An Example of a Sustainable and Well-managed Community-based Lobster (*Panulirus argus*) Fishery Within the UNESCO Bioreserve of Sian Ka'an, Mexico

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ABSTRACT

The community based artisanal spiny lobster (*Panulirus argus*) fishery has been in operation within the Ascension Bay region of The UNESCO Sian Ka'an Biosphere Reserve, Yucatan, Mexico, for approximately 50 years. Fishermen are organized in a community-based cooperative, Cooperativa de Pescadores Vigía Chico. The cooperative shows exemplary management techniques, obtaining sustainable and constant landings within the shallow lagoonal patch reef environment, compared with many lobster fisheries within the Caribbean that have experienced a sharp decrease or collapsed in recent years. Sustainability of this fishery has been achieved by establishing a sense of stewardship in all fishermen, dividing the lagoon into individually owned 'fishing-fields'. The use of concrete lobster aggregating devices ('shades' or 'sombras') was developed from techniques used by Cuban fishermen who fished in the area in the 1950s. Fishermen check their individual shades every couple of days with the use of snorkel equipment. These aggregation devices, in combination with the shallow nature of the reef, allow fishermen to be selective and to land full body lobsters, permitting fishermen to comply with national and park regulations on minimum carapace size and no landing of berried females. Seasonal restrictions also apply, allowing for the natural re-stocking of populations. Local fishermen have been developing alternative livelihood strategies, such as eco-tourism, in order to maintain the long-term sustainability of the lobster fishery. Future plans include the introduction of an eco-labelling programme in order to promote sustainable practices and to be able to target specific market niches.

KEY WORDS: *Panulirus argus*, reef fishery, lobster aggregation devices

Un Ejemplo de Pesquería Local de Langosta (*Panulirus argus*) Sostenible y Bien Manejada en la Reserva de la Biosfera UNESCO de Sian Ka'an, México

La pesquería local artesanal de langosta espinosa (Panulirus argus) en la Bahía de la Ascensión, Reserva UNESCO de la Biosfera de Sian Ka'an, Yucatán, México, ha estado en funcionamiento durante aproximadamente 50 años. Los pescadores están organizados en una cooperativa en la comunidad, Cooperativa de Pescadores Vigía Chico. La Cooperativa demuestra tener técnicas de manejo ejemplares, obteniendo capturas constantes y sostenibles en el arrecife lagunal parcheado de la Bahía, contrastando con muchas pesqueras de langostas del Caribe que han experimentado bruscos descensos o colapsos en recientes años. La sostenibilidad de esta pesquería a sido conseguida mediante el establecimiento de un sentimiento de propiedad en todos los pescadores, dividiendo la laguna en 'campos de pesca' individualmente poseídos por pescadores. El uso de mecanismos de agregación de langosta en hormigón ('sombras') fue desarrollado a partir de técnicas utilizadas por pescadores Cubanos que pescaban en el área en los '50. Los pescadores revisan sus sombras cada par de días usando equipo de esnórquel. Estos mecanismos de agregación, junto con la naturaleza poco profunda del arrecife, permiten a los pescadores ser selectivos y pescar langostas enteras, ayudando así al cumplimiento de regulaciones nacionales y del parque en talla mínima del caparazón y en la prohibición de pesca de hembras con bayas. Vedas temporales también están emplazadas para asegurar el abastecimiento natural de las poblaciones. Para asegurar la sostenibilidad a largo plazo de esta industria, la comunidad local ha desarrollado estrategias alternativas de sustento, como por ejemplo ecoturismo. Entre otros, se pretende introducir en el futuro un programa de etiquetado ecológico para promover prácticas sostenibles y poder competir en posiciones concretas del mercado de venta de langosta.

