greek diver' or 'Nicholas' in all accounts, explored the dark depths of the Sacred Cenote. Thompson thus became the first person to conduct a deep dive into a cenote, recounting this experience some years later:

During the first ten feet of descent, the light rays changed from yellow to green and then to a purplish black. After that I was in utter darkness. Sharp pains shot through my ears, because of the increasing air pressure. When I gulped and opened the air valves in my helmet a sound like 'pht! pht!' came from each ear and then the pain ceased. Several times this process had to be repeated before I stood on the bottom. I noted another curious sensation on my way down. I felt as if I were rapidly losing weight until, as I stood on the flat end of a big stone column that had fallen from the old ruined shrine above, I seemed to have almost no weight at all. I fancied that I was more like a bubble than a man clogged by heavy weights. But I felt as well a strange thrill when I realized that I was the only living being who had ever reached this place alive and expected to leave it again still living. Then the Greek diver came down beside me and we shook hands (Thompson 1932: 281-2).

Conditions like the one experienced above made the event memorable. It was necessary to rely on other senses as vision was secondary; diving in a cenote for the first time needed a backup expertise and the development of an embodied skill. The experience transcended the moment of diving, impacting on Thompson on both a physical and emotional level:

As a veteran of a long campaign in the forest and jungles of Middle America, I bear certain honourable scars. I am slightly deaf because of ear-drums injured while I was diving in the Sacred-well of Chichen Itza to prove that this venerable water pit was once used for human sacrifice (Thompson 1932: 4).

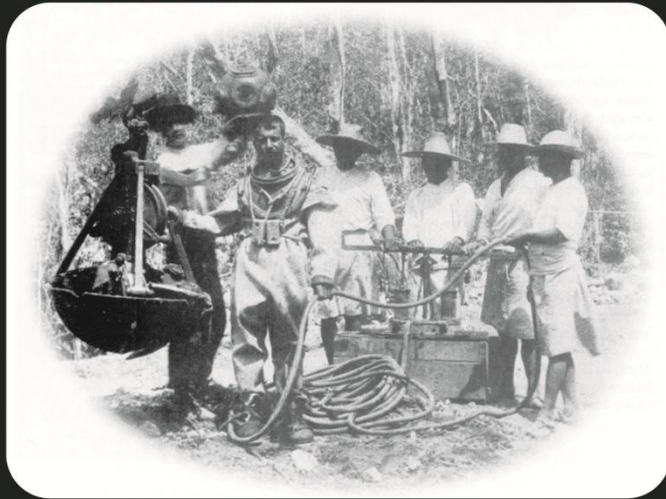
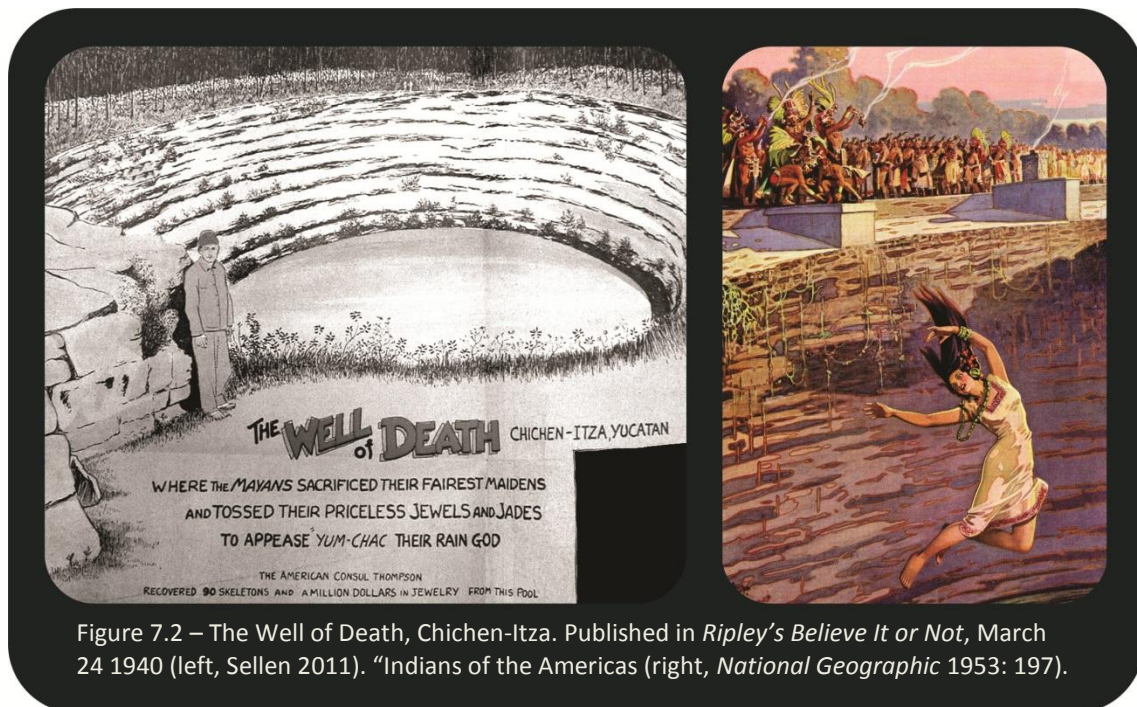


Figure 7.1– 1911 Photograph of Thompson with his Maya guide (right, Sellen 2001). 1909 Photograph in his diving great at the Sacred Cenote (left).

The dives were relatively successful and Thompson was able to retrieve a number of artefacts that he later ‘donated’ to the Peabody Museum in Massachusetts (Mediz 1956). His discoveries would subsequently help in the construction of the greater mystique surrounding the Sacred Cenote (see Figures 7.1). The material evidence extracted showed that offerings including a type of human sacrifice took place at the cenote, developing one of the most famous stories involving cenotes and the Maya world, that of the sacrificed virgins (see Figure 7.2). After Thompson’s confirmation of the early explorers’ narratives of human sacrifice and offerings to the cenotes, in combination with the physical conquest of the ‘well of death’s’ abyss, the Peninsula’s underground became a place to be explored, with multiple expeditions and field trips to the area organised by different institutions, mainly from the United States.

Between 1929 and 1960, the United States’ Carnegie Institute developed a dominant presence on the Yucatan, conducting research on Maya ruins as well as the natural environment. A number of publications produced by the Institute were dedicated to, or expressed some interest about cenotes. The most comprehensive one was a 1936 collaborative publication, titled *The Cenotes of Yucatan: A Zoological and Hydrographic Survey*, which was referred to relatively extensively in Chapter 1 of this thesis (Pearse *et al.* 1936). Notably, during this period, the involvement of Mexican scientists or explorers in the study of cenotes was minimal and it was not until the 1950s that the Mexican National Institute of Anthropology and History (INAH) started getting involved in the archaeological exploration of cenotes. This began with dives into the Sacred Cenote at Chichen Itza in 1953, then later in 1960 with dives in the

cenote at the Maya site of Dzibilchaltun (just north of Merida) (de Anda 2003), along with a handful of other cenotes across the Peninsula (Rojas *et al* 2008).



The 1953 dive in Chichen Itza was considered a failure, and it was not until the early 1960s that one of the ‘most important underwater explorations of these times took place’ (Bush 1964: 153). It was in 1961-2 when INAH, Pablo Bush Romero (founder of Akumal and president of CEDAM³⁹) and *National Geographic* joined efforts to complete the dream of many explorers, and extract whatever Thompson had left at the bottom of the Sacred Cenote (Bush, 1964). As William Folan notes:

Underwater excavations, by their nature, are fascinating occurrences and among the most fascinating of such have been the three major excavations of the Cenote Sagrado of Chichen Itza (Folan 1974: 283).

The exploration of the Sacred Cenote in 1961-2 was conducted with the aid of an innovative piece of technology called the airlift:

The airlift [was] composed of a compressor, a floating platform surrounded by wire network, an eight-inch suction tube, and the corresponding hoisting machines and cable necessary for operation. The compressor injects air through the hose forming a vacuum effect, drawing up to the platform whatever it encounters: water, mud, rocks or jewels. Water and mud are filtered by the wire network, leaving in sight the recovered objects mixed with stones and other rubble (Bush 1964: 165).

³⁹ Club de Exploración y Deportes Acuáticos [Explorations and Watersports Club]



Figure 7.3 – Aerial View of the Sacred Cenote. The barge in the centre of the Cenote was built and utilized during the 1961-2 excavation. Photo by Bats Littlehales (Folan 1974).

The installation of the airlift took almost a month, while the operation of extracting materials and objects from the Sacred Cenote lasted for four. A diver working underwater was in charge of operating the vacuum's hose and putting it in place so the machine could suck up the materials. After four months of what Pablo Bush described as a 'dangerous work', INAH stopped the operation due to possible damage caused to the archaeological material and their stratigraphic context, putting at risk their further study and analysis (Bush 1964). A second excavation expedition was later organised in 1967-8, under the supervision of INAH and also in collaboration with Pablo Bush (Piña 1970). In addition to the airlift, this expedition utilised two diesel pumps in an effort to drain the Sacred Cenote of its water. Attempts to drain the cenote proved futile, but the expedition did succeed in retrieving more Maya artefacts (Folan 1974).

The combination of the chronicles of the above-ground explorations and the final conquest of the underground with the archaeological expeditions of the Sacred Cenote, created a sense of discovery that remains vivid on the Peninsula today. The group of explorers that this chapter will now focus on is a more recent one.

7.3 Contemporary explorers of the underground forest frontier

This recent group of explorers is one that instigated a 'strange' activity in the 1970s and that in the last few decades has evolved into one of the more common livelihoods in Quintana Roo: scuba diving in flooded caves. Somehow, the scientific interest of the early years shifted to one of exploration and of conquering the space, and the initial adventurous scientists who reconnoitred the Peninsula were overtaken by the explorers. One contemporary explorer recounts those early beginnings:

During the late 1970s, one of the first divers coming to explore the caves in Quintana Roo was Bill Stone, a famous diver that came with the US Deep Caving Team to visit the underground caves here. You know, at that time if you asked any taxi driver about a cenote they would take you to Car Wash Cenote, because that is where taxi drivers washed their cars for free. So, Bill Stone went to Car Wash Cenote. He dove in for twelve minutes came out and said 'there is no cave in here', which in fact we now know is not true, according to my records Car Wash has close to 1,500 meters of cave and 1,300 hundred meters of surveyed underwater passages (I59/ June2009).

The divers along the Peninsula, particularly during the 1980s and 1990s, represented a small, interconnected community, which for the most part focused on discovering new cenotes and cave passages, and mapping the extent of the underground. As a paper published in the late 1980s shows:

In the last few years a whole new area of cave exploration has opened in Mexico's newest state, Quintana Roo. This is the systematic study of underwater caves by properly trained and equipped explorers. Quintana Roo [...] has had relatively few speleological studies due to past remoteness from civilization. Only in the last decade have modern roads and towns been built, largely as a result of growing tourism (Coke 1987: 59).

During this early period, the cave diving community predominantly lived in tents in the Xcacel area, funding their exploits by working as scuba diving guides for tourists wanting to visit the Mesoamerican reef. Cave diving in the underground forest frontier was a 'new' unspoilt location for adventure. As a result some cenotes became regular places to visit by this initially small community, an almost rookie group of explorers. For some time, the cenotes surrounding the Akumal area became convenient destinations for explorers and tourist-cave divers. Later on, some of these venues became must-visit destinations for cave and cavern divers around the world. As the explorer participant cited above went on to say:

The first cenotes that we used to explore were Aktun-Ha, Cenote Naharon and the Temple of Doom (Mike Madden named that one in honour to Indiana Jones, although it later changed to what we thought was the original name, *Cenote Esqueleto*). Those three cenotes were the main ones. We used to have free access to them because they were in ejido land. We had a really good relationship with the ejido because we were giving them drawn maps. We went to the casa ejidal and gave

a presentation to them. This was just for their records, and they appreciated it, although they were quite suspicious of our activities, as were many other people. They kept thinking that we had found jewellery and gold (I59/ June 2009).

Two simultaneous processes were taking place. First, this group of divers was exploring cenotes for the thrill of adventure and the experience of the underground (as shortly discussed). At the same time, explorers were conducting exploration to find 'new' places to bring people to. Producing this knowledge of the area in effect was also paving the way for more and more visitors to come to Quintana Roo for the purpose of visiting cenotes.

The cave diving community's size increase rapidly over the next three decades and different groups of divers emerged researching, mapping and getting involved in the tourist exploitation of caves and cenotes. This occurred in parallel to the expansion of tourism in Quintana Roo; as one diver noted, 'from 1997 to now the Riviera Maya has changed 1000%' (I54/ July 2009). Proof of this is that as recently as the late 1980s, Cenote Dos Ojos was described as 'one of the more remote caves explored, travelling on the road to Dos Ojos can be as exciting as the dive' (Coke 1987: 62). Impressively, Dos Ojos is nowadays one of the most famous cenotes on the Peninsula, daily receiving masses of visiting snorklers, cavern and cave divers. It 'starred' in the 2001 IMAX film *Journey into Amazing Caves*, the BBC's *Planet Earth* Series, and the 2005 Hollywood film *The Cave*. Almost ironically, what was once a 'remote cave' in the 1980s is, less than thirty years later, an international celebrity cenote, almost as famous as the Sacred Cenote in Chichen Itza.

Some of these early explorers did reveal and experience a new frontier, a frontier that was not just the underground and its cave passages, but also a social frontier. In the 1980s, Quintana Roo had only recently been declared a federal entity, and the image of the 'noble savage' was still vivid in the mind of many. Explorers and their 'eccentricities' opened a path for newcomers to arrive to Quintana Roo, as visitors and more permanent migrants settled in the area. Explorers established contact with landowners, acquired land and settled down in the 'new frontier', as one respondent narrates:

If you look at the explorers of cenotes and the explorers of caves in this area, we have around 25 years of history. Twenty-five years are a drop in the bucket when it comes to the history of Mexico. Twenty-five years that people, *extranjeros* [foreigners] have been exploring. We haven't had a whole lot of time to do it. We are on the 3rd or 4th generation of explorers. I only know one person from the first generation who is still exploring: myself. There are very few from the second generation, most of them would work if they have to but they have retired. The third generation –Bill Phillips, Fred Davos, Dani Riordan – they are still doing exploration. They have been around ten years already. The fourth generation is coming up. Looking at the different generations is a good way to analyse the different relationships between landowners and cave divers, but also the relationships within

the explorers group. These people from the second and third generations shared much more in the way of culture and a shared background between them. The explorers had made themselves almost a functional culture within. There is an explorers' history within the Peninsula's history (159/ June 2009).

The outcomes of exploration in nature are visible and tangible in Quintana Roo. Twenty five years of exploration have been accompanied by 25 years of landscape and waterscape transformation. Nostalgic narratives of a very recent past are evidence of this, and contradictory feelings of loss and joy emerge because now more people can experience the underground forest frontier, although sometimes at nature's expense. Some explorers dedicated their explorations to developing tourist enterprises with landowners. Other explorers preferred to establish diving shops and run cave-diving courses. Some used what they had seen and experienced in the underground forest frontier to create their own NGOs to help promote the conservation of these places, while a handful have undertaken exploration with the main purpose of documenting what has been explored. All of them have played a role in what is known about the underground forest frontier. Their current presence in Quintana Roo is constantly re-defining the social constructions and possible management of these systems.

7.4 Aquanauts in Maya-land: The Star Trek syndrome

I settled on the Yucatan to live with the Maya people in 1968 and I am now an old-timer here, having worked with a number of magazines, photographers, expeditions, ethno-anthropologists and now, to my great joy, with the cave-diving community. I took Jim Coke to Naranhal [*sic* – Naharon] and showed Mike Madden Cenote Mayan Blue. I watched Woody Jasper worm his way down the very small siphon side of Naranhal, which helped make the connection of these two great systems. I was there when Parker Turner discovered the Fire Pit and felt the excitement. I have from the beginning been drawn to the fresh water pools known as cenotes (Hiler 1987: 2).

The names of the most recognised explorers among explorers on Quintana Roo are listed in the above paragraph. Hilario Hiler, an old-timer in the Peninsula, as he introduces himself, was a key participant in trying to reconstruct the history of exploration in Quintana Roo. While being interviewed, he noted: 'But all of us explorers, the aquanauts in Maya-land, suffer from the Star Trek syndrome' (Hiler July 2009). What makes explorers stay in Quintana Roo, explore and keep doing it for years, according to Hiler, is the 'Star Trek syndrome' – once you have swum, snorkelled or dived in a cenote, you have been infected by the thrill and curiosity.

Exploration involves a sense of discovery, of being very close to the unknown and at the same time of not knowing how far or close one is from finding that 'something'. It also involves a sense of anticipation related to the Star Trek Syndrome. The thrill of entering the cenotes and the uncertainty of what would happen, the adrenaline of being where no-one else has been

before – these are all significant elements, and explorers often ask themselves ‘why do we explore cenotes? We can’t stay away it’s entrancing, we will probably stop diving cenotes when the sun no longer shines’ (Chapman and Calkins 1995: 4). In most cases it involves a systematic process of ‘making progress’, although a lack of awareness of the scale of the undertaking is not uncommon. It is better to say that it is an on-going process – exploration does not happen in one day and sometimes there is a feeling of ‘unfinished work’:

The exploration of a cave is never complete without an honest attempt to document the character and configuration of its known passages. For underwater surveyors, this venture might require minutes or years to conclude (Coke 2001: 59-60).

Exploration can thus be a frustrating and long process, but with surprising rewards:

Jose Humberto [Gomez]⁴⁰ had made the systematic exploration of the cave his hobby for almost 10 years, spending some 1,000 hours at this underground pastime. Only after this much time did he discover what seemed to be a false section on the wall of one of the chambers... previous speleologists with varying motives, including myself, must have come within a few feet of this hidden entrance (Andrews 1970: 4).

The thrill of an unexpected find is an important part of the process, and explorers quite often conduct exploration with the expectation of finding something.

[Jose Humberto] Gomez, as he gained entrance, must have experienced an emotion akin to that of Ali Baba in the cave of the thieves, for the prospect he surveyed was no less incredible (Reed 1996: 346).

Discovery, also a contested term and misused in most cases, is part of the Star Trek syndrome. ‘Discovery’ is often followed by the recognition of colleagues and ‘other’ actors not necessarily involved in the exploration sphere. Explorers in Quintana Roo often state that this is one of the latest activities in the world where exploration and discovery can occur at the same time:

There are very few places on earth that you can say: ‘I am the only person that has been there’... [For example] what we saw today, we are the only people on the entire planet that have seen it (19/ March 2009).

Certainly it was a wonderful privilege to be one of the first persons to search out and view for the first time a beautiful virgin bore-hole water-filled tunnel, to fly in and experience the thrill of exploring our truly magnificent Mother Earth... Intricate cave animals of great variety are also to be seen during the dive. In such delicate and unspoiled beauty one feels almost embarrassed to be sharing the space (Hiler 1987: 4).

⁴⁰ Jose Humberto Gomez, spelunker and tourist guide from the Yucatan that was to discover in 1959 the six secret chambers of Balankanche Cave (Reed 1996: 346)

[Cenote DziHui] it was a special habitat not used to humans. It was so quiet; I felt privileged to be in this peaceful place that few people had ever visited before. I was almost certainly the first 'gringa' to see it, I thought, gleefully (Chapman and Calkins 1995: 221).

Being the first human being entering a place, seeing, and experiencing it, is an epistemological condition of the exploration process in Quintana Roo. Having the power to visit, map and sometimes photograph that bit of the planet shows a certain type of power over nature and over the cave. With data and information come the recognition and the fame for discovering a passage that connects two cave passages, or for entering a room that leads to a new cenote. To take this idea further is to think about the impacts on nature of having for the very 'first time' a human being in its inner core, as James Coke questions in his 1986 report of the explorations taking place underneath Quintana Roo:

Specialized cave life is being found at the far reaches of this [the Peninsula's aquifer] system, a remarkable adaptation of life in this totally dark and cool environment. As the cave diver passes these animals with his or her lights, he or she must wonder if this is the first sunrise and sunset this animal has ever experienced (Coke 1986: 3).

In these encounters with nature, explorers' narratives are commonly told from the perspective and the experience of the explorer, with very examples of the narrators themselves questioning what it would be like for this cave fauna to see a complete alien arriving in their territory, also, for the very first time.

In some narratives nature is described as something static, while in others there is a shift in perspective and nature is set in motion. Explorers' narratives are fascinating in this sense, beyond any theoretical revision of nature as an agent; this short section will try to elucidate that moment in which the perspective of nature changes and its passive existence becomes active and almost aggressive for the explorer:

Another cave denizen which added more than little excitement to our life was a very large myriapod, which seemed in the darkness to have two heads, an appearance exaggerated by its motion when cornered: it rushed towards or backwards at frightening speed, attacking any objects which seemed to threaten it and leaving a sprinkling of venous looking clear liquid where it tried to bite. We and the Indian workers were terrified by its awesome appearance and aggressive habits. They call it *u-dzudz-mitlan* ("the kiss of hell") in Maya and said that it spouted venom from fangs at both ends as well as from its myriad punctate feet—either and all probably deadly. Once we succeeded in capturing one in a mason jar we chuckled (in some relief), regarding the native diagnosis attributed the friendly gecko and many harmless snakes. We were a bit taken aback when informed by a responsible biologist that this was a species of *Scolopendra*, normally an inhabitant of caves in far Northern Mexico, which was indeed venomous to the point of fatality (Andrews 1970: 4).

It appears that when explorers are in controlled situations, nature is there to be admired, observed, described and compared to the most beautiful places ever seen by the human eye or created in fantastic stories. But then, when such control disappears and nature 'acts', the narratives change their tone, and a more humble perspective is shown. Explorers also get exposed to difficult, and sometimes unfriendly environments, where their abilities to survive and keep exploring are tested.

When [Jose Humberto] Gomez discovered the sealed chambers, the access ways were dangerous and were passable with only the utmost difficulty. Living conditions inside were made impossible by darkness, complete lack of ventilation and 100 percent humidity. Thick cardboard boxes brought in during the morning would be useless by afternoon for taking out specimens. Even with less than 15 men in the large inner chambers, the oxygen became exhausted in an 8 hour day, leaving the workers panting, after a minimum exertion, as if they were atop a tall mountain peak (Andrews 1970: 6).

If explorers have something in common between them, it is the Star Trek syndrome. It is easy to catch, not easy to cure and there is no prophylaxis in existence. The use of the Star Trek syndrome as an analogy may reflect another facet of this group and their political participation in the area. Perhaps because most of them are *extranjeros* in Maya-land, and so far the underground does not ask for passports, they have limited participation in the everyday management and control of the underground forest frontier. Their presence has most definitely changed the social geography of Quintana Roo, but their formal and conscious participation in the destiny of caves and cenotes is constrained. Therefore, it is possible to say that the syndrome has not yet evolved to the point of activism.

7.5 Narrating nature: the importance of reporting for exploration

Explorers and non-explorers re-live exploration through their narrated experiences. Just a handful of people in the world have experienced similar circumstances to theirs. Therefore, to be recognised, explorers need to talk and write about it – they need someone to read or hear how their exploration enterprise develops. The idea of writing a chronicle is a recurrent way to share the experience and to make something that is difficult to access, accessible for readers. Since the first outside visitors to the Peninsula to the 21st century explorers, the idea of leaving evidence of the experience is a common practice.

[Cenote Mucuiche] has a large cavern, or grotto, with a roof of broken, overhanging rock, high enough to give an air of wildness and grandeur, impenetrable at midday to the sun's rays, and at the bottom water pure as crystal, still and deep, resting upon a bed of white limestone rock. It was the very creation of romance; a bathing place for Diana and her nymphs. Grecian poet never imagined such a beautiful scene. It was almost a profanation but in a few minutes

we were swimming around the rocky basin with a feeling of boyish excitement, only regretting that such a freak of nature was played where so few could enjoy its beauties. On a nobleman's estate in England it would be above price (Stephens 1841: 35).

This book is an adventure story. It is the story of how we explored the cenotes of the Yucatan Peninsula, which we believed to be some of the most mysterious places on earth. They are geological wonders, archaeological treasure troves, silent cathedrals of breath taking natural beauty and, for the SCUBA diver, the ultimate challenge of skill, presence of mind and courage [...] Jim and I [the authors] visited about 100 of them and dived the prettiest ones. Human beings will never know all the secrets of the cenotes, we can only infer some of their history from a few clues left in their depths and by talking to the people who still use them (Chapman and Calkins 1995: 2).

The act of exploring cenotes and the underground cave systems is often attributed to be a pseudo-religious experience. One cave diver noted that after his initial retirement from cave diving (when he was living in the US), his first visit to the Yucatan Peninsula drew him back into the pastime due to 'the beauty of seeing a cenote for the first time'. He went on to describe that 'I learned a lot about myself while I was diving... going on a cave dive is like being born again ... seeing the light of day once more' (I25/ June 2009).

This 'religious cenote experience' is not exclusive to explorers when we consider the importance of these systems in Maya cosmology. Maya stories are full of supra-natural, mystical and religious experiences. Mythical beings and divine entities emerge from the underground and give messages to the lucky one that happens to be close to a cave or cenote entrance. Maya stories of these places tend to position humans as mere spectators and sometimes as messengers. Explorers, on the other hand, are the protagonists of their stories and when the overwhelming environment is difficult to describe with simple words, emotion is imprinted in their narratives.

Such narratives, reflection of the social constructions of nature, have themselves had outcomes *on* nature. An example of the relevance and impact of narratives in the contemporary imaginary of the underground forest frontier and its management is the idea of 'underground rivers'. Nature has been conceptualised in this particular way thanks to the early explorers' descriptions of the landscape. As previously noted, there are no superficial bodies of water on the Peninsula and nothing riparian-like in the area. The concept of the river was an alien one to the Maya when the first explorers arrived. The latter included scientists, chronicles and travellers, who often found that cenotes were connected to a bigger underground system. That is when the idea of underground rivers first emerged; since then, the visual image of the Peninsula's aquifer(s) as one of rivers that run underground has not been challenged. This

aphorism has been mainstreamed among politicians, stakeholders, land and cenote owners and even scientists. The image has also been promoted by explorers whose interest in explaining and transmitting what they had seen and lived arguably makes them use concepts like underground rivers.

This perception of 'underground rivers' can be enticing. Such a construction sounds more adventurous than a water spring or a sinkhole and it has some parallels to the colonial exploration of rivers, like the discovery of their paths and sources. The idea of underground rivers has also proven to be appealing to landowners, bringing forth ideas like marinas and rivers that can be created on their property simply by removing karstic roofs. It also creates the illusion of a simplicity that is highly unrelated with the complexity of the underground forest frontier (see Chapter 1). This contemporary social construction of the underground forest frontier in particular could have interesting outcomes in the forthcoming management of the underground and the aboveground activities to be realised, in particular if the urban development plans for the Tulum area become a reality.

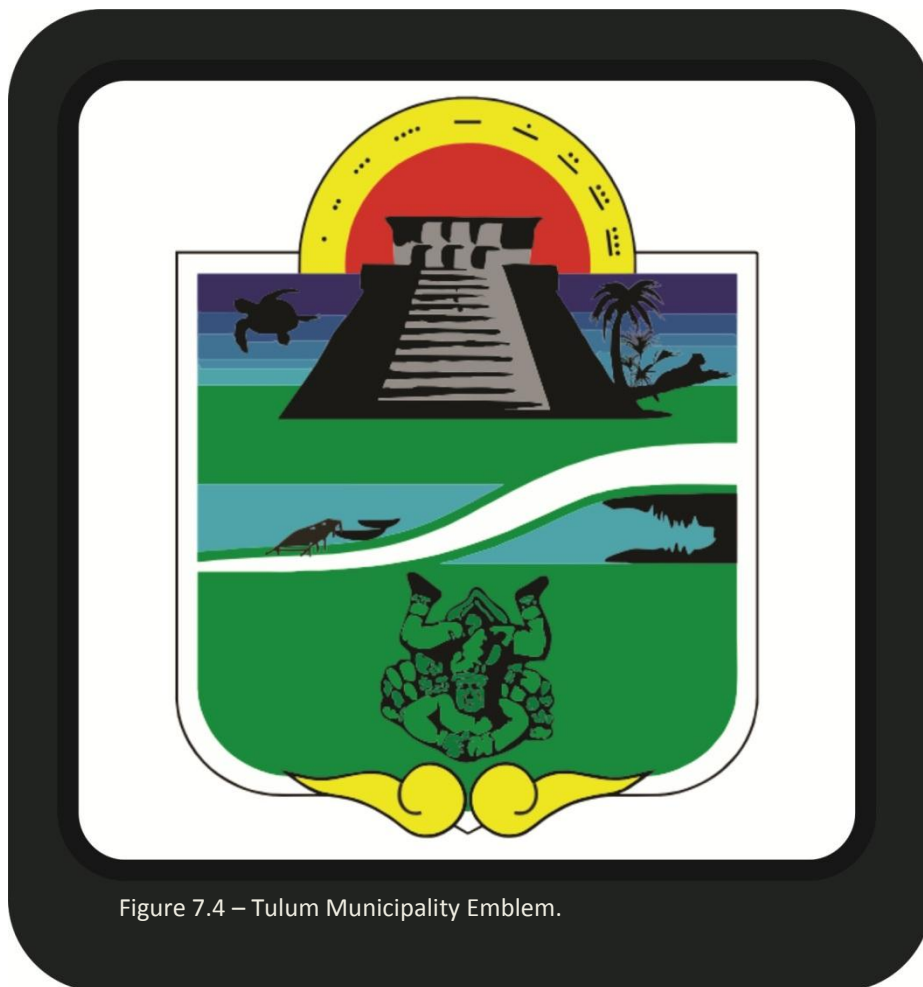


Figure 7.4 – Tulum Municipality Emblem.

