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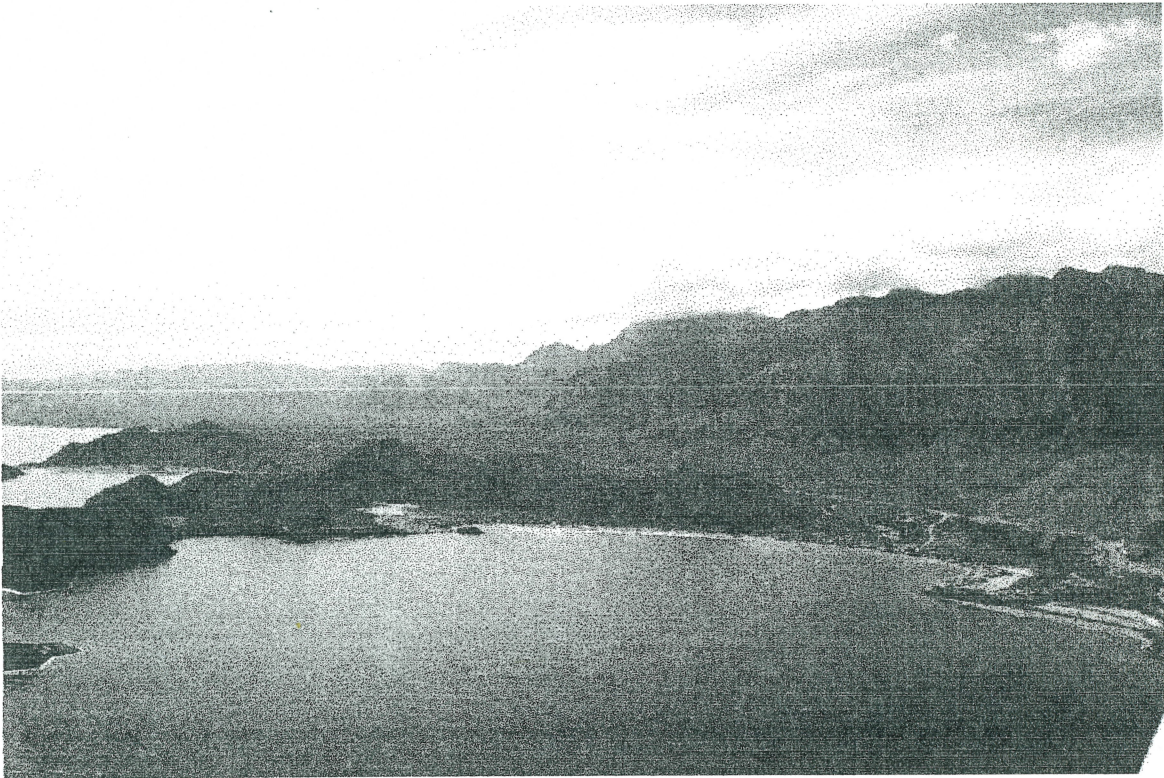
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“ASSESSMENT OF IMPACTS TO THE MARINE ENVIRONMENT IN THE REGION OF LORETO, BAJA CALIFORNIA SUR, MEXICO”



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June 2006

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**“ASSESSMENT OF IMPACTS TO THE MARINE ENVIRONMENT IN THE
REGION OF LORETO, BAJA CALIFORNIA SUR, MEXICO”**

by

Catalina López Sagástegui

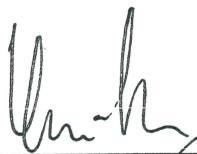
A capstone project submitted in partial fulfillment of
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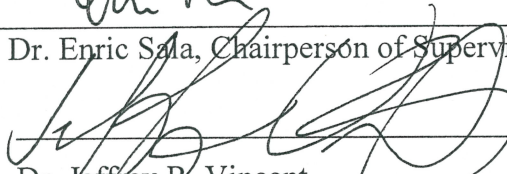
Scripps Institution of Oceanography, University of
California, San Diego

2006

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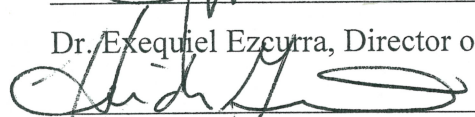
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Introduction

Economic development in Baja California Sur strongly depends on the availability of renewable resources. The most significant threats to biodiversity are driven by economic activities that can cause the deterioration of ecosystems (Carvajal et al., 2004). In Loreto, located on the central portion of Baja California Sur (Fig. 1), a development project aims at exploiting the natural resources of the area, with the risk of degrading them. This project investigates the potential consequences of such development.

