

The importance of the recognition of contemporary Mayan adaptive management strategies in the Biosphere Reserve “Los Petenes”, Campeche, Mexico

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Abstract

The importance of deepening our knowledge of current social-ecological knowledge and practices in Mayan communities in Campeche, Mexico, is not only due to the wealth of local knowledge on the environment and adaptive management techniques harboured in Mayan culture and practices, but also because such knowledge is still not socially and politically recognised, hence the Mayan social systems which store this knowledge are as much under threat as the ecological systems they help to sustain. This article shows that Mayan communities in the Biosphere Reserve “Los Petenes”, Campeche, México, are aware of both current ecological and social challenges and analyses how the strategies they employ draw upon both ancient and current knowledge and practices to address that challenge. Analysis indicates an opportunity for a bottom-up economic policy solution in the region by integrating complex socio-ecological practices of adaptive management and resilience in “Los Petenes”.

Keywords: Social Bottom-up policy; Indigenous knowledge; Mayan adaptive management; Social ecological systems;

1. Introduction

In order to increase the effectiveness of environmental policies, the 2016 Year of Global Understanding initiative takes as one of the points of departure the importance of deepening our knowledge of socio-cultural contexts of local and Indigenous environmental knowledge: “Global environmental change research has produced scientific insights into earth system processes that are rarely translated into effective policies. We need to deepen our knowledge of socio-cultural contexts”(Werle, Osterbeek, & Henriques, 2016).

In the present article we draw attention to the importance of such initiatives if we consider that despite the widening acknowledgement of the wealth of environmental knowledge and adaptive management techniques harboured by local and indigenous cultures (Raygorodetsky, 2011)(CONANP, 2016), such recognition, nevertheless, too often remains confined to certain local and international specialist groups. In Mexico environmental policy with regard to Mayan communities continues to be limited, officially, to controlling or restricting sustenance hunting and ancient practices of slash and burn land clearance(Mathews, 2005) whilst pursuing development policies to convert the indigenous population into participants of the modern economy of ecotourism (Garcia-Frapolli, Toledo, & Martinez-Alier). Such policies are supported by urban social attitudes towards Mayan culture which tend to regard it as an extinct civilisation and culture, with only certain cultural artisan skills surviving in such areas as gastronomy, basket and hat weaving, an idea recently repeated in the XXVI conference of Mayan researchers in the University of Campeche and reported uncritically in local media (PRIMERA PLANA, 2016).

This lack of recognition is not only discriminatory but is also ecologically short-sighted due to the fact that although indigenous groups represent a minority in terms of population,(4% globally (Raygorodetsky, 2011), 12% in Campeche, 2010 census, (Cuentame.org, 2016), they, nevertheless, utilize globally 22 per cent of the world’s land surface, and “In doing so, they maintain 80 per cent of the planet’s biodiversity in, or adjacent to, 85 per cent of the world’s protected areas” (Raygorodetsky, 2011). The State of Campeche has the largest protected land area in the Yucatan Peninsula, amounting to 40% of its territorial area (Campeche, Gobierno del Estado, PRONATURA Peninsula de Yucatan, a.c., 2016).

Whilst there is a general awareness amongst the local population of changing weather patterns, reduced rain fall and increased extremes in seasonal temperatures, far more specialised environmental knowledge resides in the Mayan communities whose culture is still largely organized around the agricultural calendar according to the periodicity of wet and dry seasons which in turn temporalizes the related religious offerings, thereby sustaining in differing degrees the Mayan pre-colonial world view. For this reason, not only do they harbour important information concerning the impact of climate change on particular socio-ecosystems but also constitute a vital group under pressure to continue to adapt and evolve to strengthen ecosystem resilience, yet little documentation exists regarding their current land management use and mitigation strategies.(Barrera-Bassols & Toledo, 2005, pág. 3)

The purpose of this article is to deepen our understanding of contemporary Mayan social-ecological knowledge and practices in the Biosphere reserve “Los Petenes” in the State of Campeche and, in the light of key concepts in ecological thinking and Mayan cultural studies, reflect upon the current pertinence of this knowledge for the design of bottom-up (Gibbons, y otros, 1994)public policies for sustainable development in the region.