A journey to Sian Ka'an: Exploration with the Zero Gravity Team

The zero gravity team has been exploring an underground cave system whose entrance is located in Quintana Roo state's Sian Ka'an Biosphere Reserve. The reserve, a UNESCO World Heritage Site, was established in 1986 and covers an area of 652,000 hectares along the Caribbean coastline. In the reserve, research projects and expeditions are conducted with permission of the National Commission of Natural Protected Areas (CONANP). In general, the majority of the research projects in the reserve have had a natural science focus, with biologist studying the flora and fauna in the area, hydrologists observing water flows and explorers investigating the cave systems. Some anthropologists and sociologists have also studied the impacts of the establishment of the Biosphere Reserve on the groups inhabiting the area.

For the last few years the Zero Gravity team has been conducting exploration trips to one of the submarine springs of Sian Ka'an, also called a cenote by the team members (although it might not fit the technical definition of a cenote, see Chapter 1), within the protected area. The spring exits through a hole in the floor of a lagoon, a transitional ecosystem fed by fresh water from the aquifer that flows out into the ocean. This following is an account of one of these expedition days. With the trucks loaded with scuba-diving gear, the team members gathered at the meeting point. On this occasion, the team was formed by five cave-divers (although just four of them would dive), two helpers (Maya workers from the Coba area), the boat captain, and myself. Some thirty years ago, scuba divers were a frightening sight for the Maya and other 'locals', but nowadays divers are part of the landscape. It is easier (and more 'normal') to talk to a landowner wearing a wet-suit and carrying heavy tanks than having a pen to write-down notes, while asking questions. 'Locals' have learned to coexist with what used to be an unusual group of individuals. They have also learned from the divers' exploration techniques, although only a few

of them have become divers themselves. Explorers' learning from the local knowledge of the area has also occurred, although not at the same speed and level, with almost none of them speaking Maya and many of them not even speaking Spanish.

For an exploration trip like the one being described here, it is necessary to have off-road trucks that can cope with difficult terrains and carry heavy scuba-gear. On arrival, the diving routes to be taken are discussed, as well as how they are going to operate as a team inside the flooded cave. Underwater exploration in different parts of the world requires specific gear, preparation and knowledge. In the case of Quintana Roo, most of the systems are not very deep (between 20 and 30 metres below sea level), and therefore the decompression process is relatively short. The temperature in Quintana Roo's underground water oscillates between the 23 and 25 degrees centigrade and therefore it is 'easier' to cope in during long journeys underwater.



Figure . Explorers ready to enter the cenote.

This planned expedition was expected to take a minimum of six hours. The group needed to boost energy supplies; after eating and drinking plenty of water, it was time to start suiting up. This is not an easy task – tubes connected to bags, multiple pockets and harnesses have to be ready and secured. Once wet-suits and reef walkers are on, it is time to get to the entrance of the cenote. The entrance is located 45 minutes away by boat in the lagoon part of the reserve. On arrival at the entry point and after anchoring the boat

near the cenote entrance, the divers started getting their gear on. This team travels with rebreathers, a type of breathing device that recycles exhaled carbon-dioxide and transforms it into a breathable gas, not producing bubbles. This technology is valuable for cave-divers as bubbles tend to crash against cenote ceilings causing sediments to fall, which in turn obscures vision and impacts on the 'natural' cave formation processes. Underwater explorers trust their lives to their gear, which includes suits, floatation vests, helmets, harnesses, water proof cameras, water proof note books, special pens to draw underwater, rulers, GPSs, special watches, tanks, scooters, compasses, life-lines and lamps, among others items, that are required to perform cave exploration. While putting all the gear on, one of the divers jokes: 'we look like Christmas trees'. Once in the water they go through a check-list procedure in pairs, checking once again that everything is ready and functioning.

Tow workers stayed behind in the boat, guarding the cenote entrance, together with the boat's captain, a scuba-diver and myself. During this time the above-water crew swam, ate, slept, took pictures and told stories about scuba-divers. After six hours in the sun one of the workers yelled: 'they are coming out'. The experienced worker's eye caught some movement at the entrance/exit of the cenote and after several minutes the first diver came to the surface and then a second one.

One of the divers was holding an empty plastic bottle found deep inside the system. He mentioned that finding waste inside systems during expeditions is not unusual, although this bottle had travelled to an especially deep point in the cave. Back in the boats they exchanged experiences and impressions. One of the rebreathers' hoses got caught in a cave formation but no serious damage was caused to the equipment; nevertheless, everybody expressed concern about it. The captain lifted the anchor out and with crew and gear safe we started our journey back to land. On land, the now-dry explorers took the map out and talked about their findings. Beer, dinner and a flat tire concluded the expedition.

Figure 7.5 – A journey to Sian Ka'an. Text and image by Maria de Lourdes Melo 2009.

In terms of management, conceiving the underground water aquifer systems as rivers instead of aquifers could mislead and engender a misunderstanding of the complexity of this

interconnected system, lacking shores and defined limits or traceable flowing patterns. But this perception has become mainstream as is now part of the political discourse of stakeholders. For example, Tulum, one of the newest municipalities in the state, has taken the image of underground rivers for its flag and emblem (See Figure 7.4); these were also an important part of the political discourse of the former Major of the municipality, Marciano Dzul Caamal (2008-2009).

Certainly, exploration and its narratives awaken the interest of all the other participants mentioned in previous chapters. With the development of the tourism industry in Quintana Roo, it was not difficult to establish the link between exploration and tourism. Sooner or later, it was inevitable that the infrastructure developed in the state, the growing urban centres, the better communication systems and the explorers' would pave the way for the commodification of cenotes.

7.6 The commodification of exploration

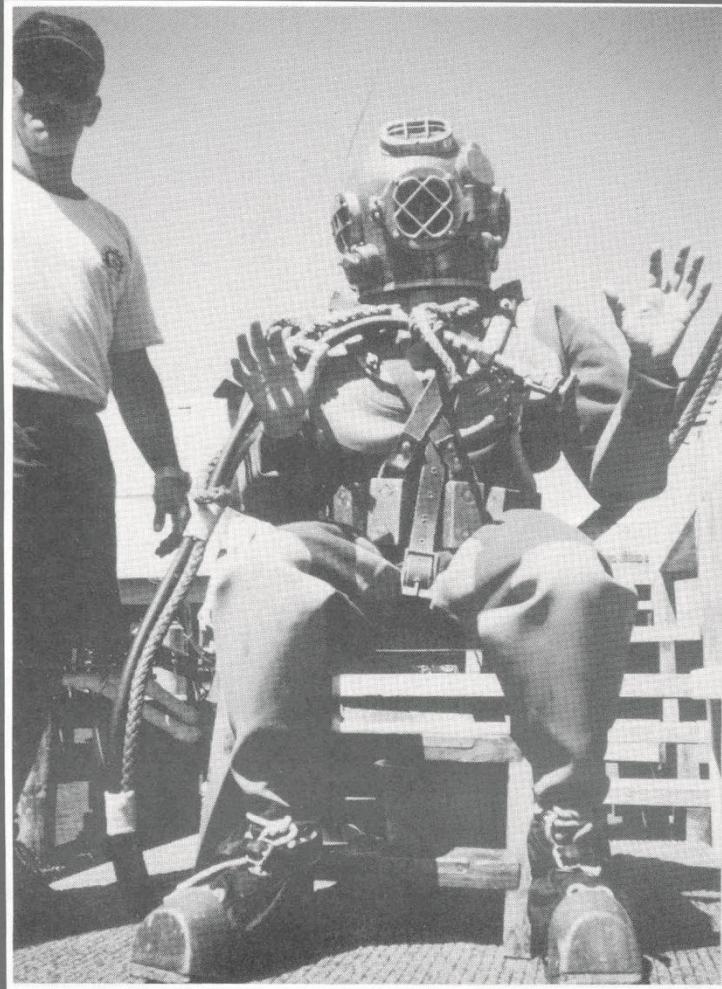
Rapid tourism development in Quintana Roo, in combination with a well-orchestrated campaign to visit and experience the underground, worked well for a group of entrepreneur divers. Brochures with the title 'experience the new frontier' have been inviting cave and cavern divers to visit the area and its underground systems since the 1980s. Flyers promoting a safe but full-of-adventure environment have been circulated in magazines for scuba divers and adventurous explorers. By the end of the 1980s, Quintana Roo was well known in cave diving circles, mainly in the United States (see Figure 7.6).

The strongest link between exploration and the mercantilisation of cenotes in Quintana Roo, (as discussed in Chapter 6), is the role of 'some' explorers in the developing of business enterprises as the result of their relationship with cenote owners in the area. And so it began. What used to be the last frontier for cave divers became a business for some of them. In the explorers' minds, the fact that the sun and beach tourism would always be the major business in the area was clear; however, it is also clear that both jungle, and sun and beach tourism, have helped each other, as an explorer and Director of the Rio Secreto project notes:

People come to Quintana Roo because of the beach. If there were no beach, and just cenotes, we would not stand a chance. Maybe the cave-divers, but it is such a small niche that it would not be an economic incentive. Cenotes are a tourist detonator but as a third factor – they are another reason to visit Quintana Roo but not the main one. Xcaret is the only business that has promoted the idea of 'come and visit the underground river,' but their marketing campaign says: if you come to Xcaret don't forget to visit Cancun. I find it difficult to believe that a tourist would

come to this area just for the cenotes or for Xcaret. The beach is the reason (11/ March 2009).

**OK, I've had ENOUGH.....
I want to go cave diving in the Yucatan!!**



Ask about our special fall accommodations rates. Stay at high quality Ocean Front Condos at an off season price!!

LGU. Inc. Loco Gringo Underground
A.P. 92 Tulum, Q. Roo, Mexico 77780
Fax: 011 52 987 12092
Tel: 011 52 984 63832
e-mail: lgu@mail.caribe.net.mx

Figure 7.6 – “Loco gringo underground” brochure advertising cave diving in the Yucatan Peninsula (*NACD Journal* 1997: 11).

In the tourism development process, it did not take long for the forest to be neglected and land became the main resource to be traded outside of the coastline. In spite of this

urbanisation tendency, a cenotes market did emerge and 1994 is often marked as an 'important year' for the substantive change in cenote consumption. This is because 1994 is the year in which Mike Madden launched the Indiana Jones adventure tour on the Peninsula, which involved the first ever diving tour into a cenote: the Nohoch Nah Chich cenote. The tour was physically intensive and was aimed at the niche 'adventure tourist' (See Figure 7.7).

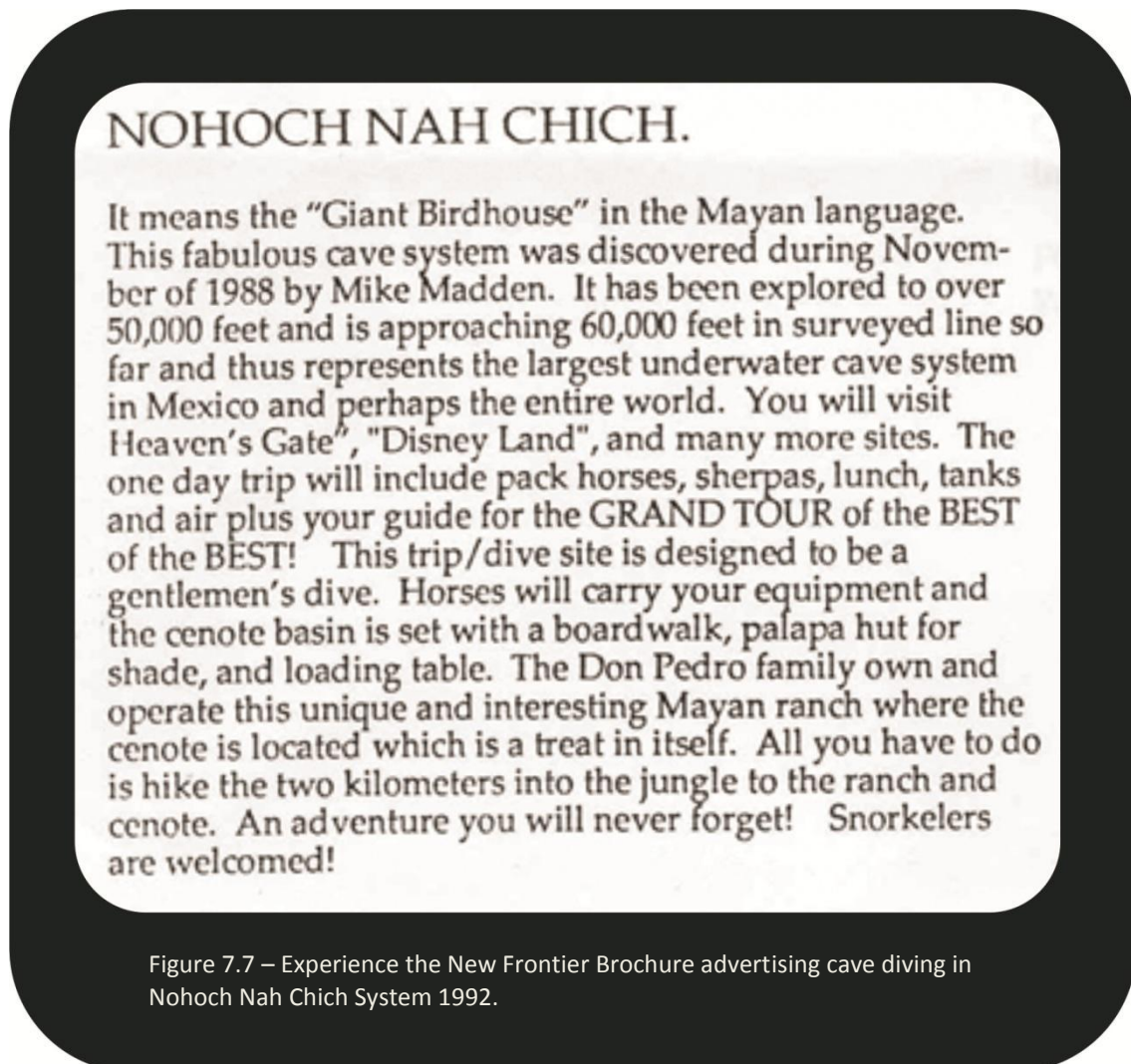


Figure 7.7 – Experience the New Frontier Brochure advertising cave diving in Nohoch Nah Chich System 1992.

Although Nohoch Nah Chich cenote was not actually discovered by Mike Madden, a kind of discovery did occur, which was the idea of creating a tourist adventure tour. Nohoch Nah Chich, as James Coke (1987) noted, had been explored by a group of divers and the conditions of the trip across the forest to get to the cenote entrance were felt to be as exciting and the dive itself. With exploration, more rooms (karstic voids) were discovered and 'catchy' names were given to them, slowly constructing a venue for cave diving tourism. The small group of explorers found this cenote fascinating, a feeling that continues to this day. Now that Nohoch has an exclusivity contract with Alltounative and hundreds of tourists visit the cenote, it

continues to be one of the most popular places for divers. And it was Mike Madden who signed the first agreement with Don Pedro, the rancho owner, changing the perception of cenotes ever since. From 1994 onwards, visits to Nohoch Nah Chich cenote have been under some type of control by private developers and tourist operators, although the land where the main cenote is found remains with the family.

Other diver-entrepreneurs have been described by Thomas 'Buddy' Quattlebaum, himself a cave diving entrepreneur, as 'funky business people' (June, 2009). They started to follow Mike Madden's lead and, soon, obscure tours to cenotes became a mainstream tourism activity. In many ways these groups of explorers were the facilitators of private sector entry into cenote commodification. As described in Chapter 6 that focuses on the private sector, this was the turning point where exploration started to become a profitable activity for landowners and they started pricing the entrance to caves and cenotes. This entailed a double process, where explorers started charging other tourist-explorers for trips to select cenotes, and then paying landowners to keep that cenote entrances restricted to a few visitors. In addition, other landowners started replicating the system and began asking for entry fees. Jim Chapman and Joanne Calkins first visited the Peninsula in 1974 and returned to the same cenote sixteen years later:

I am not going to pay 2,000 [\$1]⁴¹ pesos to go look at a cenote. The last time we were here (1974) they were free! (Chapman and Calkins 1995: 21).

The time that money started to be charged for entrance fees was right after Mike Madden began his exclusivity right in the cenote Nohoch. This was when all of a sudden cenotes became a money issue. They became a commodity, durable goods, and so as other cenotes opened-up and most of the time there was an entrance fee to pay. The fee was not that much, it was probably five dollars. Although most of the time they didn't charge me, because the owners knew me (I59/ June 2009).

The 'freedom' that some early explorers experienced in the 'last frontier' was soon to be changed. In fifteen years the same cenotes that visitors used to visit casually, became an experience to pay for. At the beginning it was 'just' the entry fee and no fences, tables, locker rooms or even walking trails were necessary. The explorers were not picky and the rougher the path, the better the experience. Entry fees were paid for tour-guides, if necessary, or only for the entrance to the cenote. As mentioned before, the 'fee' agreed between the entrepreneur-diver and the landowners had the intention of controlling the sense of adventure, by limiting the number of visitors and therefore the impact on the surrounding environment. These initial

⁴¹ After 1994 the Mexican peso currency lost 3 zeros by national decree. Therefore the 2000 pesos entry fee in 1974 would have been equal to less than one US dollar.

mechanisms of enclosure were soon to be transformed into gates, fences, tollbooths at the cenote entrance, a guard, and signs with the cenote name and the entry fee. Explorers often mention money as the main difference between the beginning of exploration in the area and the present time.

When asking divers why exclusivity agreements were necessary, from their exploring perspective, reasons such as 'you don't want to dive in a cenote full of divers' (131 /May 2009), or 'what is the sense of exploration if there is a queue to dive in the water?' (146/ June 2009) emerged. And often these reasons were more related with the fear of exploration being spoiled rather than to the protection of the cenotes.

Charging entry-fees to enjoy cenotes was a defining moment in the economic commodification of cenotes, to the point that currently no one would be impressed of having to pay on entry, even though some could be very expensive (i.e. Xplor, Rio Secreto, Xcaret). Money transactions taking place at the entrance of the cenotes is no longer questioned by explorers. To put this in perspective, it is common knowledge that beaches are national property and as such no-one should charge on entry for their 'use'; but it is also known that no-one can block or deny entry to the shore. In the case of cenotes, they are also a national asset and as such any person charging for swimming in a cenote is infringing the law. The difference is that cenotes are located *within* private lands and access to the land can be charged for, but not the use of the cenote, although it is not always publicised that way.

This process has undoubtedly had implications for the local population and their relationship with cenotes. As recounted in Chapter 4, different forms of commercialisation on the Peninsula have had different impacts on local populations and their interactions with cenotes. The boom in cenote tourism is no different. One of the explorers interviewed questioned this process and its social implications for 'locals':

There is a cenote nearby; they charge 80 pesos [US\$8] for snorkelling and 35 pesos [US\$3.50] for swimming. There are some cenotes that have a special price for locals and they would pay 10 pesos [US\$1], and this is good because they have the chance to visit these places. I remember one time, I was very sad because I saw this family getting off the public bus [colectivo] and they had their basket with lunch. It was a family with four children who wanted to swim in the cenote. When they got to the entrance, this is the dialogue that took place:

Guard: it is 100 pesos for each of you.

Dad: we just want to swim.

Guard: it is the same price for everybody.

Dad: but we live here, we are locals

Guard: the owner told me that we provide the same service for everybody and everybody pays the same

Explorer to the guard: they are just children, why don't you let them in?

Guard: the owner says everybody pays

Explorer to the guard: Ok, I will pay their fees.

I bet there are million cases like this one. How many people are not feeling anger for this kind of things? Because they can't get to know what has been in their families for generations, especially if the Dad used to go swimming in the cenote after school or on the weekends, and now someone is telling him that his family can't enjoy it. I think it is unfair, although it is part of the progress (I43/ June 2009).

There is a debate among explorers about the benefits of enclosing cenotes. Some of them would argue in favour of enclosing because 'if they know that they are getting money out of it, they know that they need to keep it clean, otherwise people would stop visiting their cenote, so 'then they take care of it' (I43, June 2009). Other groups, would argue that as soon as a landowner knows about a cave, 'that place is never going to be the same, nature is better when it remains unknown' (I44/ June 2009). Obviously there are empirical examples to support both positions; the question is if any formal management of the underground forest frontier could regulate the systems in spite of their economic vocation.



Figure 7.8 – 'Without exception everybody pays' Cenote Xunaan-Ha (Maria de Lourdes Melo Zurita 2009).

The economic commodification of cenotes has changed the local configuration of natural resources' uses and enjoyment in Quintana Roo; these effects are being felt in neighbouring Yucatan state too, as the following respondent indicated:

A Quintana Roo syndrome is starting to be felt here in Yucatan. In fact, the state government is promoting this. They are using Quintana Roo as an example. Let's face it, we cannot deny that tourism is a good economic opportunity, but what is not conceivable is that they are managing everything in such an unprofessional way. They have been going to the cenotes that we are inspecting for archaeological purposes and with the pretext of cleaning the cenote they are visiting these places and developing a tourist route of cenotes. It is not about opening roads, building stairs, it is not about making the entrance more accessible, it is about clear and strict protection criteria. (I32/ June 2009).

Tourism development on the coast of Quintana Roo has favoured the national economy and the big investors in the area. In contrast, jungle tourism (cenote tourism) has had a more individualised impact. Jungle tourism can hardly compete with beach tourism in the area in terms of profits and investments. Nevertheless, at the individual level it has had a beneficial impact on household economies, and it may be for that reason that it is seen to hold an exponential potential for transformation. The odds of having a cenote as a landowner are high, and although not every cenote is 'touristable,' the opportunity of running a family business is always a possibility. As one explorer explains:

You take a commodity like the cenotes... it is worth a whole lot because one of the things that people tend to forget is that when I first came down here the jungle was just the jungle and cenotes worth nothing. The people who lived in the jungle, the government wanted them out of the jungle and into the cities because those people were also the most rebellious. The jungle was a place that nobody wanted to go to – all the gringos [people from the US], all the gabachos [foreigners], all the Europeans wanted a white sand beach and they wanted to go to the ocean... well, they have done well in the ocean and now that there are no fish in the ocean and the corals are getting nailed because of the sewage, well let say that right now nobody is doing a lot of open water diving (I59/June 2009).

As previously noted, beach tourism has been the engine of change in the area. But by 2009, cenotes were also providing a steady livelihood for numerous families in the area, which somehow slowed down the land liberalisation process (the selling and speculating with land) that had grown rapidly in the area in previous years, because landowners now want to hold on to their assets. Cenotes and caves, and the multiple activities performed there, changed household dynamics and a new relationship with nature was born. This was not one where humans realised the importance of cenotes for the environment and human survival – that was already known and it would be presumptuous to claim that explorers and scientists brought that knowledge to the area. Rather, different human-nature relations were forged in

the area, with an economic commodification permeating most of them. Explorers, with their different goals and intentions, were the first to contact landowners. Given that for most of the landowners the rest of the actors described in this study remain as vague entities whose functions are diffuse, except for the land-provision offices, this scenario presented the perfect circumstances for explorers to act as knowledge brokers, business entrepreneurs and 'strange' people that like to spend hours underground.

However, while the relationship between explorers and landowners has been longstanding, it has also been conflicted:

Landowner and explorer relationships have changed because it stopped being a friendly sort of thing where you could sit down, joke with the person, smoke a cigarette with them, have a beer or sit down and talk with the family and children. This became a business negotiation. You pay me and I let you walk in my land and dive in my cenote (I59/ June 2009).

The discovery/commodification story has been repeated several times, with minor variations. First, a group of diver-explorers find a beautiful, pristine, crystal-clear watered cenote by chance or word of mouth. The explorers need to establish contact with landowners and ask permission to practice exploration in their land. Once those are granted and if the system is worth it (in terms of exploration), a snowballing process starts: more divers, more information, more maps, plans for opening the site for tourism, putting a sign at the entrance to the site, building infrastructure and so on. It is often the case that explorers practice exploration to retrieve information about the system, take water samples, map the area or try to establish connections with the cenote systems. Other times, cenotes are explored because landowners would like to know more about the systems located in their lands, quite often with business intentions. As a dive shop owner, lawyer and explorer said: 'I do not make business out of cenotes but if someone puts a piece of land with a cenote for sale, I would like to go and explore it' (I46/August 2009). These 'deals' between explorers and landowners changed the perspective of the 'initial' exploration trip where proprietors did not quite understand what explorers were doing, but they saw maps, pictures, videos, and felt excitement about the findings. Enclosing the cenotes was thus born of a new perspective, brought by 'outsiders' interested in cenotes, with the result that new economic values were added to the knowledge, skills and interest surrounding cenotes, suggesting a symbiotic relationship between explorers and landowners.

By the 1990s landowners began inviting some of the more well-known explorers to find cenotes. GPSs were out and it was very simple to find cenotes in an aerial image, locate the coordinates into the GPS and drive to a cenote that no-one has

seen before. I mean the whole thing is very simple... Landowners were inviting explorers and said: go ahead and explore. People walked there and found something, so the landowner said: great I got a money maker now. It was an opportunity, the explorers used the landowners and the landowners used the explorers (159/ June 2009).

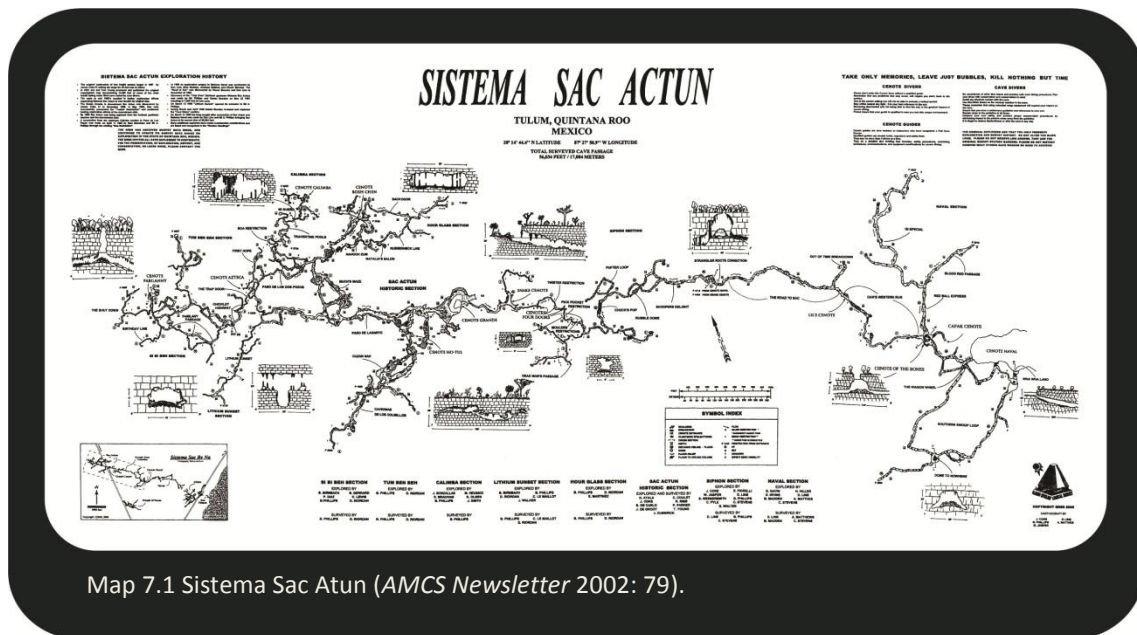
Explorers have been an important lynchpin in the commodification of cenotes along the Peninsula. They have brought the surface narratives of the underground to a wider audience, formed early relationships with landowners, and have developed full-time businesses of cenote exploitation for profit. This is not to suggest that divers were the only ingredient for creating this process – the presence of rapid tourism development along the Peninsula provided an economic context for the growth of cenote and cave exploitation. Nevertheless, the explorers have been fulfilling perhaps a somewhat unexpected role of influencing private sector infiltration into cenotes and cave spaces. However this is not the only role that explorers have played in the social construction of the underground forest frontier. As the following section shows, explorers' documentation and representations of the underground forest frontier are having an impact on other spheres, as a different commodification process.