PALABRAS CLAVES: *Panulirus argus*, Cooperativa Pescadores Vigía Chico, Sian Ka'an, pesca en arrecife, pesca sostenible, mecanismos de agregación de langostas

INTRODUCTION

Fisheries are an important resource on coral reefs, particularly in the developing world. Grinding poverty characterizes most fishing villages in Latin America. The fisher's poverty is normally directly caused by the widespread degradation of marine and coastal resources (Roberts 2000), an all too common fate of shared or open access resources. If open-access conditions are allowed, resources will often become depleted with the inevitable fall of economical return (Harding 1968). The importance of putting in place bottom-up approaches when managing community based fisheries has been stressed by Roberts (2000). It is now accepted that if effective resource management is to be achieved, government and community must share authority on decision

making. This concept is now known as community-based fishery management (Hotta 1997). This paper describes in detail how one community-based fishery in southern Mexico has organised itself into a cooperative, and has successfully and sustainably managed its resources for approximately 50 years.

Cooperativa Pescadores Vigía Chico (PVC) is a community run lobster (*Panulirus argus*) fishing cooperative based in the village of Punta Allen within the The Sian Ka'an UNESCO Biosphere Reserve (Figure 1). The reserve is located between 19°05'20-20°06'N and 87°30'-87°58'W, on the east coast of the Yucatan Peninsula, Quintana Roo, and was declared a Biosphere Reserve in 1986 and inscribed as a World Heritage Site in 1987 (Salvat et al. 2002). The reserve covers approximately 6,808 km^2 and is Mexico's third largest protected area. Sian Ka'an is described as the largest effective nature reserve in Mexico and protects one of the most pristine expanses of wetland in Mesoamerica (Salvat et al. 2002).

Sian Ka'an follows the concept of a Biosphere Reserve, in which the goals of preserving the flora, fauna and ecosystems are integrated with the needs of the local inhabitants. Conservation is not conceived of as prohibiting use, but rather as the rational and long-term sustainable use of resources. Approximately 1,000 people live in the reserve, in either small family ranches along the coast or in the reserve's two fishing settlements, Punta Allen and Punta Herrero. At present, the main economic activities are fishing for lobster and finfish within the area of Ascensión Bay, and small-scale agriculture and ranching (CIQRO 1983).

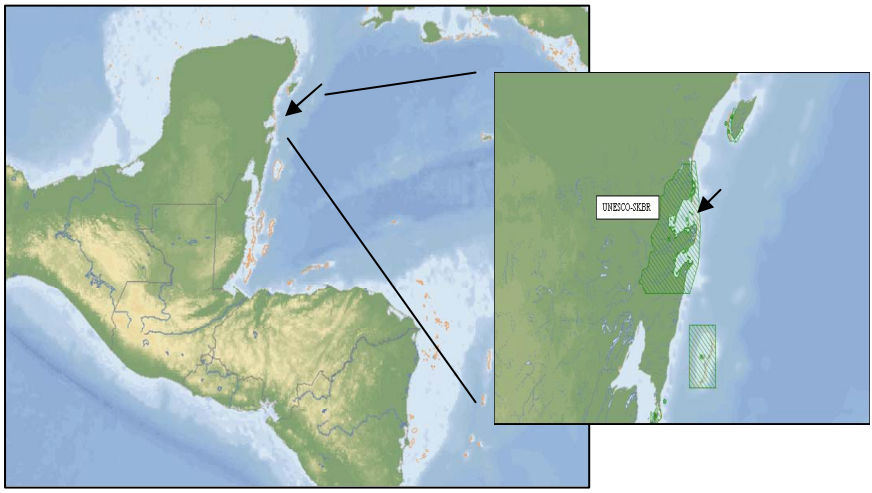

Figure 1. UNESCO Sain Ka'an Biosphere Resurve, Quintana Roo, Mexico

THE HISTORY AND DEVELOPMENT OF THE FISHERY

Ascensión Bay is an open and shallow bay (Walker et al. 2004), of approximately 740 km^2 in area. The Bay supports a Caribbean spiny lobster (*P. argus*) fishery. This species is highly prized by fisheries throughout the Caribbean, and as a result, they are fished intensively wherever they are abundant (Lozano-Alvarez 1996). The *P.argus* fishery of Ascension Bay has attracted international interest due to the fishery's productivity and excellent sustainable management techniques (Sosa-Cordero 1995).

