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The Cultural Weight of Nature: The Intra and Inter-Institutional Conflicts About Biodiversity and Ethnicity in Chile and Mexico

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1. Introduction

The rapid chemical and mechanical technification of production systems has greatly contributed to the current social, environmental and economic crises. Especially over the past decade, it has become even more evident that these transformations are putting at serious risk the integrity of the planet's social and ecological systems (MEA, 2005). At the beginning of the new millennium, the need to reflect about better ways to regulate and organize the current management practices, as well as analyzing how their effects can be buffered, has come consistently to the fore (Chapin et al 2006; Orstrom, 2007).

The negative effects of such technification are due greatly to the fact that there is not a specific set of laws and regulations that considers the planet's Socio-Ecological Systems (SSE) as a whole. In addition, technology has been applied within a competition based, market economy framework. Since the seventies it has become increasingly evident that this model favors unequal power relations resulting in a few individuals maintaining control over a few, jeopardizing the wellbeing of other social groups. This is the case of native people in Latin America that for diverse historic and cultural reasons have maintained their social, economic and political organization practices. Connected with this scenario, the market economy model has not been able to prevent the implications of overexploiting natural resources. The result has been irreversible biological and cultural diversity losses, as well as the dramatic reduction of survival possibilities for the current and future human populations (MEA, 2005).

In Latin America, this problem is acute. One of the central reasons is rooted in the history of Iberic colonization of American territories. During this process, the Spanish imposed their own land management strategies, as well as their ways to regulate the society over American societies and ecosystems that were radically different from European ones. After the new nations became independent, a large part of the new governments maintained segregation policies implemented during the colony. Only until 1957, native people were recognized internationally as citizens with the same fundamental rights as other human

beings, when the 107 Tribal People's Convention was signed. This was superseded in 1989 by the 169 Tribal People's Convention that says among other things that:

"Considering that the developments which have taken place in international law since 1957, as well as developments in the situation of indigenous and tribal peoples in all regions of the world, have made it appropriate to adopt new international standards on the subject with a view to removing the assimilationist orientation of the earlier standards, and

Recognising the aspirations of these peoples to exercise control over their own institutions, ways of life and economic development and to maintain and develop their identities, languages and religions, within the framework of the States in which they live, and

Noting that in many parts of the world these peoples are unable to enjoy their fundamental human rights to the same degree as the rest of the population of the States within which they live, and that their laws, values, customs and perspectives have often been eroded..."

The perception has taken a long time to permeate through Mexican and Chilean states, which despite signing the above agreements, still uphold practices that marginalize, weaken and fragment those cultures entailing valuable ancestral socio-ecological knowledge. Within the global change framework, and with the possibility of a collapse for many socio-ecological systems, it has become an overriding task to develop a solid, diagnostic method that will allow analyzing diversity processes and multiplicity of potential solutions about social and biophysical aspects. These methods are to tackle the large scale changes approaching (Orstrom, 2007). This chapter analyses two case studies in Mapuche (Chile) and Totonac (Mexico) communities. Both were Spanish colonies, however, their socio-ecological systems developed contrasting systems of governance. Along their history of interaction with the new government systems, we identify some of the socio-ecological factors that allowed them to resist the challenges that a radically different culture, and political system imposed.

2. Parallel historical processes

Traditional land management practices are the result of accumulated knowledge and experiences over hundreds of years, including data on useful species, their habitat, different types of soil, phenology, and the interactions amid different plants, and between them and animals. This knowledge allowed many cultures to develop highly complex agricultural systems (i.e. Gadgil and Berkes, 1991; Toledo et al., 2003). It has been suggested that studying these practices can be very useful in the design of the present management practices (Gadgil et al, 1993, Gómez-Pompa and Kaus, 1999).

Hundreds of species were managed for various purposes; for food, as fuel, for medicines, for construction work and artworks, among others. Agricultural cycles were coupled to the seasons, and marked by festivities and rituals that also maintained the sense of community and belonging, that fostered an interdependent connection with the ecosystems. In this context, human populations saw themselves as another element that interacted and contributed to vital cycles. Aside from having to endure the imposition of a management system completely different from theirs, clearly inadequate to the native system dynamics, a vast number of native people lost the right to use the land (Bengoa, 2003).