In the 1960s, Loreto's natural beauty caught the attention of FONATUR, the Mexican federal agency in charge of tourism development. Tourism is a powerful economic driver in the state of Baja California Sur, and it has been growing at an average annual rate of 20% since 1988 (Carvajal et al., 2004; Kiy et al., 2005; Steinitz et al., 2005). Although Los Cabos is still the most important destination in the state, La Paz and Loreto are close behind, with the economy of the latter largely based on tourism and fishing (Kiy et al., 2005).

FONATUR intends to make Loreto a great tourism destination through the construction of hotels, villas, condominia and marinas that cater to visitors mainly from the United States and Canada (López, 2003; Steinitz et al., 2005; Torres, 2006). The municipality of Loreto is home to some 15,000 people, 84% of whom live in the town of Loreto; the remaining 16% live on small ranches and in fishing and cattle grazing communities (Carabias et al., 2000; Soares, 2002; Steinitz et al., 2005). By 2025, the proposed development project is expected to cause a ten-fold increase in the population,

which will be accompanied by urban development, mostly along the coast (Fig. 2) (Torres, 2006).

All development planned for the region of Loreto will take place along the west boundary of the National Marine Park Bay of Loreto (NMPBL). This marine park was established in July of 1996 and covers an area of 2,066 km² (Fig. 3). Its main objectives are to manage renewable and nonrenewable resources and to restore critical habitats, while promoting socioeconomic development of the local communities in the region (Carabias et al., 2000). Historically, people living in the Loreto region have depended on marine resources, thus there is great interest in determining the possible impacts of increased human activity on these resources.

The main activities that take place within the boundaries of the marine park are commercial (artisanal) and sport fishing, and ecotourism. Ecotourism activities, such as nature walks on the islands or kayaking, have a direct impact on terrestrial and coastal ecosystems, including trampling of vegetation, deforestation of dunes, introduction of exotic species and the disturbance of colonial nesting seabirds and breeding pinnipeds and other animals (Tershy et al., 1999; Carabias et al., 2000). Kayaking has been growing in popularity, and Loreto is now considered one of the top two places for kayaking in North America (Soares, 2002). These types of ecotourism activities have not historically been subject to regulation. However, they have been increasing in the park from year to year, creating a need for a regulatory mechanism to minimize the impact visitors have on the different ecosystems (López, 2003; Torres, 2006).

Fishing is a popular activity that attracts tourists and is the sole source of income for many local families. In the year 2000 there were 594 small boats operating inside the

park, 383 dedicated to commercial fishing and 211 to sportfishing (Carabias et al., 2000; Soares, 2002). This fleet is expected to grow as the local populations and numbers of visitors increase, and as it increases fishing pressure will likely increase inside the park as well. It is probable that the sportfishing fleet will grow faster than the commercial fleet. Additionally, because there is generally more money invested in sportfishing than commercial fisheries, the sportfishing fleet may have a longer operating lifetime.

Objective

The objective of this paper is to provide an assessment of the impacts of human activities associated with the projected population growth of Loreto on the marine environment. In particular, I will assess:

- 1) The impacts of the projected growth of Loreto on marine biodiversity, and the potential consequences on human welfare
- 2) The impacts of an increase of local fish demand associated with increased human population on the fish assemblages of the NMPBL.

Other putative impacts associated with the development of Loreto, including the building of a desalination plant, will not be addressed in this report.

Methods

Information was gathered from published and grey literature on the biodiversity, fisheries, socioeconomics and history of the Loreto region. To accomplish this task, I visited the libraries of the Universidad Autónoma de Baja California Sur (UABCS) and Scripps Institution of Oceanography, obtained data through internet searches, and

gathered some data were through interviews and informal talks. Information was also obtained through communication with people directly involved in research projects in the Loreto region.

A simple correlation analysis between the number of tourists and the volume of landings in Loreto was conducted using fisheries data obtained by Leonardo Huato and Marta Haro from CIBNOR-La Paz, from records kept by the Mexican Fishery Secretariat, SAGARPA. Data on the number of tourists was obtained through the Mexican Tourism Secretariat (SECTUR) using their database "DataTur". All data gathered referred only to the region of Loreto and from the years 1998 to 2004.

Another correlation analysis using the same data on grouper landings and biomass of the leopard grouper (*Mycteroperca rosacea*) was conducted. For this analysis only data belonging to the "Grouper" category was used. This category includes several medium- and small-sized groupers; *M. rosacea* is the most abundant species. Unpublished data on grouper biomass were kindly provided by Enric Sala and Octavio Aburto-Oropeza from Scripps Institution of Oceanography. Calculations of biomass were done using a weight-length relationship.

Findings

There seems to be a positive relationship between landing volumes and number of visitors in the area (Fig. 4). This may support the hypothesis that if the tourist population of Loreto increases as the development plan proposes it will, the volume of fish extracted in the area will also increase.

