Eradications of invasive mammals on islands in Mexico: the roles of history and the collaboration between government agencies, local communities and a non-government organisation

A. Aguirre-Muñoz, A. Samaniego-Herrera, L. Luna-Mendoza, A. Ortiz-Alcaraz, M. Rodríguez-Malagón, M. Félix-Lizárraga, F. Méndez-Sánchez, R. González-Gómez, F. Torres-García, J.C. Hernández-Montoya, J.M. Barredo-Barberena, and M. Latofski-Robles

Grupo de Ecología y Conservación de Islas, A.C. Moctezuma 836, Centro, Ensenada, Baja California, México. <alfonso.aguirre@islas.org.mx>.

Abstract Eradications of invasive mammals have over the last decade been a key element in the restoration of Mexican islands. To date, 48 eradications have been completed on 30 islands. This work has provided the climate for a wider movement towards the protection and restoration of Mexican islands involving many players and institutions. Perceptions of islands have changed from earlier abuse and abandonment to current realisation of their importance for sovereignty, their rich biodiversity, and their potential as sites for sustainable development. This increased awareness was followed by social acceptance of the importance of islands, organisational development of advocates for them, scientific research, secure funding for projects on them, and institutional support for this work. A collaborative network now includes federal government agencies such as the Mexican Navy alongside academic institutes and universities, local communities, artisanal fishermen co-operatives, non-government organisations (NGOs), and national and international donors. A crucial NGO component of this network has been the Grupo de Ecología y Conservación de Islas, A.C. (GECI). This private organisation now has a field staff of 24 scientists and technicians who work closely with personnel from government agencies. Soon all Mexican islands will be legally protected under federal categories. Permanent government staff are being recruited, and activities on islands are starting to be supported with federal budgets. These public budgets may also soon supplement funds provided by private donors. During the last decade, most funds have been provided by American private foundations; comparatively Mexican private and public funding is still limited. There have been positive outcomes from international collaboration and exchange. If the current pace is sustained a strategic goal could be met: to eradicate all invasive mammals from the remaining Mexican islands by the year 2025.

Keywords: Non-government organisation, invasive species, island conservation, Mexico, islands biodiversity, restoration

INTRODUCTION

A disproportionate number of global extinctions have been on islands, often as a direct result of invasive species (Veitch and Clout 2002). In response to this, invasive species of mammals have been removed from numerous islands in many locations. The rate of removal has been particularly high in Mexico, where 48 successful eradications of large mammals and rodents have been conducted on 30 islands (Aguirre-Muñoz *et al.* 2011). In this paper, we describe how the relationship of Mexico with its insular territories has changed over time and how restoration activities have developed. We use an interdisciplinary approach that integrates the perspectives of environmental conservation and interpretative sociology. Our aim is to identify how the historic, social, institutional, organisational and financial contexts developed so that invasive species could be eradicated from islands. Specific questions include: What have been the directions and the intentions of the diverse 'social actors' towards Mexican islands? Are there relevant historic changes in the relationship of Mexico with its islands? What factors contributed to these changes? Did island restoration activities such as the removal of invasive species contribute? And finally, how have the successful eradications been conducted?

Biodiversity protection, sovereignty, and sustainable development are the three axes used for the analysis. There may be potential biases posed by the authors' active involvement in island conservation and natural resources use issues in Mexico. However, this can also be viewed as providing the richness of an insiders' experience, assuring rapport between the analyst and the research subject (Russell Bernard 2006).

Within the framework used here, 'social actors' include individuals or collectives, including fishermen's organisations, government officers or agencies, civil society groups, researchers and academic institutions. They all actively and consciously interact with the changing world around them as well as with other social groups, and with historic consciousness of their own acts (Long and Long 1992; Touraine 1969, 1987). The concept of 'social actor' implies that individuals and organisations have the capability to comprehend their own social experiences and can effectively respond to the challenges posed by their everyday life and current contingencies, envisioning alternatives to improve their future and implementing these. Understanding the intention and direction given by the actors to their actions are central to comprehensive sociology, representing its very methodological foundations (Weber 1984).

We begin with a historical account of how the protection of the Mexican islands unfolded, and the roles played by diverse actors in this process, but particularly the part played by a non-government organisation (NGO). We also show how, because of its ecological importance, effectiveness, and success, the eradication of invasive mammals has helped to develop a new paradigm for Mexican islands, characterised by strong protection and innovative conservation actions.

It may be inappropriate to suppose that this successful story can act as a model for other regions or countries, because every country or region has its own and history, and particular cultural, social, or economic setting. However, there might be parallels between this "Mexican case" and the development of conservation ethics, practices and organisations elsewhere. This is particularly true for the role of NGOs (e.g., Wilson 2002), a point that we will return to later. Before doing so, we describe how the scene was set for raised awareness, and how this was followed by social acceptance, knowledge, infrastructural support, funding, and, finally, the institutional processes that have now started to support the achievements.