2. Methodology and conceptual framework

With the objective of identifying indigenous social ecological understanding and practices within a specific social, political and environmental context, the case study methodology was employed.

2.1. Method of Data Collection

In order to inquire more deeply into examples of the continued employment of social ecological knowledge and practices in Mayan communities, the study of beekeepers and in particular the Pat family, from the village of Tankuché in the biosphere reserve of “The Petenes”, was chosen as a case study. On the basis of prior superficial acquaintance, the research team considered that the family’s activities indicated a high level of knowledge of their practice together with a collaborative disposition to share their experience and knowledge. Evidence also indicated the high regard and trust Mr Pat’s holds both within the community and from local institutions.

A semi-structured interview took place at the home of the Pat family in May 2016 and posthumous communication was maintained through conversations in informal encounters and with the son and daughter via social media.

2.2. Heuristic Approach

The results of the interview were analysed for evidence of Mr Pat’s understanding of social ecological relations, according to key concepts used in both ecological science and Mayan environmental and cultural studies.

2.2.1. Key ecological concepts

2.2.1.1. The local as the site of the ‘political’

According to Lorraine Code, given ecological thinking’s attention to the local in its diversity and its interconnectedness of “lives and events across the human and the non-human world”, the local **is** the site of the political.(Code, 2006, pág. 5)

2.2.1.2. Indigenous governance

Kyle Powys Whyte argues that Indigenous knowledges are often only considered of in terms of “supplemental value”(Powys-Whyte, 2015, pág. 7) and suggests that instead “Indigenous knowledges can actually guide scientific research; it does not have to be the other way around.(Powys-Whyte, 2015, pág. 23). Powys also focuses on the importance of maintaining “land-based practices and vibrant cultures” in order to maintain collective capacities and successful forms of indigenous governance in order to continue to adapt to change.(Powys-Whyte, 2015, pág. 15) A key element of Indigenous governance concerns not only the use but the internal transmission of knowledge. “Indigenous peoples are concerned about protecting their own internal capacity to cultivate, transmit, remember, and exercise Indigenous knowledges”. (Powys-Whyte, 2015, pág. 22)

2.2.1.3. Adaptive capacity

Vibrant cultures and successful governance are also considered by the Resilience Alliance as key factors in adaptive capacity which “in ecological systems is related to genetic diversity, biological diversity, and the heterogeneity of landscape mosaics”, but in social systems, it is related to “the existence of institutions and networks that learn and store knowledge and experience, create flexibility in problem solving and balance power among interest groups”. (RESILIENCE ALLIANCE, 2016)

2.2.1.4. Social-ecological systems and Resilience

These same factors of self-organisation, learning and adaptation are also considered key to resilience which is defined as “the capacity of a social-ecological system to absorb or withstand perturbations and other stressors such that the system remains within the same regime, essentially maintaining its structure and

functions. It describes the degree to which the system is capable of self-organization, learning and adaptation”. Resilience is considered a result of the complex relation between social and ecological systems (RESILIENCE ALLIANCE, 2016)(Manuel-Navarrete & Kay, 2004)

2.2.2. Key concepts of Mayan ecology

Recent studies show that the above mentioned ecological concepts can be identified in contemporary Maya forms of land management which adapt ancient practices and concepts stored within their still vibrant culture.