Currently, native people in Latin America share a common history of colonization and the consequent acculturation. Being such a large and diverse region, the ability of ethnic groups and *campesino* communities (rural farmers) to adapt and respond, has been determined by

the biophysical context in which political and social events have occurred. Despite having been marginalized and exploited, many resisted change and managed to conserve their culture and traditions at least partially. This trust, along with collective decision making and social networks of reciprocity, frequently based on family links, has been defined as 'social capital' (Bourdieu, 1985; Coleman, 1990). Putnam (1993, 1996) established some elements in social organization practices, for example networks of trust which facilitates action and cooperation among members from the same community. The emergence of this concept contributed to a more detailed understanding of power relationships among people living in vulnerable conditions, like *campesinos* or ethnic groups, and government and private sectors that possess greater economic and political power over the land and natural resources. We argue here that this has been mainly due to the existence of social organization practices based on trust.

'Social capital' also helped to define those elements that contribute to maintain cohesion, or those that cause fractures within the same community members. This discussion is central for understanding social and political conflicts in Latin America, as ethnic groups and *campesinos* that resisted change brought by colonists, have been historically marginalized, and have had restricted access to land and natural resources *de facto*. The concept of social capital (Bebbington, 2005) is also useful as it raises issues that are traditionally invisible to the dominant economic theories and policies.

'Social capital' is articulated in the cultural domain, where community members learn at an early age that there are expectations about their behavior as individuals that have a role in a community. The contributions that they make in the different social and productive areas are also determined by this sense of collectivity. The global economy has a strong influence on the ways in which social capital is strengthened or weakened, accordingly. Therefore, interactions among members of a society, for instance rural communities and government, become complex, due to different perceptions on what is important in the negotiation codes, language and cultural barriers.

Beside 'social capital', there are other key factors that help to maintain the integral wellbeing of rural communities, such as productivity, predictability, and ecosystem health. The fact that an ethnic group has its basic food, shelter, housing and health needs covered means that they are in a more advantageous position to negotiate land or economic and political power. Productivity in a system relates to carrying capacity, in this case, it would refer to the number of people that can be maintained per unit area. Another important element is predictability, which is very important for communities with an agricultural vocation, since it allows to plan when to plant and when to harvest, or, when to establish hunting and gathering seasons. Another determinant factor is extreme weather. It is not the same; to be able to produce food all year long than to only have the summer for covering this basic need. When an ecosystem keeps healthy, it has the capacity to be resilient. The endurance of this ability is vital, because a highly fragmented ecosystem that has been repeatedly disturbed will hardly absorb new disturbances.

With the approach of Socio-Ecological Systems, we make a comparative study of two case studies, one based in Chile, where 17 Mapuche communities live, in the margins of two natural protected areas. The other case study is based in Mexico, where 5 Totonac communities live inside a polygonal Archaeological Monuments Zone, located in lowlands mainly, with tropical rain forest vegetation. This site was declared World Heritage site by

UNESCO (ICOMOS, 14 December, 1992). Both case studies are considered touristic attractions for their scenic beauty. The relationship between the state and ethnic groups and the capacity to counteract change are compared (see Table 1 for important characteristics for both SSE).

	Totonac	Mapuche
Ecosystems where culture was developed	Weather. Warm and humid. Summer and Fall rains. Strong northern winds in the Winter. Temperature. 18.5° - 27.5. °C, Both limits tend to become more extreme (6° and 35°C). Tropical forest in the lowlands, and in the mountains, subtropical mountain forests. Topography. Broad valleys, with streams and mountainous chains. Agriculture viability. Fertile soils. Easy access to several ecological floors (e.g. the same farmer could maintain crops in lowlands and highlands). Products' availability all year long.	Weather. Temperate and humid. Rains all year long. January and February are the driest months. 1 m snowfalls. Temperature. 0° - 20° C Highest superior peak (30° C). Coniferous mountain forest, with wild pasture and lava covered soils. Topography: More than 3000 m volcanoes with valleys, lakes and rivers. During the rainy season, around 50% floods. Agriculture viability. Due to the steep terrain, only those areas closer to the valley are suitable for cultivation. Crops are cultivated in Spring and Fall only.
Main products	Subsistence: maize, beans, squash Economic: orange, banana	Subsistence: pinion (<i>Pinus cembroides</i>) Economic: <i>mosqueta</i> , berries, <i>murta</i> , <i>digueñes</i> (wild mushrooms).
Species uses	More than 300 edible species (endemic and introduced)	More than 100 edible species (endemic and introduced)
Land tenure	Precolonia: comunal Republic: private property and <i>ejidos</i> . Current situation: When the Archaeological site was decreed, land was expropriated and people were relocated in congregations.	Private. Chilean State: Reserves and Villarica National Park. Current situation: Communities recognised by the indigenous law. (private territories).