Any increase in catch will cause a decrease in biomass of the species within the boundaries of the marine park (Fig. 5). Although in the year 2004 landings exceeded 60,000 kg, there is a decreasing trend of biomass as catch volumes increase. Even when excluding the extreme value in 2004 there is a clear negative sloping trend of biomass per volume of landing. The abundance of three important species (*M. rosacea*, *Lutjanus argentiventris* and *Scarus ghobban*) has decreased inside the marine park where fishing is allowed (COBI, 2005). The same report mentions that the average size of the organisms of the target species has also decreased within the park's boundaries. The Leopard Grouper, *M. rosacea*, is a species that harbors importance on different levels: ecological, economic and as a fishery. It is a top predator on rocky reefs and forms spawning aggregations, particularly in offshore islands (Allen and Robertson, 1998; Sala et al., 2003). This species' life cycle is well known and is one of the best studied species in the Loreto region. This grouper is also of great economic importance since its meat is considered to be of great quality and is the most abundant and intensely fished grouper in the Gulf of California (Randall et al., 2005; Aburto-Oropeza et al. in prep).

Most of the grouper fishery takes place during their reproductive peak when they form aggregations yielding large catches with little effort. Although its abundance has been decreasing, the Leopard grouper (*Mycteroperca rosacea*) represents 17% of the overall catch and 94% of the groupers caught in the artisanal fishery inside the Marine Park (Randall et al., 2005). One modeling study indicates that under current fishing conditions, Leopard grouper populations in three islands in the park (Coronado, Danzante, and Montserrat) may be sustainable, but that the population in Carmen Island

is not sustainable and will decline if fishing pressure continues at the present rate (Wielgus et al., in prep.).

Recruitment patterns are important to take into account since a good recruitment season will be reflected later on in the adult population size. In the case of the Leopard grouper, larvae prefer shallow boulders (<5m depth) covered with *Sargassum*, a brown algae, as their recruitment habitat. This brown alga grows seasonally, forming a belt along rocky shores and reaches its maximum growth and density in May and June. Larvae have a settlement peak that matches with that of *Sargassum* biomass, and they stay in shallow habitats for their first year after settling (Aburto-Oropeza et al., in prep). There is a relationship between the variability in *Sargassum* biomass and oceanographic conditions. El Niño/Southern Oscillation (ENSO) is a coupled ocean-atmosphere phenomenon that causes climatic variability that can be quantified using the Multivariate ENSO Index (MEI). El Niño years are associated with positive values of MEI, while La Niña years are associated with negative values. Variation in the adult populations of the Leopard grouper occur naturally when events like El Niño affect *Sargassum* density and there is not enough suitable nursery habitat to support a large number of recruits. During El Niño years water temperature increases and nutrient concentrations in the water decrease. *Sargassum* biomass and the density of leopard grouper recruits decrease with increasing MEI. This is reflected in a smaller cohort of individuals that will later recruit to the adult population, but it will be a much smaller one than those that recruited during cold, nutrient rich years (Aburto-Oropeza et al., in prep).

Discussion and recommendations

Growths in tourism and in resident populations of the Loreto region will likely result in an increase in demand for fish, therefore causing an increase in fishing activities to meet the demand (FAO, 1998, 2000; UNEP 2002; Boshnakova, 2004). As the fleets of both industries (commercial and artisanal fisheries) begin to grow, there will be an increase in fishing effort, intensifying pressure on local fish stocks that already display signs of overexploitation (Wielgus et al., in press; COBI, 2005). Until the early 20th century, fishing was practiced only in inshore areas with small vessels powered by oars and sail. The main fishing techniques utilized in the early 1900's were lines and hooks. In the 1930's new technology was introduced: outboard motors and gillnets. Fishing became a major driving force for regional development in the 1950's; however over-exploitation of the fishing stocks is now becoming a limiting factor for the success of the regional fisheries (Carvajal et al., 2004).

Great fishing pressure is dedicated to coastal fish species to meet the increase in demand for fish resulting in unsustainable commercial fishing along the coasts of the Baja California peninsula (Ezcurra, 1998). This increase in demand results from a combination of factors like population increase, increase in tourists' demand for fish, and the commercial expansion of regional fisheries (Young, 2001). The best-known examples of important fish species that have collapsed are two groupers: the Gulf grouper (*Mycteroperca jordani*) and the Leopard grouper (*M. rosacea*). The Gulf grouper used to be very abundant and today is considered a rare species, with its population at only a small percentage of what it used to be in the 1940's (Sáenz-Arroyo et al., 2005).

Although the data discussed above for Loreto are at a very small spatial scale, the trends are consistent with more regional scale analyses. Studies show that some commercially important species have decreased in abundance and density over the last 30 years or so as a result of increasing fishing activities (Sala et al., 2004; COBI, 2005). Fisheries in Baja California Sur showed an increasing trend in catch 1950-1980, but a decreasing trend in catch-per-unit-effort (CPUE) after 1980. The only group that does not show this decreasing trend in CPUE is the multi-species category of groupers (Sala et al., 2004). However, the fluctuations of CPUE in multi-species groups may be due to the shift in target species over time.