This community-based fishery has been in operation for approximately 50 years. Lobster fishing in this area originated as a result of Cuban fishers travelling to exploit the Bay (A. Pereira Pers. comm.). After realizing the potential, local inhabitants of Punta Allen began exploiting *P. argus* in a similar way. The fishers developed a community-based cooperative (PVC) founded in 1968 (A. Pereira Pers comm.) as a result of approximately 15 local fishers partitioning the bay into 'fields' or 'campos'. The fields were allocated on a first come - first served basis until PVC gained approximately 50 members. The limits of the fields were established by general agreement using underwater topography as natural markers (Sosa-Cordero and Ramírez-Gonzalez 1993). PVC employs aggregating devices ('shades' or 'sombras') to attract lobsters to certain areas within the fields. The use of concrete lobster aggregating devices was developed from techniques used by the pioneering Cuban fishermen in the 1950s. Originally, Florida Thatch Palm or 'chit' palm (*Trinax radiata*) trunks were used to build very simple square shaped aggregating devices or 'sombra de chit' (Figure 2). However, after the Representative Council banned the harvest of the palm due to the decrease on their population and the lack of knowledge on the sustainability of this practice in 1966, the design and materials used to construct the aggregating devices was altered (Bezaury et al. 1998) to the new concrete design. In order to avoid confusion and potential problems, a 25 meter wide band from the edge of the field's limit is not used when deploying lobster aggregating devices. Thus the 50 meter wide strip avoids ownership problems, and each aggregating device is uniquely inscribed, displaying ownership. This division of the bay permits even distribution of the fishing effort, making every member aware of the fishing geographical limits of their fishing activities.

The Bay, a predominantly shallow lagoonal and patch reef environment, is currently divided into 85 fields (Table 1 and Figure 3). Each field is for the exclusive use of its owner, although fishers that do not have their own fields can work for those who do, with benefits divided using the following the formula: Total captures /number of fishers +1, with the owner receiving the extra fishers catch to account for maintenance and other expenses. Poaching outside of a field is considered a serious offence (Actas y Bases 1995). If a boat is found to be fishing in some else's field, the fisher/s are expelled from the PVC and their engine confiscated (A. Pereira, Per. comms). Fishers are allowed to inquire as to the intentions of any boat entering their field (Sosa-Cordero and Ramírez-Gonzalez 1993).

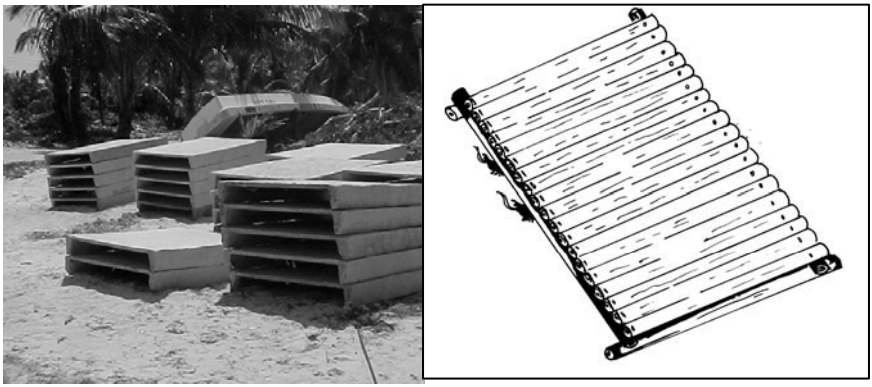

Figure 2. Traditional palm tree aggregating device or 'sombra de chit' (right) and present concrete lobster aggregating devices (right) (from Borges-Arceo 1999)