2.2.2.1. The secular dimension of resilience

Barrera and Toledo argue that despite vast literature on Mayan culture, relatively little is known about current land management practices (Barrera-Bassols & Toledo, 2005, pág. 3) Nevertheless, studies have shown that the Yucatec Maya have a good understanding of hydrological cycle and zoning, which is demonstrated by wide variety of meteorological and climatic terms, as well as the fact that the Yucatec Maya knowledge of soils makes use of the most extensive indigenous terminology known among all Mesoamerican people. Yucatec Maya land management strategy seeks “the optimal combinations of all available landscape units (mature forests, house-garden, fallow, shifting cultivation and intensive agriculture)”(Barrera-Bassols & Toledo, 2005, pág. 22) and this variety is a risk-avoidance mechanism and thus the basis of the resilience of this model of land management:

Contemporary Yucatec Maya multiple-use strategy... implies lower production per land use unit, but higher production of the aggregate landscape, and stand as a dynamic and permanent system based on the benefits of diversity, when compared with specialized use. Thus, the multiple-use strategy is an adaptive response to the high variety of landscapes, soils, relief and biotic elements and to the ecological process of tropical forests’ succession. This explains the existence of a “Maya silviculture”, (Barrera-Bassols & Toledo, 2005, pág. 22)

In this sense “Yucatec Maya practice a modality of what has been called “adaptive management”, based on the multiple use of species and landscape units, resource rotation, landscape-patch and succession management... it represents a secular mode of resilience. ”. (Barrera-Bassols & Toledo, 2005, pág. 22)

2.2.2.2. The sacred dimension of resilience

Barrera and Toledo argue that “Land, “Luúm” in Maya signifies domain, soil and spirit”,(Barrera-Bassols & Toledo, 2005, pág. 21) and this sacred dimension of resilience lies in the Mayan understanding of the “health” of the land:

According to Yucatec Maya perception, land is considered as a living being. Land health is linked to the food chain, according to a higher discourse that connects health and well-being of plants, animals and men with solid health. This principle of interconnection is used to explain the food chain: “***If plants, animals and soils are healthy, then men should be healthy***” (Vogt, 1979) (Barrera-Bassols & Toledo, 2005, pág. 22)

Barrera and Toledo argue that studies of Mayan symbolic systems and their use in the classification of flora and fauna; the relation of their deities to natural phenomena; the continued performance of agrarian ceremonies throughout the year; the organisation of their ecological knowledge around the recognition of soil-relief-vegetation units in the landscape; all “illustrate reciprocal relations between the cosmological dimension, the cognitive body and the ensemble of practice” together with 2 processes which function as key organizers of Yucatec Maya landscape management and therefore as resilience mechanisms: “(1) a wise management of both ecological processes and biodiversity,(2) a guiding concept of health, which is applied

across scale” mechanisms which recognise little or no separation between the secular and the sacred domains, rather they are “mutually determined”(Barrera-Bassols & Toledo, 2005, pág. 21).

The necessary caring for the land “shows principles of reciprocity and equality; and this is why rituals mimic conservation practices to maintain the (symbolic and material) balance between abundance and scarcity, or weakness and strength. Connectedness means that all actors should work together as a team, otherwise men may not receive the benefits from the borrowed land, and may be punished by nature and the supra-natural beings (aluxes)”. (Barrera-Bassols & Toledo, 2005)

Despite two population collapses (during the classical Maya period and following the Spanish conquest) the “Yucatec Maya culture has avoided ecological and cultural collapse, thus

It demonstrates an **adaptive capability** to re-organize both social and ecological relations, after significant change. In other words, Yucatec Maya culture demonstrates high levels of resilience.

Resilience is defined as the capacity of adaptive systems to absorb disturbances, which translated to the field of cultural history means the ability to collectively memorize success and failure, including ways to overcome unexpected changes and perturbations. (Barrera-Bassols & Toledo, 2005)

Toledo considers it necessary for both policy designers and local people to acknowledge the importance of the diversification of practices which provide sustenance and income for the resilience of the Maya communities. (Toledo & Martínez-Alier, 2007, pág. 15)

2.2.2.3. Mayan cosmology and the practice of beekeeping

Since the ancient Mayas, the native melipona bee without sting (*Melipona becheii*) has been cultivated in the Mayan house-gardens. Their cultural significance can be appreciated in the Mayan Trocortesiano Codices which Dr Laura Sotelo has dated back to 1300 A.D. Their sacred and ecological importance is enhanced by recent linguistic analysis which has revealed that “**the word for bee in Maya is *kaab* which is also the Mayan name for honey and for the planet earth**”. (Chuc, 2016).