Capturing fish when they form spawning aggregations is not the only threat they face. Coastal development, through modification of the coastline, and pollution, can result in the modification of areas that can serve as potential recruitment habitat. The two major critical habitats present in the region are mangroves and *Sargassum* beds. There are only a small number of mangroves left in the area as small patches on Carmen, Coronado and Danzante, Nopoló and Puerto Escondido. These last two locations have suffered great modifications in their coastline since they have been sites of major tourist developments.

Sargassum beds should be given priority when considering conservation strategies. Recruitment intensity of the leopard grouper is related to the abundance of suitable nursery habitat, which in turn is determined by climatic variation. The effects of changes in recruitment densities can be seen years later in smaller adult populations, and indirectly in smaller catch volumes. Leopard grouper spawning aggregations are targeted because they yield large catch volumes but there is also a natural variability in

recruitment success due to habitat availability. Any further loss of nursery habitat will result in lower possibilities of population replenishment and the negative effects of fishing will be amplified (Aburto-Oropeza et al., in prep).

Data indicate that the Leopard Grouper, as well as other species, are showing signs of overfishing (Sala et al. 2004; Saenz-Arroyo et al., 2005; Wielgus et al., in prep) but it only becomes apparent when fisheries data is disaggregated by species. Mexican fishing statistics group different species in a single group. The category of "Groupers" has been increasing in catch volume since 1988, and CPUE for this group has been growing since 1980 (Sala et al. 2004; Saenz-Arroyo et al., 2005). This can lead to a false interpretation that these trends are signs of healthy fish stocks.

The creation of the marine park resulted in restrictions and regulations of fishing activities. However, local fishermen comment on how during the last 20 years the most prized species have been overexploited. This overexploitation is mainly due to the use of unsustainable fishing techniques and illegal fishing activities by the commercial and sportfishing industries. Park managers need to work towards more rigorous control of fishing activities within the boundaries of the protected area. Although data on commercial fishing activities is not of the greatest resolution, it provides enough information to begin understanding the tendencies of the activity. The effects of sportfishing cannot be quantified because there is no data collection; there is no information on the number of trips or what and how much fish is extracted. This information would prove useful if discussions about activity regulations arise.

There hasn't been any investment in training or technological upgrades that make fishing more economically efficient and environmentally sustainable. Some of the

problems this industry has been facing over the past years include fishermen migrating to the state, large number of middlemen, lack of marketing skills on behalf of the fishing co-ops, lack of research related to fish population dynamics, and illegal trafficking. Infrastructure deterioration and obsolete equipment are two major problems that need immediate attention if sustainable practices are to be reached (Díaz-Gea et al., 2001; Kiy et al., 2005).

The future of Loreto depends on the wellbeing of the surrounding environment. In order to support any type of development in the area, management officials as well as city and government officials need to regulate and control all activities that impact on the region's natural resource stocks. The most urgent need is the establishment of ecosystem-based fisheries management, and officials need to find an effective way to implement and enforce this management scheme. Conservation of critical habitats and spawning aggregations should be among the most important issues to address since their protection ensures replenishment of adult populations of target species.

Sustainable fisheries should be based on scientific research that incorporates adaptive management criteria based on the fishery's ecological impact and its economic value. It is critical that local fishermen are able to adjust their activities as the fishery changes without compromising their livelihood. An investment in technology, better boats, engines or fishing gear, will make the extraction process more efficient (Casas-Valdez, 2004). Fishing quotas should be based on local or regional studies of target species, and they should differ from other places if the fishery takes place inside an NPA (Díaz-Gea et al., 2001).

Community development will be enhanced if the surrounding environment is healthy enough to support the livelihoods of local people. A development like the one planned by FONATUR implies that there will be large amounts of money invested in the area, creating new growth opportunities for the city and its inhabitants. However, economic value of local resources is something that has yet to be analyzed. It is important to know what the short and long-term economic impacts of the development will be on a local and regional scale. This will aid in future decisions on how to manage the region's resources and on the area's development.