7.7 Maps: let me show you what is underground

At the best one should assume that a map reflects a delicate balance between the surveyors' repertoire of techniques and commitment to detail and accuracy, and the realities of managing time and air reserves in the cave (Coke 2001b: 59).

Mapping is a common way for documenting, recording and recreating the physical conditions of a cave or an underground system in Quintana Roo. Mapping is a progressive practice that has taken advantage of technological improvements through time. It is an activity that requires time, patience and economic resources. Speleologists usually spend years in a single cave trying to recreate and capture as many details as possible. For some, mapping is almost an artistic activity that has its own language, vocabulary and symbolism. Maps are in themselves valuable commodities for landowners, private investors and other explorers. Fragments of maps circulate around, but most map-developers are protective of the information and data that a map can hold. This research obtained information from the explorers group and is thus proof that information is available for everybody, although not publicly accessible. Some divers would argue that there are ethical reasons to be discreet with data, especially if they are trying to protect the natural and cultural heritage found in the systems. Maps, especially those of the already exploited caves, are printed and sold to provide a safe journey to visitor explorers who are new in some systems and want to know their route. Selling certain maps is not an

uncommon practice among explorers, and having a map to lead your underground journey can increase the safety of this practice.



Map 7.1 Sistema Sac Atun (AMCS Newsletter 2002: 79).

Mapping is also a good way of showing people the complexity and intricacies of the aquifer, as well as being good evidence of the ‘conquered’ space. Maps, compared with other visual images of the underground, like photos or videos, keep a certain level of abstraction; they summon the observers’ skills to picture the ‘real thing’. They are also for the expert reader as previous knowledge is required to understand what is visually represented. The cave maps in Quintana Roo are highly valued and sometimes act as currency among different exploration groups. Maps for some explorers might be one of the most valuable outcomes of their activities:

Can you imagine the importance the master vellum copy gains after six months of diving? I must confess, I had a few noteworthy moments of panic. Sleeping with my map tube in a hotel room in Coba during Hurricane Gilbert was bad enough... (Coke 2001b: 66).

The majority of maps produced are of individual caves or systems, but no comprehensive maps have yet been publicly presented. There have been some efforts to reproduce a visual image of the underground in Quintana Roo, meaning a comprehensive picture of the aquifer(s). As explained in Chapter 1, hydrologists and geologists have made decent attempts to explain the fluxes and composition of individual systems and through a sampling process some generalisations have been inferred about the aquifer. Nevertheless, stakeholders and decision makers still argue that it is difficult to know exactly where these veins are located. In a recent

effort to solve this issue, the non-profit organisation Amigos de Sian Ka'an, in a joint effort with the Technical University of Denmark (DTU), produced a model of the underground water fluxes covering an area of 35,000 km² within the state of Quintana Roo:

On a local scale karstic caves were mapped using airborne electromagnetic (EM) measurements, and verified using cave maps produced by scuba divers. For the regional-scale, potential high-permeability zones were outlined using visual inspection of optical and near-infrared satellite imagery (Gondwe 2010: VI).

This study, as the ex-director of the water conservation programme of the Amigos de Sian Ka'an organisation said, has shown us that the underground is not homogeneous (I57/ July 2009). The results have been somehow kept at a discreet level but Amigos de Sian Ka'an has already used part of the analysis to stop (at least temporarily) the construction of new resorts and the development of some projects.

SEMARNAT has used our information to advise some projects and the Senate of the Republic has launched a point of agreement on a development project in Tulum. The state government recognises us more from this work. We will use all this information for the Urban Development Project of Tulum. We as NGOs are dependent on 'cracking the egg' so that society and politicians take us into account, and we must show off what we have done. Another advantage of this project is that it is very attractive and has given us visibility. It is very interesting to see a giant helicopter of the Navy with a torpedo hanging from it, and the journalists having the opportunity to get on the helicopter and see what is being done. This project is a research tool; it is a conservation tool and an environmental marketing tool. You need a project like this one to make people aware of what lies below the ground. This is the first time that this type of study has been done in a karst system in the world, from a hydrological perspective (I174/ September 2009).

The use of information from this study has remained at this level between Amigos de Sian Ka'an and the public sector, with some scientific publications in peer-reviewed journals made public (Gondwe *et al.* 2010, forthcoming), although the accessibility of the knowledge produced by such an impressive research project has not reached all the sectors in Quintana Roo, especially local government and other NGOs.

Amigos de Sian Ka'an at the time of the research was also in the process of implementing a project called *Amigos del Oro Azul* [Friends of the Blue Gold] which targets the improved management of the underground aquifer. As the project states "The Yucatan Peninsula with the most extensive network of underground rivers in the world and one of the most important aquifers in Mexico, represent a mineral of 'Blue Gold'." It is interesting that they need to frame the underground aquifer as a 'precious mineral commodity' in order to promote its management. This typology of framing is not neoteric to the Peninsula; henequen was dubbed

el oro verde (the green gold) during its peak production, while chicle was dubbed *el oro blanco* (the white gold) during its heyday.

QRSS Survey Data Contributors

Cave summary statistics and overview maps are produced by QRSS using survey data contributed from 1986 to 2011 by over 340 cave explorers working individually, in small groups, or as part of larger projects. As of December 2011, explorers known to have contributed in this way include Aaron Addison, Raquel Aguilar, Victoria Alexandrova, Alejandro Alvarez, Alex Anisimov, Mia Arvidsson, Tomas Asp, Franco Attolini, Harry Averill, Geronimo Aviles, Yair Azubel, Shelly Baker, Michael Bandow, Patricia Beddows, Anatoly Beloshchin, Andy Beltram, Heather Beltram, Nadia Berni, Emanuela Bertoni, Susan Bird, Bernd Birnbach, Kirk Bloede, Steve Bogaerts, Mauro Bordignon, Scott Brooks, Greg Brown, Lennart Brusell, Paul Bryant, Len Bucko, Dane Buczowski, Steve Burman, Cindy Butler, Dane Buzzardo, Patrick Campbell, Bill Carlson, Doug Carlson, Scott Carnahan, Kevin Casey, Richard Chapski, Yannig Charles, Roberto Chavez Arce, Petr Chmel, Daniela Cipolla, Jeff Clark, Dustin Clesi, Karen Cleveland, Ralf Coerreia, Jim Coke, Lorie Conlin, Paula Simone Cook, Andrew Cope, Mark Corkery, Steve Cox, Ray Craig, Kyle Creamer, John Curtis, Joe Datri, Kim Davidsson, Steve DeCarlo, Johanna DeGroot, Fernando Del Valle Prieto, Ned DeLoach, Paul DeLoach, Daniel Dens, Nancy DeRosa, Tony DeRosa, Fred Devos, Mauricio Diamant, Pablo Diaz, Pietro Donaggio, Logan Dooley, Sanja Dordevic, Per Dovland, Carlos Duarte, Dave Duguid, Chad Dunn, David Dusek, Zdenek Dusek, Zed Dusek, Miloslav Dvoracek, Mason Earles, Randi Eisen, Don Ellerbrock, Lamar English, Luci English, Tom English, Jean Charles Erba, Sheck Exley, Ed Fiorelli, Evy Fiorelli, Ken Fiorelli, Alan Formstone, Joe Fortuna, Gary Franklin, Shane Fryer, Orlando Garcia Villanueva, Tone Garot, Bill Gavin, Steve Gerrard, Natalie Gibb, Lee Gibson, Bob Giguere, Grant Graves, Robin Greaves, Ed Grossenbacher,

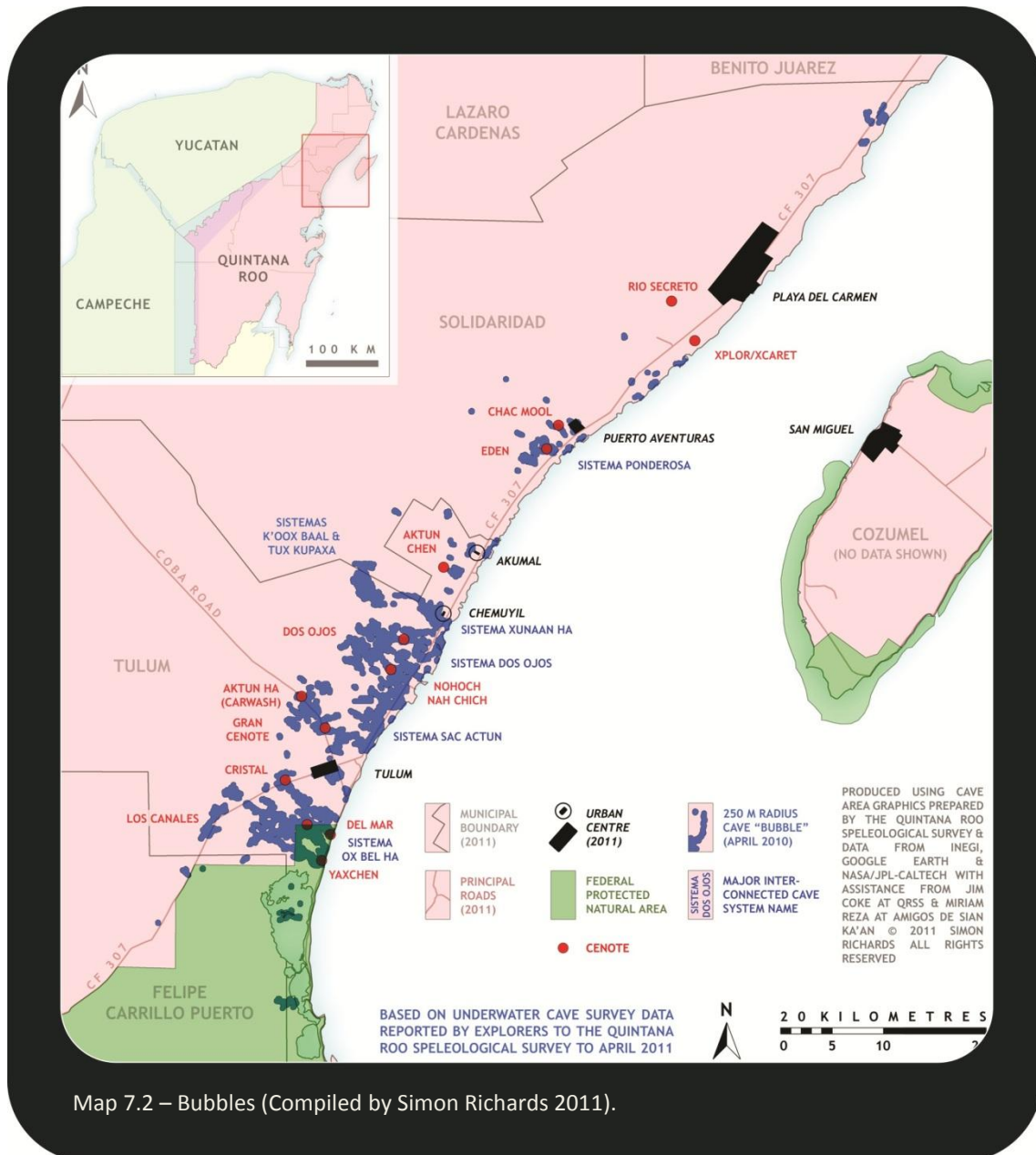
Harry Gust, Alton Hall, Gil Harmon, Will Harris, Dig Hastilow, Jill Heinerth, Paul Heinerth, Andy Henderson, Melissa Hendrickson, Mike Hensak, Baard Hermansen, Johannes Hernandez Rustige, Harry Hicks, Hilario Hiler, Lamar Hires, Zdenko Hochmuth, Jürgen Hofer, Martin Hones, Philipp Huber, Jiri Hurab, Radoslav Husák, Eric Hutcheson, Daniel Hutnan, Martin Hutnan, George Irvine, Steve Irving, Johan Ivarsson, Jarrod Jablonski, Radek Jancar, Marike Jasper, Woody Jasper, Wolfgang Jetz, Petter Johansen, Dai Jones, Mercedes Jones, Kevin Joyce, Brian Kakuk, Vit Kaman, Pat Kambesis, Alexandra Kampe, Thorsten Kampe, Tom Karch, Hans Kaspersetz, Steve Keene, Sebastien Kister, Anders Knudsen, Oyvind Knutsen, Terry Koritz, Adam Korytko, Sigurd Kowitz, LP Kronwich, Andres Labarthe, Juan Laden, Paal Larsen, Christophe Le Maillot, Luis Leal, Arnaud Leblant, Phillip Lehman, Tomas Lehmann, Gary Lemme, Barbara Lewis, Kate Lewis, Gideon Liew, Rick Lindal, Dan Lins, Chris Lloyd, Simon Lodge, Connie Lore, Travis Lore, Henning Lucht, Barbara Luke, Devin MacKenzie, Mike Madden, Sandro Madeo, Luca Maghelli, Bill Main, Ed Mallon, Miroslav Manhart, Andrea Marasich, Carlos Marquez Rodriguez, Steve Marsh, Ossi Martinez, Andreas Matthes, Gabriel Mazon Chulim, George McCulley, Frank McDowell, Casey McKinlay, Mungo McWilliams, Orane Meacham, Sam Meacham, Michal Megela, Harvey Meister, Jim Mellon, Jacob Mellor, German Mendoza, Bob Messersmith, Rogelio Mier, Che Miller, Dave Miner, Jose Mis, Tomas Mokry, Sarah Morgan, Tom Morris, Zdenek Motycka, Alberto Nava, Fernando Nelson, Rick Nelson, Rob Nelson, Gavin Newman, Eric Noftall, Heidemarie Nordahl, Andi Nowara, Jim Olsen, Kurt Olsen, John Orłowski, Bob Osburn, Robbie Osman, Mario Pacheco, Mathieu Paratte, Joan Patrick, Kenny Peakman, Toine Peeters, Rolf Pfister, Bil

Phillips, Santiago Pintado, Clark Pitcairn, Andrew Pitkin, Christian Pittaro, Charlotte Places, Bill Plaut, Alain Pocobelli, Karin Pointner, Mike Poucher, Sandra Poucher, Renee Power, Dave Pratt, Mike Pugliese, Chris Pyle, Buddy Quattlebaum, Rhiannon Raggatt, Kendall Raine, Tania Ramirez, Jesus Rangel, Jana Raucinova, Charles Read, Alessandro Reato, John Reekie, Ryan Reid, Andreas Reiner, Bill Rennaker, Jason Renoux, Brian Renton, Kevin Renton, David Rhea, Richard Ribb, Donna Richards, Jason Richards, Simon Richards, Daniel Riordan, Emiliano Rios, Nat Robb, Gianmario Rocca, Alberto Rodriguez, Carmen Rojas, Dominic Roth, Vincent Rouquette Cathala, Etienne Rousseau, Benja Sacristian, Emanuella Sala, John Sampson, Leo Sastre, Sherwood Schile, Richard Schmittner, Robbie Schmittner, Sabine Schnittger, Wulf Schubert, Alejandra Serrano, Bruce Shadow, Sue Sharples, Roger Sherman, Karl Shreeves, Dave Sieff, Ray Siegfried, Cliff Sifton, Mark Singer, Jan Sirotek, Stan Sitar, Wes Skiles, Noel Sloan, Jana Smith, Greg Sommer, Tomas Spangberg, Peter Sprouse, Mike St. Germain, Chris Stanton, Krzysztof Starnawski, Chuck Stevens, Ron Stoessel, Bill Streever, Carl Sutton, Rune Svendsen, Kamila Svobodova, Tara Tanaka, Fatima Tec Pool, Radomir Teichmann, Christian Thomas, Per Thomsen, Harve Thorn, Toni Thorn, Lukas Tietz, Olmo Torres Talamante, Hairo Trejo, Victor Trostyanskiy, Richard Tuma, Pierre Turgeon, Parker Turner, Terrence Tysall, Wes Underwood, Maarten van Baal, Miguel Vasquez, Liliana Viola, Cyndie Walck, Gary Walten, Kay Walten, Henry Wang, Twyla Wasmuth, Pat Watson, Christoph Weber, Chris Werner, Roger Werner, Patrick Widmann, Ryszard Wiejski-Wolschendorf, Blake Wilson, Nichole Wischlinski, Jo Wisely, Martin Wright, Tom Young, Ondřej Zajíč, Alexander Zens, Jan Zilina, and John Zumrick. QRSS apologises to any contributor whose name has been omitted.

Figure 7.9 – QRSS Survey Data Contributors

Another attempt to use a map as a political tool, although less scientifically rigorous, was made by SAVE, a non-profit organisation. SAVE produced a map superimposing the ‘available’ surveyed-cave maps in a topographic map of Quintana Roo. The result, although not accurate,

as scale and other geological variables were not taken into consideration, was used as a political tool to call the attention of the federal government highlighting the relevance of the underground aquifer (See Appendix 6 and 7). The map was criticised by explorers and other ‘experts’ for its lack of rigour and inaccurate use of the information, although it did receive a response from Mexico’s President and other government agencies (see the final section of this chapter).

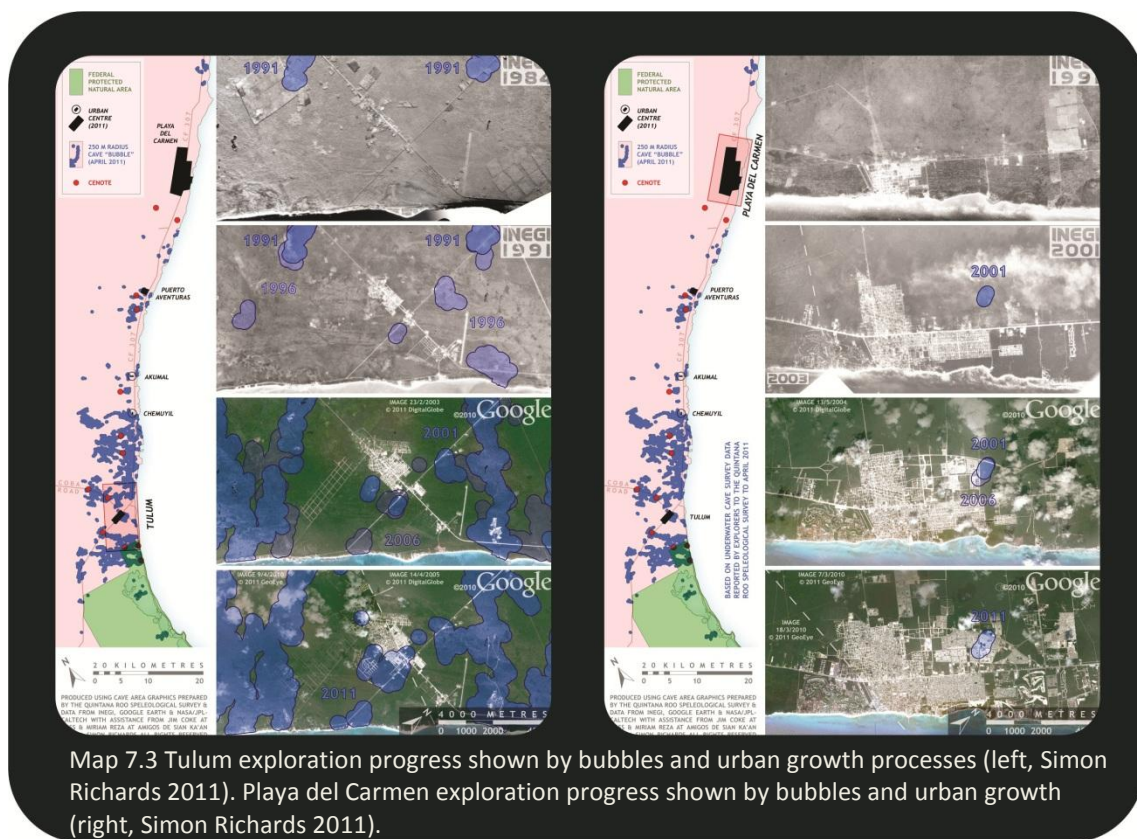


When exposing these concerns about maps to a group of explorers during the fieldwork for the present research project, some of the explorers joined efforts to produce the map that is shown below. The map above (Map 8) was produced by Simon Richards using data provided by James Coke (founder of the QRSS) and includes information gathered so far by 336 explorers over a period of 30 years. The list of contributors (Figure 7.9) is not included as an appendix, rather in text here, first as a sign of gratitude and recognition to the many hours and resources invested in mapping every centimetre of every new passage reflected on the map, but also to show that a coordinated effort among the different actors involved in the everyday relationship of the underground forest frontier is very much possible, even if at a very small scale. The 'simple' image of the map shown here involves great difficulty and skilled technique. It is interesting to note, that sometimes, the outcomes of exploration are not fully perceived by its practitioners – something as 'trivial' as mapping 100 metres of new cave passages could add valuable information in the understanding of the complexities of the underground forest frontier.

The map is not showing 'underground rivers'; rather, it shows 'bubbles' - a term forged by James Coke that refers to the 300 metre area surrounding all known surveyed underwater cave, to include what cave divers cannot report in their line plots. This means that this map shows more than the surveyed passages between 1987 and 2011. Considering the formal definition of caves provided by Munroe (1970) (see Chapter 1) as the underground voids that are large enough for a person to pass through, it is obvious that any surveyed cave will not show the non-human size conduits, thus limiting the understanding and knowledge of the aquifer.

Analysing the map, several inferences can be made. First, it is possible to see that a significant percentage of the underwater caves are located to the south of Akumal. This may be due to the fact that exploration in this area is older and started when no big urban developments were there. Second, some of the data available for analysis north of Playa del Carmen was not produced with exploration purposes and, therefore, is not available in the QRSS database. Third, with the urbanisation process, exploration became more difficult to practice, imposing serious constraints on this activity north of Akumal (as discussed in Chapter 1). Finally, it might be possible to say that the majority of underwater caves within the state's limits are located to the south of Akumal. The implications of showing the abundant existence, distribution and location of the underwater caves are important for the already projected development of the Tulum area, where more resorts, golf courses, and an airport have been proposed, along with

a projected annual intake of nearly 18 million tourists by the year 2025. The construction of the Tulum airport has already been a contentious topic among explorers, given the fragility of the soils, the high vulnerability of the system to airplane pollutants, and the dangers of constant vibrations on the ground. Maps, like the Bubbles Map, would be of interest for a multiplicity of actors; unfortunately, the dialogue between them has been fragmented and isolated. There is also a great risk of such maps being misinterpreted. 'If they see the map, and the maps shows an empty spot, it does not mean it is okay to build on top of that surface area, it is more complex than that' (159/ June 2009). Therefore, 'having the map' without considering its deeper meaning is meaningless, and the information presented there could be misused.



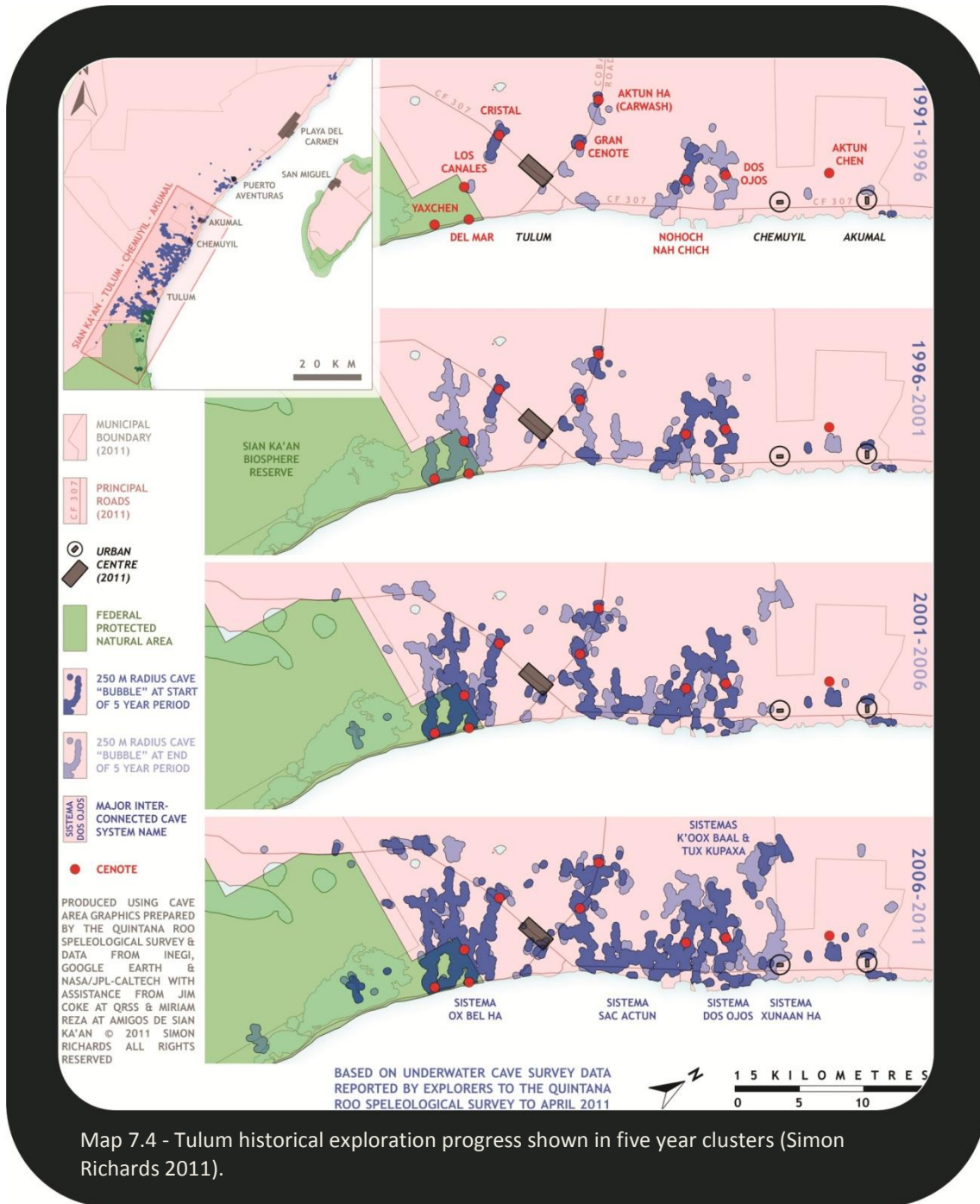
Cenote entrances are also shown in the map, although not all of the existing and known ones. The intention of this is to stop visual saturation on the map and only show the major interconnected cave systems in the area. Looking at the map, it is possible to see the high appearance of flooded caves systems in the south, but also the interconnectivity of the systems. From this perspective, the notion of underground rivers gets somewhat discredited and a more connected system can be perceived.

Continuing with the historical intentionality of the thesis, a couple of maps showing the development of exploration in a small section of Playa del Carmen and Tulum areas are represented.

In the historical close-up shown on the left-hand map above, it is possible to observe the historical process of cave exploration in the Tulum area. In the early 1990s, underwater exploration was practiced by just a few individuals and the available technology made it a very long process with sometimes slow results. In 2001, the increase in explored systems is significant. Exploration became an active and expanding activity to the south of the state. If we compare this with the map on the right for the same period of time, we can observe that the 2001 'exploration boom' observed in the south near Tulum did not happen with the same intensity in Playa del Carmen. The fast urban growth reported for the area may have influenced this outcome, as discussed before.

Finally, Map 7.4 reflects another historical perspective of exploration and cenote entrances in the area between Akumal and the Sian Ka'an Biosphere Reserve. It also shows how historically the way of referring to the underground has changed. What were just cenote entrances in 1990 gradually became understood to be a complex and interconnected system by the year 2000. To find more connections between cenotes and cave systems, is often seen as a challenge for explorers. Currently in 2011, as a result of exploration in Quintana Roo, there are 221 underwater caves and cave systems, 992.9km of underwater cave passages and 67 dry caves that are known in the area (QRSS 2011). The largest known flooded cave system (on the Peninsula and the world) is the Ox Bel Ha system, which currently has 231.8 kilometres of surveyed passages and 137 connected cenotes. Sac Atun is the next largest, with at least 162 cenotes reported as being connected to the system.

One of the concerns about maps is exactly how they are going to get used. Someone, will figure out that all these maps are geo-referenced so if you buy a piece of property that does not have a cenote on it and you know there is an underwater cave, there is nothing like a little bit of 50 kilos of dynamite to make your own cenote, so that piece of property that was worth two dollars now it is worth two million. How did the cenotes start to be treated like they were being traded on wall-street or the dow-jones? When we started diving, nobody really cared, the landowners didn't care but they were curious about us, they were curious about the reasons for our exploration and one day they told me: you are a gringo, you are stealing from Mexico. They went through all my gear looking for gold and jewels and they found my survey maps and they told me: you are making a treasure map; this is the map to where the gold is. They were absolutely convinced that there was gold. (I59/ June 2009).