The commercial cultivation of the “American” bee (*Apis mellifera mellifera*)- introduced into the peninsula at the beginning of the 20th century - and the European bee (*Apis mellifera ligustica*) – mid-century” (Güemez Ricalde, 2003, pág. 120), currently forms an important part of the multiple strategy resource management providing family income. (Toledo & Martínez-Alier, 2007, pág. 8).The melipona honey is mainly for personal consumption due to its low levels of production (1 litre of honey as compared to 7 litres of the *Apis* bee), although it has recently acquired a commercial value due to the recognition of both its alimentary and medicinal properties (Chuc C. Russell L., 2016). Both the melipona and other native wild bees, together with the *introduced* varieties, play an important role in the pollination of the local and agricultural ecosystems.

2.3. Geographical Context

Campeche is one of the three states which conform the Yucatan Peninsula in the southeast of Mexico, bordering in the south Guatemala and the Mexican states of Tabasco, Chiapas and Quintana Roo and in the north the State of Yucatán.

In terms of Demographics, Campeche is one of the least populated states in Mexico with a little less than 900,000 inhabitants. The highest concentration of Indigenous language speakers live in the north, in the municipalities of Calkini, Hecelchakan and Hopelchen, where more than 32% of population are Mayan speakers.

In terms of climate the Peninsula is more humid in the south, whereas in the north, also known as the northern Maya Lowlands, the region is

...characterised by a lack of rivers and surface water, low rain-fall, lower elevation and more level terrain, and low forest canopy. Water seeps into limestone base and flows underground to the sea. Soils are shallow and stony best suited to the shifting milpa cultivation practiced by the Mayan population. The climate is a humid tropical climate with dry (Nov-April) and wet (May-Oct) seasons (Barrera-Bassols & Toledo, 2005, págs. 7-9)

2.4. Climate change

The PECC has reported that during the last 50 years rainfall has decreased in the southeast of México whilst temperatures have risen and warns that the Yucatan Peninsula is at risk from the increase in sea levels. Research has indicated that the rise in sea levels can affect the mangrove forests putting at risk these natural coastal defences which protect the land against a rise in sea-levels (Kolb, 2016). Nevertheless, there is currently a lack of data available on the question of climate change and its impact, a point confirmed in June 2016 by José Sarukhán Kermez, the coordinator of the National Commission for knowledge and use of biodiversity (CONABIO), when he warned that Mexico lacks studies, research teams and a strategy regarding the effects of climate change. (Vincenteño, 2016)

2.5. Environmental policy

CONABIO was created in 1992 as an inter-secretariat commission.(CONABIO, 2016) in the same year as the “Earth Summit”, and although in Mexico, the beginnings of environmental policy for the protection of natural areas of high ecological value go back to the beginning of the 20th century, it was not until after the *Earth Summit*, that Mexico acquired various environmental commitments and elaborated all the Instrumentation needed to meet environmental protection objectives.

In 1992 the Secretariat for the environment, Natural Resources and Fishing was created (SEMARNAP) and in 1997 it created the Wildlife Conservation and Productive Diversification Program in the Rural Sector to integrate environmental, economic, social and legal strategies focused on wildlife through a broad social participation. Environmental management units (UMA) were also created as schemes for alternative and sustainable use of natural resources, to reverse environmental deterioration.(Gallina-Tessaro, Hernández-Huerta, Delfín-Alfonso, & González-Gallina, 2009). In the year 2000, SEMARNAP became SEMARNAT as fishing became responsibility of the Secretariat of Agriculture, Livestock, Rural Development, Fishing and Food, and National Commission for the Protection of Natural Areas (CONANP) was created as a decentralised body of SEMARNAT, which reinforced the institutional presence in environmental matters.