	Totonac	Mapuche
Population statistics and land use	<p>Land use</p> <p>Forest cover ~10%</p> <p>Wild pastures and agricultural areas 75%</p> <p>Population density</p> <p>Precolonial¹ 56 hab/km²</p> <p>Current 160 hab/km²</p> <p>Totonacs represent 24% of municipal population (INEGI 2005).</p>	<p>Land use</p> <p>40% forest cover (30% forest plantations).</p> <p>Agricultural area 30%</p> <p>Prairies and bushes 22.4%</p> <p>Bare soils or permanent snows 10.5%.</p> <p>Population density</p> <p>Precolonial² 1 hab/km²</p> <p>Current: 6.3 hab/km²</p> <p>Mapuche represent 50% of Curarrehue population (2002).</p> <p>Population with moderately poor level 43,1%, Population living in extreme poverty 22,3%.</p>
Ecosystem management	<p>Integrated management system. Landscape units were managed in ~40 yrs cycles (Family vegetable gardens with consumption animals, maize, managed wild pasture (wood), regenerating acahual, incipient forest, mature forest). Vanilla and orange plantations, and wild pastures were added later on. The rotation systems implied that lands were communal but harvested products were private.</p>	<p>Economic agricultural system in forest clearings or riverbanks, with abundant gathering products (pinion, berries, fungus). Subsistence cattle ranching. Added to this are small scale agriculture and fruit trees. <i>Chilihueques</i> (llamas) were substituted by cows, goats and pork.</p>
Impacts in the ecosystem impacts	<p>High degree of deforestation mainly due to cattle ranching and soil pollution by PEMEX. 3,220 oil wells and many more in prospect. Chemical pollution.</p>	<p>In lands occupied by Mapuche and non Mapuche population, the main problem is deforestation. Soil erosion and nutrient lixiviation are caused by rain and floods.</p>

	Totonac	Mapuche
Important events in the State conformation	Independence 1810 Revolution 1910 Neoliberalism 1982 Nº 169 Indigenous and Tribal People’s Convention year 1989. Zapatista Rebellion 1994 (Revindication of indigenous peoples rights) Indigenous law	Independence 18 September 1810. Nuevo Imperial Agreement 1989 (basis for the creation of the indigenous law). Indigenous Law 1993. Nº 169 Indigenous and Tribal People’s Convention, year 2008.
Important regional events	Three declarations that recognize the importance of Totonac culture: <ul style="list-style-type: none">• UNESCO Declaration, 1992. Human Heritage and Monuments Zone.• Presidential declaration. 2000. Federal Law for Archaeological, Artistic and Historical Monuments.• UNESCO Declaration. 2010. Flyers ritual. Intangible Human Heritage. When the ZMAT obtained the decree, territories were expropriated, many people were relocated and the generated tension remains until today.	No events recognize the importance of the Mapuche culture. 1912 Villarrica National Reserve is created. 1940 Villarrica National Park is created.
Totonac social organizations	<ul style="list-style-type: none">• CAPIT• Popular and <i>Campesino</i> Organizations Central (Cocyp)• Flyers Organizations• Juan Simbrón Cooperative (for pepper and maize leaves’ commerce)• 3 sewers’ and embroiderers’ organizations• Artcraft sellers	Indigenous communities with juridical parsonality (mechanism to relate with the State according to the Indigenous Law). Ponuwemanke Association (10 communities to coopt the tourism bidding at the Villarica National Park). Artcraft workshops for men and women.