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HISTORY OF THE MEXICAN VIEW OF ISLANDS

Greed, abandonment, and weakness

Before the first Spanish contact, some Mexican islands were inhabited or visited by pre-Hispanic native groups. Those visited included Cedros, off the Pacific coast; some islands of the Gulf of California (Bahre and Bourillón 2002); and Mujeres and Cozumel, in the Caribbean. On Cedros Island, the native "Cochimíes" developed a distinct marine culture (Del Barco 1988). However, most Mexican islands are arid and lack fresh water. The oceanic islands far from the continent, such as the Revillagigedo Archipelago and Guadalupe Island (Fig 1), were not even visited by Native Americans.

During the European discovery of the American continent and the early conquest of Mexico, conquerors competed intensely to claim as much new territory as possible. Because islands have strategic value for navigation and military purposes they received particular attention. Mythical views also permeated this interest as is demonstrated by the historic origin of the "California Island" that was described in fiction well before the name was assigned to a real location. The word California first emerged in the late 15th century, when descriptions of a utopian island appeared in the classic Spanish cavalry book *"Las Sergas de Esplandián"* (The heroic adventures of Esplandián). Esplandián, the heroic fiction character was the first son of the Spaniard Amadís de Gaula and a Great Britain Princess. The book was originally published in 1490 (Rodríguez de Montalvo 1526) as part of a series of Spanish romances that were very popular in Europe. Among the places visited by Esplandián, the book states:

"Know that on the right hand of the Indies there was an island named California, very close to Earth's Paradise, inhabited only by black women, with no single male in there…, women rich in pearls and gold …".

This wishful thinking became a reality when the mythical "island" of California was discovered and named by the Spanish conquerors.

Another symbolic view forms an essential part of Mexican historic identity. The national seal represents an image revealed to an Aztec priest that headed an epic diaspora from a coastal island on Mexico's northwest to the current valley that hosts Mexico City (Enciclopedia de México 1987). The divinity indicating the end of their journey would be an eagle devouring a snake. The eagle and the snake represent a fusion of complementary

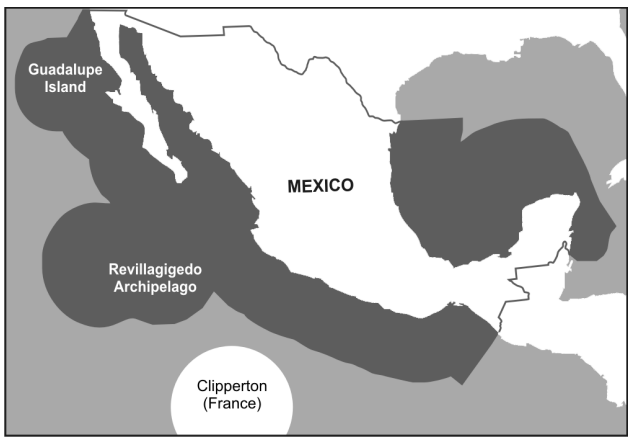

Fig. 1 Mexico and its Exclusive Economic Zone (EEZ), which at 3,149,920 km² is the 13th largest in the world, and larger than its terrestrial territory of 1,964,375 km².

Fig. 2 The Aztec's founding myth of the Promised Land (an island), now Mexico City. "La Fundación de México". Colour lithograph by J.G. Posada, 1900.

symbolic forces. The eagle represents the day, the sun and the diurnal sky; the snake symbolizes the night, the moon and the nocturnal sky. The Aztecs' Promised Land was found: a fertile valley with a lake; in the middle of the lake, an islet with a cactus tree; on top of the cactus tree, a golden eagle devouring the snake (Fig. 2). These elements are in the Mexican National seal. The islet, at the core of the founding Aztec territory became Mexico City, the geographical and political centre of the current country.

When Spain permanently departed the Americas, and with the independence of Mexico early in the 19th century, the colony's vast maritime power was lost. Islands were not a priority for the new country. In order to confer some legal protection, Mexican islands were decreed as federal territories by successive constitutions and remained so in the Constitution of 1917, at the birth of the modern country after the Mexican Revolution. During the 19th and early 20th centuries, leases to exploit guano on several islands were granted to private companies, some linked to foreign interests (González Avelar 1992). As part of that period and following an international dispute, France gained possession of Clipperton Island in the tropical Pacific Ocean off Acapulco (Fig 1); the island is still a French possession (González Avelar 1992; Restrepo 1999).

Sovereignty and natural resources

These experiences encouraged modern Mexican authorities to increase their presence and sovereignty over the islands. In order to induce settlement and exercise sovereignty on the (then remote) Baja California Peninsula and nearby islands, fishermen cooperatives were given financial and technical assistance, and received long-term and exclusive fishing rights to abalone and lobster.

In 1983, Mexico signed the United Nations Convention on the Law of the Sea (UN 1982). Linked to the international

adoption of the Exclusive Economic Zone (EEZ), Mexico developed military and productive infrastructure and establish permanent settlements on its remote islands, as a means of exercising granted sovereign rights on the islands and the EEZ (Fig. 1). Permanent Navy facilities, garrisons, piers and airfields were built on the remote Socorro, Clarión, and Guadalupe islands. Other islands, closer to the mainland, have permanent Navy facilities, and have permanent fishing villages.

ISLAND CONSERVATION

Raised awareness: the early years

Protection of the ecological integrity and natural resources of islands dates back to 1922, with a presidential decree to protect the wildlife of Guadalupe Island and its surrounding waters (DOF 1922). By that time, the Guadalupe Island fur seal (*Arctocephalus townsendi*) and the Northern elephant seal (*Mirounga angustirostris*) populations had been overexploited and were at risk of extinction.