Nevertheless, calls for more knowledge and recognition of indigenous environmental knowledge and practices in the design of environmental policy, continue, especially with regard to the introduction of UMA in the south. (García-Marmolejo)(Weber, 2006) , (Valdez, 2006)(Sisk, Castellanos, & Koch, 2007)Toledo argues that regional public policy in general, has historically been designed with a complete lack of ecological cultural and productive contextualization regarding the Mayan communities. (Toledo & Martínez-Alier, 2007) On the other hand, Mathews argues that ignorance of Indigenous practices is as much a part of the exercise of state power as is knowledge (Mathews, 2005).

However, it can also be argued that the fact that the participation of civil society is now recognized as an important factor in the development and effective implementation of public policies, this reflects the progress of conservation concepts within institutions. CONANP manages funds for eight conservation and development programmes, including since 2014 the "Conservation Programme for Sustainable Development" (PROCOCODES). (CONANP, 2016)Despite continuing difficulties in the introduction of UMA in the south, local community participation in projects with researchers have had beneficial results in

diversifying away from a reliance on hunting tourism (Retana Guiascón, Hinojoso-Garro, & Vargas Soriano, 2013).

2.6. The Petenes Biosphere Reserve

“The Petenes” Nature Reserve is administered by CONANP (CONANP, 2015). It was created in May 1996 with a total extension of 282,857 hectares, including the coastal mangrove swamps and 12,000 nautical miles of territorial waters, and covering the 4 municipalities of Calkiní, Hecelchakán, Tenabo and Campeche. In 1999 it was upgraded to a Biosphere Reserve and its management programme “Petenes Ecosystems” was officially approved in 2006.

Petén is a Mayan word which means flat small coastal island fields.

3. Case Study Results

3.1. The Pat Family

Mrs Maria Isabel Canul Pech and her husband Mr Jose Vidal Pat Colli, and their young adult children Josefa y Rogaciano are the members of the Pat Canul family. They live in Tankuché, in the Petenes Nature Reserve in the State of Campeche. Tankuché is a village in the Petenes that before the Mexican revolution was a hacienda. The villagers have preserved the wing of hacienda which houses a catholic chapel.

Mr Pat has land and forest and free roaming cattle in the forest but his main occupation nowadays is beekeeping. His wife Maria has an extensive medicinal herb garden. Both Mr and Mrs Pat are respected members of the local community and very active in the conservation of the chapel and its calendar of activities many of which are related to the traditional Mayan agricultural cycle within the eclectic tradition of the rural catholic church in Mexico.

3.2. Beekeeping and honey production

Mr Pat has been a beekeeper since he was a child and since 2000 he started cultivating the melipona bee as well. He also identifies 4 other native species (canzab, xik, uxcab, boloncab) that live in the forest. He has received grants from the National Commission for the development of indigenous villages, (CDI) and he also received support from CONANP to develop the production of organic honey from the *Apis mellifera*. CONANP funded the construction of a honey collection centre used by 30 families which Mr Pat has instructed on organic production techniques. They get a slightly better price per litre for organic honey but in the second half of 2016 he began to bottle the honey himself and sell it directly thus getting a fairer trade deal.

Perhaps more importantly, Mr Pat unloads and stores the honey separately according to the area where the hives are kept and thus the type of flower and pollen the bees feed from. He is the only beekeeper in the region that produces and sells a selection of single flower honey with distinct colours, scents and tastes.

Up until November 2016 he could only sell these locally as artisan products for in order to sell his product nationally and internationally and thus generate greater income, he had to complete a long and complicated process of legally constituting and then registering the honey cooperative with the Mexican Inland Revenue then registering the cooperatives brand of honey.

3.3. The challenges Mr Pat identifies

3.3.1. Social challenges

Mr Pat talks about “the knowledge of the grandparents” to refer to the cultural memory of his people. He regrets the loss of traditions, because at the same time certain considerations towards the environment are lost which are required to keep it “healthy”. The traditions of "respect" for the forest, respond to a series of

sustainable practices that maintain the health of the environment to ensure a better production, yet little by little he observes that nature has come to be seen merely as an object or a resource and not a living being that deserves respect and care.