And there was gold, although a different kind of gold, and the economic valuation of cenotes became a 'normal' thing to do. Exploration, as has been shown, started as a recreational, almost ludic experience. However, as part of the process, a sub-group of explorers saw in this activity a business potential and created the conditions for its entrepreneurial success. But also, as if through an invisible process, explorers became the gatekeepers of the underground. They knew how it looked, what to do in it and how to commodify it. For some time, the presence of this group was only noticed by landowners and some private investors interested

in caves and cenotes. It was not until 2009 that their activities caught the attention of another group of actors discussed in this study, the public sector, especially of those agencies concerned with urban development and the protection of cultural and archaeological heritage. Recently, more contact has been established between these groups of actors, mainly in relation to the information that explorers have produced, and a strong interest has been manifested specifically towards mapping the result of years of continuous exploration.

7.8 Explorers and the public sector: who knows what we got?

Interactions between explorers and the public sector have generally been in an *ad hoc* and fragmented fashion. The agency in charge of urban development and the environment in Quintana Roo state, SEMARNAT, has directly contacted some of the explorers regarding the availability of maps and information about cave system locations. This contact has been established mainly via email and has focused on direct requests for information, rather than attempts to start a dialogue or talk about the possibility of working together to develop a better understanding of the systems. Other links between these explorers and the public sector occur when explorers want to conduct an expedition or exploration in a natural protected area or a federal zone, as in the case of Sian Ka'an, where they need to obtain a permit in order to perform their activities.

However, without question, the most common and recurrent encounters and 'liaisons' between explorers and the public sector have taken place within the National Institute of Anthropology and History (INAH), specifically with members of the sub-direction of underwater archaeology. Overall, INAH and the diving community have experienced a fairly turbulent relationship. Entrepreneur divers often have relied on the paleontological and archaeological artefacts in cenotes as a way of luring tourists to diving tours. Thus it is not uncommon to see brochures and other types of publicity advertising 'fire pits', 'megafauna bones' or 'hundreds of skulls.' Nevertheless, the reliance is two ways, as it is usually explorers who are discovering precious artefacts at the bottom of cenotes. INAH and explorers have also worked together in the everyday improvement of archaeological techniques and underwater methods. Thus it can be said that some kind of collaboration has occurred.

However, there have been occasions when the relationship has been less than amicable, especially in cases when affectation (removal or damage of archaeological artefacts) of the sites is claimed, either from exploration or from tourist processes. Interestingly, in February 2011, in an isolated and almost unique formal attempt to contact the explorer community, an

open letter was sent by the Deputy of Underwater Archaeology, which recognised the important role of the diving community in finding artefacts in cave and cenotes in the area, and at the same time requesting the halt of underwater activities in sites identified as fragile in the Tulum area.⁴² INAH made public, through this letter and a number of public presentations, that it is not in their interest to 'close' cenotes and so far not a single cenote has been closed, but in some cases INAH has extracted the evidence found underwater by claiming research purposes. This has created certain tensions, as one explorer explains:

Let us say you find some really cool stuff in Quintana Roo, around the town of Tulum. You find human remains 9,000 years old, or some chiclero stuff, or colonial era. In other words, it's part of those people who once lived in Quintana Roo. Why in the world would you take that stuff out of Tulum and put it in some museum in central Mexico. But much more so is to remove any sort of cultural heritage these people have to a point that 99% of the people don't have the way to see it, don't have the money to travel to see it and don't want to travel thousands of kilometres to see it (I59/ June 2009).

This was perhaps one of the most commonly mentioned issues with INAH that the explorer community expressed in interviews, the extraction and transfer of cultural evidence of the area to a decontextualised place for research purposes. In this sense, INAH and the very early extraction of materials from the Sacred Cenote by Thompson are not all that different, and in the public perception this image is reinforced when more and more fragments from cenotes are formally removed. Nevertheless such discontent generally remains at the individual level, where explorers in each particular 'discovery' case decide what to do with the knowledge that they possess.

Explorers have performed all sorts of enterprises in Quintana Roo, they have helped in the current perception of the underground forest frontier and their presence has changed forest dynamics forever. In the coming years, more involvement between the public sector and explorers is likely to be observed. While this involvement may be more related with the impacts of urban development in the area than with the conservation of archaeological evidence, these relations are still in incipient form and therefore it is difficult to pose a possible future scenario.

7.9 The impacts of exploration: tell me a story about cenotes!

The physical impacts on those cenotes open for tourism or accessible to visitors is the occurrence of practices that could directly damage the appearance of the cave. Indirect

⁴² Cenote la Virgen, Cenote Profundo or el Pit, Cenote los Huesos, Pet Cementery, Cenote Kamlina, Cenote las Palmas, Cenote Naharon or Cristal, Cenote Chan Hol y Cenote Nal Tucha.

impacts, like water pollution or water extraction, have been discussed in previous chapters. Without adding any moral value to the impacts of human action over nature, this section will examine explorers' perspectives and reflexivity about the outcomes of their activities, findings and dissemination of the latter.

This, is the explorers' point of view, let's say that it is our responsibility to take care of what we have seen. It is a big responsibility because I am going to a place that no one has seen before or been there before, the responsibility of being the first there is enormous; you are opening a path for other people. Then we face this dilemma between the urge to see these beautiful places and our contribution to their sudden or gradual destruction. When I set my life-line, I am showing other people what places I have been to and it is very likely that destruction will come right after. And by destruction I don't mean that people will come with a hammer and will knock everything down. It could be more subtle, from the cenote roof crashing and damaging the formations to the simple fact that your bubbles are touching the roof. It is, for sure, a negative impact on the landscape but at the same time you start thinking, if I do not go myself, someone else will (I36/ June 2009).

Once the cave has been penetrated, it seems that its fragility is exposed as the cave then becomes vulnerable to be explored, visited and photographed. This includes over ground and underground practices. The unknown outcomes of human practices in the underground in the face of the 'real' fragility of the systems have already been discussed.

Explorers, specifically scuba-divers, have developed informal ways of minimising the impacts of their activities; their motto: 'take nothing but pictures, leave nothing but bubbles, and kill nothing but time', is evidence of the 'general' approach to the sort of exploration that should be practiced to minimise environmental damage caused by exploration. Physical impacts on caves and cenotes are the result of explorers' and visitors' presence, sometimes hundreds of them per day, in restricted environments with very delicate equilibriums. During interviews with explorers, an awareness and sometimes concern of the effects of exploration were questioned and discussed. Examples of a compelling, non-remote past, or the way that such a cave or such a passage used to look, how clear the water was, or how much forest you needed to cross to get to the cenote, emerged during almost every open conversation with the explorer participants. Images of rapid change and transformation are part of the discursive ways of explaining what they do and the reason for it. Nevertheless, exploration discourses regarding concern for the environment stay at the level of *in-situ* impacts; most of the time, the social impacts of exploration and 'discovery' are not recognised or questioned.

At the end of every semi-structured interview, research participants were asked to recount a story about cenotes that they would like to share. Quite often the stories told related to difficult situations during exploration, such as accidents or equipment failure, or difficulties

incurred when certain fauna, such as bees or crocodiles, gets involved. In contrast to these common stories, one explorer-scientist, recalling the blurred boundaries between actor identities, recounted a story of that reflects some of the impacts of exploration in terms of the social outcomes in Quintana Roo:

One day [in 1995] I was at the ranch of Don Pedro, Nohoch Cenote, and for many years the landowner's family lived there. The research team went there to make some measurements. After surveying the cenote my co-workers went out to the entrance, with all the diving gear and the horses. The cenote, back then, was 45 minutes' walk away from the road. I was working on some data in the cenote when the daughter of Don Pedro and the wife of one of his sons realised that I was not leaving with the main group. They came to me with a plate of fruit and began to ask me questions about birth-control. They wanted to know everything I knew about how to manage their families, birth control pills and the risks of taking them. For me, that is a story about cenotes. We were there talking for almost one hour and I said, 'I am not a doctor I cannot give you that kind of information,' but they told me that they had no one else to talk to about these topics on the ranch. For me, this is a story of cenotes because it is a story about the lack of communication and information. They saw all this development, all the tourism coming and all the changes, and they were seeking the same that everybody else wants: prosperity. (I11/ March 2009).

Explorers who have witnessed the urbanisation process and landscape transformation tend to openly question the impacts and effects of the processes and the current direction that these are taking. Nevertheless, grounded questions about the social implications, like the one seen in the narrative above, are not common. Discursively, key phrases such as 'sustainable development', 'environmentally friendly' and 'conservation' are mentioned and very often related with specific examples and the names of specific resorts and/or developmental projects. There is a tendency to associate the 'big', 'massive' development projects with impacts on the environment and the destruction of the ecosystems, or even the disappearance of the local fauna (mainly jaguars). However, other problems associated with the commodification of cenotes, such as workers' labour conditions, sexually transmitted diseases, or cultural transformation, are sometimes overlooked. This is not to argue that such problems are more pressing than others, but to put in context how much of the formal mainstream national discourse, before the current 'drug-war' that the country is facing, has influenced what is perceived to be happening to the environment in Quintana Roo. When discussions take place, an ambiguous process is identified where most of the participants are confronted with a choice between their livelihoods and the environmental macro-discourses. Existing empirical studies regarding the everyday experiences of facing this duality/ambiguity are not abundant but might be necessary in order to shed some light on the direct implications of the over-imposing of a mainstream discourse that contests everyday practices. Explorers are sometimes

located between the politics of their identity group (exploration, discovery) and the politics of the activities they perform – opening new paths, mapping the underground and developing more knowledge about it.

7.10 Campaigning for the Cenotes

In light of the previous argument, it is interesting to note that some explorers have founded NGOs and civil society organisations, trying to resolve mainly environmental problems and obtain funds to develop projects related with the aquifer(s) and the exploration of cenotes. The two main examples are SAVE (Society for Akumal's Vital Ecology) and CINDAQ (Centro Investigador del Sistema Acuífero de Quintana Roo). SAVE is a non-profit organisation which was founded in 1998 by Nancy de Rosa (mentioned in previous chapters in association with cenote *Ponderosa*), one of the few female explorers in the area and owner of De Rosa Hotel located in Aventuras Akumal. SAVE states its mission as 'keeping [Quintana Roo's] unique and fragile ecology safe from the dangers of unsustainable development, for our children's futures, and their children's children' (SAVE, 2011). One of the main programmes created by SAVE is the 'Aguas con los Cenotes' campaign, directed at protecting cenotes and the underlying freshwater aquifer, with the battle-cry of:

Protection of these tremendous underground water ways needs to be established to ensure that cenotes and the connecting fresh water systems are protected, so that they can be visited and enjoyed by future generations. The livelihoods of all people on the Peninsula, both tourists and locals, require a healthy and safe aquifer (SAVE, 2011).



Figure 7.10 - Aguas con los Cenotes [Be careful with the cenotes], SAVE's logo to promote awareness of the importance of cenotes.

SAVE gave a presentation at the Cenotes' Forum in Quintana Roo (2009), showcasing the beauty of cenotes and emphasising the importance of protecting them. They have also made multiple videos about cenotes and their aesthetic uniqueness. On the activist side, SAVE also

sent a letter (See Appendix 6) to the President of Mexico, Felipe Calderon, urging him to take action and decisions about the protection of the fresh water aquifer. The letter received replies from both the President of Mexico and CONANP (National Commission of Natural Protected Areas), stating the pressing need for regulating the aquifer and the different activities developed on the surface of the Peninsula. However, the current budget allocated to address the country's environmental problems is limited, and therefore insufficient to approach effectively the protection of cenotes. In spite of the discredit that SAVE has suffered from their actions (see Chapter 6) and the pending court case against its founder, it is possible to say that the SAVE campaign has been one of the few direct actions towards the protection of caves/cenotes and of the aquifer in Quintana Roo.

In contrast, CINDAQ's projects are mainly research orientated, and through their projects they try to:

- Provide underwater cave exploration expertise about the karst aquifer of Quintana Roo, Mexico.
- Develop outreach programs to better educate local and state governments, residents and visitors about the importance and fragility of the region's karst aquifer.
- Develop relationships with the scientific community and concerned national and international institutions and foundations to expand the knowledge base and develop sustainable management practices and policies for Quintana Roo's karst aquifer (CINDAQ 2001).

CINDAQ's founder, Sam Meachan, is a renowned explorer in the area and commonly summoned as an aquifer expert to a number of NGO meetings and forums when the aquifer needs to be discussed. CINDAQ has participated in the shooting of BBC videos of cenotes in the Peninsula, as well as with National Geographic projects about the Peninsula's underground. At the time of the research, CINDAQ had a project called 'adopt a sensor' which consisted of engaging the general public in the collection of data, obtained through depth and temperature sensors. Such data had the intention of contributing to the general understanding of the ecosystem in Quintana Roo.

CINDAQ's projects are more aligned with mainstream activities related with cenotes, i.e. those of research, with mainly natural scientists collecting data and trying to gain a better understanding of the nuances of the system. In this sense, CINDAQ does not have an activist platform, but the results of their explorations and the data obtained from their sensor programme contribute to answering questions posed by the public sector and general population (see previous section).

SAVE and CINDAQ are two grassroots organisations with two completely different missions and approaches. Nevertheless both of them have been founded by explorers who 'fell in love with the cenotes' and are trying to do something in favour of their protection and regulation. In this sense, it is interesting to note the different paths that explorers have taken after being seduced by the beauty and mystery of the underground forest frontier in Quintana Roo. They also present a contrast with the limited environmental civil society sector that exists in Quintana Roo. Many of the largest environmental NGOs have been produced by hotel groups (e.g. Eco-Bahía foundation and Flora, Fauna y Cultura) or landowner groups (e.g. Centro Ecológico Akumal), which means that they have taken a more corporatist (rather than activist) approach to environmental issues in Quintana Roo.

Other groups have also been formed as a direct result of exploration, with the main goal of exploring and reporting their findings, and with no overt political agenda. The QRSS, mentioned earlier in this chapter, was created in 1990 with the pursuit of encouraging the production of cartographic representation of the cave systems (Coke 2001a). QRSS has become one of the 'most' solicited sources of information for other explorers, scientists and, more recently, the public sector. As its founder notes:

The municipality of Tulum is now literally king and queen of all cenotes, they have 86% of all known caves and cenotes in all of Quintana Roo. The seal of the municipality at the bottom shows an underground river. This is going to be the new situation, cave divers and cave explorers are already dealing with landowners and private developers, but we are going to see more involvement at the municipality level. You can call it documentation, but the municipality of Tulum is going to be more involved (Coke, 2009)

Another example is the Grupo de Exploración Ox Bel Ha, which was formed in 1999 and is a non-profit organisation committed to the preservation, conservation and raising of public awareness of the unique and beautiful Ox Bel Ha cave system, although no formal activity of this group was witnessed during the research.

7.11 Cenoting: the act of relating to cenotes

This section has discussed the group of actors broadly categorised as explorers. As a group they are formed by individuals with multiple backgrounds and interests, and when cenoting, their purposes and intentionalities also varied. The empirical information discussed and analysed along this last empirical chapter has attempted to show how explorers have had an important role in constructing the imaginaries of the underground. Through their practices and the physical outcomes of their exploration processes (i.e. stories, maps, and videos) is how most of the non-explorers can imagine these spaces. Such narratives combined with 'lighter'

versions of exploration trips (snorkelling tours, cavern diving) create a sense of mystical, almost ungraspable place, where everybody believes management is needed but no one really knows how.

Differing to the public sector, the members of this group *need* the physicality of the frontier. It is the uniqueness of the place that provides the explorations with the necessary thrill factor. The private sector, often with the advice of explorers, has transformed the underground, making it a controlled environment that can be safely consumed by a 'non-explorer' demographic (i.e. tourist). In contrast, explorers desire an unpredictable environment, for their experiences and exploration consumption they rely on an 'unmodified' place, an almost a capitalistically 'uncommodified' cenote.

The production of stories and narratives as a result of exploration processes contribute to the construct of other forms of commodification, but they also may influence in the near future the creation of new politics surrounding the underground forest frontier. As emphasised above it is important to acknowledge the contributions that this group could bring to the knowledge and understanding of the underground, as they may play a significant role in proposing innovative ways of managing this space. Social Institutions renewal in this sense does not have to come via formalised means but they do need to find a way through the hegemonic political scene.

Chapter Eight

Conclusion

8.1 Introduction

This final chapter considers the varied social constructions and materialities that surround the underground forest frontier in Quintana Roo. It highlights the main findings and developments, emphasising the complex social and natural scenario of the underground.

Following a short summary of the thesis' contents, this chapter will discuss the research questions and hypothesis that have been developed, using a reflexive approach. There will be a discussion of how examining the underground's multiple constructions can provide a better understanding of the politics and management that surround it. Subsequently, this chapter will establish a relational perspective where discursive constructions of the underground and material practices are put into play within and between each of the different sectors: private sector, public sector and explorers. Finally, there will be a consideration of how further research on the underground forest frontier could help to inform the current knowledge of the underground and its applicability and pertinence in other contexts. The thesis concludes by highlighting the importance of the underground as a space to be understood in social terms rather than just in natural ones to be exploited.

8.2 Thesis synopsis

Chapter 1 introduced the thesis and defined cenotes in the context of Quintana Roo. It offered an analysis of the underground forest frontier, illustrating the complexity surrounding its physicality. Utilising images, charts and descriptions, it provided an initiation for any reader unfamiliar with the Yucatan Peninsula's waterscape, developing a necessary foundation for the historical and social analyses of the underground presented in the subsequent chapters.

Chapter 2 developed the thesis' theoretical framework. Many theories that currently inform understandings of socio-nature relations have emphasised the role of non-humans. Although this thesis is not directly influenced by these theories, it does pay attention to the understanding of the physicality of the environment and how it affects socially constructed nature. This thesis argues, once the non-human has been uncovered, one of the main relationships arising between humans and non-humans occurs through commodification

processes of objects in nature. Therefore, one of the main arguments of this thesis is that humans, depending on their position in the system, commodify nature in different ways. Such commodification ranges from merely discursive constructions of nature to the more aggressive material transformations of the environment. To explore this, the thesis drew on the belief that social constructions of nature – how humans perceive, describe and imagine nature – affect and influence how humans relate and act towards it. Finally, to embed the theory in a relevant and wider context, the thesis utilised a social institutions framework as an approach to allow for the transferring of abstract social discourses to the everyday material practices occurring in Quintana Roo.

Chapter 3 described the methodological approach utilised in the field and for data analysis. It described the methodological instruments employed as well as the hurdles and challenges experienced during the field research period.

Chapter 4 recounted the history of cenotes on the Yucatan Peninsula. Based predominantly on historical literature, the main intention here was to convey to the reader the different historical social constructions and materialities that the underground forest frontier has been subjected to. The chapter discussed extensively the different commodification processes that caves and cenotes have undergone. One of the main findings in this chapter was the relevance of international influences on commodity consumption in the ‘local’ management of natural resources. Henequen, chicle and now tourism are strongly linked with the external economy. The same object of nature –cenotes- have offered, through time, diverse opportunities and uses for human consumption.

Chapters 5, 6 and 7 constituted the empirical analysis of the dissertation. Chapter 5 examined the public sector perspective of the underground forest frontier. It discussed, from this perspective, how different aspects of the underground are currently being managed in a piecemeal fashion by various public agencies. It also showed how this sector struggles to provide a unified definition of this space, arguing that the lack of information is one of the main factors blocking an integrated approach to its management. Although these agencies recognise the unique environment and the need for more formal institutions applicable to manage it, the decisions they take about the underground are underpinned by standardised federal schemes for water and land management and, as such, are inappropriate for the Peninsula’s unique waterscape.

Chapter 6 discussed how the private sector has been able to take control over natural resources under the pretext of calling it land. In this sense, a sector of the population that owns the land has now become aware of the profit contained in these natural resources. This chapter examined the position of the private sector in relation to the underground forest frontier, showing how 'having nature' is the first step towards commodifying it. It further showed how nature's commodification in Quintana Roo is almost a repetitive tendency, whereby 'successful' commodifications of nature are often repeated on different scales and locations across the Peninsula. It also demonstrated that it was not just Quintana Roo's unique waterscape which was important for commodification, but also a context of readily ignored environmental regulations and relatively lax labour protection laws.

The final empirical chapter, Chapter 7, examined the role of explorers in producing knowledges, perceptions and materialities of the underground. This group has played an important role in producing information and shaping perceptions of the underground. However their participation is somehow overlooked by other actors, demonstrating an example of how environmental management and the construction of environmental problems in Quintana Roo are dominated and controlled by the public and private sectors. In this chapter, the participation of some NGOs in the underground forest frontier was also discussed. The focus was on NGOs participating directly in the study or management of caves and cenotes, especially those founded by explorers. Data from the research indicate that in the near future one might see more civil society organisations proposing projects and studies concerning the understanding and management of the underground forest frontier, quite possibly in relation to commodification processes.

8.3 Research questions: Research answers

The research questions presented in the introduction have been addressed along the different research stages, from fieldwork to the writing up of this final chapter. This section addresses each of the questions in a succinct direct manner, linking the analysed information with the thesis' objectives.

The first research question ponders about what types of commodification we see in Quintana Roo regarding caves and cenotes and with what social and material outcomes. The relationship between social constructions and material outcomes was difficult to grasp as, most of the time, the social constructions of a certain group influenced in unexpected ways members of other groups. Therefore, one of the main challenges of this first research question was to track

the paths that information takes in relation to the underground forest frontier, and how decisions are taken in accordance with the existing or absent knowledges. The nuances of such a process are discussed in some depth below in section 8.4.

The next set of research questions are related more with the idea of commodity production and its different processes. This set of questions had the intention of not only explaining processes, but also to question whether or not talking about commodities in the context of the underground forest frontier is pertinent.

- 2) Has the underground forest frontier in Quintana Roo – comprising cenotes, caves, water, archaeological artefacts, geology, flora and fauna – been predominantly perceived and promoted as a set of capitalist commodities? And, if so, through what processes and by whom?
- 3) Can nature – in this case, cenotes and caves – be privatised? Can they be accumulated?

Question 2 grounds the ‘situation’ of nature in the context of exploitative practices in the Peninsula, more obviously in relation to tourism in Quintana Roo. Cenotes have indeed been transformed into commodities, but the complexity of the answer arises when we think about which part exactly of the cenotes has been commodified: the water? The land surrounding them? Or the ‘object’ as a whole? Overall, this research has found that cenotes, partially and as a whole, have been commodified in different ways and with different purposes. Economic commodification processes have been promoted, or at least allowed by the public sector, while they have been conducted by the private sector. Finally there are the explorers, who through their practices have been exposing the underground. As a collective they have promoted caves and cenotes as something to be experienced, consumed and/or transformed.

A complete privatisation of cenotes is unlikely ever to occur due to the limits imposed by nature in the process. This is because, while the management of caves and cenotes can be accumulated, the system in itself cannot be, thus transforming management into another type of commodification that individualises nature without necessarily extracting nature from its context. The socio-environmental landscape in Quintana Roo is one that promotes the privatisation of management, including the multiple commodities extracted and/or used in the underground forest frontier.

This research found that all cenotes could be capitalist commodities. It is this potential which invites further research in the area. Having a cenote and not transforming it does not fit the tendencies found in the area. 'Something' – even if this is environmentally friendly tourism, low impact tourism or a natural reserve project – must be done according to the empirical information found in the area. The idea of leaving the underground forest frontier *just as it is* does not seem plausible.

The final thesis question interrogates what is the institutional role of the different actors participating in the underground forest frontier and it is discussed in depth in section 8.5 of this chapter. Overall, this PhD has used a theoretical framework adopting a constructivist approach to give relevance to the physicality of nature grounded in what individuals and groups use to conduct their actions: social institutions. A multi-method approach was taken that had to be reformulated on the ground to address research challenges imposed by some participants in the field.

8.4 Summary of findings

The main interest of this thesis was to explore the ways in which nature is socially constructed, and to show how such constructions have direct consequences as material outcomes. The body of theory used to address such concerns was that relating to the commodification of nature. Throughout, the thesis has indicated that it is more than a monetary capitalistic commodification of nature that is taking place in Quintana Roo, even if most of the commodification processes have led to a monetary capitalistic process of nature consumption.

The thesis examined the above questions through classified sectors (public, private and explorers). Although there were some concerns surrounding such classification due to biased generalisation processes, the approach nevertheless showed that even though a unified vision of the underground forest frontier was not found among every participant within their identity group, it did illustrate how the way in which nature is commodified corresponds with their everyday practices and livelihoods. Such a conclusion is not so unexpected if we believe that our positionality in the field, as described by Pierre Bourdieu, makes us act accordingly. However, the most interesting part of this is that actors, through their more personal stories of the underground, display complex and conflicting relationships with nature. For example, public sector participants openly talk about the need to regulate the system and act accordingly by organising forums; yet, at the implementation level, they admit that a technical (engineering) approach is what is needed, one which actually cannot be achieved through

forums but through field-research activities. Therefore, inviting archaeologists, tourism experts and ecologists to the forums seems to be more a political move to placate those increasingly aware and concerned about the fate of the underground. At the same time, those in the public sector openly recognise that they do not hold the 'proper' knowledge to take decisions, and require the input of foreign experts. Inviting foreigners to 'illustrate' the intricacies of the systems is in itself an interesting process, whereby most of the 'invitees' want to be politically correct and discreet with their research results due to fears that any controversial findings could jeopardise their ability to continue practicing research in Mexico.

In some sense, actors in the public sector are politicising a place that they claim not to know or understand sufficiently to take decisions about, although publicly they pride themselves on having a clear idea of what is needed to manage it. As Noel Castree (2003: 209) points out '[i]t is one thing to have a new political vocabulary [i.e. cenotes, karst, halocline], but quite another to have substantive political concepts that ground new forms of practice'. An example of this is that in spite of favouring technical understandings, no numbers and figures about the underground are being produced by the public sector. This contrasts with the management of 'other' environmental problems in the state such the environmental impacts surrounding the coral reef, which is extensively studied and monitored.

The kind of commodification that the public sector has favoured is a political one, where it oscillates between claiming certain understandings and concurrently denying others. An example of this is when representatives of the public sector claims in interviews that there is no shortage of water in the Peninsula, and that information should be managed discreetly, because the implications of a formal discourse saying 'no shortage of water' would have dramatic repercussions on people's water consumption behaviours. For example, during 2009, the city of Merida started a radio campaign announcing a drought in the area, based on the fact that the year's rains were scarce rather than on the actual availability of fresh water, which most public sector participants claimed was sufficient for years to come. The kind of nature constructed here by the public sector has the main intention directly to influence people's behaviours and actions, although is not completely related with the 'actual' state of nature.

Also interesting is that most of the public sector agents claimed to need 'more' technical information to take decisions, yet most of the literature written so far about the relationship between humans and the biophysical world in the area has focused on the technical side, and

generally with a lack of appreciation of related social dynamics. This technical, almost natural science approach is influenced by the national approach to the environment where 'definitions' and physical description of objects in nature are required in order for decisions to be taken about environmental management. Therefore, what is happening in Quintana Roo is a localised effect of a national approach to environmental problems. Adding a level of complexity to this technical interest is the fact that the physical environment of the Peninsula and Quintana Roo is different to the rest of the country. Such peculiarities have been highlighted when trying to sell Quintana Roo as a tourist destination with unimaginable beauty and places that would take your breath away – when it comes to the management of such a peculiar place, the federal approach is extended and implemented in the area without hesitation. Therefore, it is possible to say that when socially constructing a commodity – an object of nature – the discourse construction is one remarking its uniqueness; however, when it comes to the actual management of this commodity, such uniqueness is a burden. The stories provided by public sector participants about their experiences of the caves and cenotes are evidence of this contradiction that recognises the peculiar but avoids it at the same time.

This managerial public perspective of the underground forest frontier fragments nature. Thus, in reference to the thesis' third research question, it is possible to say that the public sector promotes the individualisation and managerial commodification of nature, leaving to the landowners the decisions about what to do with their land. As discussed before, the land or the agrarian scheme in Mexico, for a long period, involved endowing large extensions of land to people. This ejido scheme satisfied historical needs while simultaneously forging the identity of generations of campesinos. Throughout this thesis, it has been highlighted that such processes in Quintana Roo were different and responded to a local configuration as part of a federal scheme of land management. Quintana Roo's ejidatarios were endowed with some of the largest extensions of land in the whole country, a strategy to compensate for the low productivity of the karst environment's soils.

In general, nostalgic attitudes towards protecting the forest and/or animosity towards rapid urban growth were not found during fieldwork among the ejidatarios. Conversely, among the explorers group there was a yearning for the past, a yearning for the times when it was possible "to dive in Dos Ojos without crashing with another diving" (I46), or when "we did not have to pay an entrance fee for diving" (Calkins and Chapman 1995). This sector has actively created an image of the underground that has been appropriated by the 'other' sectors to be used in different contexts for political, managerial or capitalistic purposes. As discussed earlier,

specific members of this group have also been active in promoting and engaging with the capitalist commodification of cenotes for tourism consumption.