Except for such rare cases, the relevance of biodiversity, conservation of insular ecosystems, and sustainable use of fisheries only became apparent in Mexico during the second half of the 20th century. Movement towards environmental conservation and wise use of the natural resources gained momentum in Mexico over the past three decades, accompanying similar global views. The first interest in the ecology and conservation of Mexican islands came from academia, with the pioneering comprehensive compilation on the ecology of Mexican islands published by Case and Cody (1983). The first applied island conservation actions were combined with scientific research, when the National Autonomous University (UNAM) initiated one of the first successful island conservation projects. The eradication of invasive mammals started in 1994 with the removal of house mouse (*Mus musculus*) and ship rats (*Rattus rattus*) from Rasa Island, a seabird sanctuary in the Gulf of California (Tershy 1995; Bahre and Bourillón 2002). Soon thereafter the first comprehensive review on the Gulf of California Islands was undertaken (Bourillón *et al*. 1988) and the first Official Atlas of Mexican islands (INEGI 1990) was published.

Following this early conservation activity, a small bi-national group of US-Mexican biologists conceived the possibility of restoring northwest Mexican and US islands by eradicating invasive vertebrates (Bernie Tershy and José A. Sánchez-Pacheco pers. comm.). Two private NGOs were established by the end of the 1990s to assist with this: one in the US (Island Conservation; hosted by the University of California in Santa Cruz) and one in Mexico (Grupo de Ecología y Conservación de Islas; GECI). By the early 2000s, these two organisations had successfully collaborated over the eradication of several species of invasive animals on islands of both countries (Aguirre *et al*. 2008; Samaniego-Herrera *et al*. 2009; Tershy *et al*. 2002; Wood *et al*. 2002). After 2002, the Mexican organisation started to unfold on its own, became autonomous, and has developed working relationships inside Mexico as well as collaborative links with teams dealing with invasive species elsewhere, including New Zealand, Australia, USA, Ecuador, Canada, Cuba, Brazil, Argentina, Chile, Dominican Republic, and with international organisations.

Enduring, successful and tangible results of invasive species eradications on Mexican islands during the last decade (see Aguirre-Muñoz *et al*. 2011) have attracted attention from government, local communities, fishermen organisations, donors and academic institutions. Coupled with greater understanding of biodiversity on the islands, the successful eradications have sown the seeds of a wider movement, with impacts and concerns beyond the scope of eradications. Two threads have since emerged. One views islands as ecologically valuable territory, integrating them with issues of sovereignty and sustainable development. The second builds on the introduced species issue as the basis for a new perspective of Mexico's mainland territory. A recent dispute over the use of Coronado Sur Island illustrates the former.

Development of a social movement for conservation

Island conservation reached a complex array of actors and institutions in Mexico as a result of conflict over Coronado Sur Island, adjacent to the border between the USA and Mexico. The conflict did not originate from local communities but came as a result of globalisation. Tensions developed when the multinational petrochemical company ChevronTexaco proposed building a liquefied natural gas (LNG) regasification facility adjacent to Coronado Sur Island. The gas would then cross the border by a pipeline to San Diego, USA.

The Coronado archipelago contains four species of endemic reptiles, two subspecies of endemic terrestrial birds and one species of endemic rodent. Pinnipeds and seabirds are abundant. The vegetation of Coronado Sur has not been heavily modified and the island supports the world's largest population of a subspecies of Xantus' murrelet (*Synthliborampus hypoleucus scrippsi*), which is a listed threatened species in Mexico and the USA. Feral donkeys (*Equus africanus*) and goats (*Capra hircus*) were removed from the island, although house mice are still present. Local fishermen harvest abalone (*Haliotis* spp.), lobster (Palinuridae), and sea urchin (Echinodermata) from around Coronado Sur Island and the northernmost Mexican Navy base is on the island.

Before the LNG project started, a proposal was presented in 2003 by GECI and the Protected Areas Commission (Aguirre Muñoz *et al*. 2003) to protect the Baja California Pacific Islands. The initiative was backed by the Mexican Congress of the Union, which then passed a resolution requesting the Federal Government to publish the protection decree, to eradicate the invasive pests on the region's islands (Congreso de la Unión 2003, 2007), and to confer Biosphere Reserve status over all the islands

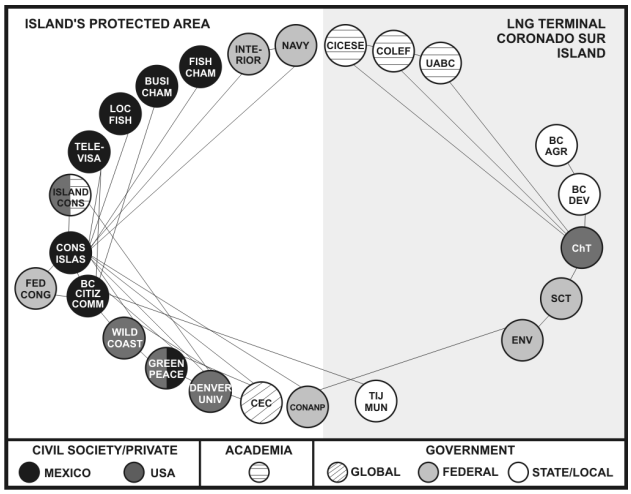

Fig. 3 General sociogram showing the social actors and agencies choosing between the LNG facility on Coronado Sur Island and a new protected area. The lines represent formal or informal linkages between the involved actors or agencies.