	Totonac	Mapuche
Institutions	<div>A large number of social scientists from different Mexican universities apply research in the region.</div> <div><ul style="list-style-type: none">• Instituto Veracruzano de Cultura.• Intercultural University of the State of Veracruz• National Institute of Anthropology and History• Takilhsukut Thematic Park• Center for Indigenous Arts</div>	<div>Very few research studies, only in focal points, such as the Catholic University of Chile through the Villarica campus.</div>

Table 1. Main characteristics and events in the Totonac and Mapuche SES

3. The Chilean and Mexican state

The following section presents an overview of public policies in Chile and Mexico, as in general terms both governance forms have much in common in how they relate with the different ethnic groups and their traditions, habits and values. Public policies have not been able to incorporate native people’s cosmovision within the plans, norms, programs, and development projects. Neither the State has developed a coordinated and planned strategy over time. It seems that a central aim is to integrate native people to the State, without recognizing their identity. An example is those issues associated with development and quality of life of the Mapuche. On the one hand is the State offer from a Western perspective, and on the other are cultural identity demands (Arce, 2006). The result is a cultural clash, where in the end the power of decisions and the government’s economic system impose.

On December 1994, in Chiapas, Mexico, the Zapatista uprising brought to the public eye fundamental social and political issues that affect American Indians. Themes such as autonomy, marginalization, discrimination and constant abuses from the landlords and the state itself were brought to the surface. Until now, these demands have not been solved. The Mexican government opted for a low intensity war (Proceso, 2004). On the other hand, due to national and international public demands, and funded by development organizations, the Mexican government has dedicated to promote clientelist projects. Government projects in the discourse aim to improve living conditions for indigenous communities. However, in practice the great majority have essentially failed to hamper or even reduce poverty.

In general, decision making and action implementation from public institutions is extremely complex. The first obstacle is function duplicity, not only among institutions but also within them. One example is conventional tourism initiatives against rural tourism. Secretaries or ministries frequently develop local programs that clash with other institutions connected with indigenous groups that have similar interests. These examples evidence the sectorial character and functions’ duplicity by which public institutions work. Institutional interventions cover sectorial aims, without coordinating with the rest of public institutions.

At the local level, invested resources end up unstated, and with few positive outcomes. Since results lack follow up and assessment, they are recurrently replaced by new development initiatives. At the same time, local development strategies homogenize broad regions, blocking each region's specific potentials. Political and administrative decisions respond to the centralized form in which the state functions. Undoubtedly this represents an obstacle in communication channels with local actors; hence policies are designed in a top-down manner: there are no evaluation or feed-back mechanisms. The latter causes more problems than those that were supposed to be solved originally.

In Mexico, indigenous groups have organized and acquired legal and organizational knowledge to defend their rights. They have had support from human rights groups, from the organized civil society, and from broad *mestizo* population sectors. However, with regards to access to natural resources, there have been diverse conflict points. The basic interest of ethnic groups is to conserve natural resources and use them in the same way they have done for centuries. This management form is not considered viable for the market economy, neither for development plans. Therefore, for indigenous people and their descendants, defending the right to the land has had high social costs, causing jailing and even murder of their members.

This lack of power for decision making is another factor that accentuates vulnerability of indigenous people (Westra, 2008). The meagre representation lies in the fact that the elaboration and development of public instruments linked with indigenous people is reduced to public consultations that only include the public institutions component. Surprisingly, the right to participate in decision making is not considered in Chile's indigenous law. There is a National Commission for Indigenous Development (CONADI) and it is through its Advisor Council how the interests of indigenous people are veiled. In Mexico, the issue of representation is very similar. The directives of the National Commission for Indigenous people are defined by the president, and are not of direct ethnic origin.

4. The Mapuche

The Mapuche live in mountainous ecosystems, in valleys and near the sea. Due to the extreme seasonal conditions with harsh winters and floods, they did not develop a complex agrarian system, they just used the riverbanks and forest clearings to plant potatoes and '*pallar*', a native potatoe which required little soil preparation. The *piñon* (a pinenut, *Araucaria araucana*) was, and still is the most important food product, that used to be stored during the winter, and would be complemented with berries, mushrooms, game and fish. *Chilihueques* (llamas) were another food source for self consumption. Because they were not connected with an established agrarian system, they had mobility, migrating seasonally, a characteristic of hunters and gatherers. Historic records describe them as strong, healthy and bellicose, which reveals sufficient food availability conditions. The "bellicose" adjective derives from the defense they made of their territories against the Spanish for more than three centuries (Bengoa, 2000).