Literature Cited

1. Aburto-Oropeza, O., E. Sala, G. Paredes, A. Mendoza and E. Ballesteros. In prep. Climate variability determines ref. fish recruitment via changes in the availability of nursery habitat.
2. Allen, G.R. and D.R. Robertson. 1998. Peces del Pacífico Oriental Tropical. University of Hawai Press. U.S.A. 327 pp.
3. Boshnakova, M. 2004. Bulgaria Fishery Products. USDA Foreign Agricultural Service. GAIN Report. 15 pp.
4. Carabias, J., J. de la Maza, D. Gutiérrez, M. Gómez and B. Bermúdez. 2000. Programa de Manejo Parque Nacional Bahía de Loreto. CONANP. Mexico. 185 pp.
5. Carvajal, M.A., E. Ezcurra and A. Robles. 2004. The Gulf of California: Natural resource concerns and the pursuit of a vision. In: L.K. Glover and S. Earle (eds.) *Defying Ocean's End. An agenda for action*. Island Press, Washington, D.C. pp. 105–124.
6. Casas-Valdez, M. 2004. La región marina del noroeste de México: Oportunidades, su potencial y necesidad de investigación científica y tecnológica. Ponencia en la 3ª Reunión sobre Legislación y Política en Ciencia, Tecnología y Educación superior en la Región Noroeste. 10 de agosto 2004. Foro Consultivo Científico y Tecnológico.
7. COBI. 2005. Diseño y Evaluación de recursos marinos en las Islas del Golfo de California (A-1-00/24). 37 pp.

8. Díaz-Gea, G. 2001. Consulta Nacional del Sector Pesquero. Informe de la Cámara de Diputados de la LVIII Legislatura. 158 pp.
9. Ezcurra, E.M. 1998. Conservation and Sustainable use of Natural Resources in Baja California: An Overview. Briefing Paper prepared for San Diego Dialogue's Forum Fronterizo series, San Diego Dialogue, San Diego, California, October 1998, 15 pp. (available at <http://sandiegodialogue.org/pdfs/>)
10. FAO. 1998. Fishery Country Profile: Maldives. Available at: <http://www.fao.org/fi/fcp/es/MDV/profile.htm>
11. FAO. 2000. Fishery Country Profile: Santa Lucía. Available at: <http://www.fao.org/fi/fcp/es/LCA/profile.htm>
12. Kiy, R., A. McEnany and C. Monahan. 2005. Baja California Sur's community-based opportunities and needs. International Community Foundation. San Diego, CA. 106 pp.
13. López, R. 2003. Caracterización y diagnóstico de las actividades recreativas en el Parque Nacional Bahía de Loreto. Technical report. 11 pp.
14. Randall, A., P. Thinet, J. Torre and A. Sáenz-Arroyo. 2005. Impacto en la composición de peces de los arrecifes rocosos en el Parque Nacional Bahía de Loreto con dos métodos de pesca: piola y red de cerco. Poster-Simposio Ciencias Pesqueras en México. La Paz, B.C.S., México.
15. Sáenz-Arroyo, A., C.M. Roberts, J. Torre, M. Cariño-Olvera and R.R. Enríquez-Andrade. 2005. Rapidly shifting environmental baselines among fishers of the Gulf of California. Proc. R. Soc. B. (272):1957-1962.

16. Sáenz-Arroyo, A., C.M. Roberts, J. Torre, M. Cariño-Olvera. 2005. Using fisher's anecdotes, naturalists' observations and grey literature to reassess marine species at risk: the case of the Gulf grouper in the Gulf of California, Mexico. *Fish and Fisheries*. 6:121-133.
17. Sala, E., Aburto-Oropeza, O., Paredes, G., Thompson, G. 2003. Spawning aggregations and reproductive behavior of reef fishes in the Gulf of California. *Bulletin Marine Science*. 72(1):103-121.
18. Sala, E., Aburto-Oropeza, O., Reza, M., Paredes, G., López-Lemus, L.G. 2004. Fishing down coastal food webs in the Gulf of California. *Fisheries*. 29(3):19-25.
19. Soares, D. 2002. De gentes y mares: diagnóstico socioambiental con perspectiva de género en la llanura costera del municipio de Loreto. The Nature Conservancy. 59 pp.
20. Steinitz, C., R. Faris, J.C. Vargas-Moreno, et al. 2005. Alternative Futures for the Region of Loreto, Baja California Sur, Mexico. 48 pp.
21. Tershy, B.R., L. Bourillón, L. Metzler and J. Barnes. 1999. A survey of ecotourism on islands in northwestern Mexico. *Environmental Conservation*. 26(3): 212-217.
22. Torres, M.A. 2006. Loreto ve los límites del crecimiento: Paso a paso se llega más lejos. Programa de Las Américas del International Relations Center (available at <http://www.ircamericas.org/esp/3250>).
23. UNEP. 2002. <http://www.unep.org/pc/tourism/sensitive/coral-threats.htm>
24. Wielgus, J., F. Ballantyne, E. Sala and L.R. Gerber. In prep. Assessment of the viability of reef fish populations with limited demographic information.

25. Young, E. 2001. State intervention and abuse of the commons: Fisheries development in Baja California Sur, Mexico. *Annals of the Association of American Geographers*. 91(2): 283-306.