Table 1 Participants in debate over the use of Coronado Sur Island, Mexico, identified in the general sociogram (clockwise), with intensity of involvement identified.

Actor/Agency (Acronym)	Full name	Involvement	Intensity
CICESE	Centro de Investigación Científica y Educación Superior de Ensenada	Federal Government Research Centre. Contracts from ChT.	Low
COLEF	Colegio de la Frontera Norte	Federal Government Research Centre. Contracts from ChT.	Low
UABC	Universidad Autónoma de Baja California	State University. Contracts from ChT.	Low
BC AGR	Baja California State Agriculture and Fisheries Promotion Ministry	Baja California State Government (vs. Protected Area)	High
BC DEV	Baja California State Development Ministry	Pro LNG - Baja California State Government	High
ChT	ChevronTexaco de México, S.A. de C.V.	Pro LNG - Project developers	High
SCT	Communication and Transportation Ministry, Federal Government.	Pro LNG - Lease to ChT	High
ENV	Environmental Ministry, Federal Government.	Pro LNG - Lease to ChT EIA approval.	High
TIJ MUN	Municipality of Tijuana	Pro LNG - Permit for the LNG pipeline	Medium
CONANP	Natural Protected Areas Commission, Federal Government	Pro Protected Area – Promotion	High
CEC	Commission for Environmental Cooperation (Canada, US and Mexico), NAFTA	Pro Protected Area - Environmental law compliance review	Medium
DENVER UNIV	Denver University, USA.	Pro Protected Area - Integration of the citizen's petition to the CEC	High
GREENPEACE	Greenpeace Mexico and Greenpeace USA	Pro Protected Area - Protests and public opinion campaigns	High
WILDCOAST	US (California) NGO	Public opinion campaigns	Medium
BC CITIZ COMM	Baja California State Citizens' Committee, a civil society independent organisation	Pro Protected Area- Protests, political activism, public opinion campaigns	High
FED CONG	Federal Congress of the Union. All the political parties.	Pro Protected Area - Formal requests to protect the islands.	High
CONS ISLAS	Grupo de Ecología y Conservación de Islas, A.C. Mexican NGO.	Pro Protected Area – General coordination, legal defence, media	High
ISLAND CONS	Island Conservation, US NGO	Pro Protected Area - Coordination in the US and conservation research	Medium
TELEVISA	Televisa, a national TV broadcasting company	Pro Protected Area - National news broadcasting at peak hours	High
LOC FISH	Fishermen Cooperatives Regional Federation (FEDECOOP)	Pro Protected Area – Activism	High
BUSI CHAM	Baja California State Business Chamber, Formal Organisation	Against LNG facility	Medium
INTERIOR	Ministry of the Interior, Federal Government	Pro Natural Protected Area – Information	Medium
NAVY	Mexican Navy, Federal Government	Pro Natural Protected Area – Information	Medium

in the Pacific Ocean off Baja California, including the Coronado Archipelago. However, in March 2005 the Communications and Transportation Ministry granted a 30-year renewable lease to ChevronTexaco de México. The LNG plant was immediately viewed by some sectors in Mexico as a potential target for terrorists, a threat to territorial sovereignty, and a threat to the islands' natural resources. The challenges raised by the lease aligned diverse players in complex ways, created novel forces and alliances, started a new social movement and generated intense press coverage in both countries (Lindquist 2004). After years without street protests, there were marches against the proposed plant in the cities of Baja California.

A general sociogram (Moreno 1934; Aguirre-Muñoz 1998; De la Rosa *et al.* 2005) defined the confrontations and linkages of the stakeholders by geography, nationality, attitude towards the LNG facility, and social affiliation, such as civil society, government, and academia (Fig. 3). The sociogram illustrates how the conflict did not follow a simple division between the USA and Mexico. On the contrary, stakeholders on both sides of the border favoured or opposed either the LNG facility or the new protected area (Table 1). Organised fishermen, represented by their Regional Cooperatives Federation (FEDECOOP), actively promoted the new protected area. There was also international activism. Mexican and USA members of Greenpeace, together with other activists, protested at a ChevronTexaco stakeholders meeting in San Francisco. An alliance developed in favour of the protected area and against the LNG facility, encompassing fishermen organisations, conservation NGOs, some federal government agencies, academic institutions, and the local civil society. Important media were sympathetic to the social movement, with national TV coverage at prime time. The lease on Coronado Island was presented at peak

hour by the largest TV broadcasting company in Mexico, Televisa, as "a theft from the Nation".