The Mapuche occupied the whole Araucania region until the "Pacification" process that ended in 1883; when they lost the war against the colonizers and were forced to live in reservations. The criteria for the establishment of these reservations were defined by the

Chilean state. Many Mapuche ran away from the central valley to the mountains that were not populated due to the extreme weather. Some asked for citizenship permits. This is how our study site, Curarrehue, was born. Their traditional organization consisted of a *lof*; and the hierarchy was a political chief (*lonko*), another figure in charge of health and religion (*machi*, mainly) and a chief in case of war (*toqui*). In 1993, with the promulgation of the Indigenous Law, it was established that community representatives would lose their historic ways of organization and replace them with the Western hierarchies: president, treasurer and secretary. The law determined that the new hierarchy should renew every two years. This shift has caused division among communities, stopping them from maintaining the juridical personality in the National Commission for Indigenous Development. Hence, they struggle to access public development plans promoted by the State. Since the return to democracy in Chile, in 1990, the Indigenous Law and the CONADI, have set the regulatory basis for various initiatives with the objective to reconstitute lands and to launch local development plans. Understandably, this meant the introduction of new productive activities, different from the practices traditionally performed by the Mapuche.

Sixty percent of the political-administrative area of Curarrehue belongs to protected areas. This is the case of the Villarrica National Reserve and Park, and this explains why development projects are tourism oriented. Productive activities are subsistence agriculture, subsistence cattle ranching, and forestry. However, as the native forests in Araucania, have been reduced, and there are restrictions in the present normative, the latter activity has lost importance. In the *comuna* there are not many differences among the Mapuche and the *mestizo* population, although Mapuche have to live in the reservations. Nevertheless, some even have moved to cities like Curarrehue, Temuco (regional capital), Santiago (the capital), and the frontier area with Argentina, in the search for work opportunities. Soil erosion and biodiversity loss, in addition to roads in bad condition are synergistic factors that make poverty more acute during winter, increasing financial dependency from the State. Both Mapuche and *campesino* population, classified with a high poverty indexes work their fields in the traditional way, while those considered to be moderately poor, have introduced new productive systems, and have accessed the municipality's equipment for which they have to pay. Production remnants are sold, and this activity is complemented with informal jobs that are also badly paid. Another sector of Mapuche and non Mapuche have jobs as technicians and other informal jobs in Pucón, Villarrica or Temuco. In the field they do minimum work, or are hired by other members of the community.

The Mapuche belonging to the lower economical tier receive State benefits, through a series of social assistance programmes. The ones considered moderately poor also have access to State social development programs, but additionally, they have implemented activities connected to tourism, artwork production, honey, preserves and other products. To obtain these benefits, they have constituted different social organization forms. Through social organization, seven communities have gotten access to natural resources from Villarrica National Reserve, such as *piñon* (pinenut) recollection and *veranadas* (sheep ranching). However, in 2007 a conflict arose due to the exploitation of 12,8 has of Oregon pine, in the same reserve. The government proposed 60% of the benefits for local communities, and 40% for the State, but local communities were asking for a 70%. Finally the discussion scaled to a regional level and a political decision was made. At the beginning, communities felt marginalized, but when they started receiving benefits, they conceived further basic

demands, however most of them have not been possible to fulfill given the present protected area regulations. Another conflict aspect is the management of the Villarrica National Park. The state called the park for licitation with touristic purposes. For this reason, ten communities came together as a legal community organization and now they are in direct competition with the private enterprise for the park bidding.

5. The Totonac

The Totonac lived in several towns in the mountains and the lowlands in northern Veracruz, they shared language, cosmovision and culture. The Lords (*señores*) ruled in each town and collected tributes in form of work and spices. When the Spanish arrived, the region was dominated by the Aztecs that collected taxes. The Totonacs allied with the Spanish against the Aztecs; hence the Totonac did not have the 'defeated' status that other native groups had. This alliance was broken afterwards, and a new tax and control system was established by the *criollos* (Spanish born in America). Nevertheless, many Totonac families remained in power and established new alliances allowing traditional productive systems and their government forms to endure without great changes. Many new crops were added to the system. Until today, citric and banana plantations have an important economic value in the region. During this time, community leaders were restricted to religious and political posts, but these positions served as an ethnic and political resistance strategy. Religion became syncretic, as in many other areas of Mexico. Catholic festivities were adjusted to the planting and harvesting soil rituals.