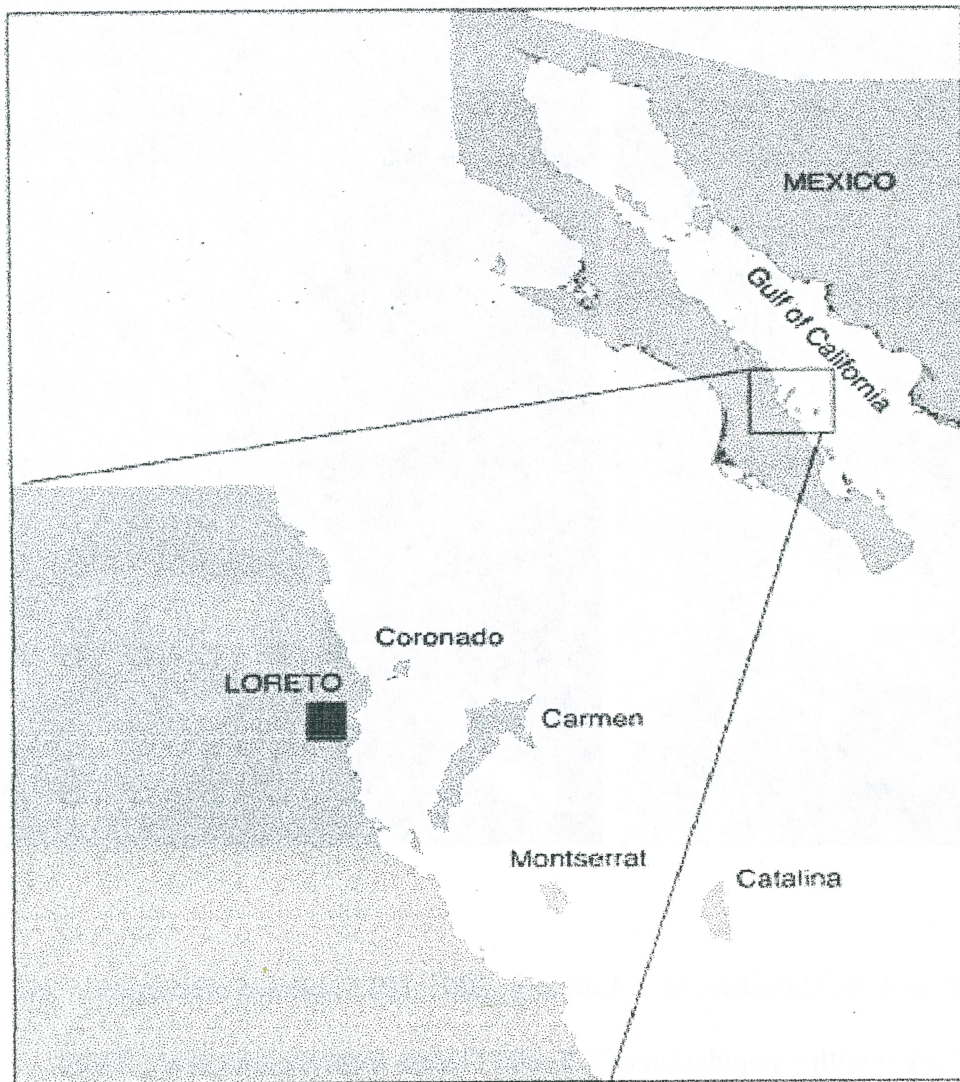


Fig. 1. Location map of study area.