Legal procedures in Mexico against the LNG lease were ignored by the judicial system, so a request to review the case was sent by US and Mexican citizens to the Commission for Environmental Cooperation (CEC), part of the Free Trade Agreement (NAFTA) between Mexico, the USA and Canada. In 2005, the CEC Secretariat in Montreal, Canada ruled that the Citizens' Petition fulfilled the required terms and requested a response from the Mexican Government (CEC 2005). While not legally binding, the resolution possesses moral strength. In early 2007 the LNG project suddenly ceased. ChevronTexaco informed the Mexican Environmental Ministry that "ChevronTexaco has decided, because it is convenient to its own interests not to continue with the authorised project …". Legal protection of the islands has since advanced, with active backing from organised fishermen, the Protected Areas Commission and NGOs. Public hearings concluded and a Conservation and Management Plan draft already exists. The eventual decree has become a public presidential commitment. Networks supporting long-term conservation of the islands saw threats to conservation values and long-term access to fisheries by local fishermen, resulting in a new alignment between conservation NGOs and fishermen. Local communities had an opportunity to understand and appreciate the islands' wildlife while conservation organisations became more empathetic to the needs and perspectives of local communities.

An organisation to eradicate invasive species from Mexican islands

In addition to the conditions already outlined, one factor has fundamentally affected the success of island restoration through the eradication of invasive pests: a specialised organisation to undertake the complex work. Most eradications of invasive species from Mexico were conducted by GECI, which was formally integrated in 1998. Until 2002, the organisation had a loose structure. By then, full time staff comprised two persons: an improvised manager and a hunter / trapper.

After 2002, a more systematic and strategic organisation was developed. Each employee was hired within a predefined profile based on a specific need or function, and after competing for the job. Key roles and job descriptions followed practical field activities. Currently, the organisation has 24 full time employees with 15 multifunctional biologists and oceanographers as core professional staff. These are supported in the field by seven technicians with skills in animal management, but also able to drive and maintain vehicles, undertake trapping, hunting, and telemetry, and to assist with the aerial dispersion and monitoring of baits. Everyday management is performed by a professional manager and an accountant. Of the professional staff, nine are women, and eight have postgraduate qualifications in biology, ecology, or natural resource management.

There are four main project teams: Guadalupe Island, Marine Birds, Wild Fauna and Rodent Eradications, and Tropical Islands. However, depending on work load, the teams regroup, which enables several projects to run simultaneously (Table 2). A high level of flexibility and skill is promoted by ensuring that the biologists and the technicians know all of the islands where GECI has worked, and through collaborative work on islands in other countries.

Biologists and technicians with ability and experience represent GECI's most valuable asset. Keeping them and increasing their capacity to restore all of the Mexican islands is a crucial challenge. Additional skills are now being gained within GECI by facilitating postgraduate research on questions derived from applied conservation work. One biologist recently returned to the organisation after completing an MSc degree at the *Instituto de Ecología* investigating food webs on San Pedro Mártir and Farallón de San Ignacio desert islands, where ship rats were recently removed using aerial bait dispersion (Rodríguez Malagón 2009). Two project directors are attending PhD programmes on invasive species on Mexican islands at the University of Auckland (New Zealand) and supported by scholarships from the National Science Council of Mexico (CONACYT).

GECI now has specialised field and office equipment, a biological field station on Guadalupe Island, and a building in Ensenada, Baja California that hosts offices, workshops, vehicles and a warehouse. The total value of the assets has increased from close to zero in 2002 to $US 915, 000 in early 2010.

The organisation is officially authorised by the Mexican federal tax system to receive deductible donations. GECI is registered with the National Science Council, which enables the organisation to bid when proposals are requested by the Council.

Table 2 Invasive species eradication projects and associated activities under way on Mexican islands during the first semester of 2010.

Island	Project	Activity
Socorro, Revillagigedo Archipelago (remote oceanic Pacific tropical island)	Sheep eradication	Ground hunting, last phase
Guadalupe (oceanic Baja California Pacific island)	Comprehensive restoration	Vegetation recovery monitoring - post goat eradication; feral cat control; bird monitoring
Banco Chinchorro (coral cay on the Caribbean)	Feral cat eradication	Full assessment, baseline and eradication preparations
Asunción and San Roque, Baja California Pacific island	Seabird restoration (post feral cat eradication)	Social attraction techniques
San Benito Oeste (Baja California Pacific island)	Introduced mouse eradication	Full assessment, baseline and eradication preparations
San Pedro Mártir, Farallón de San Ignacio, and Isabel (Gulf of California islands)	Ship rat eradications	Post eradication (2007 to 2009) monitoring
Alacranes (Caribbean island)	Ship rat eradication	First assessment
Islas Marías Archipelago (tropical Pacific)	Goat eradication on Maria Cleofas	Baseline and eradication executive plan