However, during the XIX century, these posts were disbanded and reduced to the sacramental spheres (Masferrer, 2005). Also a series of rebellions related with landlord abuses and religious prohibitions unleashed. Between 1830 and 1910, vanilla commerce hit the highest peak, exporting to Europe, which meant economic bonanza, and the configuration of new power groups, both Totonac and *mestizo*, that came to dominate and transform social, economic and political life in the region (Kouri, 2000). The latter had deep implications for the Totonac, because the vanilla boom meant a reorganization of the old land tenure models. Vanilla growers associated with the wealthier Totonac landlords and were able to fragment and militarize the communal Totonac lands (called '*codueñazgos*'); in this way they took possession of the vanilla plantations (Kouri, 2000; Masferrer, 2005). The loss of land and the alliance of some Totonac with the *mestizos* produced the social fabric rupture that had resisted for so many years (Kouri, 2000). After the Mexican Revolution, *ejidos* and communal lands were legally established. Nevertheless, in the sixties, a great deal of the vanilla plantations, still privately owned, were sold to cattle ranchers, that represented the new economic alternative.

For centuries, community representatives were elected under the uses and customs system, where the community representative was assigned by common agreement. However, this election has been lately politicized, and currently, several candidates affiliated to political parties are proposed and voted. This has contributed to fracture the social fabric even more, as many do not recognize them as their representatives and therefore do not respond to their calls. Changes in land tenure had deep implications in the ecosystem. Traditionally, crop lands were open by slash-burn, used for 3 years and then left to recover to forest in a 40-50 years rotational cycle. But currently, as paddocks are left out of the landscape rotation

units, large areas of land are permanently open. With land use intensification, and plot reduction, *campesinos* were forced to apply a non-rotational system. As a result only some tropical forest fragments remain. Aside from being strongly degraded, these fragments are surrounded by paddocks and occasionally, maize fields.

Over the last decades, Totonac have been receptors of development programs that provide limited resources, which coincided with a boom in oil exploitation in the region since the seventies. Currently, thousands of new oil exploration platforms are being opened, and each one requires at least a hectare for their exploitation. Proprietors are receiving significant payments for allowing the oil company to use the land, which is cleared and polluted. Situations like these bring new instability in the area: land prices rise, and food and basic goods also become more expensive due to the arrival of many workers from the oil companies, that live there on a temporary basis, but cause an intensive social, economic and environmental impact as long as the oil wells are producing.

Despite this problematic, in El Tajín, the majority of the land was privately owned until 2001, when it was expropriated by the government after the Archaeological Monument Zone was decreed. People were relocated in congregations with 300 m² plots in average. The Totonac lost once more their lands, a situation that currently generates greater conflicts within local people and the National Institute of Anthropology (Instituto Nacional de Antropología, INAH, in Spanish), the institution responsible of keeping and maintaining those sites of archaeological importance in the country. This is another example of intra-institutional conflicts, as another function of INAH, is to steward the living cultural heritage. However, on the positive side, efforts are taking place to implement a management plan, lead by INAH and CITRO, that looks for ways to better communicate with local people's needs by incorporating different disciplinary perspectives.

With the lack of land, the majority of Totonac people and their descendants have looked for other subsistence forms, as paid workers for other landowners, as construction workers, bus and taxi drivers, shop and oil company employees, or as art craft sellers in the archaeological site. This last occupation has allowed an income increase for many families living inside the archaeological site polygon. However, it has broadened a gap within the agro-ecological system that in the past used to be their subsistence means and deeply rooted in their cultural identity. On the other hand, the opening of the archaeological site to the general public, aside from becoming an important income generating activity, has revived interest for the Totonac culture, bringing international recognition (Table 1). It was mentioned that since the 1994 Zapatista uprising took place, indigenous cultures were projected in the global scenario. This revival has had a direct local impact, motivating private and governmental initiatives for the establishment of programs focused on promoting the knowledge preservation and, in this case, Totonac values and traditions. Currently, young Totonacs are at a crossroad, between the two worlds, that of their ancestors, and the present communications era. In front of them is the challenge to preserve the cultural and natural legacy inherited from their parents.

Despite the multiple historic and political vicissitudes, basic organization forms have remained, and the ethnic-political chiefs have been able to maintain very discreet but effective mechanisms to consolidate their leaderships. In nearby *ejidos*, agricultural practices subsist, and family vegetable gardens in the studied communities are still rather diverse, despite their small size (Contreras and Silva, 2010). The socio-ecological system is once more

in a re-structuring stage, but this time, the internal social structure and the ecosystem have been greatly fragmented. Hence, there is a need to find the appropriate means to establish connectivity within the elements in the system.