Mr Pat explains that previously, when Tankuché was an hacienda, there were cattle to keep the grass short, or the grass was cut for fodder, but now young people who migrate to work in other places, returning only temporarily to the village, often burn the fields of grass, not realising that they are also burning not only the trees where the bees feed, but sometimes the hives at the edge of the forest and also the mangrove forests at the edge of the fields. He observed that the villagers showed more interest in such environmental issues when they began to lose their fruit tree production from their gardens in the village due to the loss of bees and consequent lack of pollination.

3.3.2. Climate change challenges

On the subject of climate change Mr Pat said that they have noticed changes in the last 8 or 9 years, but this year has been the worst. Temperatures have increased, rainfall is low and the marked change of seasons has been lost. Agriculture is badly affected and the trees are drying out whilst rising sea levels in the mangrove swamps means there has been no dry summer period for the last three years and as a result locals cannot get in to harvest the *jipi* palm, a material used in the local craft of hand woven “Panama” hats. The extremes of heat and cold kill off the flowers from which the bees collect the pollen. In 2015 they lost 40 of their 60 hives so that this year they have had to dedicate the honey produced to the cultivation of new hives to recover the loss.

3.4. Mr Pat’s mitigation strategies

To mitigate the effects of climate change and environmental degradation Mr Pat and his son practice crossing either the queen bees or the larva of the *apis*, a technique which they learnt from researchers from the Veterinary department of the University of Yucatan. They have also crossed the African bee with the *apis mellifera* both to placate the African bee and to strengthen the American and European *apis mellifera*. To protect the hives from the heat and from hurricanes they clean between the trees at the edge of the forest and position the hives under the trees.

Mr Pat has reforested a 400 hectares area following the extraction of rock in the 1980’s for a local highway construction. A small lake formed during the last hurricane and the area has become a wild life refuge. He also introduced cattle which help to keep the grass low and because they wander freely, so transporting and plant seeds of the fruits they eat and thus reproducing the forest, although he has been warned that grazing cattle in the forest is against the guidelines of the PNUD.

3.5. Mr Pat’s vision for sustainable development

Mr Pat believes that believes that more young people would stay in the village if they could earn a decent income from the land. The strategy he envisions is one by which increasing the income to be obtained from the commercialisation of honey products, and by training the young men in beekeeping, they will thereby come to take an increased interest in their local environment. In short, his project revolves around the idea “**many producers** (of honey), means **many protectors**” (of the forest).

His plan is to increase the earnings from honey production by selling his own brand of single flower organic honey directly over the Internet. He also sells organic melipona honey at eight times the price of the organic *Apis Mellifera* honey and in small quantities for cataract treatment. His daughter is taking courses in how to make soap and other products.

4. Discussion

Mr. Pat's work with bees implies that he observes climate change closely and its impact on ecosystems. From his past experience working with veterinary beekeeping specialists, he has applied and adapted the knowledge acquired. He is also open to sharing his own knowledge and experience.

With his theme of **“many producers (of honey) many protectors (of the forest)**, Mr Pat's shows a deep respect for the traditional knowledge of the elders and demonstrates a complex understanding of the interconnectedness of social and ecological systems, **relating human well-being to environmental integrity**. This theme has distinct echoes of the concept of linking land health to human health, which Vogt's suggest is an ancient Mayan environmental understanding that *“If plants, animals and soils are healthy, then men should be healthy”*. Nevertheless, Mr Pat also shows the ability of **adaptive management**, a capacity **key to resilience**, the capacity not only to understand a system but to change it in the face of new challenges: he identifies as a contemporary leverage point the social factor of the need for new income opportunities for young people at a local level. For this reason he proposes that engendering economic viability in traditional eco-friendly practices of bee-keeping can help restore local social ecological systems.