Private sector participants directly favoured a capitalist commodification of nature. Although they talked about 'better management practices' and the need to promote a regulatory process for the underground, they did not come forward with a more active approach. Therefore, their actions are more related with a competition process of obtaining the 'most' or 'better' cenotes or caves and transforming nature. Private sector members are buying and selling places that they can be individualised and isolated, both verbally and through more physical barriers such as fences and roads.

Just a quick look at Quintana Roo's dynamic clearly shows that there is one main style of commodification: an economic one. All levels, from the informal to the formal, are embedded in a capitalist form of commodification. What is distinguishable in this case study is the absence of a counter discourse, even if it is just to mitigate mainstream environmental discourses. In this sense, intentions to conserve and protect caves and cenotes – or even the aquifer – have not come through as a shared objective among groups. Comparatively, and maybe as a result of the mainstream environmental discourse, forms of 'green tourism' have arisen (i.e. nature tours). As part of this process, cenotes and caves have been inserted into a nature-friendly discourse, but not with further conservationist intentions. Instead, the emphasis is on 'experiencing nature' rather than protecting it.

Quintana Roo has been integrated into Mexico's development and the world's economy through the exploitation of commodities in different historical periods: henequen, chicle and tourism (beach, coral-reef, caves and cenotes). This, the youngest state in the country, is a good example of the social processes that drive adaptation to economic demands. In the different historical exploitation activities, discourses about who has the right to exploit such resources have arisen. The different actors in these historical processes have learned corresponding discourses and created social institutions accordingly.

8.5 Sectorial interaction

As previously highlighted, there was discursive agreement among the participants in this research that there is a need for 'actions' to aid the protection of the underground forest frontier. Nevertheless, that perception became diluted when it came to organised actions within each group and between them. During fieldwork sessions in Quintana Roo, the one evident relationship between the public sector and the private sector occurred during the

Swine Flu 'pandemic' crisis, when Quintana Roo, and the country, was closed down for tourism. During this time the private sector unified its voice, asking for help from the authorities. Faced with this 'local' crisis, the government created an emergency budget to provide monetary aid to those involved in tourist activities who were earning the minimum wage or who had lost their jobs as a consequence of the crisis. During fieldwork, this was the only time any intentions of large-scale negotiations between sectors was observable. In terms of cave and cenote management in general, the sectors remained in their own corners, leaving the management of caves and cenotes to each individual's discretion, from major capitalist investments (i.e. Xplor), the creation of profitable private nature reserves (i.e. Rio Secreto), to communal cenotes (i.e. Dos Ojos).

During fieldwork there was no observed intentionality of members within the private sector to meet and discuss cenote management experiences, problems or challenges regarding contracts or agreements with land-owners. This was most likely to be a result of 'commercial competition'; comparatively, however, such associations do exist in the hospitality sector (i.e. *Asociacion the Hoteleros de Quintana Roo, Fideicomiso de la Riviera Maya*). The situation in Quintana Roo, when it comes to environmental management, is that the private sector remains individualised. In spite of this, certain behavioural commonalities are shared in the individual management of cenotes and caves (such as requiring visitors to wash off insect repellent and sun-screen before entering the cave or cenote). It was interesting to observe that such commonalities are being implemented by word-of-mouth processes rather than through organised promotions coming from the public sector. In this sense, informal institutions can be seen as arising from individual decisions applied to specific cases. This is in contrast to other cases in the world where such grassroots informal institutionalisation comes from organised groups (such as NGOs). The fact that these informal norms did not come from organised groups could potentially be for two reasons. First, it may be an early stage of future organised actions; second, that such individualistic tendencies are more common in a neoliberal context where eco-friendly practices and discourses need to be presented to consumers.

It was also observed that natural science researchers (biologists, limnologists, hydrologists), when conducting field research, establish a 'light' relationship with cenote managers and/or owners. The information and results of their research projects, however, have travelled through different means of communication, more often than not through informal means. In this sense, it was interesting to note that although researchers and academics have not

performed formal actions to transmit information to cenote managers, a dissemination of certain knowledge is occurring. As a result, a tendency to conduct 'eco-friendly' practices is observable. However, this is not one that could be classified as a group consensus, but more as homologate activities based on rumours. Historically that is how 'things' have occurred in Quintana Roo, where isolated cases of the commercialisation of cenotes promoted a generalised livelihood in the area, as well as their current individual management.

Although the public sector has manifested a unified perception of the need to do 'something' to regulate the systems, there is no agreement about the possible ways of achieving 'it'. In light of this, an evident interest towards implementing a regulatory framework emerged through the different forums and sessions organised by the different governmental agencies. Nevertheless, and as mentioned earlier, land-owners and tourism promoters were not invited to these events, even though the presentations acknowledged the need to do so in order to promote good practices and protection. What was observable here was that there exists a discourse recognising caves and cenotes, integrating them with the political dimension and placing them within the hierarchy of subjects for public speeches and events. In the neighbouring state of Yucatan this has been taken to the action level with the creation of a Directorate of Karst Systems (*Direccion de Sistemas Carsticos*) as part of the Urban Development and State Environmental Agency. However, in Quintana Roo the outcomes of the Forums have not materialised in a similar manner. Although the states are geographically close, the internal differences are important; the fact that Quintana Roo's economy is almost completely reliant in tourism might be one of the reasons why further action has been resisted.

There have been isolated attempts to consolidate the findings of different sectors, with very limited impacts. An example of this is the publication produced by the Geophysics Institute at the National University in Mexico (UNAM). This project gathered results of exploration groups (i.e. QRSS), outcomes of a research project funded by the private sector (Xcaret) and the Geophysics Institute, which was UNAM's own project. The publication in general does not present any of the results obtained by any of the above-mentioned organisations; rather, it aims to provide a final consideration regarding the aquifer under Quintana Roo political state's delimitation:

In the northeastern part of the peninsula, however [compared to the one found in Merida], the rate of development is so high that it may already be too late to implement

any meaningful sustainable water management programme there. Even so, efforts are under way to raise the issues with regard to conserving water supplies (Urrutia 2005: 94).

This somewhat defeatist position towards the environment might be another reason why cenote and cave management is kept at a discursive political level, assuming that any forms of action would be useless in the current context. It is not unusual to hear speeches mentioning the need for caution with future development, especially in the Tulum area, and portraying the development in the north as an example of what is wrong when it comes to 'sustainable' development. However, in spite of this, there are already well-advanced plans to build an airport in Tulum (at a site about 130km from Cancun airport) in order to facilitate greater tourism development in the area.

The only formal relationship between sectors has been that of INAH with explorers and the private sector, where either the private sector has financed research projects in their properties, or where INAH has intervened to save and protect the material evidence found in a private property.

The relationship between the explorer and private sectors has been and continues to be complex. Early explorers in the Peninsula (such as John Lloyd Stephens) helped to perpetuate the imagery of a land full of wonders and unique landscapes. This then assisted in creating an image of a wild land waiting to be transformed – an image that has continued to be an important theme in the Peninsula's tourism discourses. More recent explorers (e.g. cave divers) have been involved in visiting and documenting the underground forest frontier, which is one of the few places in the world where one can still feel the thrill of exploration, of finding a 'virgin place' never visited before by human beings. Unknowingly, these explorers have also become pioneers of something else. They have helped to pave the way for new types of commodification of the underground. Some of them pioneered this in a more direct and active fashion (i.e. Mike Madden), but most of the time this has occurred indirectly through their romanticised descriptions, images and maps, which subsequently constructed an enticing space for tourism consumption to occur. Explorers have also maintained a constant relationship with landowners since the beginning of their ventures. In this sense, explorers and landowners are among the groups that maintain a more intricate relationship with one another. In some extreme cases, the presence of explorers is, for the landowners, merely the beginning of a profitable enterprise, even when the explorer has a 'purely' exploration-focused purpose in mind. Thus the result of such activities and relationships can often lead to increased commodification and exploitation of the underground forest frontier.

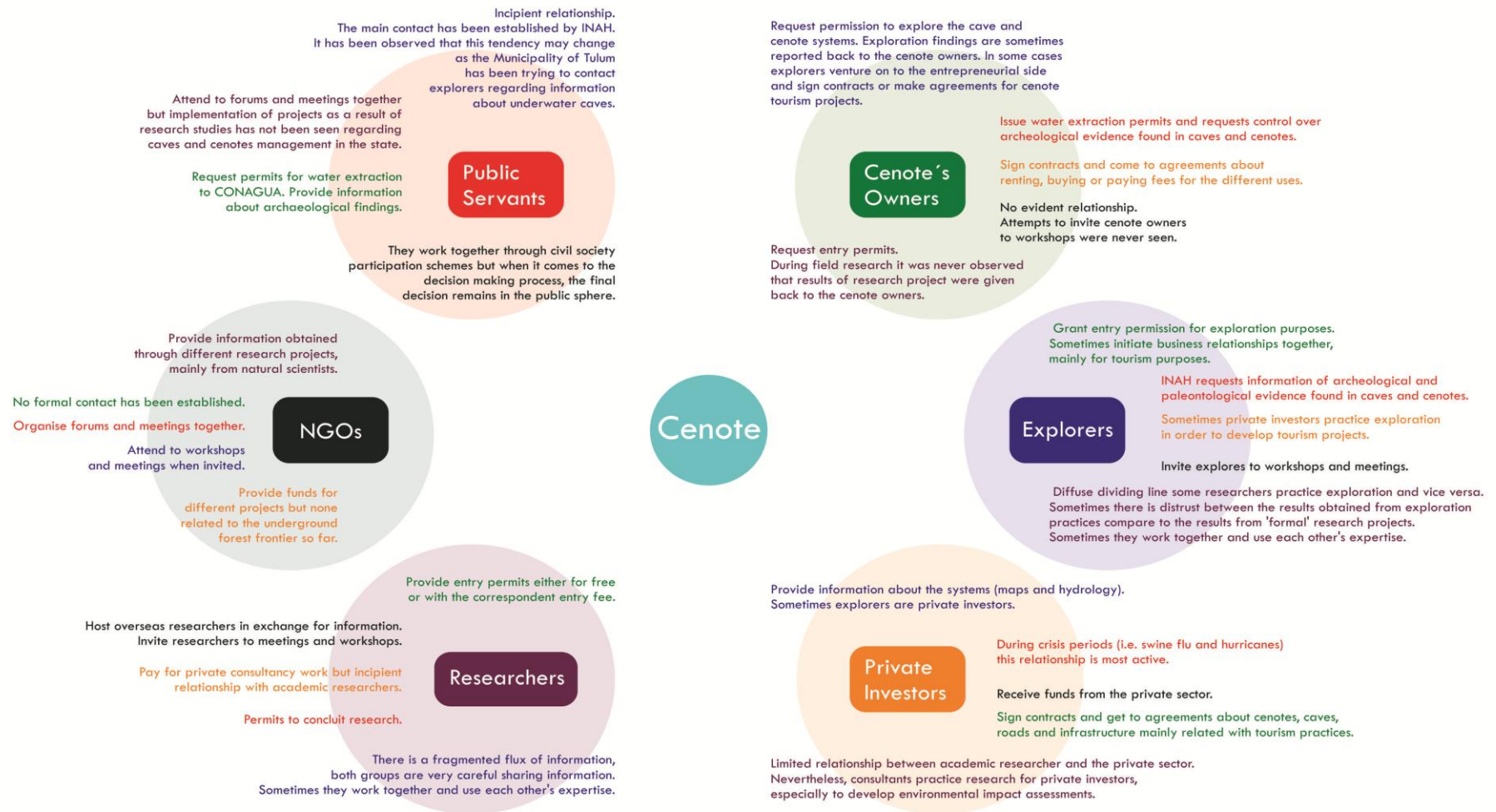


Figure 8.1 – Institutional Interactions in the Underground Forest Frontier.

As previously discussed, the presence of explorers in the area has been somehow denied by the other sectors analysed in this research. They have played a protagonist role in the destiny of the underground forest frontier, but so far their direct political involvement and participation in its management has been minimal.

Over time, cenotes and the systems within them have interacted with different groups of actors and their understandings. Cenotes, for humans, were and still are places to perform sacred and religious rituals, places to hide, places to deposit material goods, places to study, places to explore and places to be regulated. Such historical functions have created multiple social institutions, from the Cult of the Sacred Cross to the contemporary CINDAQ and the government's Committees of Water.

This research project has made two major contributions to the broader academic field: the first one theoretical; the second, practical. The first contribution is related to the theoretical body on the commodification of nature. A wide range of arguments and perspectives have been developed about the status of nature as commodities: from the disbelief that nature can be commoditised due to its intrinsic characteristics, to the idea that everything can be permeated by a monetary and capitalist system. This thesis has argued that in order to understand commodification in the context of environmental studies there is ultimately a need for it to be studied from a historical perspective, where processes of appropriation, modification, exclusion, inclusion and transformation are described and analysed. Through the use of an Environmental History approach, this thesis identified the values given to cenotes through a multiplicity of narratives made by different actors in various historical moments, showing overall the changing commodification relationships with nature. The main question not being related to the direct notion of nature's possible commodification, but rather a focus on what happens to nature in a context of constant and multiple commodification processes.

The practical contribution of the thesis relates to the study of the underground. Not from an extractive perspective with direct environmental repercussions, as has been common in the literature, but rather from the perspective of a fluid frontier that changes its physicality and that is transformed by human actions. So far, literature on the underground has generally focused on the extraction of water or mineral resources in complex socio-political contexts, commonly analysed in the context of intense utilisation, extraction and commercialisation of natural resources. The innovative element of the current study is the coalition of two perspectives – one of utilisation and the other of embodiment – to explain social processes

occurring in the underground forest frontier. Additionally the ideas that have been developed here contribute to the understanding of the 'unseen' and how it can be grasped and managed via a multiplicity of human instruments, even though its 'total' understanding remains out of reach. The overall result of these two contributions has been a study of the commodification processes of the underground forest frontier in a specific space: the Yucatan Peninsula in Mexico.

8.6 Pertinence and relevance: the underground forest frontier outside Quintana Roo

After four years of thinking, dreaming and living this PhD, a set of questions emerge in these final considerations. The idea of conducting research about cenotes and caves in the state of Quintana Roo was appealing not only for the opportunity to conduct research in Mexico in a truly beautiful place (with the exception of Cancun), but also for the opportunity to *explore* new and challenging research territories that are relevant to Human Geography. Thinking it through after all these years, the pertinence of this present study is that a precedent has been set for the future study of the underground aquifer, its governance and management. This research can hopefully open doors for more social science studies of Quintana Roo's underground forest frontier.

The symbolic meanings of caves around the world abound with mythical creatures, religious significances, and a multiplicity of stories of people disappearing or just finding the pot of gold in them. Quintana Roo is no exception, especially due to the importance of cenotes in Maya mythology. Although this dissertation does not talk in depth about the symbolic meanings of caves and cenotes, some of these meanings were found. What this research discovered in Quintana Roo is that such beliefs, although not hidden, are not expressed as social events but mainly as private practices at the household level. Therefore, further studies may find it interesting to research the 'private' versus the public practices that reflect other beliefs and socio-natural relations among landowners in Quintana Roo.

The theoretical framework used in this thesis has potentially wider applications, particularly in the study of the underground and its understanding. Not just in karst environments like in Slovenia, China and Brazil, but also in places where livelihoods rely on the underground – from the extraction of minerals to the management of aquifers. The study of underground spaces worldwide has been mainly based on the understanding of natural processes and infrastructure limitations imposed by that same underground physical environment. This framework could illuminate other studies of the underground, its perceptions and

management. In so doing, such studies would build on the understanding of an environment that most of the time is hidden from our sight, and within which processes of transformation are not easily perceived.

Future studies of the underground may consider the relevance of this frontier for geographical literature and the understanding of historical processes of commodification where humans and nature have left their marks.

Reference List

- Agrawal, A. and C. Gibson (1999) 'Enchantment and disenchantment: The role of community in natural resource conservation,' *World Development* 27(4), pp. 629–649.
- Aitken, S. and J. Craine (2005) "Visual methodologies: what you see is not always what you get" in R. Flowerdew and D. Martin (eds), *Methods in Human Geography. A guide for students doing a research project*, Edinburgh: Pearson Education Limited: 250-269.
- Alanis, G. de A.(2010) 'Los Ultimos secretos del inframundo mayo,' *Mexico Desconocido* 35(406): 26-42.
- Albin-Najera, S. (2011) 'More of Mérida and My First Experience Swimming in a Cenote,' *The Mexico Report* May 10 (<http://themexicoreport.com/>)
- Alcocer, J., A. Lugo, L. E. Marín and E. Escobar (1998) 'Hydrochemistry of waters from five cenotes and evaluation of their suitability for drinking-water supplies, northeastern Yucatan, Mexico,' *Hydrogeological Journal* 6: 293-301.
- Alexander, R. T. (2004) *Yaxcaba and the Caste War of Yucatan*. Albuquerque: University of New Mexico.
- Alexander, R. T. (2008) 'Architecture, Haciendas and Economic Change in Yaxcabá, Yucatán, Mexico,' *Ethnohistory* 50(1): 191-221.
- Alston, L. J., S. Mattiace and T. Nonnenmacher (2009) 'Coercion, Culture, and Contracts: Labor and Debt on Henequen Haciendas in Yucatán, Mexico, 1870–1915,' *The Journal of Economic History* 69(1): 104-137.
- Andrews, A. P. and R. Corletta (1995) 'A Brief History of Underwater Archaeology in the Maya Area,' *Ancient Mesoamerica* 6: 101-117.
- Andrews, E. W. (1960) 'Excavations at Dzibilchaltun, Northwestern Yucatan, Mexico,' *Proceedings of the American Philosophical Society* 104(3): 254-265.
- Andrews, E. W. (1970) *Balancanche: Throne of the Tiger Priest*, New Orleans: Middle American Research Institute, Tulane University.
- Arnold, C. and F. Frost (1909) *American Egypt: A Record of Travel in Yucatan*, London, Hutchinson.

- Arrivillaga, A. and M. A. Garcia (2004) "Status of coral reefs of the Mesoamerican Barrier Reef Systems project region, and reefs of El Salvador, Nicaragua and the Pacific Coasts of Mesoamerica" in C. Wilkinson (ed), *Status of coral reefs of the world: 2004*, Townsville, Queensland: Australian Institute of Marine Science: 473-491.
- Assies, W. (2008) 'Land Tenure and Tenure Regimes in Mexico: An Overview,' *Journal of Agrarian Change* 8(1): 33-63.
- Avila, F. (1974) *El General May, último jefe de las tribus mayas*, Merida: Gobierno del Estado.
- Back, W. (1995) 'Water management by early people in the Yucatan, Mexico,' *Environmental Geology* 25(4): 239-242.
- Back, W., B. B. Hanshaw, J. S. Herman and J. N. Van Driel (1986) 'Differential dissolution of a Pleistocene reef in the ground-water mixing zone of coastal Yucatan, Mexico,' *Geology*, 14: 137-140.
- Back, W. (1999) "The Yucatan Peninsula, Mexico" in David Drew and Heinz Hötzl (eds) *Karst Hydrogeology and Human Activities: Impacts, Consequences and Implications*, Rotterdam, A. A. Balkema: 14-19.
- Back, W. and J. M. Lesser (1981) 'Chemical constraints of Groundwater Management In the Yucatan Peninsula, Mexico,' *Journal of Hydrology* 51(1-4): 119-130.
- Bakker, K. (2005) 'Neoliberalizing Nature? Market Environmentalism in Water Supply in England and Wales,' *Annals of the Association of American Geographers* 95(3): 542-565.
- Bakker, K. (2007) "Neoliberalising Nature? Market Environmentalism in water supply in England and Wales: in Nik Heynen, James McCarthy, Scott Prudham and Paul Robbins (eds) *Neoliberal Environments: False promises and unnatural consequences*, London: Routledge: 101-113.
- Barke, M. (1984) 'Merida, Yucatan: A core within a periphery,' *Scottish Geographical Journal* 100(3): 160-170.
- Barnes, G. (2009) 'The Evolution and Resilience of Community-based Land Tenure in Rural Mexico,' *Land Use Policy* 26(2): 393-400.
- Barsimantov, J., A. Racelis, G. Barnes and M. DiGiano (2010) 'Tenure, tourism and timber in Quintana Roo, Mexico: land tenure changes in forest ejidos after agrarian reform,' *International Journal of the Commons* 4(1): 293-318.

- Bassie-Sweet, K. (1991) *From the Mouth of the Dark Cave*, Norman: University of Oklahoma Press.
- Bauer-Gottwein, P., B. R. N. Gondwe, G. Charvet, L. Marín, M. Rebolledo-Vieyra and G. Merediz-Alonso (2011) 'Regional Review: The Yucatán Peninsula karst aquifer, México,' *Hydrogeology Journal* 19(3): 507-524.
- Beddows, P. A. (2002) 'Where does the sewage go? The karst groundwater system of Municipalidad Solidaridad, Quintana Roo,' *AMCS Activities Newsletter* 25: 47-52.
- Beddows, P. A. (2004) *Groundwater Hydrology of a Coastal Conduit Carbonate Aquifer: Caribbean Coast of the Yucatán Peninsula, México*, PhD Thesis, University of Bristol.
- Beddows, P. A., P. L. Smart, F. F. Whitaker and S. L. Smith (2007) 'Decoupled fresh–saline groundwater circulation of a coastal carbonate aquifer: Spatial patterns of temperature and specific electrical conductivity,' *Journal of Hydrology* 346(1-2): 18-32.
- Beck, B. F. (1986) 'A generalized genetic framework for the development of sinkholes and Karst in Florida, U.S.A.,' *Environmental Geology* 8(1-2): 5-18.
- Bennett, R. (1930) 'Maya Stone Road Links Two City Ruins,' *The Science News-Letter*: 183+188.
- Blanchon, P. and J. Shaw (1995) 'Reef drowning during the last deglaciation: Evidence for catastrophic sea-level rise and ice-sheet collapse,' *Geology* 25(1): 4-8.
- Blomley N. (2007) "un-real estate: propriety space and public gardening" in Nik Heynen, James McCarthy, Scott Prudham and Paul Robbins (eds) *Neoliberal Environments: False promises and unnatural consequences*, London: Routledge: 177-189.
- Bonor, J. (1989) *Las Cuevas Mayas: Simbolismo y Ritual*, Madrid: Universidad de Madrid.
- Bosselman, F. P. (1978) *In the Wake of the Tourist: Managing Special Places in Eight Countries*, Washington DC: The Conservation Foundation.
- Bourdieu, P. (1990) *The Logic of Practice*, Stanford: Stanford University Press.
- Bourdieu, P. and L. Wacquant (1992) *An Invitation to Reflexive Sociology*. Chicago: Chicago University Press.
- Bradshaw, M. and E. Stratford (2005) "Qualitative Research Design and Rigour" in I. Hay (ed) *Qualitative Research Methods in Human Geography*, Oxford: Oxford University Press: 67-76.

- Brady, J. E. and K. M. Prufer (2005) *In the Maw of the Earth Monster Studies of Mesoamerican Ritual Cave Use*, Austin: University of Texas Press.
- Bray, D. B, E. A. Ellis, N. Armijo-Canto and C. T. Beck (2004) 'The institutional drivers of sustainable landscapes: a case study of the 'Mayan Zone' in Quintana Roo, Mexico,' *Land Use Policy* 21(4): 333-346.
- Brenner, N. and N. Theodore (2007) "Neoliberalism and Regulation of the Environment" in Nik Heynen, James McCarthy, Scott Prudham and Paul Robbins (eds) *Neoliberal Environments: False promises and unnatural consequences*, London: Routledge: 153-160.
- Brook, G. A., J. B. Cowart and S. A. Brandt (1998) "Comparison of Quaternary environmental change in eastern and southern Africa using cave speleothem, tufa and rock shelter sediment data" in A. S. Alsharhan, K. W. Glennie, G. L. Whittle and C. G. Kendall (ed) *Quaternary deserts and climatic change*, Rotterdam: A. A. Balkema: 239-250.
- Bridge, Gavin (2007) "Acts of Enclosure: Claim staking and land conversion in Guyana's gold fields" in Nik Heynen, James McCarthy, Scott Prudham and Paul Robbins (eds) *Neoliberal Environments: False promises and unnatural consequences*, London: Routledge:74-88
- Bryant, G. and D. Jary (eds) (1991) *Giddens' Theory of Structuration: a critical appreciation*. London: Routledge.
- Brymant, A. (2004) *Social Research Methods*, Oxford: Oxford University Press.
- Bush Romero, P. (1964) *Under the Waters of Mexico*, Carlton Press.
- Casares, D. (1906) 'A notice of Yucatan with some remarks on its water supply,' *Proc American Antiquarian Society* 17: 207-230.
- Castree, N. and B. Braun (1998) *Remaking Reality, nature at the millennium*. London: Routledge.
- Castree, N. (2000) 'Environmental Economics' in *The Dictionary of Human Geography* London Blackwell Publishing: 217.
- Castree, N. (2001) "Marxism, Capitalism, and the Production of Nature" in N. Castree and B. Braun (eds) *Social Nature, theory, Practice and Politics*, Oxford: Blackwell Publishers: 189-207.

- Castee, N. (2003) 'Commodifying What Nature?,' *Progress in Human Geography* 27(3): 273-297.
- Castree, N., D. Demeritt, D. Livermann and B. Rhoads (eds) (2009) *A Companion to Environmental Geography*, Sussex: Wiley-Blackwell.
- Castree, N. (2010a) 'Neoliberalism and the Biophysical Environment 1: What 'Neoliberalism' is, and What Difference Nature Makes to it,' *Geography Compass* 4(12): 1725-1733.
- Castree, N. (2010b) 'Neoliberalism and the Biophysical Environment 2: Theorising the Neoliberalisation of Nature,' *Geography Compass* 4(12): 1734-1746.
- Castree, N. (2011) 'Neoliberalism and the Biophysical Environment 3: Putting Theory into Practice,' *Geography Compass* 5(1): 35-49.
- Castro, R. (2000). *La vida en la adversidad: el significado de la salud y la reproducción en la pobreza*, Cuernavaca: Centro Regional de Investigaciones Multidisciplinarias: UNAM.
- Chapman, J. L. and J. Calkins (1995) 'Exploring the Myseries of the Cenotes in the Yucatan Peninsula' Unpublished Manuscript.
- Chardon R. (1961) *Geographic Aspects of Plantation Agriculture in Yucatan*, Washington DC: National Research Council.
- Charnay, D. ([1882] 1992) *Viaje al país de los mayas*, Merida: Dante.
- Charnay, D. (1888) *Ma dernière expedition au Yucatan*, Mérida: la Revista de Mérida.
- Chowdury, R. R. and B. L. Turner II (2006) 'Reconciling Agency and Structure in Empirical Analysis: Smallholder Land Use in the Southern Yucatan, Mexico,' *Annals of Association of American Geographers* 96(2): 302-322.
- CINDAQ (2011) El Centro Investigador del Sistema Acuífero de Quintana Roo <http://www.cindaq.org/> [last accessed October 12 2011].
- Clancy, M. C. (2001) *Exporting Paradise: Tourism and Development in Mexico*, Pergamon: Oxford.
- Clark, G. (2005) "Secondary data" in R. Flowerdew and D. Martin (eds), *Methods in Human Geography. A guide for students doing a research project*, Edinburgh: Pearson Education Limited: 57-77.

- Coggins, C. C. (1992) *Artifacts from the Cenote of Sacrifice, Chichen Itza, Yucatan : textiles, basketry, stone, bone, shell, ceramics, wood, copal, rubber, other organic materials, and mammalian remains*, Harvard University: Harvard University Press.
- Cohen, E. (1988) 'Authenticity and commoditization in tourism,' *Annals of Tourism Research* 15(3): 371-386.
- Coke, J G. (1986) 'Explorations underneath Quintana Roo' *CEDAM: World Headquarters News* 3(2): 3.
- Coke, J G. (1987) 'Underwater Caves of Quintana Roo,' *AMCS Activities Newsletter* 16: 59-63.
- Coke, J G. (2001a) 'The Quintana Roo Speleological Survey,' *AMCS Activities Newsletter* 24: 95-98.
- Coke, J. G. (2001b) 'Surveying Underwater Caves,' *AMCS Activities Newsletter* 24: 59-68.
- Cole, L. J. (1907) 'The Occurrence of Heroes in Yucatan,' *New Series* 26: 637-638.
- Cole, L. J. (1910) 'The Caverns and People of Northern Yucatan,' *Bulletin of the American Geographical Society* 42: 333
- Collins, C. O. (1979) 'Site and Situation Strategy in Tourism Planning: A Mexican Case Study,' *Annals of Tourism Research* 6(3): 251-366.
- Collins, H. and R. Evans (2002) 'The third wave of science studies: Studies of Expertise and Experience,' *Social Studies of Science* 32(2): 235-296.
- Commons, J. (1934) *Institutional Economics: its place in political economy*, London: MacMillan.
- CONAGUA (2010) *Estadísticas del Agua en México, edición 2010*, Insurgentes: Comisión Nacional de Agua (CONAGUA).
- Coordinación de Asesores Procuraduría Agraria (2006) *Estadísticas Quintana Roo*, 31 de diciembre de 2006 <http://www.pa.gob.mx/estados/estadisticas/qoo.html> (accessed March 8 2010).
- Corbera (2005) *Interrogating development in carbon forestry activities: a case study from Mexico*, PhD Thesis, University of East Anglia.
- Cornelius, W. and D. Myhre (eds) (1998) *The Transformation of Rural Mexico: Reforming the Ejido Sector*, Center for US-Mexican Studies, University of California: San Diego.
- Curl, R. L. (1964) 'On the Definition of a Cave,' *NSS Bulletin* 26(1): 1-6.