6. The past and present of ethnic groups in the context of environmental governance

The historic process that has taken the Mapuche and the Totonac to the current situation, has been broadly similar in terms of the great events that influenced them and modified their socio-ecological systems. They both received the impact of the Spanish colonization, however, in different historical moments. In Totonac territories, there were Spanish settlements since 1530, but it was until the end of 1800 that the Mapuche lands were conquered by the Spanish. Although Mexico's and Chile's independence took place in the same year, 1810, the way in which each of these groups has responded, first to colonization and later to the imposition of a development model centered in private property, competitiveness and efficiency, has not been the same (see Table 1).

In the following section, we will compare some aspects of the biophysical environment in which both ecosystems evolved. The Totonac, geographically located in the neotropical belt, lived in a lower montane forest ecosystem. The weather is warm and humid, favoring the presence of fertile soils and water. The Totonac had easy access to several ecological floors that allowed them to grow crops both in lowlands and highlands. In this way a complex and very productive agricultural subsistence system emerged. Whereas the Mapuche, living also in a mountainous ecosystem, at higher altitudes, face extreme weather conditions and a temperate climate, with a very steep terrain, floods and heavy snowfalls which reduce the area suitable for cultivation. Therefore, they developed an economic system based on a variety of seasonal activities, fruit and wild plants recollection, fishing, hunting and nomadic cattle ranching.

The Mapuche society had reached a high degree of complexity in its political and social organization. They had access to abundant resources and a natural and biological ordinance that was regulated to the inside of large extended families, through a specialized power system, that regulated conflicts for the establishment of alliances, and consisted of an advisor and main judge called *ulmén* (Bengoa, 2000).

Development policies are based mainly on land tenure, however, the traditional property concept used to be different. Groups maintained hunting and collecting territories (Mapuche), or communal lands for agricultural management (Totonac) over which they implemented their hunting, collecting and cultivating rights. This type of tenancy allowed flexibility and adaptation capacity, as groups could freely move within their territories. The Mapuche would do it seasonally, according to the fructification months, and animal migration. Agricultural activity for Totonacs allowed the rotation of landscape units within a 40-50 years cycle, to let the land rest and obtain resources from vegetation at different regeneration stages. In literature, the importance of establishing management agreements has been constantly debated (Agrawal, 2002). The efficiency of these agreements is essential because groups can evaluate how actors comply with the agreed conventions, and the kind of response given by each resource to this type of management. In practice, this calibration between management rules and the ecosystem was facilitated

by mobile management systems where actors moved through the different biogeographical regions, and under a temporary scale that allowed them to observe the consequences of their actions.

Today, as they are being restricted to a fixed territory, it is more difficult to relate the causes of the management forms with the consequences, since they are using fast changing new technologies and share space with other management forms (for example, forestry or cattle ranching). Another aspect is the delayed effect of agrochemicals in the impoverishment of the soil, as they break the structure and the biotic community. The first harvests are rather abundant, but afterwards, inputs need to be increased to maintain sufficient production levels. However, there is a conscience based on the experience of many years of using agrochemicals, that chemicals 'kill the soil', and that many species that would flourish spontaneously in the maize fields, are now disappearing (Silva-Rivera, 2004).

Ecosystem productivity and type of weather are other important aspects to consider when designing management strategies. Despite the current systems are much more connected within them – as many foods come from other regions-, the system resilience to economic or energetic crises, depends greatly from the regional food sustainability. The amount of food that can be produced is limited by the carrying capacity of the system. El Tajin region, is more densely populated than Villarrica (160hab/km² versus 6 hab/km²), has a higher carrying capacity, producing hundreds of kilograms of maize, beans and squash per hectare, as well as tons of orange or bananas, generating food and securing income each year. The Mapuche population density, despite being very low, has increased 6 times with regards to density in the pre-colonial era. In the case of Totonacs, although having a higher population density, there has been only a 2.7 increase, keeping the system closer to the carrying capacity limits. Even though the Mapuche today have vegetable gardens and poultry, a lot of their collecting and production practices are still done traditionally. In addition, although the collection of berries and *mosqueta* roses generate income for mapuche families, as they are not being processed, they imply lower sales prices. This fact, added to the exponential increase in population density, has meant that the carrying capacity of the territory has been taken close to its limits. This is how the high poverty index is explained, among other motives. The latter makes them more vulnerable and dependent of governmental assistance hence less able to negotiate than the Totonacs.