Institutions like CONANP, the Commission for Indigenous Development (CDI) and some regional NGO's have provided substantial support to Mr Pat's project of organic honey production, yet research is necessary to tailor environmental guidelines to local needs in consultation with Indigenous communities regarding what works as sustainable land management in distinct ecosystems. This point is related to the issues of self-governance, the importance for inter-generational relations and reviving the respect for traditional knowledge and practices and thus the vibrancy of the culture.

5. Concluding remarks

The case study of the Pat family in deepening our knowledge of the socio-cultural context of the Biosphere Reserve “Los Petenes” indicates a solid opportunity for Mexican environmental policy to implement effective bottom-up solutions based on contemporary Mayan adaptive management strategies. The study also demonstrates the importance of recognising both the ecological and social aspects of the Mayan land management practices, given that they are both aspects of an integrated socio-ecological system which successfully sustain practices of adaptive management of the environment and hence the capacity of resilience of the socio-ecological system. Furthermore, scientific, political and social recognition would play an important role in vindicating the knowledge of the Mayan elders after centuries of discrimination and thus in sustaining inter-generational respect for the “knowledge of the grandparents” and thus the vibrancy of the culture which sustains the valuable capacities of adaptive management and resilience. Mr Pat's observations on the social and ecological consequences of youth migration indicate the urgency for such, long overdue, recognition.

References

- Barrera-Bassols, N., & Toledo, V. M. (2005). Ethnoecology of the Yucatec Maya: Symbolism, Knowledge and Management of Natural Resources. *Journal of Latin American Geography*, 4(1), 9-41.
- Campeche, Gobierno del Estado, PRONATURA Peninsula de Yucatan, a.c. (2016, noviembr). *Sistema-Estatal-ANPs-Camp*. Retrieved from CONACYT.GOB.MX:
http://conacyt.gob.mx/cibiogem/images/cibiogem/sistema_nacional/documentos/ANPL/Camp/Sistema-Estatal-ANPs-Camp.pdf

- Chuc, C. (2016). Cambio cultural en el cultivo de la Xunaan Kaab y en el aprovechamiento de las abejas silvestres entre los mayas del noreste de Campeche. *Doctoral Thesis, Estudios Mesoamericanos, (examination pending)*. Mexico City, Mexico: , UNAM.
- Chuc, C. R. (2016). "Saberes y estrategias contemporáneas de las comunidades mayas de los Petenes, Campeche, para el desarrollo sustentable de las abejas nativas. Un estudio comparativo". *X Congreso Mexicano de Etnobiología. Rumbos y Continuidades: Etnobiología y biodiversidad biocultural mexicanas*. Mérida, México.
- Code, L. (2006). *Ecological Thinking. The politics of epistemic location*. Oxford: Oxford University Press.
- CONABIO. (2016). *CONABIO.GOB.MX*. Retrieved from http://www.conabio.gob.mx/web/conocenos/quienes_somos.html
- CONANP. (2015). *Reserva de la Biosfera LOS PETENES*. Retrieved from <http://petenes.conanp.gob.mx/index.php>
- CONANP. (2016). *gob.mx*. Retrieved from Comisión Nacional de Áreas Naturales Protegidas: Acciones y Programas : <https://www.gob.mx/conanp/acciones-y-programas/programa-de-conservacion-para-el-desarrollo-sostenible-procodes-57997?idiom=es>
- Cuentame.org. (2016). *Información por entidad, Campeche*. Retrieved from <http://www.cuentame.org.mx/monografias/informacion/camp/poblacion/diversidad.aspx?tema=me&e=04>
- Gallina-Tessaro, S. A., Hernández-Huerta, A., Delfín-Alfonso, C. A., & González-Gallina, A. (2009). Unidades para la conservación, manejo y aprovechamiento sustentable de la vida silvestre en México (UMA). Retos para su correcto funcionamiento. *Investigación clínica*(octubre), 143-152.
- García-Frapolli, E., Toledo, V. M., & Martínez-Alier, J. (n.d.). Adaptations of a Yucatec Maya Multiple-Use Management Strategy to Ecotourism. *Ecology and Society*, 13(2). Retrieved from <http://www.ecologyandsociety.org/vol13/iss2/art31/>
- García-Marmolejo, G. .. (n.d.). Caracterización y sustentabilidad de las unidades para la conservación, manejo y aprovechamiento sustentable de la vida silvestre en Campeche. *Tesis*. Campeche, Mexico: ECOSUR.
- Gibbons, M., Limoges, C., Nowotny, H., Schwartzman, S., Scott, P., & Trow, S. (1994). *The new production of knowledge: The dynamics of science and research in contemporary societies*. London: SAGE.
- Güemez Ricalde, F. J. (2003). La apicultura en la Península de Yucatán. Actividad de subsistencia en un entorno globalizado. *Revista Mexicana del Caribe*, 117-132.
- Kolb, A. (2016, 08 26). *humanature*. Retrieved from Conservation International blog: http://blog.conservation.org/2016/07/6-things-you-need-to-know-about-mangroves-but-never-thought-to-ask/?utm_source=enewsupdate&utm_medium=email&utm_content=082516-ndenews-link&utm_campaign=ND&s_src=enewsupdate_email&s_subsrc=082516-ndenews-link#post-2564
- Manuel-Navarrete, D., & Kay, J. D. (2004). Ecological Integrity Discourses: Linking Ecology with Cultural Transformation. *Research in Human Ecology*, 11(3), 215.
- Mathews, A. S. (2005). Power/Knowledge, Power/Ignorance: Forest Fires and the State in Mexico. *Human Ecology*, 33(6), 795-820. doi:10.1007/s10745-005-8211-x
- Powys-Whyte, K. (2015, 5 27). *Google search*. Retrieved from www.uoguelph.ca/~ks2015ca/pdfs/2015_Whyte.pdf
- PRIMERA PLANA. (2016, noviembre). "Los investigadores de la cultura Maya" 2016. *Primera Plana*. Retrieved from <http://www.primeraplana.org.mx/2016/11/08/dolores-echeverria-lanz-en-conferencia-para-el-xxvi-encuentro-internacional-los-investigadores-de-la-cultura-maya-2016/>