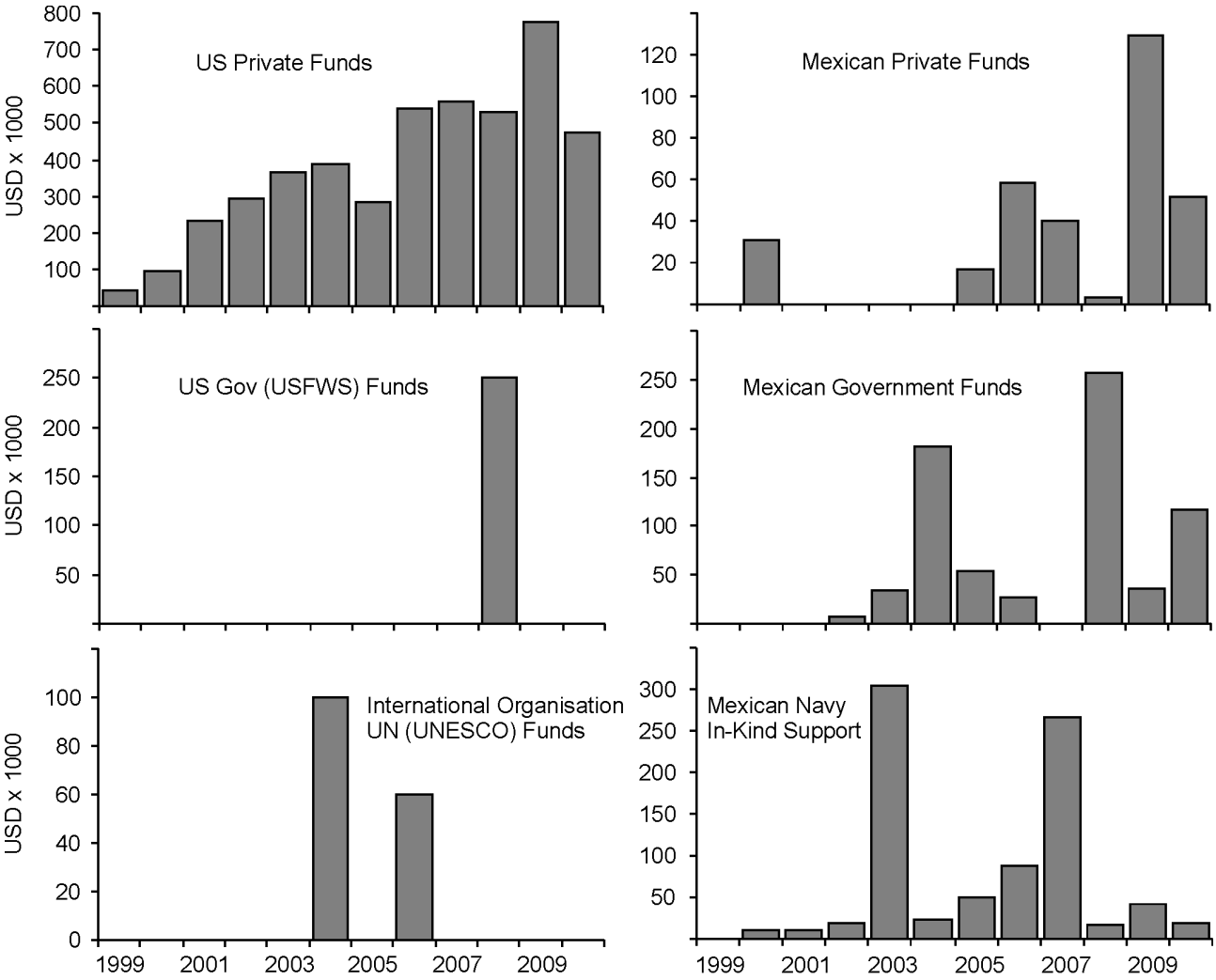

Fig. 4 Time series from 1999 to 2010, showing the origin of funds that enabled the eradication of 48 populations of invasive mammals on 30 Mexican islands.

Finances for eradications of invasive species

Funding obtained by GECI has on average increased since inception, but the sources are variable and the funds are insufficient to enable some of the more challenging projects. Other prerequisites for such projects, including capacity, collaborative networks, government support and permitting, and available techniques, are in place or are readily accessible. Insufficient resources to retain key personnel would severely threaten continued restoration work. Alternatively, sufficient and sustained funding could enable an unprecedented opportunity for the restoration of all the Mexican islands by 2025, a globally important strategic goal and a viable achievement.

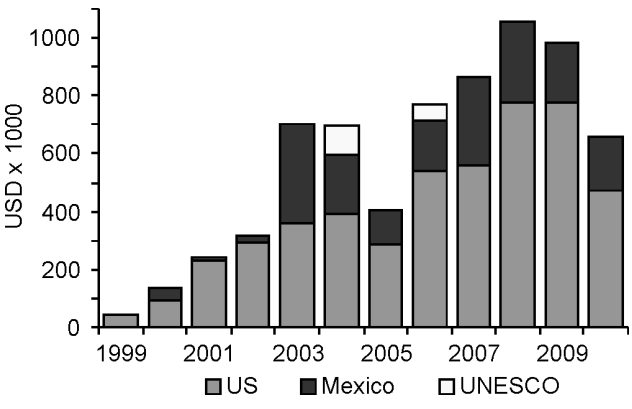

Fig. 5 US, Mexico, and UNESCO funding to eradicate invasive species on Mexican islands.

Between 1999 and 2010, approximately $US 7 million has been invested in eradications on Mexican islands, with funds from Mexico, the US, an international organisation (UNESCO) and in-kind support from the Mexican Navy. The figures also include work on pre-eradication assessments, eradication planning and post-eradication monitoring (Fig. 4).