Table 1. Coop Vigía Chico general statistics adapted from Borges-Arceo, 1999

Number of Fishers/Members	78
Number of fishers owning fields	52
Number of fields	85
Number of boats	35

FISHING TECHNIQUES

The new design and materials used in the construction of aggregating devices was developed by a series of 'trial-and-error' experiments (A. Pereira Pers. comm., Borges-Arceo 2001). The first designs used concrete as the main component, although at present most fishers use a combination of concrete and steel reinforcement (Figure 2). The decision on what material to use will depend on the targeted substratum, whether that might be sandy bottom or harder substratum closer to the reef. A typical aggregating device will be 1.5 x 1.5 m (Sosa-Cordero and Ramírez-Gonzalez 1993). The cost of building these devices is covered by the fishers, with national government help distributed by PVC. To date, PVC have been able to re-pay these 'loans' within the stipulated dates, and thus not incurring in any extra charges that would diminish the member's confidence in the organisation. This change reflects the willingness of PVC to collaborate and agree with the reserve managers — La Comisión Nacional de Áreas Naturales Protegidas.

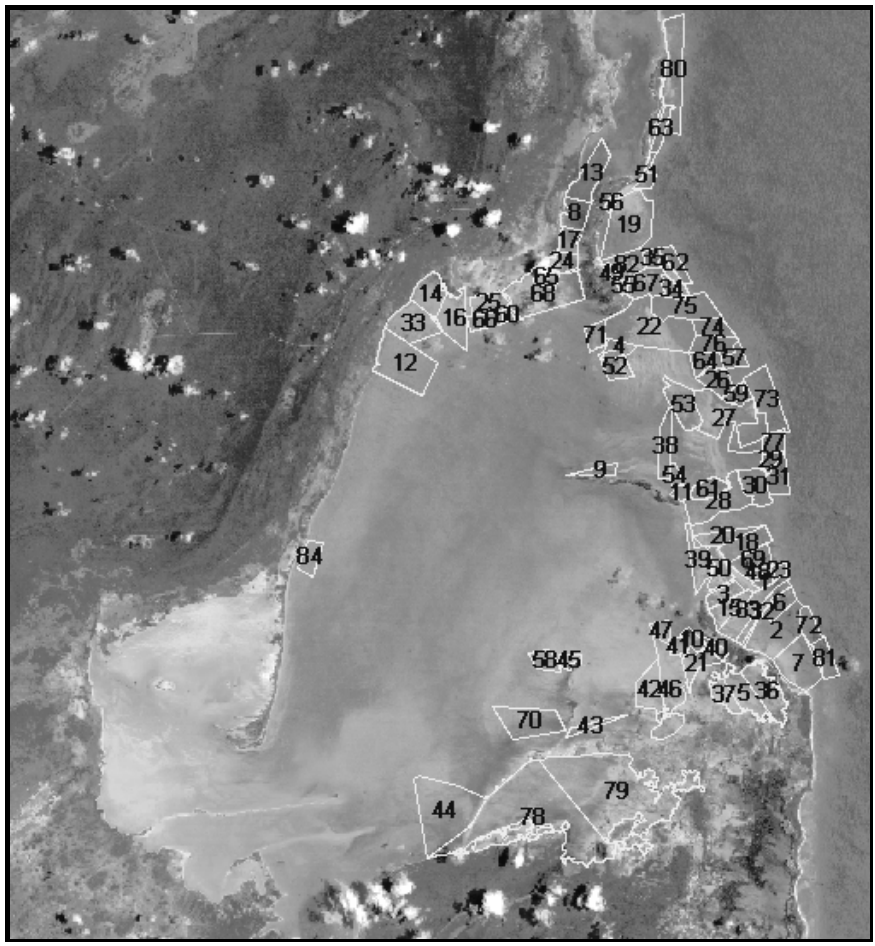

Figure 3. GIS of Ascension Bay with PVC's 85 fishing fields marked.