Despite the majority of people living in El Tajin polygon lost their land, they are surrounded by productive ejidos, which leaves them with the ability to reach a great diversity of food products at very accessible prices that they occasionally can have through barter or gifts. In both productive systems, new species have been introduced. The utilization of endemic and native species is associated with beliefs, practices and traditional cultural knowledge on the environment that surrounds them. However, the use of introduced species shows the transculturation process that both groups have gone through since the colonial times. Species assimilation has meant new innovations, knowledge and commercialization processes. In the Totonac case, the assimilation of more than 41 new species has taken 500 years, and began with the insertion of orange and banana Spanish plantations. During this time, species were tested and incorporated into the productive systems. This assimilation reveals a general knowledge on how to domesticate and adapt plants to the system, a characteristic that distinguishes tropical areas, recognized as many species' domestication and diversification centers.

In the Mapuche case, climate is much more extreme and the state has been the main mediator of change through recent local development projects. The latter has caused strongly adapted and resistant species and varieties to be left aside. The extreme weather is an important factor that makes them dependent on state subsidies and benefits, limiting their possibilities to maintain more resilient and autonomous livelihoods.

Dependence on subsidies is also shared with the Totonacs, as they require government support for the installment of basic services like water, electric energy, sewage and streets. The State has not created the regulatory policies for more efficient and democratic governance; as a consequence, the dialogue with local actors becomes more difficult. This model should be based upon a communication system that flows in both directions, however, it is reduced to environmental assessments and literature reviews. For instance, despite the extensively documented evidences pointing at how inefficient it is to maintain bovine cattle in the tropics, every year, governments support and encourage such initiatives. The simple ratification of agreements and international treaties is insufficient if they do not go along internal norms that generate communication mechanisms within these groups and the State.

These regulation mechanisms should also consider other actors in the society; such would be the case of private businesses. On the other hand, is the process of competition for natural and financial resources between actors. This is what happens with the Mapuches, and the various associated projects with ethnotourism, or special interests tourism. The inexistence of regulatory mechanisms not only generates unequal competence among actors, it also increases dependency of Mapuches from the State financial resources.

The process turns even more complex when it comes to a resource that is a nation's patrimony, as in the case of the Villarrica National Park and Reserve. Currently, land overexploitation by these groups means new erosion processes, biodiversity losses, etc. In consequence they have no choice but to look for new strategies, increasing pressure over vital local resources. Biodiversity valuation mechanisms imposed by the State only consider economic factors such as profitability or income. However, ethnic groups' cosmovision values them in ways that go beyond the Western utilitarian ones, recognizing human populations as another component in the larger ecosystem. As long as alternative visions on the relationship of humans and nature are not acknowledged, the State clientelist mechanisms will continue to be perpetuated and local development projects will remain alien to the environmental conditions and cultural patterns of a given territory. The consequences add on to the multiple causes that will continue to put in risk the integrity of social and ecological systems.

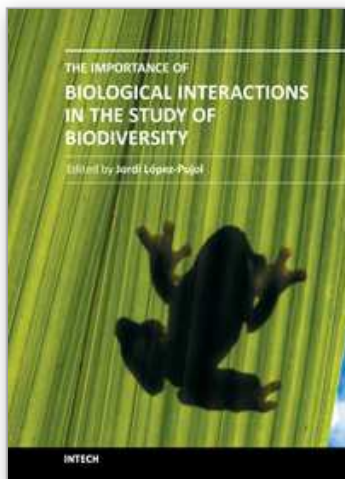
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The Importance of Biological Interactions in the Study of Biodiversity

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The term biodiversity defines not only all the variety of life in the Earth but also their complex interactions. Under the current scenario of biodiversity loss, and in order to preserve it, it is essential to achieve a deep understanding on all the aspects related to the biological interactions, including their functioning and significance. This volume contains several contributions (nineteen in total) that illustrate the state of the art of the academic research in the field of biological interactions in its widest sense; that is, not only the interactions between living organisms are considered, but also those between living organisms and abiotic elements of the environment as well as those between living organisms and the humans.

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