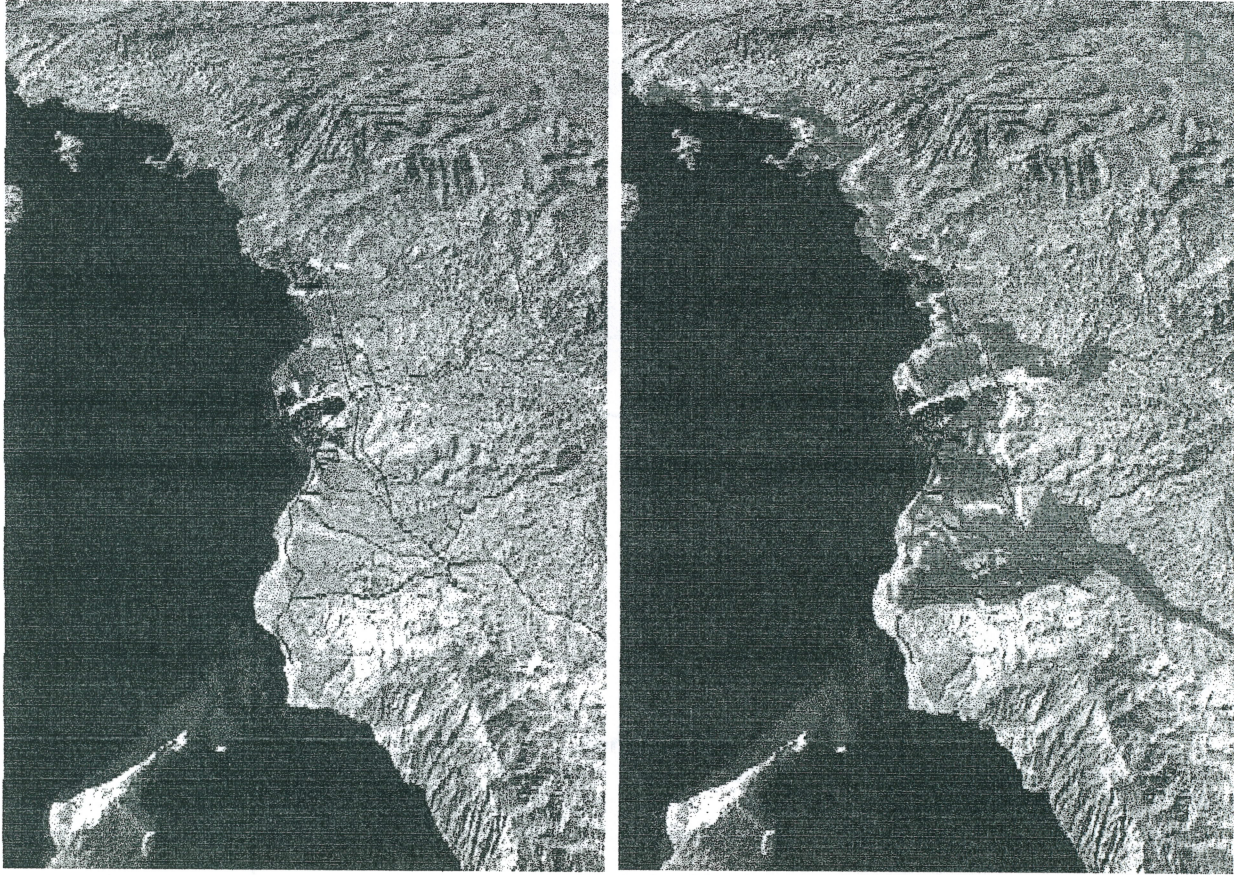


Fig. 2. (A) Urban and developed areas of Loreto in 2005. (B) Predicted urbanization and development of Loreto with a population of 120,000 (Taken from Steinitz et al., 2005).