Fishers check their individual aggregating devices every 7 to 10 days with snorkel gear, although in certain periods, for example the beginning of the season and during high winds, the aggregating devices are checked more regularly. Fishers use a small net to extract lobster from the aggregating devices. This technique was developed after the original 'hook' was proved to be economically and ecologically non-viable. The hook technique used to damage, sometimes lethally, a high number of juvenile lobsters. By using a small net, fishers can be selective, both in size and reproductive stage of the females, thus complying with the reserve regulations. Typically, aggregating devices are deployed within areas of 3 to 7 m depth, although a small fraction are located at depths of 8 to 12 metres. Aggregation devices and the use of nets, in combination with the shallow nature of the reef, allow fishers to be selective and to land live lobsters, permitting fishers to comply with national

and reserve regulations on minimum carapace size and no landing of berried females.

The effectiveness of the aggregating devices has been the subject of many studies (Sosa-Cordero and Ramírez-González 1993, Borges-Arceo 1999, Eggleston et al. 1990). It is obvious that aggregating devices will concentrate lobsters and thus make harvesting more effective. However, this can have a negative effect on the regional lobster population. PVC has identified areas of high productivity within the bay, targeting them by locating aggregating devices. The density of these devices within one field depends entirely on the owner, although experience has shown that even in the most device-populated fields the minimum distance between aggregating devices is 25 m (Sosa-Cordero and Ramírez-Gonzalez 1993). Conversely, to avoid overexploitation, fishers are also targeting areas of less productivity, in order to dissipate the fishing pressure (Sosa-Cordero and Ramírez-Gonzalez 1993).

The use of aggregating devices allows a better organization and scheduling of fishing activity. Checking each individual aggregating devices for lobsters and maintenance work can both be planned depending on weather conditions and past landings, thus maximizing time, fishing efficiency, and costs. Studies have reported this fishing technique is one of the most efficient and lucrative for small-scale fisheries (Sosa-Cordero and Ramírez-Gonzalez 1993).

MANAGEMENT TECHNIQUES

PVC has adopted very strict fishing restrictions following national and reserve regulations, in some cases even stressing restrictions that go beyond those legally required. Decisions such as those show the deep commitment of the PVC members and directors to sustainable development of the industry and to eradicating activities and fishing methods that could harm the local marine ecosystem and stocks. Despite lobster aggregating devices located within the shallow lagoonal patch reefs, only approximately 5% of the annual landings come directly from reef-dwelling lobsters (Borges-Arceo 2001). The strategic location of the aggregating devices allows for reef dwelling individuals to restock regional populations.

Fishing by SCUBA gear is not allowed under PVC rules and reserve regulations. The shallow nature of the bay means that the use of SCUBA has gear never really been considered, with many fishers stating that the use of SCUBA gear would not be cost effective, thus making it much easier to regulate its use (A. Pereira Pers. comm.). Seasonal restrictions apply, allowing for the natural restocking of populations. The fishery is active from the 1st of July to the last day of February. The fishery only harvests individuals with a minimum carapace length (MCL) of 13.5 cm. PVC will not accept any lobster smaller than this, discouraging fishers to harvest them and allowing juvenile lobsters to reach reproductive age. It has been observed that 30 - 40% of the lobsters found within these devices are smaller than the MCL (Sosa-Cordero and Ramírez-Gonzalez 1993), so the non-destructive harvesting techniques ensure there is no bycatch of undersized individuals.

Berried females are not to be landed by fishers and are not accepted by PVC. This measure, not widely followed in the rest of the Caribbean, together with the MCL allows natural re-stocking of lobster populations. Fishers are very aware of the damage caused by poor and non-sustainable practices (A. Pereira Pers. comm.), thus becoming very protective of their resource.