By country of origin, 70.1% of the total cumulative resources was provided by US donors, largely from private foundations (Fig. 5). Mexico contributed 27.6%, half of which was 'in-kind' contributions from the Mexican Navy through support given by large vessels during eradications, regular transportation to islands, logistic support and use of their infrastructure facilities.

Mexican federal government agencies within the sphere of the Environment and Natural Resources Ministry (SEMARNAT) include the Biodiversity Commission (CONABIO), Natural Protected Areas Commission (CONANP) and National Institute of Ecology (INE). Collectively, these have contributed 10.4% of the total invested in eradication projects on islands during the last decade.

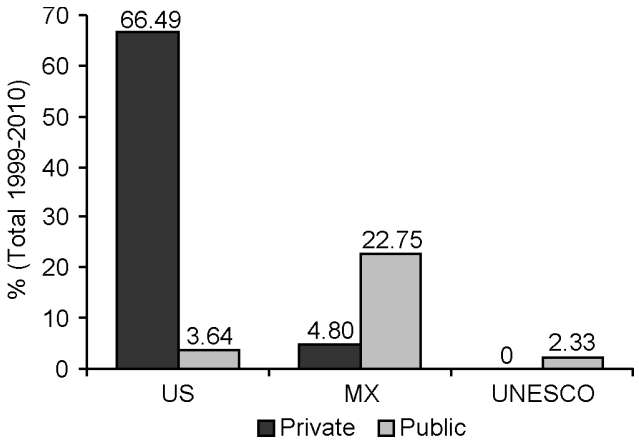

Fig. 6 Private and public contributions to eradicate invasive species on Mexican islands from 1999-2010.

Fig. 7 The Mexican Navy MV Sonora supporting the ship rat eradication on San Pedro Mártir Island, Gulf of California, October 2007. The operation used CI 25 (Bell Labs) brodifacoum bait spread by a helicopter from Aspen Helicopters, USA, and a special bucket from Helicopters Otago, New Zealand.

So far, the private Mexican sector has contributed 4.8% of the total. Support from international organisations has been 2.3% of the total provided by UNESCO for a goat eradication on the Espíritu Santo Island. The straightforward eradication, was stopped when almost completed following political challenges during the 2006 presidential election.

A 'one-off' US $500,000 US-Mexico bi-national fund was established in 2008 to eradicate invasive species on Mexican islands as a means of protecting migratory species of common interest, mainly migratory birds. Half of the resources were granted by the US Fish and Wildlife Service and the other half by CONANP. The fund was operated during 2009 by GECI under supervision of CONABIO. Four projects were successfully undertaken (Table 2): the eradication of sheep (*Ovis aries*) from Socorro Island; the eradication of ship rats from Isabel Island; an eradication plan for feral cats (*Felis catus*) from Guadalupe Island; and a workshop on island invasives for federal government staff, including CONANP, INE, CONABIO, the Mexican Navy, SEMARNAT and fishermen co-operatives.

Although funding has followed a positive growth trend during the last decade, the funds available during 2009 and 2010 are lower than the immediate previous year, reflecting reduced private donations from the US. These donations are still the largest component of private funding to date (Fig. 6).

Beginning in 2009, a combination of federal and private funds became available to conduct eradications on islands through the Mexican Fund for the Conservation of Nature (FMCN) as part of the National Fund for Protected Areas (FANP). This fund is being maintained and expanded, providing now opportunities for multi-annual support. If the pace is sustained and funding is assured a strategic goal could be met: to eradicate all invasive mammals from the remaining Mexican islands by the year 2025.

Institutional support for eradications of invasive species

The positive results from eradications on Mexican islands have caught the attention of several state and federal government agencies. The Congress of the Union has been involved with invasive species. As a result, the following policy instruments and partnerships provide a framework for the eradication of invasive species.

Firstly, CONABIO recently completed a National Strategy on Invasive Species: Prevention, Control and Eradication (CONABIO 2010). Public hearings have concluded and an Advisory Committee is in place to implement the strategy. CONABIO has also co-ordinated a State of the Nation analysis (Sarukhán Kermes 2009), where a comprehensive chapter on invasive species identifies islands as a special case (Aguirre-Muñoz and Mendoza Alfaro 2009).

Secondly, in 2008 CONANP, which is part of the Environment Ministry (SEMARNAT), formed a compact department that deals with introduced species with emphasis on island eradications. Departmental personnel assist by pursuing permits from the Wildlife General Directorate and facilitating inter-institutional collaboration. In March 2010, CONANP approved Guidelines to Prevent, Control and Eradicate Invasive Species on Insular Federal Natural Protected Areas (CONANP 2010), thereby officially supporting eradications projects on islands.

Thirdly, the Ministry of Interior (SEGOB) has a special office – Subdirección de Administración del Territorio Insular – to deal with general governance issues in Mexican federal insular territory. With a constitutional mandate to manage the Mexican islands, this office facilitates relationships with the Mexican Navy, and has the legislative power to provide any general permits required in support of those granted by the Environment and the Health Ministries.