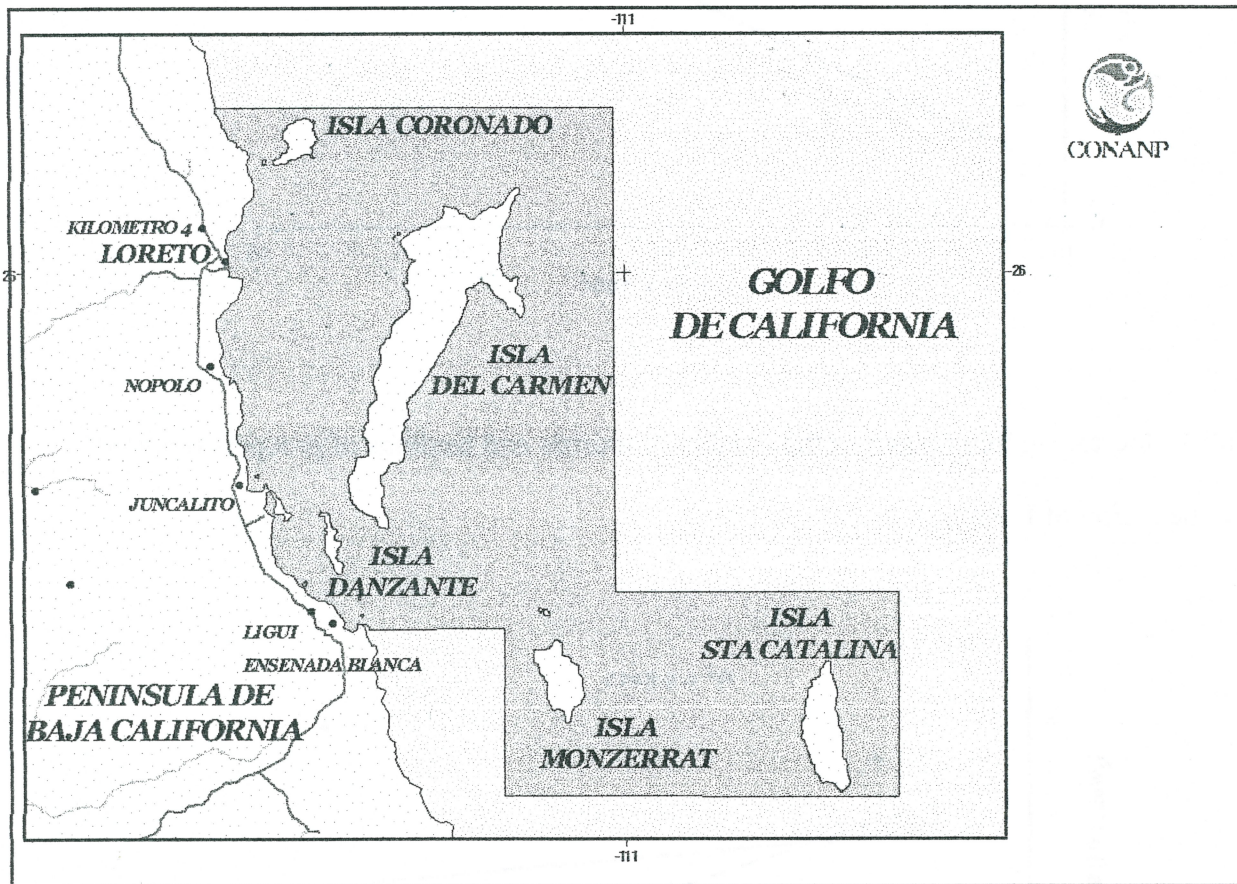


Fig. 3. Location map of the National Marine Park Bay of Loreto and its boundaries.

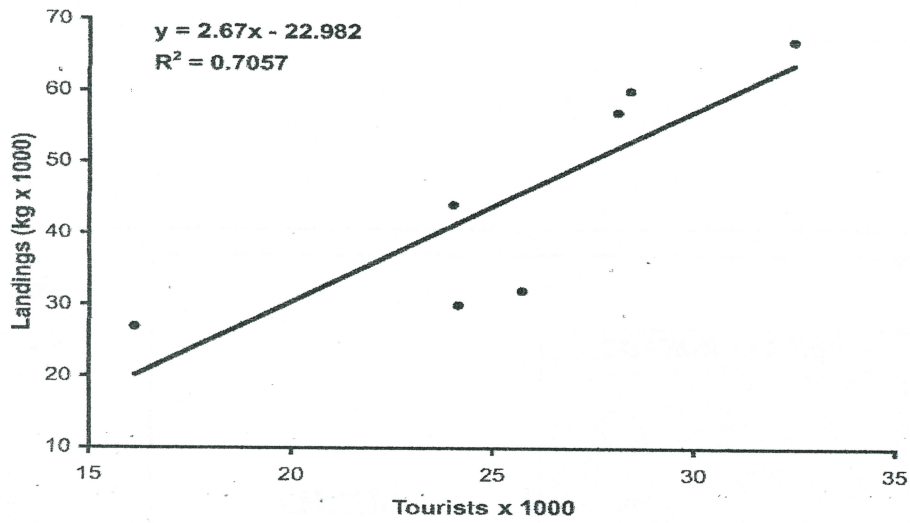


Fig. 4. Increasing trend between the number of tourists and landings of groupers reported for the region of Loreto

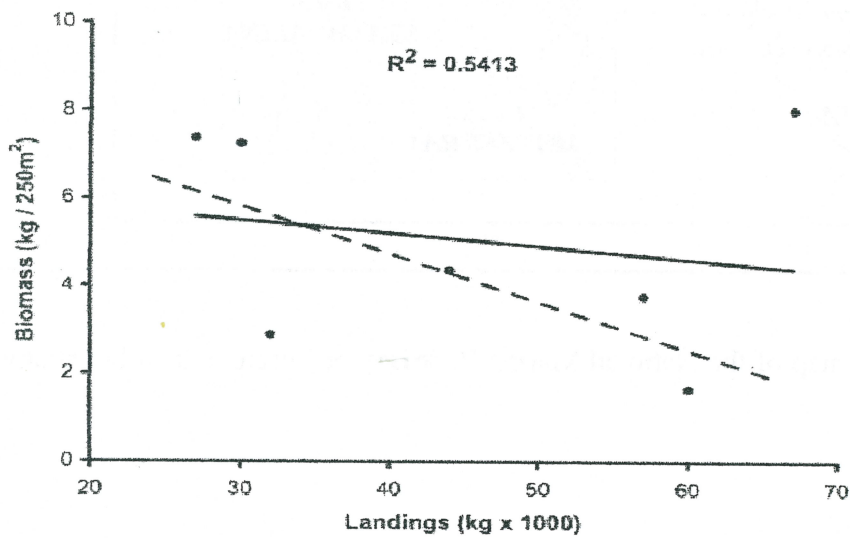


Fig. 5. Relationship between volume of landings and the biomass of *Mycteroperca rosacea* observed inside the marine park.