YIELD OF THE FISHERY

Responsible management has ensured local fishers have maintained landings in the region 80,000 - 125,000 kg per annum (Figure 4) between 1989 and 2003. Landings have increased every year with only the most ruthless hurricanes effecting catch levels (Gonzalez-Cano Publication date unknown) Presently, the fishery provides enough financial resource for the local population to overcome the closed season (A. Pereira Pers. comm.).

DISCUSSION

In 2000, almost 36,000 metric tonnes of lobster species were exported from the Caribbean and west central Pacific (FAO 2002) indicating the valuable resource potential of the species. A biodiversity survey of Ascensión Bay goes some way to demonstrating the sustainability of the fishery. Twelve sites within the bay were surveyed with results showing that abundance of *P. argus* were higher than the regional mean for the wider Caribbean (Hodgon and Lebeler 2002) across eight of the 12 sites (Walker et al 2004). Hodgon and Lebeler (2002) state that 49% of surveyed reefs in the Caribbean are completely devoid of records for *P. argus*. Indeed, the study collected data that allowed the comparison of key species assemblages within the bay with other comparable sites within the same biogeographic region. Analysis of these data has shown that the status of the ecosystem within the Acensión Bay can be considered to be superior to many other comparable sites in terms of species richness and diversity (Hodgson and Liebler 2002). This suggests the fishery is having a minimal impact on the local environment.

The well managed structure and sustainable ideals that drive the PVC are well documented (Borges-Arceo 1999, Borges-Arceo 2001, Álvarez 2003). However, the effectiveness of this fishery has not been as well researched, although there is a belief amongst the fishers that there fishery is far more effective than similar fisheries exploiting the same species elsewhere in the region. It is clear that if it were to be concluded that the PVC is of higher effectiveness that other similar fisheries, the well managed structure and conservation vision would have played major roles. Small-scale community based fisheries management has become very critical during the past decade, and poses an extraordinary challenge both for local communities and governments. Small-scale fisheries are highly difficult to manage, and if open-access conditions are allowed, resources will become depleted with the inevitable fall of economical return (Harding 1996). The focus has moved to the opposite end of the spectrum; instead of the dated approach of ‘protecting ecosystems from people’, many successes have been achieved through ‘protecting ecosystems by people and for people.’