- Curl, R. L. (1966) 'Caves as a Measure of Karst,' *The Journal of Geology* 74(4): 798-830.
- Curtis, J. H., D. A. Hodell, and M. Brenner (1996) 'Climate Variability on the Yucatan Peninsula (Mexico) during the Past 3500 Years, and implications for Maya Cultural Evolution' *Quaternary Research* 46 (1): 37-47.
- Cvijić, J. (1893) *Das karstphänomen: Versuch einer morphologischen monographie*, Vienna: E. Hölzel in Wien.
- Dasher, G. and D. Boyer (1997) "Dye Tracings in The Spring Creek Area, Greenbrier County, West Virginia" in T. Younos, T. J. Burbey, E. H. Kastning and J. A. Poff (eds) *Karst-Water Environment Symposium Proceedings*, Virginia Polytechnic Institute and State University: Blacksburg: 23-36.
- de Anda, G. (2003) *Los cenotes y su reconocimiento, una aportación metodológica*, BA Thesis. Universidad Autónoma de Yucatán (UADY): Merida.
- de la Garza, M., and A. L. Izquierdo (1983). *Relaciones historico-geograficas de la Gobernacion de Yucatan*. Vols. I and II. Universidad Nacional Autonoma de Mexico. Mexico, D.F.
- de Janvry, A., G. Gordillo and E. Sadoulet (1997) *Mexico's Second Agrarian Reform: Household and Community Responses, 1990-1994*, Center for US-Mexican Studies, University of California: San Diego.
- de Landa, D. ([1566] 2001) *Relación de Las Cosas de Yucatán*, Merida: Dante.
- DeWalt, B., A. Murphy and M. Rees (1994) *End of Agrarian Reform in Mexico: Past Lessons, Future Prospects*, Center of US-Mexican Studies, University of California: San Diego
- Díaz, R. (1999) 'La bonanza del chicle en la frontera Caribe de México: Indígenas y empresarios, 1918-1930,' *Revista Mexicana del Caribe* 4(3): 172-193.
- Dirección General de Comunicación Social (2010) "Se Crea una Red Nacional de Promotores de Inversiones en Ejidos" *Boletín* 022, Mexico Df, 21 February http://www.pa.gob.mx/pa/sala_prensa/boletines/2010/2210.html (accessed March 8 2010)
- Dowling, R. (2005) "Power, Subjectivity and Ethics in Qualitative Research" in I. Hay (ed) *Qualitative Research Methods in Human Geography*, Oxford: Oxford University Press: 19-29.
- Duffy, R. (2002) *A Trip Too Far: Ecotourism, Politics and Exploitation*. London: Earthscan.

- Dumond, D. (1985) *'The Talking Crosses of the Yucatán: A New Look at their History,' Ethnohistory* 32(4): 291-308.
- Edgerton, S. Y. (2001) *Theaters of Conversion: Religious Architecture and Indian Artisans in Colonial Mexico*, Albuquerque: University of New Mexico Press.
- Edwards, C. R. (1957) *Quintana Roo: Mexico's Empty Quarter*, Master's thesis, Berkeley: University of California Press.
- Edwards, C. R. (1986) 'The Human Impact on the Forest in Quintana Roo, Mexico,' *Journal of Forest History* 30(3): 120-127
- Endfield, G. (2009) "Environmental History" in N. Castree, D. Demeritt, D. Livermann and B. Rhoads (eds) *A Companion to Environmental Geography*, Sussex: Wiley-Blackwell: 223-237.
- Escobar, A. (1996) 'Construction nature: Elements of a post-structuralist political ecology,' *Future* 28(4): 325-343.
- Evans, S. (2007) *Bound in twine: the history and ecology of the henequen-wheat complex for Mexico and the American and Canadian Plains, 1880-1950*, Texas: A&M University Press.
- Evia Cervantes, C. A. (2002a). *El mito de la serpiente de las grutas*. Unicornio, suplemento cultural del diario Por Esto .
- Evia Cervantes, C. A. (2002b) 'Baño de cenote' *Por Esto*, July 2.
- Evia Cervantes, C. A. (2005a), 'La función social de las grutas' *Revista de la Universidad Autónoma de Yucatán*, 195: 20-26.
- Evia Cervantes, C. A. (2005b) 'Las cuevas de Santa Rita' *Por Esto*, May 15.
- Evia Cervantes, C. A. (2007) 'Las cuevas en la Historia de la Humanidad' *Por Esto*, May 13.
- Eyles, J. (1988) *Research in Human Geography*, Oxford: Blackwell Publishers.
- Farriss, N. M. (1984) *Maya society under colonial rule: the collective enterprise of survival* Princeton: Princeton University Press.
- Fedick, S. L. and B. A. Morrison (2004) 'Ancient use and manipulation of landscape in the Yalahau region of the northern Maya lowlands,' *Agriculture and Human Values* 21(2-3): 207-21.

- Folan, W (1974) 'The Cenote Sagrado of Chichen Itza, Yucatan, Mexico, 1967-68: The excavation, plans and preparation,' *The International Journal of Nautical Archaeology and Underwater Exploration* 3(2): 283-293.
- Folan, W, B. Faust, W. Lutz, and J. D. Gunn (2000) 'Social and Environmental Factors in the Classic Maya Collapse', in W. Lutz, L. Prieto, and W. Sanderson (eds) *Population, Development, and Environment on the Yucatan Peninsula: From Ancient Maya to 2030*, Vienna: Remaprint: 2-31.
- Ford D. and P. Williams (2007) *Karst Hydrogeology and Geomorphology*. John Wiley & Sons.
- Forero, O. A. and M. R. Redclift (2005) 'The Role of the Mexican State in the Development of Chicle Extraction in Yucatan and the Continuing Importance of Coyotahe,' *Revista Mexicana de Caribe* 10(2): 119-158.
- Forero, O. A. and M. R. Redclift (2006) 'The Role of the Mexican State in the Development of Chicle Extraction in Yucatán, and the Continuing Importance of Coyotaje,' *Journal of Latin American Studies* 38(1): 65–93.
- Forero, O. A. and M. R. Redclift (2007) 'The production and marketing of sustainable forest products: chewing gum in Mexico,' *Development in Practice* 17(2): 196-207.
- Gandy, M. (2004) 'Rethinking urban metabolism: Water, space and the modern city,' *City* 8(3): 363-379.
- Gallareta, T. (2007) 'Cenotes y asentamientos humanos en Yucatán,' *Arqueología Mexicana* 14(1): 36–43.
- Gibson, C., M. McKean and E. Ostrom (2000) *People and Forest, Communities, Institutions and Governance*, Cambridge: MIT Press.
- Giddens, A. (1984) *The constitution of society: Outline of the theory of structuration*, Cambridge: Polity Press.
- Giddens, A. (1991) "Structuration Theory: past, present and future" in C. Bryant and D. Jary (eds) *Giddens' theory of structuration a critical appreciation*, London : Routledge: 201-209.
- Gill, R. B., P. A. Mayewski, J. Nyberg, G. H. Haug and L. C. Peterson (2007) 'Drought and the Maya Collapse,' *Ancient Mesoamerica* 18(2): 283-302.

- Gomes, N. A. de N. C., (1985) 'Modern stromatolites in a karst structure from the Malmani Subgroup, Transvaal Sequence, South Africa,' *Transactions of the Geological Society of South Africa* 88(1): 1-9.
- Gondwe, B. R. N. (2010) *Exploration, modelling and management of groundwater-dependant ecosystems in karst. The Sian Ka'an case study, Yucatan, Mexico*, PhD Thesis Technical Institute of Denmark.
- Gondwe, B.R.N., S. Lerer, S. Stisen, L. Marín, M. Rebolledo-Vieyra, G. Merediz-Alonso and P. Bauer-Gottwein (2010) 'Hydrogeology of the south-eastern Yucatan Peninsula: New insights from water level measurements, geochemistry, geophysics and remote sensing,' *Journal of Hydrology* 389: 1-17,
- Gondwe, B.R.N., D. Ottowitz, R. Supper, K. Motschka, G. Merediz-Alonso and P. Bauer-Gottwein (forthcoming). 'Exploring regional-scale preferential flow paths in the karst aquifer of Southern Quintana Roo, Mexico,' *Journal of Hydrology*.
- Gonzalez Gonzalez, A. H., C. Rojas Sandoval, A. Terrazas Mata, M. Benavente Sanvicente and W. Stinnesbeck, (2006) 'Poblamiento temprano en la Península de Yucatán: evidencias localizadas en cuevas sumergidas de Quintana Roo, México,' in J. C. Jimenez, O. J. Polaco, G. Martinez and R. Hernandez (ed) *Simposio Internacional el Hombre Temprano en América*, Mexico: INAH 2006.
- Gonzalez Gonzalez, A. H., C. Rojas Sandoval, E. Acevez Núñez, J. Avilés Olgúin, S. Analco Ramírez, O. Lara, P. Luna Erreguerena, A. Velázquez Morlet, W. Stinnesbeck, A. Terrazas Mata, and M. Benavente Sanvicente (2008) "Evidence of Early Inhabitants in Submerged Caves in Yucatan, Mexico" in M. E. Leshikar-Denton and P. Luna Erreguerena (eds) *Underwater and Maritime Archaeology in Latin America and the Caribbean*, Walnut Creek: West Coast Press, 127-142.
- Gonzalez Grosjean, S. A. and C. Rojas Sandoval (2007) 'El Cenote Ziiz Ha: Evidencias de Artería,' *Arqueología Mexicana* 17: 64-65.
- Grimes, K. G. (1994) 'The Southeast Karst Province of South Australia,' *Environmental Geology* 23(2): 134-148.
- Grove, R. H. (2001) "Environmental History" in Peter Burke (ed) *New Perspectives on Historical Writing*, Polity Press, Cambridge" 261- 282.

- Hall, F. G. (1936) "Physical and chemical survey of cenotes of Yucatan" in A. S. Pearse, E. P. Creaser, F. G. Hall (eds) *The Cenotes of Yucatan: A zoological and hydrographic survey*, Washington: Carnegie Institution: 5-18.
- Harvey, D. (1996) *Justice, Nature and the Geography of Difference*, Oxford: Blackwell.
- Harvey, D. (2003) *The New Imperialism*, Oxford: Oxford University Press.
- Haug, G. H., D. Gunther, L. C. Peterson, D. M. Sigman, K. A. Hughen, G. Aeschlimann, (2003) 'Climate and the collapse of Maya Civilization,' *Nature* 299: 1731-1735.
- Heilprin, A. (1891) 'Geological Researches in Yucatan,' *Proceedings of the Academy of Natural Sciences of Philadelphia* 43: 136-158.
- Heltberg, R. (2002) 'Property Rights and Natural Resource Management in Developing Countries,' *Journal of Economic Surveys* 16(2): 189-214.
- Hevly, R. H. (1974) 'Recent Paleoenvironments and Geological History at Montezuma Well,' *Journal of the Arizona Academy of Science* 9(1): 66-75.
- Heynen, H., J. McCarthy, S. Prudham and P. Robbins (eds) (2007) *Neoliberal Environments*, New York and London: Routledge.
- Hidden World's Cenote Park (2008) "About Hidden Worlds" <http://www.hiddenworlds.com/AboutHiddenWorlds.aspx> (accessed March 4 2010).
- Hiler, H. (1987) 'Cave Diving in the Land of the Living Maya,' *National Association for Cave Diving News* 19(4):1-4.
- Hodell, D. A, J. H. Curtis, and M. Brenner (1995) 'Possible role of climate in the collapse of Classic Maya civilization,' *Nature* 375: 391-394;
- Hoggart, K., L. Lees and A. Davies (2002) *Researching in Human Geography*. Oxford: Arnold Publishers, Oxford University Press Inc.
- Huntington, E. (1912) 'The Peninsula of Yucatan,' *Bulletin of the American Geographical Society* 44(11): 801-822.
- INAH (2008) "Cave and Cenotes Treasure exhibited" Mexico's *National Institute of Anthropology and History (INAH)*, October 20.
- INEGI (2009) *Estados Unidos Mexicanos Censo Agropecuario 2007, IX Censo Ejidal*, Aguascalientes: Instituto Nacional de Estadística y Geografía (INEGI).

- INEGI (2011) *Mexico in Cifras* Instituto Nacional Estadísticas y Geografía (INEGI): Mexico City.
- Isola, R. (1987) *Tourism in the Periphery: An Examination of the impact of Resort Tourism on the Socio-Economic Organization of a Rural Mayan Village*, MA Thesis, Simon Fraser University.
- Jaume, D., G. A. Boxshall and W. F. Humphreys (2001) 'New stygobiont copepods (Calanoida; Misophrioida) from Bundera Sinkhole, an anchialine cenote in north-western Australia,' *Zoological Journal of the Linnean Society* 133(1): 1–24.
- Jordan, A., and T. O'Riordan (1996) 'Institutional adaptation to Global Environmental Change (I): Social Institutions, Policy Change and Social Learning,' Centre for Social and Economic Research on the Global Environment (CSERGE) Working Paper GEC 95-20.
- Joseph, G. M. (1982) *Revolution from without: Yucatan, Mexico and the United States, 1880-1924*, Cambridge: Cambridge University Press.
- Joseph, G. M. (1985) 'From Caste War to Class War: The Historiography of Modern Yucatán (c. 1750-1940),' *The Hispanic American Historical Review* 65(1): 111-134.
- Juarez, A. M. (2002) 'Ecological Degradation, global tourism, and inequality: Maya interpretations of the changing environment in Quintana Roo, Mexico,' *Human Organization* 61(2): 113–124.
- Konrad, H. W. (1991) "Capitalism on the Tropical-Forest Frontier: Quintana Roo, 1880s to 1930" in J. T. Brannon and G. M. Joseph (eds), *Land, Labor and Capital in Modern Yucatan: Essays in Regional History and Political Economy*, Tuscaloosa: The University of Alabama Press: 112-142.
- Knab, O. (2003) 'The Cenotes North of Tunkas, Yucatán,' *AMCS Activities Newsletter* 26: 84-91.
- Kurjack, E. B. (1977) 'Sacheob: parentesco y desarrollo de estado maya' in *Los procesos de cambio en Mesoamerica y áreas circunvecinas*, Guanajuato: Sociedad Mexicana de Antropología, XV Mesa Redonda.
- Lanfant, M. F. (1995) "Introduction" on M. F. Lanfant, J. B. Allcock and E. M. Bruner (eds) *International Tourism Identity and Change*, London: Sage: 1-23.
- Landon, C. (1935) 'The Chewing Gum Industry,' *Economic Geography* 11(2):183-190.

- Leach, M., R. Mearns and I. Scoones (1999) 'Environmental Entitlements: Dynamics and Institutions in community based natural resource management,' *World Development* 27 (2): 225-247.
- Leal-Bautista, R. M., G. Hernández-Zárate, N. A. Jamime M., G. Cuevas R. and G. Velázquez Oliman (2011) 'Pathogens and Pharmaceuticals Pollutants as Indicators of Contamination at the Northeastern Aquifer of Quintana Roo,' *Tropical and Subtropical Agroecosystems* 13: 211-219.
- Lee Peluso, N. (2007) "Enclosure and privatization of neoliberal environments" in Nik Heynen, James McCarthy, Scott Prudham and Paul Robbins (eds) *Neoliberal Environments: False promises and unnatural consequences*, London: Routledge: 89-93.
- Levis-Strauss, C. (1992) *Tristes Tropiques*, Penguin Books: New York.
- Lockhart, J. (1969) 'Encomienda and Hacienda: The Evolution of the Great Estate in the Spanish Indies,' *The Hispanic American Historical Review* 49(3): 411-429.
- López Ramos, E. (1975) "Geological summary of the Yucatan Peninsula" in A.E.M. Nairn and F.G. Stehli (eds) *The Ocean Basins and Margins: The Gulf of Mexico and the Caribbean*, New York: Plenum Press: 257-282.
- Luna Erreguerena, P. (2008) "The Submerged Cultural Heritage in Mexico" in M. E. Leshikar-Denton and P. Luna Erreguerena (eds) *Underwater and Maritime Archaeology in Latin America and the Caribbean*, Walnut Creek: Left Coast Press, pp. 55-66.
- MacDuff, E. (1991) 'Chicleros: A Season in the Jungle' in U. Keller and C. Demangate (eds) *The Modern Maya : a culture in transition*, Albuquerque: University of New Mexico Press: 89-122.
- MacLeod, B. and D. Puleston (1979) 'Pathways into darkness: the search for the road to Xibalba' in M. G. Robertson and D. C. Jeffers (eds) *Third Palenque Round Table, 1978, Part 1*. Palenque Round Table Series 4, Palenque/Monterey: Pre-Columbian Art Research Institute/Hearl Printers: 71-78.
- MacSwiney G, C. M., P. Vilchis L., F. M. Clarke and P. A. Racey (2007) 'The importance of cenotes in conserving bat assemblages in the Yucatan, Mexico,' *Biological Conservation* 136(4): 499-509.
- MacSwiney G, C. M., B. B. Cimé, F. M. Clarke and P. A. Racey (2009) 'Insectivorous bat activity at cenotes in the Yucatan Peninsula, Mexico,' *Acta Chiropterologica* 11(1): 139-147.

- Mansfield, B. (2003) 'Imitation crab' and the material culture of commodity production' *Cultural Geographies* 10: 176-195.
- Mansfield, B. (2004) 'Rules of Privatization: Contradictions in Neoliberal Regulation of North Pacific Fisheries,' *Annals of the Association of American Geographers* 94(3): 565-584.
- Mansfield, B. (2007) "Neoliberalism in the oceans: "rationalization," property rights, and the commons question" in N. Heynen, J. McCarthy, S. Prudham and P. Robbins (eds), *Neoliberal Environments: False promises and unnatural consequences*, London: Routledge: 63-73.
- Manuel-Navarrete, D., M. Pelling and M. R. Redclift (2009a) "Governance as Process: Powerspheres and Climate Change Response" Environment, Politics and Development Working Paper #9, Department of Geography, King's College London.
- Manuel-Navarrete, D., M. Pelling, and M. R. Redclift (2009b) "Coping, governance, and development: The climate change adaptation triad" Environment, Politics and Development Working Paper #18, Department of Geography, King's College London.
- Manuel-Navarrete, D., M. Pelling and M. R. Redclift (2011) 'Critical adaptation to hurricanes in the Mexican Caribbean: Development visions, governance structures, and coping strategies,' *Global Environmental Change* 21(1): 249-258.
- Marker, M. E. (1976) 'Cenotes: a class of enclosed karst hollows,' *Zeitschrift für Geomorphologie* 26: 104-123.
- Martos Lopez, L. A. (2008) 'Underwater Archaeological Exploration of the Mayan *Cenotes*,' *Museum International* 60(4): 100-110.
- Mathews, J. P. (2009) *Chicle: The Chewing Gum of the Americas, from the Ancient Maya to William Wrigley*, Tuscon, University of Arizona Press.
- Mathews, J. P. and L. Lizama-Rogers (2005) "Jungle Rails: A Historic Narrow-Gauge Railway in Quintana Roo" in J. M. Shaw and J. P. Mathews (eds) *Quintana Roo Archaeology*, Tuscon: University of Arizona Press: 112-126.
- May, T. (2001) *Social Research. Issues, methods and process*, Buckingham: Open University Press.
- McKittrick, K. and L. Peake (2005) "What difference does difference make to geography" in N. Castree, A. Rogers and D. Sherman (eds) *Questioning Geography*, Oxford: Blackwell Publishing: 39-54.

- Meahcam, S. (2004) 'Exploring Xibabla: watery realm of the Maya Underworld,' *The Explorers Journal* 78(4): 14-21.
- Mediz Bolio, A. (1956) *A la sombra de mi Ceiba. Relatos fáciles*, México, Ediciones Botas.
- Melo Zurita, M. de L. (forthcoming) 'La tierra el pretexto, los recursos naturales el motivo: El caso de la mercantilización de la naturaleza mediante dos estudios de caso en México, in R. F. Macip (ed) *Deslindando prácticas, símbolos y realidades*. Coloquio de Antropología en Homenaje a Robert D. Shadow.
- Mercer, H. C. ([1896] 2005) *The Hill-Caves of Yucatan*, Texas: AMCS Reprint Series.
- Mercer, H. C. (1897) 'Cave Hunting in Yucatan,' *Technology Quarterly* 10(4): 352-371.
- Metcalf, C. D., P. A. Beddows, G. G. Bouchot, T. L. Metcalfe, H. Li, H. Van Lavieren (2011) 'Contaminants in the coastal karst aquifer system along the Caribbean coast of the Yucatan Peninsula, Mexico,' *Environmental Pollution* 159(4): 991-997.
- Monroe, W. H. (1970) *A Glossary of Karst Terminology*, US Geological Survey Water-Supply Paper 1899-K.
- Montes, Brian (2009) *Memories of war: Race, class, and the production of post caste war Maya Identity in east central Quintana Roo* Urbana: University of Illinois
- Moran, E. (2005) "Human Environment Interactions in Forest Ecosystems, an Introduction" in E. Moran and E. Ostrom (eds) *Seeing the Forest and the Trees*, Cambridge: MIT Press: 3-23.
- Moravec, F, C. Vivas-Rodríguez, T. Scholz, J. Vargas-Vázquez, E. Mendoza-Franco, D. González-Solís (1995) 'Nematodes parasitic in fishes of cenotes (= sinkholes) of the Peninsula of Yucatan, Mexico, Part 1. Adults,' *Folia Parasitol (Praha)* 42(2): 115-29.
- Mowforth, M. and I. Munt (1998) *Tourism and Sustainability: New Tourism in the Third World*, London: Routledge.
- Munro, P. G. and M. de L. Melo Zurita (2011) 'The Role of Cenotes in the Social History of Mexico's Yucatan Peninsula,' *Environment and History* 17(4): 583-612.
- Muñoz-Piña, C., A. de Janvry, and E. Sadoulet (2003) 'Recrafting Rights over Common Property Resources in Mexico,' *Economic Development and Cultural Change* 52(1): 129-158.
- Murray, G. (2007) 'Constructing Paradise: The Impacts of Big Tourism in the Mexican Coastal Zone,' *Coastal Management* 35(2-3): 339-355.

- Mutchler, T., K. H. Dunton, A. Townsend-Small, S. Fredriksen and M. K. Rasser (2007) 'Isotopic and elemental indicators of nutrient sources and status of coastal habitats in the Caribbean Sea, Yucatan Peninsula, Mexico,' *Estuarine, Coastal and Shelf Science* 74(3): 449-457.
- Myloie, J.R. and J.E. Myloie (2007) 'Development of the carbonate island karst model,' *Journal of Cave and Karst Studies* 69(1): 59-75.
- National Geographic* (1958) 'Indians of the Americas'
- Naverrete, M. (2008) 'Garment Maquiladoras in Rural Yucatan: An Environmental Tale,' *Journal of Latin American Geography* 7(2): 105-132.
- Nohoch Productions (2009) 'Mike Madden' <http://www.nohoch.com/> [last accessed 10/11/2010]. medios" 3 March.
- Olivares, Juan Jose (2010) "Kukulcán, entre el piano y la voz de Elton John" *La Jornada*, 5 April: 16.
- Orea, M. (2009) 'México en la Piel' *Latitud 21: Líderes y Negocios en el Caribe Mexicano* 7(76): 42-49.
- Ostrom, E. (1990) *Governing the Commons: The evolution of institutions for collective action*. New York: Cambridge University Press.
- Ostrom, E. (1998) "The International Forestry Resources and Institutions Research Program: A Methodology for Relating Human Incentives and Actions on Forest Cover and Biodiversity" in F. Dallmeier (ed) *Forest Biodiversity in North, Central and South America, and the Caribbean: research and monitoring* New York: Parthenon: 1-28.
- Ostrom, E. and C. Tucker (2005) 'Multidisciplinary Research Relating Institutions and Forest Transformations' in E. Moran and E. Ostrom (eds), *Seeing the Forest and the Trees: Human-Environment Interactions in Forest Ecosystems*, Massachusetts: MIT: 81-103.
- Ostrom, E., R. Gardner and J. Walker (1994) *Rules, Games, and Common-Pool Resources*, Ann Arbor: University of Michigan Press.
- Patch, R. W. (1991) "Decolonisation, and the Agrarian Problem, and the Origins of the Caste War, 1812-1847" in J. T. Brannon and G. M. Joseph (eds) *Land, labor & capital in modern Yucatan : essays in regional history and political economy* , Tuscaloosa, The University of Alabama Press: 51-82.

- Pearce, D. and A. Markandya (1991) *Blueprint for a Green Economy* London: Earthscan publications.
- Pearse, A. S., E. P. Creaser, F. G. Hall (eds) (1936) *The Cenotes of Yucatan: A zoological and hydrographic survey*, Washington: Carnegie Institution.
- Perry, E. C., L. Marin, J. McClain and G. Velazquez (1995) 'Ring of Cenotes (sinkholes), northwest Yucatan, Mexico: Its hydrogeologic characteristics and possible association with the Chicxulub impact crater,' *Geology* 23(1): 17-20.
- Perry, E. C., G. Velazquez-Oliman and L. Marin (2002) 'The hydrogeochemistry of the karst aquifer system of the northern Yucatan Peninsula, Mexico,' *International Geological Review* 44: 191–221
- Perry, E. C., A. Paytan, B. Pedersen and G. Velazquez-Oliman (2009) 'Groundwater geochemistry of the Yucatan Peninsula, Mexico: Constraints on stratigraphy and hydrogeology,' *Journal of Hydrology* 367: 27–40.
- Peissel, M. (1963) *The Lost World of Quintana Roo: An adventurous quest for Mayan ruins on the untamed coast of Yucatan*, E. P. Dutton & Co.
- Philips, B. (2002) 'A New Map of Sac Actun,' *AMCS Activities Newsletter* 25: 78-80.
- Pichler, T., R. Brinkmann, G. I. Scarzella (2008) 'Arsenic abundance and variation in golf course lakes,' *Science of the Total Environment* 394(2-3): 313-320.
- Piña Chan, R. (1970) Informe preliminar de la reciente exploración del Cenote Sagrado de Chichen Itzá. Instituto Nacional de Antropología e Historia, México.
- Polanyi, K. (1957) *The great transformation*, Boston: Beacon Press.
- Pope, K. O., K. H. Baines, A. C. Ocampo and B. A. Ivanov (1997) 'Energy, volatile production, and climatic effects of the Chicxulub Cretaceous/Tertiary impact,' *Journal Of Geophysical Research* 102(9): 21,645-21,664.
- Proskouriakoff, T. (1974) *Jades from the cenote of sacrifice Chichen Itza, Yucatan*. Cambridge: Harvard University.
- Prosser, J.J. and H. V. Grey (1992) *NSS Cave Diving Manual*, Cave Diving Section of the National Speleological Society, Inc.
- Pringle, H. (2009) 'A New Look at the Maya's End,' *Science* 324: 454-456.

- Quintana Roo Speleological Survey (QRSS) (2011) 'Updates and News' <http://www.caves.org/project/qrss> [accessed 14 December 2011].
- Randall, L. (ed) (1996) *Reforming Mexico's Agrarian Reform*, New York: ME Sharpe.
- Rebolledo, M. (2008) 'Water, Rock and Time,' in A. Medina (ed) *Cenotes, Imprints of Water and Light in the Jungle*, Cancun: Pixel Press: 20-34.
- Redclift, M. R. (2003) 'El Chicle: Sombras Detras Del Consumo,' *Revista Mexicana del Caribe* 8(15): 159-167.
- Redclift, M. R. (2004) *Chewing Gum: The Fortunes of Taste*, New York: Routledge.
- Redclift, M. R. (2005) 'A Convulsed and Magic Country: Tourism and Resource Histories in the Mexican Caribbean,' *Environment and History* 11(1): 83-97.
- Redclift, M. R. (2006) *Frontiers: Histories of Civil Society and Nature*, Massachusetts, The MIT Press.
- Redclift, M. R. (2010) "Frontier Spaces of Production and Consumption: Surfaces, Appearances and Representations on the 'Mayan Riviera'" in M. K. Goodman, D. Goodman and M. R. Redclift (eds) *Consuming space: placing consumption in perspective*, Ashgate Publishing: 81-96.
- Reed, N. (1997) 'Juan de la Cruz, Venancio Puc, and the Speaking Cross,' *The Americas* 53(4):497-523.
- Reed, N. (2001) *The Caste War of Yucatan*, Stanford, Stanford University Press.
- Rissolo, D. (2003) *Ancient Maya Cave Use in the Yalahau Region, Northern Quintana Roo, Mexico* Association for Mexican Cave Studies Bulletin 12.
- Rissolo, D. (2005) "Beneath the Yalahau: Emerging Patterns of Ancient Maya Ritual Cave Use from Northern Quintana Roo, Mexico" in J. E. Brady and K. M. Prufer (eds) *In the Maw of the Earth Monster: Mesoamerican Ritual Cave Use*, Austin: University of Texas: 342-372.
- Robertson, M. (2000) 'No net Loss: Wetland Resaturation and the Incomplete Capitalisation of Nature,' *Antipode* 32(4): 463-493.
- Robbins, P. (1998) 'Authority and Rajasthan, India,' *Annals of the Association of American Geographers* 88(3): 410-435.
- Robbins, P. (2004) *Political Ecology*, London: Blackwell.