- Raygorodetsky, G. (2011, 12 13). *Why Traditional Knowledge Holds the Key to Climate Change*. Retrieved from <http://unu.edu/publications/articles/why-traditional-knowledge-holds-the-key-to-climate-change.html>
- RESILIENCE ALLIANCE. (2016). *RESILIENCE ALLIANCE Key Concepts*. Retrieved from <http://www.resalliance.org/key-concepts>
- Retana Guiascón, O., Hinojoso-Garro, D., & Vargas Soriano, J. (2013, 11). A case study of an integrated wildlife management strategy using a sustainable approach in a rural community of southern Mexico. *E3 Journal of Environmental Research and Management*, 4(11), 0352-0358.
- Sisk, T. D., Castellanos, A. E., & Koch, G. W. (2007). Ecological impacts of wildlife conservation units policy in Mexico. *Frontiers in Ecology and the Environment*, 5(4), 209-212.
- Toledo, V., & Martínez-Alier, J. (2007). Apropiación de la Naturaleza por una Comunidad Maya. *REVISTA DE LA RED IBEROAMERICANA DE ECONOMÍA ECOLÓGICA*, 7, 27-42.
- Valdez, R. J.-A.-A.-S. (2006). Wildlife Conservation and Management in Mexico. *Wildlife Society Bulletin*, 34(2), 270-282.
- Vincenteño, D. (2016, 06 26). México carece de estudios y equipos para enfrentar cambio climático. *EXCELSIOR*. Retrieved from <http://www.excelsior.com.mx/nacional/2016/06/28/1101366>
- Weber, M. G.-H. (2006). . The Tragedy of the Commons: Wildlife Management Units in Southeastern Mexico. *Wildlife Society Bulletin*, 34(5), 1480- 1488.
- Werle, B., Osterbeek, L., & Henriques, M. (2016, 04 16). 2016 International Year of Global Understanding: *Forum*, 604-611. doi:10.18814/epiugs/2016/v39i4/103894