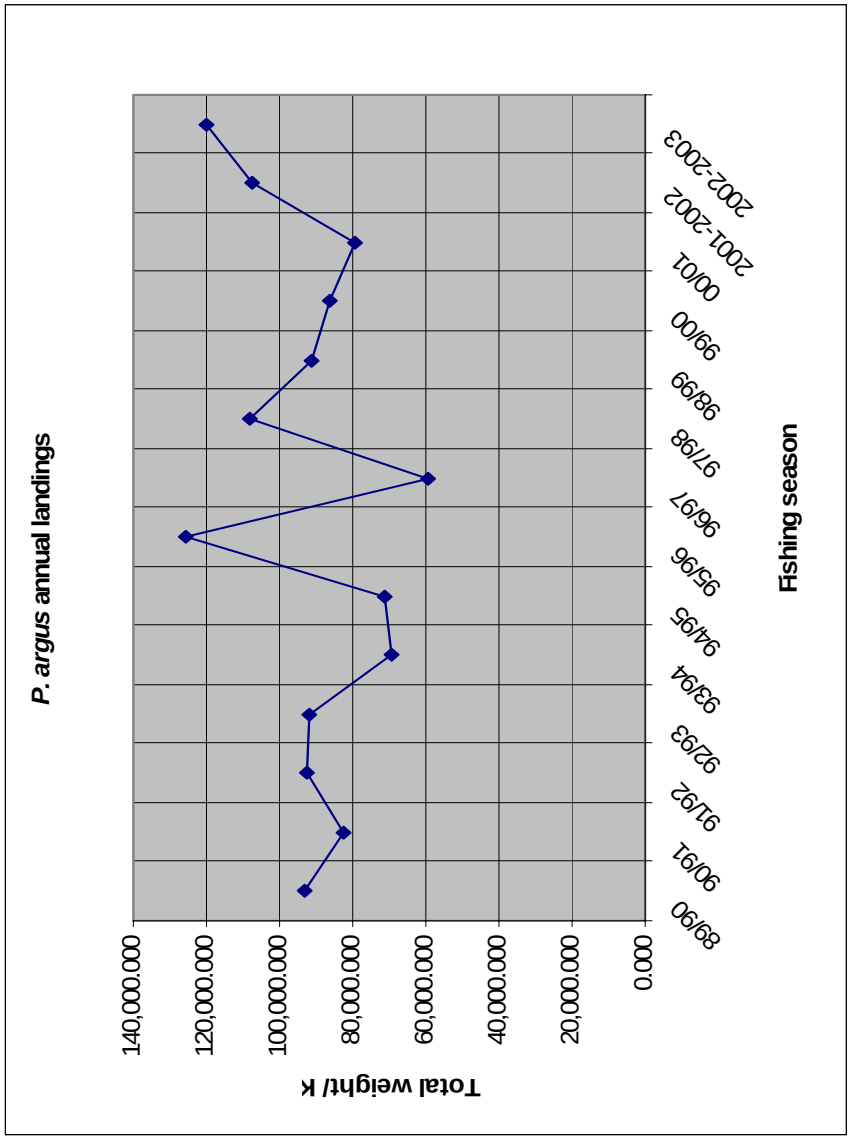

Figure 4. Annual landings of spiny lobster, *Panulirus argus*, from the Cooperativa Pescadores Vigía Chico. (adapted from Borges-Arceo 1999).

The custodial empowerment of the very stakeholders who were once seen as being the problem has lead to an increasing number of self-regulating community-based programmes being implemented. Projects such as the Apo Island Marine Sanctuary in Negros Oriental, Philippines (Russ and Alcada 1996), have proven that communities that are active stakeholders and decision-makers in the management of their own resources can succeed in finding ways to sustainably exploit those resources for their own benefit. This kind of stewardship system creates 'ownership' of the resource, tackling the 'tragedy of the commons' at the heart of the issue (Hardin 1968).

What makes the community-managed lobster fishery of PVC of particular interest is that it was the community itself which instigated such a 'stewardship' approach to their fishery, without the external influence of conservation ecologists. What is of further note is that the cooperative was set up half a century ago, when ecology was a fledgling science and had yet to learn the lessons that would ultimately lead it to endorse the self-imposed strategy of these fishers. The cooperative shows exemplary management techniques, obtaining sustainable and constant landings, compared with many lobster fisheries within the Caribbean that have experienced a sharp decrease or collapsed in recent years (FAO 2002). The members of PVC have recently had the foresight to try and establish alternitive livelihoods within the bay in the form of catch and release flyfishing and snorkel tours. This is to releave their sole dependency on the fishery as a sourse of income. Sustainability of this fishery has been achieved by establishing a sense of stewardship in all fishers, dividing the lagoon into individually managed 'fishing-fields' for which each steward is individually responsible. Plans are being implimented for the introduction of an eco-labelling program in order to promote sustainable practices and to be able to target specific market niches. Furthermore, the development of a 'cooperative' approach to the exploitation of the resource encourages 'good practice' amongst the fishers of the community, and stigmatizes misuse of the resource as being socially unacceptable.

The lesson to be learned from the interpretation of the data presented herein is that even vulnerable and exploited marine ecosystems can be sustainably managed by the communities who exploit them if the community is empowered to make the decisions which will affect their continued livelihood. It is, of course, a prerequisite that the community must be educated enough to make appropriate decisions in this regard, whether this 'education' is academic or learned through experience. It is hoped that other communities may be able to learn from the experience of the fishers Ascenión Bay.

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