- Robbins, P. and A. Luginbuhl (2007) "The last enclosure: resiting privatization of wildlife in the western United States" in N. Heynen, J. McCarthy, S. Prudham and P. Robbins (eds), *Neoliberal Environments: False promises and unnatural consequences*, London: Routledge: 74-88.
- Rojas Sandoval, C., A. H. Gonzalez Gonzalez, A. Terrazas Mata, and M. Benavente Sanvicente (2008) "Mayan Mortuary Deposits in the Cenotes of Yucatan and Quintana Roo, Mexico" in M. E. Leshikar-Denton and P. Luna Erreguerena (eds) *Underwater and Maritime Archaeology in Latin America and the Caribbean*, 2008, Walnut Creek: West Coast Press: 143-155.
- Rojas Sandoval, C. and A. Gonzalez Gonzalez (2009) 'En los Cenotes de Quintana Roo, Parte 3,' *Espacio Profundo* 98: 10-14.
- Rodriguez Ochoa, P. (2000): *Xcaret*, Promotora Xcaret: Quintana Roo.
- Rugeley, T. (1996) *Yucatan's Maya peasantry and the origins of the Caste War*, Austin, University of Texas Press.
- Rugeley, T. (2009) *Rebellion now and forever: Mayas, Hispanics, and caste war violence in Yucatán, 1800-1880*, Stanford: Stanford University Press.
- Ruíz Sosa, L. A. (ed) (1999) *Cenotes y Grutas de Yucatán*, CEPESA: Secretaría de Ecología de Yucatán.
- Santiago, E. and F. Bates (1991) 'El uso del agua en la política de congregación indígena a fines del siglo XVIII, el caso de San Antonio Xul' *Boletín de la Escuela de Ciencias Antropológicas de la Universidad de Yucatán*, 18.
- SAVE (2008) *A Tale of Impunity Society for Akumal's Vital Ecology (SAVE): Akumal*
- SAVE (2011) 'The Cenotes' Society for Akumal's Vital Ecology <http://www.cenotes.com/> [last accessed 14 October 2011].
- Scarborough, V. L. (2008) 'Ecology and Ritual: Water Management and the Maya,' *Latin American Antiquity* 9(2): 135-159.
- Schmitter-Soto, J. J., F.A. Comín, E. Escobar-Briones, J. Herrera-Silveira, J. Alcocer, E. Suárez-Morales, M. Elías-Gutiérrez, V. Díaz-Arce, L.E. Marín and B. Steinich, (2002) 'Hydrogeochemical and biological characteristics of cenotes in the Yucatan Peninsula (SE Mexico),' *Hydrobiologia* 467 (1-3): 215-228.

- Schulte, P., L. Alegret, I. Arenillas, J. A. Arz, P. J. Barton, P. R. Bown, T. J. Bralower, G. L. Christeson, P. Claeys, C. S. Cockell, G. S. Collins, A. Deutsch, T. J. Goldin, K. Goto, J. M. Grajales-Nishimura, R. A. F. Grieve, S. P. S. Gulick, K. R. Johnson, W. Kiessling, Ch. Koeberl, D. A. Kring, K. G. MacLeod, T. Matsui, J. Melosh, A. Montanari, J. V. Morgan, C. R. Neal, D. J. Nichols, R. D. Norris, E. Pierazzo, G. Ravizza, M. Rebolledo-Vieyra, W. U. Reimold, E. Robin, T. Salge, R. P. Speijer, A. R. Sweet, J. Urrutia-Fucugauchi, V. Vajda, M. T. Whalen and P. S. Willumsen (2010) 'The Chicxulub Asteroid Impact and Mass Extinction at the Cretaceous-Paleogene Boundary,' *Science* 327: 1214-1218.
- Schultz, P. H. and S. D'Hondt (1996) 'Cretaceous-Tertiary (Chicxulub) impact angle and its consequences,' *Geology* 24(1): 963-967.
- Schwartz, N. (1989) 'Some notes on the folklore and political economy of la Chicleria,' *Revista Española de Antropología Americana* 19: 169-192.
- Sellen, A (2010) "El ultimo viaje de Santiago Bolio" in Carolina Depetris (ed) *Viajeros por el Mundo Maya*, UNAM: Merida: 59-78.
- Sellen, A. (2011) *Murky Waters: Revisiting the Looting of the Sacred Cenote of Chichén Itzá, Yucatán*, Fellowship Report, Dumbarton Oaks [<http://www.doaks.org/> - accessed 15/12/2012].
- Serio-Silva, J. C., V. Rico-Gray and G. Ramos-Fernández (2006) "Mapping Primate Populations in the Yucatan Peninsula, Mexico: A First Assessment" A. Estrada, P. A. Garber, M. S. M. Pavelka and L. Luecke (eds) in *New Perspectives in the Study of Mesoamerican Primates*, Springer US: 489-512.
- Sharer, R. J. and S. G. Morley (1947) *The Ancient Maya* Stanford: Stanford University Press.
- Silverman, D. (1993) *Interpreting Qualitative Data* London: SAGE Publications Ltd.
- Scoones, T. (Director) (2005) *Secrets of the Maya Underworld*, Video Documentary, British Broadcasting Corporation (BBC).
- Smart, P.L., P. A. Beddows, J. Coke, S. Doerr, S. Smith and F. F. Whitaker (2006) 'Cave development on the Caribbean coast of the Yucatan Peninsula, Quintana Roo, Mexico,' *Geological Society of America Special Papers* 404: 105-128.
- Smith, N. (1984) *Uneven Development: Nature, Capital and the Production of Space*, Oxford: Blackwell.

- Stephens, J. L. (1841) *Incidents of travel in Central America, Chiapas, and Yucatan*, Volume I, London: John Murray.
- Stephens, J. L. (1842) *Incidents of travel in Central America, Chiapas, and Yucatan*, Volume II, London: John Murray.
- Stephens, J. L. (1843) *Incidents of travel in Yucatan*, Volume I, London: John Murray.
- Stephens, J. L. (1848) *Incidents of travel in Yucatan*, Volume II, London: John Murray.
- Stoessell, R. K., J. G. Coke and D. H. Easley (2002) 'Localized Thermal Anomalies in Haloclines of Coastal Yucatan Sinkholes,' *Ground Water* 40(4): 416-424.
- Stone, A.J. (1989) "The Painted Walls of Xibalba: Maya Cave Painting as Evidence of Cave Ritual" in William Hanks and Don Rice (eds) *Word and Image in Maya Culture: Explorations in Language, Writing, and Representation*, Salt Lake City: University of Utah Press: 317-335.
- Strang, V. (2009) *Gardening the World: agency, identity and the ownership of water*, New York: Berghan Books.
- Strickon, A. (1965) 'Hacienda and Plantation in Yucatan: A historical-ecological consideration of the Folk-Urban Continuum in Yucatan' *América Indígena* 15(1): 35-65.
- Strauss, A. (1987) *Qualitative Analysis for Social Scientists*, Cambridge: Cambridge University Press.
- Swartz, D. (1997) *Culture and Power: the Sociology of Pierre Bourdieu*. Chicago: University of Chicago Press.
- Swyngedouw, E. (2004) *Social Power and the urbanization of water: flows of power*, Oxford, Oxford University Press.
- Swyngedouw, E. (2007) "Dispossessing H2O: The Contested Terrain of Water Privatization" in N. Heynen, J. McCarthy, S. Prudham and P. Robbins (wds) *Neoliberal Environments*, New York and London: Routledge: 51-62.
- Taylor, P. L. and C. Zabin (2000) 'Neoliberal reform and sustainable forest management in Quintana Roo, Mexico: Rethinking the institutional framework of the Forestry Pilot Plan,' *Agriculture and Human Values* 17(2): 141-156.
- Thompson, E H. (1897) *Cave of Loltun, Yucatan*, Harvard University: Memoirs of the Peabody Museum.

- Thompson, E. H. (1932) *People of the Serpent: Life and Adventure among the Mayas*, New York: Capricorn Books.
- Torres, R. (2002) 'Cancun's tourism development from a Fordist spectrum of analysis,' *Tourist Studies* 2(1): 87–116.
- Torres Maldonado, E. J. (1997) *From Tropical Hell to Tourist Paradise: State Intervention and Tourist Entrepreneurship in the Mexican Caribbean*, PhD Thesis, Austin: University of Texas.
- Torres R. and J. Momsen (2005) 'Planned Tourism Development in Quintana Roo, Mexico: Engine for Regional Development or Prescription for Inequitable Growth?,' *Current Issues in Tourism* 8(4): 259–285.
- Turner, J. K. ([1910] 1990) *Barbarous Mexico*, Austin: University of Texas Press.
- Uc, E. and C. A. Evia Cervantes (1991) 'Los Sombreros de las Grutas del Calcehtok' *Revista del Divulgacion del Patrimonio de Yucatan* 3: 52-53.
- Urrutia-Fucugauchi, J., J. M. Chavez-Aguirre, L. Pérez-Cruz and J. L. De la Rosa (2008) 'Impact ejecta and carbonate sequence in the eastern sector of the Chicxulub crater,' *Comptes Rendus Geoscience* 340(12): 801-810.
- Valdez Tah, R. (2006) 'Apropiación y manejo del medio natural como recurso turístico: los cenotes' in *Yucatán: Identidad y Cultura Maya*, Merida, Unidad de Ciencias Sociales, Universidad Autónoma de Yucatán.
- Valentine, G. (2005) "Tell me about...:using interviews as a research methodology" in R. Flowerdew and D. Martin (eds) *Methods in Human Geography: A guide for students doing a research project*, Halcrow: Pearson Prentice Hall: 110- 127.
- Van Hengstum, P. J. (2008) *Paleoenvironmental analysis using thecamoebians and foraminifera in Mexican anchialine caves: a focus on Aktun Ha (Carwash) Mexico*, MSC Thesis, McMaster University.
- Vazquez-Dominguez, E. and H. T. Arita (2010) 'The Yucatan peninsula: biogeographical history 65 million years in the making,' *Ecography* 33(2): 212-219.
- Veni, G. (1990) 'Maya utilization of karst groundwater resources,' *Environmental Geology* 16(1): 63-66.

- Villa Rojas, A. (1945) *The Maya of East Central Quintana Roo, Mexico*. Carnegie Institution of Washington Publication 559, Washington.
- Ward, W. C., A. E. Weidie and W. Back (eds) (1985) *Geology and hydrogeology of the Yucatan and Quaternary Geology of northeastern Yucatan Peninsula*. New Orleans Geological Society: New Orleans.
- Watts, M. J. (2004) 'Resource Curse? Governmentality, Oil and Power in the Niger Delta, Nigeria,' *Geopolitics* 9(1): 50-80.
- Weidie, A. E. and W.C. Ward (eds) (1976) *Carbonate Rocks and Hydrogeology of the Yucatan Peninsula, Mexico*, New Orleans Geographical Society.
- Webb, J. A., K. G. Grimes and I. D. Lewis (2010) 'Volcanogenic origin of cenotes near Mt Gambier, southeastern Australia,' *Geomorphology* 119(1): 23-35.
- Zarate Lomeli, D., T. Saavedra Vazquez, J. L. Rojas Galaviz, A. Yanez-Arancibia, and E. Rivera Arriaga (1999) 'Terms of reference towards an integrated management policy in the coastal zone of the Gulf of Mexico and the Caribbean' *Ocean & Coastal Management* 42 (2-4): 345–368.
- Zimmerman, C. (1965) 'The Hermeneutics of the Maya Cult of the Holy Cross,' *Numen* 12(2): 139-159.
- Zumrick, J. L., J. J. Prosser and H. V. Grey (1988) *NSS Cavern Diving Manual*, Cave Diving Section of the National Speleological Society, Inc.

Glossary

Aluxes: cave and cenote guardians.

Campamentos: temporary settlements developed by Maya groups established originally with extractive purposes.

Cave and Cenote Systems: refers to the passages, conduits and entrances found in the Yucatan Peninsula as a result of karstification processes. Along the dissertation cave and cenote systems and plainly referred as systems, in such situation it will be clearly explained that refers to these systems part of the physical geography of the Peninsula and not to the Social Systems, for example.

Ceremonia de desagravio: ceremony performed by traditional Maya priests.

Chaaks: Maya word that refers to the rain god that usually inhabits the underground.

Chultunes: human made cavities utilised to extract water.

Commodification: the process of producing commodities.

Commodity: parts of the human process of transformation and production of goods, not only capitalist ones.

Ejidatarios: members of the ejido.

Ejido Surveillance Committee: part of the ejido structure that is in charge of monitoring and patrolling the ejido land.

Encomenderos: Spanish nobility in the Yucatan that had been granted by the Spanish crown control over lands and Maya labourers.

Explorers: refers to the group of actors that has practised or is practising exploration in caves and cenotes in the Yucatan Peninsula.

Extranjero: Spanish word that refers to foreigners.

Gringo: expression that refers to United States of America citizens.

Haciendas: system of large land-holding established by the Spanish in Mexico.

Halocline: interface between saline and fresh water.

Karst: refers to a specific type of geologic formation that forms as a result of processes of soil dissolution.

La Maya: refers to the Language spoken, mainly by members of the Maya ethnic group.

Maya: Refers to the Pre-Hispanic Civilisation located in the Mesoamerica cultural region. It also refers to the indigenous ethnic group that currently inhabits the south of Mexico (The state of Chiapas and the Yucatan Peninsula) and Guatemala, Belize, El Salvador and Honduras. This research focuses in the Maya groups located in the Yucatan Peninsula in Mexico.

Nature: as opposed to humanly constructed environments.

Objects of Nature: refers to individual physical unanimated parts of nature.

Palapa: constructed shelter with a roof made out of dry palm leaves.

Private Sector: refers to the group of actors related with activities in the underground forest frontier for profit purposes. It belongs outside the public sector realm, although is regulated by it.

Public Sector: refers to the government sector.

Riviera Maya: tourism corridor located between Cancun and Tulum.

Speleo tourism: activity performed inside caves by visitors to the Peninsula that usually pay entry fees.

Subuy Ha: virgin water obtained of cenotes and caves that is usually used during ceremonies.

Talus pile: stack formed by the rock breakdown when the ceiling collapse forming the entrance to the cenote.

Tierras Nacionales: term that refers to the land owned by the State.

Underground Forest Frontier: concept created for this research to explain the nuances between the physical border that is the soil in the Peninsula, the above the ground and the underground, and the liminal intangible frontier that such physicality creates.

Usucaption: process where landownership can be gained through long time possession.

Usufruct: a legal right

Xcaret: private eco-park located in the Quintana Roo State. The park contains modified underground rivers, cenotes and caves.

Xibalbá: sacred underworld for the Maya.

Xplor: cave and cenote park located in the Quintana Roo state.

Yucatan Peninsula: the piece of land that comprises the Mexican states of Yucatan, Campeche and Quintana Roo. In the text can also be found written as The Peninsula.

Yucatecos: Spanish descendants living on the Peninsula.

Appendix 1: Interview Templates

Name

Job position

What does your work specifically involve?

What are your main interests in studying caves and cenotes?

Why in Quintana Roo?

For how long have you been working in the area?

What is the main goal or goals of your research?

Caves and Cenotes

What is a cenote?

What is a cave?

Do you have a favourite one? Why?

What role do caves and cenotes play in Nature?

What role do caves and cenotes play in Society, and is it different from the previous one?

How have cenotes been used?

What is the value of caves and cenotes, for you?

What do you think could be the impacts of current practices and activities on caves and cenotes?

Who or what is going to be affected by such practices and activities?

Do you know of any public education campaigns or programs to inform the population of such consequences?

What is your opinion on using caves and cenotes as a resource for tourism?

Exploration

For how long do you think that caves and cenotes have been explored in Quintana Roo?

How have these places, caves and cenotes, changed during this time?

Can you give a description of what it is like to explore a cave or a cenote?

How does one experience cenotes and caves?

Who do you share the results of your research with?

What is the reaction of land owners or communities when you explain the purposes of your exploration trips?

Regulation

Do you think these places belong to someone?

Do you know if there are any laws to protect caves and cenotes?

Who should be protecting these places?

Do property regimes affect regulation?

Do you think that property regimes influence the current situation?

Who should be in charge?

What could be an impediment to regulate caves and cenotes?

Is your research contributing to the regulation of caves and cenotes?

What do you think should be prioritised in the short term?

What is your perspective for the future?

Can you make a difference between private and public cenotes?

Story

Can you tell me a story about caves and cenotes?

Appendix 2: Coding example

Land Owners		Tourist Operators		Private Investors		Public Servants		Explorers	
Major Codes	Minor Codes	Major Codes	Minor Codes	Major Codes	Minor Codes	Major Codes	Minor Codes	Major Codes	Minor Codes
Land	Land extensions	Contracts to Manage Cenotes	Exclusivity rights	Cenotes	Planning an investment	Government		Nature's Agency	
	Land property		Rights of use		Monetarian investment	Law		Collecting Nature	
	Land titles		Access to roads	Law	Environmental legislation	Legislation		Exploration	
	Land Concessions		Access to cenotes		Law enforcement	Institutions	Formal Insitutions	Discovery	
Land values	Paying rents	Land	Cenotes status in the law	Informal Institutions	Extreme Conditions				
Ejido	Junta Ejidal	Crisis	Paying comisions		Purchasing land in Quintana Roo	Institutional Change	Competition		
Private land owners	Ejidatarios		Swine Flu		Purchasing Cenotes	Institutional Interplay	Using Nature		
Forest	Management Chicle	Organising tours to visit cenotes	Violence			Formal Actions	Narrating/Describing Nature		
		Selling discourses				Informal Actions			
Early Settlements	Campamentos Fisheries	Promoting cenotes				Organisations			
Urban Development		Visitors discourses	Xibalba			Caves and Cenotes Activities	Uses of Cenotes	Recreational Use	
Tourism			Hydrology					Exploration Use	
What is a cenote?			Mayans			Market	Cenotes Market	Archaeological Use	
Cenotes in my land		Cenotes Management	Formal			Open Access		Research Use	
Cenotes	Management	Paying taxes	Informal			State Property	Mayan Families	Contemplative Use	
	Value Market	Relations with cenotes owners				Private Property		No Use	
Exclusivity of use						Common Property			
	Aquifer's Vulnerability					Rights of Use	Access rights	Technology Innovations	
Aquifer	Water abundance						Management rights	Dependance	
	Ban Areas						Exclusion rights	Lights	
	Use water concessions						Allienation rights	Frontier	
	Technical knowledge					Aquifer	Aquifer's administration	Naming Cenotes	
Explorers							Technical Difficulties		
Knowledge of the systems							Aquifer's	What is a Cenote?	
Roads							Water abundance	Paying fees	
Government							Ban Areas	Mapping	
							Use water concessions	Limestone	
							Technical knowledge	Experiencing a cenote	
							Impacts of Exploration		
							Destruction of archeological evidence		
							Management of archeological sites	Halodine	
							Protecting archeological evidence	Underground Rivers	
							Land	Aquifer's administration	
							Urbanisation	Aquifer's vulnerability	
							Tourism	Water abundance	
								Technical Knowledge	
								Protecting archaeological evidence	
								Destruction of archaeological evidence	
								Management of archaeological sites	
								Scuba Diving	
								Cave Diving	
								Cavern Diving	
								Speleology	
								Dry caves	
								Accidents	
								Exploration Distances	
								Famous Explorers	
								Deforestation	
								Historical Changes	
								What is left?	
								Land	
								Number of Cenotes	
								"Hay Cenote"	
								Exploration Hazards	
								How are explorers perceived?	
								Pollution	
								Tourist visiting cenotes	
								Tuorist cenotes	

Appendix 3: Analytical Diary Example

Accidents: ~~at~~ In the exploring circles it is common to hear conversations about ~~at~~ events that put at risk the life of explorers and people visiting the caves or cenotes. This code will be used when in the narrations people talk about accidents, experiences or reckless actions that put at risk any of the member of the exploration team.

When asking explorers a story they remember or want to tell others about cenotes it is interesting the high percentage of people telling accidents.

"Between 1960 and 1991 more than 860 divers lost their lives exploring underwater caves in North America" (Chapman 1995: 39)

The spirit of exploration does get affected by some circumstances. On the morning of the 27th of June 2009 radio coverage and the front page of the Por Esto newspaper were covering ~~the news~~ an accident occurred in a cenote located in the Playa del Carmen Ejido:

"Swimmer dies in Rio Secreto "cave system"

The news caught the attention of the tourist sector, firstly because Rio Secreto being a tourist cave was responsible for the accident, and secondly because the "Rio Secreto Project" might be close down due to lack of safety for visitors. Later on the news were disclosed and it was clarified that ~~ever~~ ~~later~~ a group of jomateros went swimming in a cenote close to the Rio Secreto system and while free diving drown in the cenote. At the same time a group of explorers were planning to scope a "new cenote" found very close to Rio Secreto. Everything was ready for the exploration journey but the morning news interfered with the plans. A "cave-diver" was already called to retrieve the body of the drown swimmer. ~~The group~~ Explorers have a kind of verbal agreement ~~where~~ were a cenote that has experienced an accident is no longer ~~not~~ ~~visit~~ explored. The group of explorers did not know ~~that~~ if it was the same cenote they were trying to explore. When the body was retrieved from the cenote the group of explorers got the gps coordinates of the cenote where the accident took place. Once they were certain that ~~the~~ it was not the same cenote the exploration journey began.

When trained cave divers talk about accidents there is always a "blaming" tone towards the victims: "people without expertise, knowledge or the equipment do silly things" (). They do not

understand the systems", "If someone without preparation died in one cenote, the cenote is spoilt for ever", ~~and~~ that regarding cave divers, but when it comes to "locals" or "swimmers" a tendency to discredit their understanding of the underground ~~best~~ becomes latent: "obviously there are accidents, specially in the cenotes without owners. People go there without ~~permission~~ permit, ~~and~~ they get drunk and then jump in the cenotes, obviously there are accidents. And then what do you do. By the time the call for help is too late. Help needs to cross the jungle and when they get there, they realized they need a cave diver. And believe me it is not fun to be the one taking the bodies out"

Others blame the lack of control "I mean if the cenote is not private, anyone can go in and there is no control, but the government ~~is~~ is not doing a lot. The ~~or~~ cave divers have the NOM but it is not a law and therefore not illegal not following it but the "locals" that go swimming, they have no protection"

Currently if cave-divers want to explore a system in a "tourist site" they are asked to show their credentials and certifications up-to-date. ~~What~~ ~~the~~ Who wants to be blamed for an accident where someone dies" that is why they are more careful ~~too~~ nowadays, but still we need more control from the authorities".

1 **Appendix 4: Transcribed Interview Example**

2

3 **Entrevistado: Francisco Díaz Carvajal**

4 **Cargo Secretario de Desarrollo Urbano y Medio Ambiente del**
5 **Estado de Quintana Roo**

6 **Fecha: noviembre2009**

7 **Lugar: Wild9**

8 **Clasificación: I73-2009**

9

10 Una importancia regional por eso estamos trabajando a nivel de consejo de
11 Cuenca, las tres entidades federativas, porque representa para la Península,
12 independientemente del tema hídrico o la capacidad de almacenamiento en
13 función de este tipo de ríos subterráneos, cenotes etc., pues también estamos
14 preocupados por la fragilidad de los mismos, así como se tiene la oportunidad
15 de captar un volumen de agua impresionante por la misma percolación por lo
16 cárstico de nuestra orografía y subsuelo, también está implícita la fragilidad por
17 una contaminación. En ese sentido, como gobierno estamos dándonos a la tarea
18 de incorporar aquellas actividades o acciones que tiendan a proteger a estos
19 cenotes y ríos subterráneos de posibles contaminaciones. En el caso de
20 Quintana Roo pues esto está muy vinculado al tema turístico ¿no? Que es la
21 parte de la hotelería y lo que ellos representa en el crecimiento en nuestros
22 centros de población y nos estamos enfocando en dos sentidos, uno el que se
23 pudiera evitar la contaminación de los ríos subterráneos en la disposición del
24 agua tratada, por eso estamos generando inversiones muy importantes
25 conjuntamente con CONAGUA en la construcción de plantas de tratamiento
26 principalmente y por otra parte en el destino de los residuos sólidos urbanos
27 que es en donde tenemos una prioridad como gobierno en apoyo a los
28 municipios para que podamos erradicar esos tiraderos a cielo abierto que
29 generan una cantidad enorme de lixiviados y que al no tener ninguna protección
30 pues estos se están yendo directamente a la contaminación de los mantos
31 acuíferos y ríos subterráneos. Es ahí en donde estamos enfocando las baterías
32 para poder lograr unificar esta contaminación potencial que se tiene y con ello
33 coadyuvar a la protección de este sistema hídrico.

34 Los cenotes si están considerados desde algún punto de vista muy rebuscado
35 técnico, no específicamente como lo queremos plantear dentro de la misma
36 norma y de la ley. Por ello se le está dando ese énfasis y sí se requerirá una
37 especificación más al detalle sobre el tema, determinarlo muy bien como se
38 conoce de manera general no solamente pública-popular, hay que establecerlo
39 como tal y no como una similitud de un lago superficial o de un río superficial,
40 hay que especificarlo bien, hay que hablar exactamente del cenote y sus ríos
41 subterráneos que no quede ninguna duda de lo que se pretende normar. Esa

42 modificación sí hay que hacerla y se requerirá complementarla con algunas
43 normas o algo y pues habrá que hacerlo. Lo otro que vemos bueno pues que se
44 busque que lo que se dé en la aplicación de esta reglamentación tenga la
45 competencia local, estatal principalmente, para poder darle un puntual
46 seguimiento a toda la regulación que se pretende establecer.

47 La necesidad de generar normas generales de carácter regional, sobre todo para
48 la Península de Yucatán y lo que es el sistema cárstico y el acuífero. Pero
49 también la necesidad de generar otras normas más específicas de carácter
50 regional, ¿por ejemplo la 083 sobre la disposición de residuos. En el caso de esa
51 complementariedad, las normas son generales que tienen su función y son
52 nacionales, pero por ejemplo en la 083 nos hemos podido en la aplicación de la
53 misma nos hemos podido dar cuenta de que los requerimientos y requisitos
54 establecidos están planteados como para la zona centro o norte del país porque
55 cuando hablan de distancias en donde por ejemplo se pueda llevar a cabo un
56 relleno sanitario lo establece de manera superficial lineal 500 metros a distancia
57 del último pozo por ejemplo y eso aplica muy bien en donde tú tienes un estrato
58 de suelo como la del centro en donde bueno para que encuentres agua ahí hay
59 que profundizar a cientos de metros y esa aplicación se puede cumplir, pero
60 aquí en la Península en donde a 60cm puedes tener ya contacto directo con el
61 agua como que no es lo adecuado, por eso la aplicación de normas hay que
62 hacerlas de carácter regional y nosotros como Estado estamos tratando de
63 proponer que las normas mexicanas puedan establecer un carácter regional y
64 que se detallen un poco más las condiciones de la Península. Porque al
65 momento de la revisión y aplicación de la misma pues esto no es del todo
66 aplicable tomando en cuenta las características geológicas de la Península.

67 El consejo del Cuenca también lo va a proponer y entre los tres secretarios de las
68 tres entidades federativas se estará complementando. Y seguramente así
69 surgirán otras cuestiones a nivel regional. Yo creo que lo que hay que ir
70 haciendo de manera general es regionalizar la parte reglamentaria y no dejarla
71 tan abierta. La norma es general, pero hay que ver las aplicaciones en cada
72 región, dependiendo de sus características. Sí hay que buscar aplicaciones más
73 regionales y locales.