The Mexican Navy provides essential support for eradication activities on a case-by-case basis. For example, a helicopter was deployed on Guadalupe Island by a Navy vessel with a platform and hangar. Hunters were transported repeatedly to Socorro Island to remove sheep, while ammunition and conservation personnel were transported between the mainland and Socorro Island by helicopter; a 3.5 hour flight. The MV Sonora and its crew supported the helicopter-based eradication of ship rats on islands from the Gulf of California (Fig. 7). Navy lodging facilities on the islands are offered to the scientists and technicians that do the eradication work. In these examples, the Mexican Navy takes care of natural capital in a novel and productive way of attending to sovereignty.

The National Institute of Ecology (INE), following a research perspective, has been a long time partner in eradication projects. Their first financial investment was for goat eradication from Guadalupe Island. Over the last three years, INE has coordinated a project with the Public Security Ministry and GECI to assess the invasive species situation on the Islas Marías Archipelago, in preparation

for systematic eradication of invasive vertebrates. INE, with other government agencies and GECI, is also starting the integration of a "National Strategy for the Conservation and Sustainable Use for the Mexican Islands".

Overall, the government's approach to introduced species has shifted from regulatory, to proactive facilitation. Institutional development, the creation of federal protected areas, and the generation of new policy instruments, indicate that eradications, particularly on islands, have gained widespread institutional support.

CONCLUSIONS

The historical perspectives outlined here follow remarkable changes in values, attitudes, discourses and practices towards islands by the 'social actors' in Mexico, with particularly rapid change over the last three decades. Beginning with abuse of island resources, abandonment of remote territories, and then questionable dealings by the state over aspects of sovereignty, attitudes have since been transformed. These changed attitudes were illustrated recently when a proposed LNG plant near one island became linked to perceived threats to sovereignty and stimulated a national conservation movement.

Changing attitudes are sometimes influenced by chapters of history linked to national or global events. In Mexico, these events included fragility of the new nation during the 19th and early 20th centuries, the international adoption of the Exclusive Economic Zone (EEZ), and recent pressures and opportunities presented by globalisation. In addition to events that shaped attitudes within Mexico, other components of change echo those found elsewhere. The way that recent attitudes towards island conservation were transformed into a sustained '*Leitmotiv'* by a non-governmental environmental organisation reflects gaps and delays between the concerns of a dynamic civil society and the corresponding more rigid government agencies and agendas (Giddens 1998). Nonetheless, issues that are of enduring concern to civil society are eventually incorporated into government agendas. The process this followed for island conservation in Mexico began with raised awareness of the issues, continued by social acceptance, scientific research, organisational development to exploit identified needs, securing of funding to support projects, and finally, institutional acceptance and support.

Awareness is a particularly important component, and stemmed from recognition by civil organisations and academic institutions of the great ecological value and fragility of Mexican island ecosystems and biodiversity, sustainable practices that could be followed by local communities such as fishermen co-operatives, and the need for government agencies to pro-actively strengthen sovereignty and make good use of national territory.

Recent and efficient eradications of invasive mammals on Mexican islands have been central to a new, caring attitude towards the Mexican insular territory. This new attitude developed as a 'bottom-up' social construction that then spread to a complex suite of diverse social actors. Central to this success has been the development of an NGO, GECI. Although focused on the eradication of invasive species on islands, this organisation has built collaborations with government agencies and local communities such as fishing villages.

This crucial role of NGOs in conservation of natural resources in Mexico has parallels in other federal government systems such as the USA, where Wilson (2002) regarded them as the spearhead of conservation movements. As in Mexico, the most successful model identified by Wilson (2002) involved strong relationships between the private sector, government and science and technology. In Mexico, protection of biodiversity, attention to sovereignty and good use of natural resources formed a simple philosophical triad that produced outstanding results for island restoration and conservation. There is little need to change this approach, but it could be reinforced.

As Wilson (2002) also recognised, finances are a crucial issue for NGOs. Secure funds and retention of experienced personnel are prerequisites if we are to meet our goal of restoring the remaining Mexican islands still inhabited by invasive mammals. Funds coming from outside Mexico through private US donors will need to be maintained and increased while funds from within Mexico are developed. Mexican public funds for island restoration should also grow consistently and significantly. An investment of approximately two million dollars per year over the next 15 years is needed to eradicate the remaining invasive vertebrates on Mexican islands.

The effects of these restorations should not be limited to positive outcomes for biodiversity. They can also provide an incentive to use models for sustainable development. Compared with the mainland, Mexican islands are well suited to such an approach. The islands are self-contained, the actors are few, governance is high, social aspects are simpler and ecosystems are also less complex than on the mainland. Abalone and lobster poachers do not make it to the islands or are relatively well controlled. Green certificates such as those granted by the Marine Stewardship Council can be achieved for all of the island fisheries. This movement to sustainable use has already started, adding value to products in the markets and increasing consciousness of local fishermen communities. Careful use of the natural resources on islands can then become an element of pride and territorial identity. The possibility of switching fully to alternative energies such as solar and wind is a viable option, as most of the communities are small and industrial needs are few. Increased understanding through quality education about biology, ecology and sustainable development can be offered and developed on islands as in few other locations. Restoration and management models can be researched, understood and applied on islands where there are fewer variables than on the mainland but with prospects of relatively effective control over them.

A successful, well documented and well understood story around restoration and sustainable development on islands could inspire similar work on larger scales and on continental territories. Few places in the world are at present improving all aspects of their natural, social and financial capital. Mexican islands are.

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