74 En principio hacer conciencia, es parte de la educación y cultura y hay que
75 trabajar con los diferentes grupos. Al hablar de cenotes y río subterráneos no los
76 puede delimitar con polígonos estos es muy amplio y por eso estamos tratando
77 de impulsar zonas ya trabajadas con superficies o poligonales para las reservas
78 hidrológicas que se han detectado, pero en sí toda la parte centro de la
79 Península es una gran reserva hídrica, entonces hay que trabajar con el hecho de
80 que la tenencia de la tierra es 90% ejidal y entrarle mucho al tema de los
81 servicios ambientales. Yo creo que eso es algo que hay que hacer porque al
82 campesino al ejidatario pues hay que darle incentivos para la protección de esas
83 zonas de la superficie para que las puedan mantener y sigan cumpliendo con su

84 objetivo y en la parte turística pues reglamentarlos, porque particularmente en
85 Quintana Roo se está haciendo un uso ya intensivo de la actividad en cuanto a la
86 parte recreativa, la parte de observación, buceo sobre todo tanto de cenotes
87 como de Ríos Subterráneos.

88 Yo no me he metido a la parte de la espeleología. Aparte de que implica riesgos
89 pues desde el punto de vista ambiental hay que tener mucho cuidado de no
90 sobre explotar con estas actividades a este sistema que son muy frágiles.

91 En función de este objetivo de identificación de los cenotes en la Península y
92 como parte de ello se tendrá que diferenciar qué va a conservación y protección
93 y qué va para uso y aprovechamiento. Siento que es obligado porque hay zonas
94 que seguramente tendrán una condición diferente y hay que procurar que se
95 prevalezca y lo que sea aprovechable pues como todo hay que reglamentarlo.
96 Yo considero que la evaluación del inventario se tendrá que llegar a esta
97 diferenciación y clasificarlo.

98 Yo creo que los que vivimos en la Península, como Quintanarroenses pues
99 hemos convivido con los cenote por toda la vida. Yo desde que tengo unos de
100 razón desde chavito y somos costeros, estamos vinculados al tema de cenotes.
101 Algunos superficiales, en el sentido de que son abiertos y se puede nadar y otras
102 que son tipo de cueva o caverna, pero yo por ejemplo desde muy chavo mi
103 familia es de Cozumel y en Cozumel está Chancaná que le llamamos laguna, pero
104 es un cenote y allá hay diferentes la Caletita, son aportaciones de agua, son
105 cenotes y muy de manera directa en Bacalar por ejemplo. Que mejor ejemplo de
106 esos cenotes, al menos yo en lo personal aprendí a nadar en el cenote azul de
107 Bacalar y bueno a veces de pequeño uno no valora lo que hace de pequeño, ese
108 cenote de Bacalar tiene 90mts de profundidad, es impresionante. Bucearlo a
109 pulmón era algo impresionante y ahí estábamos nadando, jugando y
110 echándonos clavado en el cenote y en los otros cenotes que están dentro de la
111 misma laguna. Hemos vivido con los cenotes, Yo desde mi infancia tengo muy
112 claro lo que es el cenote. Además lo traemos como parte de una tradición de
113 nuestra cultura maya, los mayas se asentaban a la orilla de esto sitios porque
114 tenían garantizado el suministro de agua de los cenotes. A quien le preguntes de
115 la Península te va hablar de esa convivencia, porque crecimos con los cenotes.
116 Hoy los conocemos más porque estamos profundizando el conocimiento y hay
117 que darle su particular importancia para su conservación y preservación y en
118 donde se pueda aprovechar que se aproveche con los que conlleva un
119 aprovechamiento sustentable, porque también lo podemos agotar, como todo.

120 Aprovechar la entrevista para comentarle que creo que el tema cenotes y ríos
121 subterráneos como sistema ha propiciado una unión entre estos tres estados de
122 la Península, bajo un esquema de participación de los tres órdenes de gobierno,
123 la sociedad civil organizada, los centros de investigación sobre el tema. Creo que
124 lo hemos podido palpar. Cuando se han convocado a reuniones donde hay que

125 entrarle a los convenios escritos los tres gobernadores han estado juntos para
126 participar en torno al tema de cenote y ríos subterráneos, yo creo que es un
127 buen ejemplo de cómo cuando se privilegia el sentido de la protección y
128 conservación aquí estaremos siempre vinculando a gobiernos o niveles de
129 gobierno sin distingos de divisiones geopolíticas y mucho menos, que fuera el
130 caso, partidarias en un momento dado. Yo creo eso es lo que vale la pena
131 resaltar, esa unidad que se da en torno al tema de los cenotes y ríos
132 subterráneos.

133 También estamos buscando que los ordenamientos ecológicos, los nuevos como
134 el de Solidaridad, ya incluyen criterios específicos que hacen referencia
135 específica a los cenotes, por ejemplo no se puede desmontar vegetación activa
136 alrededor de quinientos metros de un cenote. Ya por ejemplo se metieron unos
137 investigadores a participar del tema y hasta por ejemplo del tipo de luz que se
138 puede meter en las cuevas para no afectar a la fauna. El tema cenotes lo hemos
139 metido a los ordenamientos ecológicos, se está impulsando para cuestiones de
140 infraestructura. Al decir obras me refiero a edificios, hoteles y demás pero
141 también a las propias vías de comunicación. Hemos visto como construir una
142 carretera, a veces por no tener los estudios suficientes y necesarios pasan sobre
143 cavernas que al rato tienden a ser cenotes y se derrumban y generan
144 problemas. Hay que hacer identificaciones en ese sentido, por eso la parte de los
145 monitoreos, sobre todo en la infraestructura, pues tener con el conocimiento
146 que ya se ha dado en la práctica y profundizar esos estudios. Nosotros ya
147 estamos incorporando el tema de ordenamiento y eso lo hicimos en el más
148 reciente publicado que es el de Solidaridad porque salió como un tema que
149 pareciera aislado y hoy ya está incluido, independientemente de una regulación
150 y/o norma ya lo identifica el ordenamiento de Solidaridad que es en donde
151 están un gran número de cenotes y es parte del proceso que comentábamos y lo
152 otro es que una vez que los hayamos identificado que no solamente son cenotes
153 que son las zonas de captación de agua ya las estamos proponiendo como
154 medidas de conservación y protección independientemente de que más
155 adelante se logran decretar ciertas áreas para elevar la protección del sitio. Está
156 entrando de una regulación vía ordenamientos ecológicos.

157 El ordenamiento ecológico es básicamente para lo que viene en el futuro, claro
158 que estamos viendo en algunas normas oficiales mexicanas de desarrollos
159 turísticos y ahí también podría incluirse. Hay que meter algo ahí que no afecte a
160 los ríos subterráneos. Es parte de los que estamos trabajando y cosas nuevas se
161 van incorporando.

Appendix 5: List of Research Activites

Ref	Date	Activity	Position	Organisation	Sector	Location
11	12/03/2009	Semi-structured Interview	Tourist Operator	Alltournative	Private	Playa del Carmen
12	14/03/2009	Semi-structured Interview	Tourist Operator	Chaak Tun	Private	Ejido Playa del Carmen
13	16/03/2009	Semi-structured Interview	Ejidatario	System Pool Tunich	Private	Ejido Playa del Carmen
14	18/03/2009	Semi-structured Interview	Director	CONAGUA Quintana Roo	Public	Chetumal
15	19/03/2009	Semi-structured Interview	Director	Direccion Ecologia Cancun	Public	Chetumal
16	19/03/2009	Semi-structured Interview	Director	SEDUMA	Public	Chetumal
17	20/03/2009	Semi-structured Interview	Private Consultant		Private	Chetumal
18	21/03/2009	Semi-structured Interview	Aquatic Systems Ecology	Colectividad RAZONATURA	Explorers/NGO	Tulum
19	21/03/2009	Semi-structured Interview	GIS coordinator. Researcher	Washington University	Academic	Akumal

I10	25/03/2009	Semi-structured Interview	Researcher/ Director of the Programme Mayan Sub-aquatic Cemeteries	INAH	Public	Tulum
I11	25/03/2009	Semi-structured Interview	Lecturer in Geohydrology	Department of Earth and Planetary Sciences. North-western University	Academic	Akumal
I12	26/03/2009	Semi-structured Interview	Diver		Explorers	Akumal
I13	26/03/2009	Semi-structured Interview	Researcher	CICY	Public	Cancun
I14	30/03/2009	Semi-structured Interview	Sub-Director	CAPA	Public	Playa del Carmen
I15	2/04/2009	Semi-structured Interview	Coordinator of the Marine Programme on the Yucatan Peninsula	TNC	NGO	Merida
I16	8/04/2009	Semi-structured Interview	Director of Environment and Pollution	SEDUMA	Public	Merida
I17	14/04/2009	Semi-structured Interview	Director	Centro Ecologico Akumal	NGO	Akumal
I18	18/04/2009	Semi-structured Interview	Diver/Environmental Lawyer	Dos Ojos Scuba	Explorer	
I19	21/04/2009	Semi-structured Interview	Ejidatario/Cenote owner	Yaaxmul	Private	Tulum
I20	22/04/2009	Semi-structured Interview	Ejidatarios usufructuarios/ Divers/owners labna-ha park	Labna-Ha	Private	Tulum
I21	22/04/2009	Semi-structured Interview	Tourist Guide	Aktun-Chen	Private	Tulum

I22	22/04/2009	Semi-structured Interview	Real Estate Agent	REMAX Riviera	Private	Akumal
I23	23/04/2009	Semi-structured Interview	Diver/Tourist Guide	Hidden Worlds	Explorer	Tulum
I24	23/04/2009	Semi-structured Interview	Head Gardener	Xcaret	Private	Playa del Carmen
I25	23/04/2009	Semi-structured Interview	Diver/Owner	Hidden Worlds	Explorer	Tulum
I26	2/05/2009	Semi-structured Interview	Diver	Cave Exploration	Explorer	Puerto Aventuras
I27	20/05/2009	Semi-structured Interview	Researcher/Specialist in Caves and Cenote Myths	UADY	Academic	Merida
I28	23/05/2009	Semi-structured Interview	Director of the Consejo de Cuenca Peninsula de Yucatan	CONAGUA	Public	Merida
I29	28/05/2009	Semi-structured Interview	Tourist Entrepreneur	Delphinus and Rio Secreto	Private	Cancun
I30	28/05/2009	Semi-structured Interview	Researcher/Director of CICY-CEA/ Specialist in the Yucatan Peninsula's Hydrological system	CICY-CEA	Academic	Cancun
I31	28/05/2009	Semi-structured Interview	Environmental Lawyer/Proposing a legislation for the aquifer	CEMDA	Private	Cancun
I32	3/06/2009	Semi-structured Interview	Speleodiver archaeologist	UADY	Academic	Merida
I33	9/06/2009	Semi-structured Interview	Land owner/ Cenote	Jacinto Pat	Private	Dos Ojos
I34	9/06/2009	Semi-structured Interview	Researcher	CEA/ECOSUR	Academic	Tulum

135	11/06/2009	Semi-structured Interview	Land owner/ Cenote	Cenote en Akumal Pueblo junto a Rancho Santa Cruz	Private	Akumal Pueblo
136	12/06/2009	Semi-structured Interview	Environmental Lawyer		Private	Aventuras Akumal
137	15/06/2009	Semi-structured Interview	Land owner/ Cave	Santa Rita/ Ejido de Valladolid	Private	Santa Rita
138	15/06/2009	Semi-structured Interview	Land owner/ Cave	Santa Rita/ Ejido de Valladolid	Private	Santa Rita
139	15/06/2009	Semi-structured Interview	Land owner/Cave/Elder	Santa Rita/ Ejido de Valladolid	Private	Santa Rita
140	17/06/2009	Semi-structured Interview	Diver	Director of CINDAQ	NGO	Playa del Carmen
141	17/06/2009	Semi-structured Interview	Environmental Consultant	GPPA	Private consultant/explorer	Cancun
142	17/06/2009	Semi-structured Interview	Diver/ Cave explorer	Zero Gravity	Explorer	Puerto Aventuras
143	20/06/2009	Semi-structured Interview	Diver/Cave explorer	Zero Gravity	Explorer	Puerto Aventuras
144	22/06/2009	Semi-structured Interview	Biologist/Conservationist/Director of Sustainable Development	XEL-HA	Private	XEL-HA
145	22/06/2009	Semi-structured Interview	Land Owner/Cenotes	Nohoch-Nahich	Private	Rancho San Felipe
146	22/06/2009	Semi-structured Interview	Diver/Cave explorer	Dos Ojos Scuba	Explorer	Dos Ojos
147	24/06/2009	Semi-structured Interview	Land Owner/ Cenotes	Labna-Ha/Cenote Caracol	Private	Dos Ojos

148	24/06/2009	Semi-structured Interview	Land Owner/Diver/ Diveshop owner	Dos Ojitos	Private	Dos Ojos
149	27/06/2009	Semi-structured Interview	Land Owner	Mil columnas	Private	Dos Ojos
150	7/07/2009	Semi-structured Interview	Land Owner	Chac Mol	Private	Puerto Aventuras
151	7/07/2009	Semi-structured Interview	Land Owner/Cenote	Aktun-Chi	Private	Playa del Carmen
152	7/07/2009	Semi-structured Interview	Environmental consultant/Hydrological Engineer	CAPAGHC A.C de C.V	Private consultant	
153	9/07/2009	Semi-structured Interview	Director Water Programme	Centro Ecologico Akumal	NGO	Akumal
154	11/07/2009	Semi-structured Interview	Cave Diver	California	Explorer	Akumal
155	12/07/2009	Semi-structured Interview	Cave Diver/Maya Speaker		Explorer	Akumal
156	14/07/2009	Semi-structured Interview	Director/Social Anthropologist	Flora, Fauna y Cultura	Private	Parque la Ceiba/Playa del Carmen
157	16/07/2009	Semi-structured Interview	Subdirector Water Programme	Amigos de Sian Ka'an	NGO	Playa del Carmen
158	2/09/2009	Semi-structured Interview	CO Xcaret	Grupo Xcaret	Private	Xcaret
159	5/07/2009	Semi-structured Interview	Speleologist	QRSS	Explorer	Cenote Carwash/ICS Yucatan
160	6/07/2009	Semi-structured Interview	Speleologist	QRSS	Explorer	Valladolid/ ICS Yucatan

161	6/07/2009	Semi-structured Interview	Grotto Vice-Chairman California		Explorer	Valladolid/ ICS Yucatan
162	6/07/2009	Semi-structured Interview	Professor of Speleology	Norway	Explorer/Academic	Valladolid/ ICS Yucatan
163	6/07/2009	Semi-structured Interview	Speleologist	Brazil	Explorer	Valladolid/ ICS Yucatan
164	6/07/2009	Semi-structured Interview	Professor of Speleology	Karst Research Institute, Slovenia	Explorer	Valladolid/ ICS Yucatan
165	9/07/2009	Semi-structured Interview	Geologist	Carste Consultores y Asociados	Consultant/Explorer	Cancun
166	10/10/2009	Semi-structured Interview	Anthropologist	Grupo Ahau	Consultant/Explorer	Merida
167	10/10/2009	Semi-structured Interview	Archaeologist	Grupo Ahau	Consultant/Explorer	Merida
168	10/10/2009	Semi-structured Interview	Archaeologist	Grupo Ahau	Consultant/Explorer	Merida
169	9/11/2009	Semi-structured Interview	Director	Banco Chinchorro	NGO/Explorer	Merida/Wild 9
170	9/11/2009	Semi-structured Interview	Director	Amigos de Sian Ka'an	NGO	Merida/Wild 9
171	11/11/2009	Semi-structured Interview	Anthropologist	SEDUMA Yucatan	Public	Merida/Wild 9
172	12/11/2009	Semi-structured Interview	Project Coordinator	SEDUMA Quintana Roo	Public	Merida/Wild 9
173	12/11/2009	Semi-structured Interview	Director	SEDUMA Quintana Roo	Public	Merida/Wild 9

V1	16/06/2009	Group Interview	Ejidatarios Playa del Carmen	Vigilance Committee	Private	Playa del Carmen
V2	18/06/2009	Group Interview	Ejidatarios Playa del Carmen	Vigilance Committee	Private	Playa del Carmen
F1	24/09/2008	Workshop	Conservation Experts Workshop	TNC		Akumal
F2	25/09/2008	Workshop	Conservation Experts Workshop	TNC		Akumal
F3	26/09/2009	Attendance	Cenotes Symposium	UADY		Merida
F4	18/03/2009	Attendance	Forum de Cenotes	SEMARNAT, CONAGUA, Consejo de Cuenca de la Peninsula de Yucatan, SEDUMA		Chetumal
F5	19/03/2009	Presentation	Forum de Cenotes	SEMARNAT, CONAGUA, Consejo de Cuenca de la Peninsula de Yucatan, SEDUMA		Chetumal
F6	21/08/2009	Attendance	Regional Forum of Cenotes	SEMARNAT, CONAGUA, Consejo de Cuenca de la Peninsula de Yucatan, SEDUMA		Merida

Appendix 6: Ethical Approval Letter

Maria de Lourdes Melo Zurita

Department of Geography

31st March 2009

Dear Maria,



REP(GGS)/08/09–19 'The Underground Forest Frontier in Mexico's Quintana Roo: competing discourses and materialities surrounding caves and cenotes'

Thank you for sending in the amendments requested to the above project. I am pleased to inform you that these meet the requirements of the GGS Research Ethics Panel and that full approval is now granted.

Please ensure that you follow all relevant guidance as laid out in the King's College London *Guidelines on Good Practice in Academic Research*

(http://www.kcl.ac.uk/college/policyzone/attachments/good_practice_May_08_FINAL.pdf).

For your information ethical approval is granted until 30th June 2010. If you need approval beyond this point you will need to apply for an extension to approval at least two weeks prior to this explaining why the extension is needed, (please note however that a full re-application will not be necessary unless the protocol has changed). You should also note that if your approval is for one year, you will not be sent a reminder when it is due to lapse.

If you do not start the project within three months of this letter please contact the Research Ethics Office. Should you need to modify the project or request an extension to approval you will need approval for this and should follow the guidance relating to modifying approved applications:

(<http://www.kcl.ac.uk/research/ethics/applicants/modifications.html>)

Any unforeseen ethical problems arising during the course of the project should be reported to the approving committee/panel. In the event of an untoward event or an adverse reaction a full report must be made to the Chairman of the approving committee/review panel within one week of the incident.

Please would you also note that we may, for the purposes of audit, contact you from time to time to ascertain the status of your research.

If you have any query about any aspect of this ethical approval, please contact your panel/committee administrator in the first instance (<http://www.kcl.ac.uk/research/ethics/contacts.html>). We wish you every success with this work.

With best wishes

Yours sincerely

Daniel Butcher
Research Ethics Administrator

Appendix 7: SAVE's Letter to President Felipe Calderón



Society of Akumal's Vital Ecology

C. PRESIDENTE CONSTITUCIONAL DE LOS ESTADOS UNIDOS MEXICANOS.
RESIDENCIA PRESIDENCIAL, LOS PINOS
MEXICO, DISTRITO FEDERAL.
P R E S E N T E.

NANCY ELLEN DE ROSA, mexicana por naturalización, en mi carácter de representante legal de la persona moral denominada S.A.V.E., A.C. o Salvamento Akumal de Vital Ecología, Asociación Civil, en términos del instrumento notarial que en copia certificada se acompaña (Anexo 1), señalando como domicilio para oír y recibir todo tipo de notificaciones y documentos el de tercer piso del Conjunto Villas de Rosa, en Aventuras Akumal, Municipio de Tulum, Estado de Quintana Roo, C.P. 77760, México, con el debido respeto comparezco para exponer:

Que por medio del presente escrito y con fundamento en los artículos 4º párrafo cuarto, 8º y 27º Constitucionales, vengo a solicitar de Usted, como titular del Poder Ejecutivo Federal y en uso de las atribuciones que la Ley le otorga, se sirva emitir el DECRETO que corresponda, a efecto de que LOS SISTEMAS DE RIOS SUBTERRANEOS Y CENOTES DE LA FRANJA COSTERA QUINTANARROENSE QUE COMPRENDE DESDE LA ZONA NORTE DE PUERTO MORELOS HASTA LA ZONA SUR DE TULUM, sean integrados al Sistema Nacional de AREAS NATURALES PROTEGIDAS, con el adecuado nivel de salvaguarda y cuidado a la mayor brevedad posible, en razón de los hechos que a continuación exponemos, basados en los motivos que también se señalan y en los documentos que como prueba se acompañan.

HECHOS:

- I. Todos los ríos de Quintana Roo son subterráneos. Las características geomorfológicas de la costa de Caribe mexicano, especialmente entre Puerto Morelos y Tulum, permiten la exploración de dichos sistemas fluviales y gracias a ello se ha logrado saber mucho de estos singulares ecosistemas. En esta sección de la franja costera quintanarroense se encuentran los ríos subterráneos más largos del mundo: el sistema Ox Bel Ha con 162 kilómetros, el sistema Sac Aktún con 155 kilómetros y el sistema Dos Ojos con 67 kilómetros, entre muchos otros.
- II. NO SE PUEDE PROTEGER LO QUE NO SE CONOCE y para muestra basta solo consultar las cartas hidrológicas del Estado de Quintana Roo (tanto de aguas superficiales como subterráneas) que el Gobierno Mexicano tiene a través del INEGI. La información que contienen estos mapas oficiales es tan lejana a la realidad que no solo sorprende sino que asusta (Anexos 2 y

Apartado Postal #48 Akumal, Quintana Roo, México 77760 Phone/Fax: 987-5-9020 Email: SAVE@cenotes.com

- 3). La realidad es que hasta el final del mes de noviembre del año 2008 se han explorado, delimitado y registrado con las asociaciones internacionales de buceo espeleológico (entre otras la denominada Quintana Roo Speleological Society) un total de 750 kilómetros de cavernas y cuevas inundadas a lo largo de esta costa y hasta una distancia de 15 kilómetros tierra adentro (Anexos 4 y 5). Sistemas fluviales llenos de maravillosa agua prácticamente potable que fluye libremente hasta el océano. El cálculo conservador de quienes practican esta rama de la espeleología en la zona es que esta cifra podría ser 10 veces mayor en los próximos años. Hoy en día pueden contarse alrededor de 173 sistemas, aunque se piensa que todos ellos podrían ser parte de uno solo de mucho mayores dimensiones: el sistema fluvial mas largo y complejo del mundo.
- III. Los cauces de estos ríos subterráneos cercanos a la costa tienen un “techo” o plafón muy delgado y frágil (al estar constituido por roca calcárea tipo “karst”), desde unos cuantos centímetros en algunos lugares hasta solo algunos metros en otros. Esta circunstancia los hace sumamente débiles y vulnerables a la filtración de contaminantes, así como al constante riesgo de sufrir colapsos con motivo de la actividad humana de la superficie. Actualmente la mayor parte de estos sistemas fluviales llamados “kársticos” se encuentra sana, limpia y prácticamente intacta. Ellos constituyen la base de un delicado equilibrio natural, ya que proveen a la selva maya de agua limpia durante todo el año, aún en la temporada de sequía. Los colapsos naturales de los sistemas fluviales de la península de Yucatán son conocidos como cenotes y se consideran los “oasis” de la selva. En esta región son de gran importancia, ya que no solo son la fuente de agua de los habitantes humanos, animales y vegetales de la zona, sino también un importante medio de sustento de los propietarios de las tierras circundantes, ya que son utilizados para el turismo y la recreación.
- IV. Los sistemas fluviales menos profundos estuvieron secos durante las eras glaciares, ya que durante estos periodos mucha del agua del planeta se congela en los polos y los niveles de los mares y de las aguas interiores en el resto del mundo descienden considerablemente. Durante estas épocas (la última hace entre 10 y 12 mil años) y al estar secos los cauces subterráneos, se presentó el desarrollo de formaciones sedimentarias conocidas como espeleotemas (estalactitas, estalagmitas y columnas), así como actividad animal y humana (muy anterior a la Cultura Maya). Una visita de buceo a estos lugares representa un verdadero sueño (anexo 6). Un auténtico viaje en el tiempo a épocas remotas: pueden verse fogatas intactas y esqueletos humanos de la era glacial, huesos de mastodontes, de perezosos gigantes, de camellos... Restos de actividad humana reciente en los cenotes y de actividad animal y humana prehistórica en el interior de las cuevas. Todo preservado por el agua y detenido en el tiempo. Patrimonio antropológico, arqueológico, paleontológico y geológico. Tan importante como digno de ser protegido con toda la fuerza de las leyes.
- V. Una sombra de destrucción comienza a cubrir estos maravillosos lugares. El peligro acecha a los ríos subterráneos del Caribe mexicano y las leyes actuales que se encuentran relacionadas con las fuentes de agua y las formas

de desarrollo e infraestructura urbana, no consideran la singularidad de estos fantásticos sitios. Las leyes que actualmente se aplican (en el mejor de los casos) fueron concebidas sin conocerse ni considerarse las características únicas de esta región. La diversa legislación aplicable con la que se regula el desarrollo en la zona conocida como la Riviera Maya, es tan general como ignorante de lo que se encuentra en el subsuelo y no podemos pedir a un legislador que proteja lo que ignora. El subsuelo de la franja costera de la Riviera Maya tiene características tan especiales que requiere de una protección también muy especial. La zona de los mayores ríos subterráneos del planeta es tan delicada como lo es el equilibrio de los ecosistemas que tiene encima y que de ellos dependen. Tenemos el privilegio de poseer los mas maravillosos sistemas fluviales subterráneos del mundo y ello conlleva una gran responsabilidad de los mexicanos ante el planeta y ante toda la humanidad. De los mexicanos y sobre todo del Gobierno Mexicano.

- VI. La sombra de destrucción tiene varios nombres y ya cubre parte de este singular mundo subterráneo. Uno de esos nombres es contaminación. Contaminación provocada por la utilización de sistemas de construcción de infraestructura convencionales, así como de un tratamiento de igual modo convencional de aguas residuales (en el mejor de los casos). Contaminación proveniente del creciente número de campos de golf y la consecuente utilización en ellos de gran cantidad de fertilizantes químicos, mismos que no pueden ser debidamente filtrados por la delgada capa de roca calcárea y son conducidos así al flujo del río subterráneo, para posteriormente ser depositados en la segunda barrera de arrecifes de coral del mundo: el SAM o Sistema Arrecifal Mesoamericano, el cual es también nuestra indiscutible responsabilidad internacional proteger. Estamos contaminando de manera alarmante una importante reserva de agua potable del país. Se ha descubierto que en estos complejos sistemas fluviales se presenta la existencia de flujos y contra flujos, es decir, movimientos de agua en direcciones diversas e irregulares a su paso rumbo a alguna salida al mar. Esta situación hace aún más importante el cuidado de los drenajes y el manejo de las aguas residuales, así como depósitos de basura, ya que los contaminantes pueden viajar e invadir sistemas enteros.
- VII. El uso abusivo y descontrolado de explosivos y maquinaria pesada, la insuficiente vigilancia de las autoridades locales y federales, el otorgamiento indiscriminado de permisos de construcción, así como la aplicación de criterios desinformados de análisis de impacto ambiental, están generando graves riesgos de colapsos mayores en el techo de los sistemas fluviales y la consecuente destrucción de cuevas maravillosas y únicas. Es urgente detener la destrucción. Es urgente detener más proyectos irresponsables. No podemos ni debemos ignorar los efectos a mediano y largo plazo. Necesitamos proteger y preservar ecosistemas sanos con agua limpia para las futuras generaciones.

Hemos llegado a la conclusión de que no podemos ser testigos mudos de la destrucción de uno de los ecosistemas más maravillosos del planeta. No podemos eludir nuestra responsabilidad. Un testigo mudo es un testigo cómplice. No seremos cómplices de los

daños irreversibles. Asumimos la responsabilidad de defender los maravillosos ríos subterráneos y cenotes de la costa del Caribe mexicano. PEDIMOS que se decrete su protección. Que sean integrados cuanto antes al Sistema Nacional de Áreas Naturales Protegidas bajo un adecuado nivel de salvaguarda.

Nuestra solicitud tiene un nombre que conlleva una advertencia. La advertencia de que con la destrucción de los sistemas acuíferos nos destruiremos a nosotros mismos, a nuestra fuente de vida. Nuestra advertencia tiene un nombre que es ya un llamado social:

“AGUAS CON LOS CENOTES”

Sr. Presidente, quien suscribe y firma este documento, así como quienes estamos en la lucha por la conservación en nuestra asociación y en nuestra región, no buscamos más que eso, la conservación. No queremos fama ni buscamos gratitudes. Queremos que nos vea como sus proveedores de información valiosa, de información que le dé la convicción necesaria para decidir la protección inmediata de un lugar importante para la región, para el país y para toda la humanidad. Un lugar único e irrepetible.

PROTESTO LO NECESARIO

Akumal, Quintana Roo, República Mexicana, a los 9 días del mes de febrero del año 2009.



NANCY ELLEN DE ROSA

Anexos:

1. Instrumento Notarial
2. Mapa Regional de Aguas Superficiales. INEGI.
3. Mapa Regional de Aguas Subterráneas. INEGI.
4. Lista de Ríos Subterráneos. QRSS.
5. Mapa de Ríos Subterráneos. S.A.V.E.
6. Libro y/o imágenes de buceo en cenotes.

Appendix 8: SAVE's map Underground Rivers



