

Management of the Spiny Lobster Fishery in CARICOM Countries: Status and Recommendations for Conservation

Gestión de la Pesquería de Langosta Espinosa en los Países de CARICOM: Estado Actual y Recomendaciones para la Conservación

La Gestion de la Pêche de Langouste Epineuse dans les Pays de CARICOM: Statut Actuels et Recommendations pour la Conservation

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ABSTRACT

The Caribbean Spiny lobster fishery is in decline, indicating that it is fully or overexploited in most or all of its range. Declining stocks coupled with high demand for the luxury seafood item have added to the pressure on the resource as well as on those 250,000 individuals who rely on the fishery for their livelihood. This paper compiles data and research undertaken in CARICOM States regarding the current state of the lobster fishery. The findings reveal that the open-access nature of the fishery; lack of monitoring, control, and enforcement of existing regulations; widespread illegal, unregulated and unreported (IUU) fishing; inadequate policy framework, for long-term sustainable use; lack of harmonization of conservation and management regulations among the countries involved; insufficient financial resources and human capacity are all obstacles that need to be overcome. Four recommendations are made to improve conservation and management of the species throughout its range: improved data collection and regional standardization of data types; harmonized regulations at the sub-regional level; review and reform of governance systems at local, national and sub-regional levels; and control of IUU lobster fishery.

KEY WORDS: Spiny lobster, management, CARICOM, Caribbean, conservation

INTRODUCTION

The Caribbean spiny lobster (*Panulirus argus*) is a highly prized luxury seafood item that sustains one of the most economically important fisheries in the Caribbean region, generating over U.S. \$456 million to fishers per year (Ehrhardt et al. Unpublished ms., Ehrhardt 2005). It is estimated that approximately 50,000 lobster fishers are active in the Caribbean region, with an additional 200,000 people working in positions related to the lobster fishery (FAO 2003). The fishery therefore represents a significant source of food, employment and foreign exchange earnings for a number of countries in the region (Luckhurst and Auil-Marshalleck 1995).

The stocks of Caribbean spiny lobster cross many national boundaries and this imposes specific difficulties and requirements for their effective management, including the need for regionally coordinated measures. Although there are numerous barriers associated with regionally coordinated management of the spiny lobster fishery, in an important step towards improving the governance of this species, CARICOM States are endeavouring to prepare a regional agreement setting key principles and standards for sustainable use and conservation to safeguard the long term economic viability and profitability of the fisheries.

This paper summarizes the findings and recommendations of a larger CRFM report: *Baseline Review on the Status of the Spiny Lobster Fisheries in the CARICOM Region*, which addresses the urgent need to consolidate and review available information on the status, domestic use, international trade, and management of *Panulirus argus* fisheries in order to better understand the current state of the fishery and thus, to inform the regional policy-making process.

METHODS AND FINDINGS

Regional data as well as country-specific information on domestic use, international trade, conservation, management and research on *P. Argus* in the Caribbean was collected in 2010. Data was compiled in the Caribbean Regional Fisheries Mechanism's *Baseline Review on the Status and Management of the Caribbean Spiny Lobster Fisheries in the CARICOM Region*. Analysis and recommendations of this document are presented in the following sections.

BACKGROUND

The Caribbean Spiny Lobster is a long-lived species, with reasonable stock abundances existing for up to age 12 (Ehrhardt 2005). It serves as a keystone predator influencing species composition and size-frequency distributions of invertebrates such as sea urchins, mussels, isopods, ostracods and gastropods (Lipcius and Cobb 1994 in Munoz-Nunez, 2009). There are five major phases within the life cycle of the Caribbean spiny lobster: adult, egg, larval, post-larval and juvenile. The species is migratory, inhabiting shallow seagrass nurseries and nearshore environments during transformation from the puerulus to the juvenile, while gradually moving to a deep reef and coral systems with natural hiding places as they matured. Migration occurs for spawning and in response to cold front; during these migrations, lobsters are particularly vulnerable to fishing activity.

Spiny lobster reproduction appears to be consistently higher in the spring and summer months (March – July) although this activity is observed year-round (Arce and de Leon 2001). Distribution is determined during the lengthy planktonic phase (several months), during which time the pelagic larvae are carried by oceanic currents from spawning areas to settlement habitats, which may not be in their national waters of origin.

Thus, *Panulirus argus* is widely distributed in the western central Atlantic, occurring from North Carolina south to Brazil, including Bermuda, and from the Antilles islands in the east to the Gulf of Mexico, with the greatest stock abundances observed in the Western Caribbean and Brazil (Ehrhardt et al. Unpublished ms.) (Figure 1).

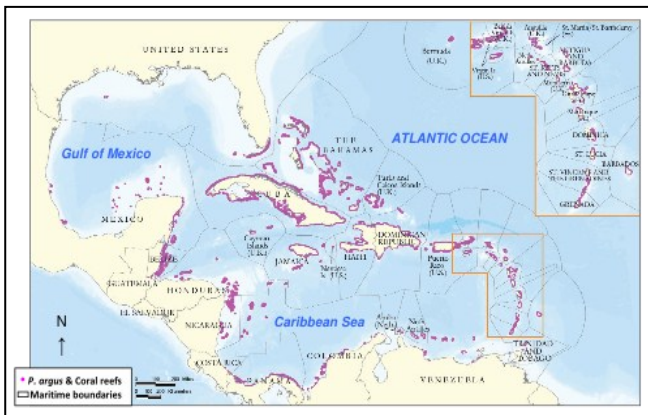


Figure 1. Distribution of *P. argus* in the Caribbean Region (Munoz-Nunez, 2009).

The main spiny lobster resources in the Central Western Atlantic Ocean are located on the larger continental shelf-reef areas of that region; the shelves of Brazil, Honduras-Nicaragua, Belize-Mexico, Florida, Bahamas, and south of Cuba (Ehrhardt 2001). Smaller fisheries also occur in most of the island nations in the Caribbean; and while they are smaller, they are still economically significant.

The connectivity of *P. argus* stocks, by the drift of their pelagic larvae, creates a strong ecological link among countries in the region and emphasizes the need for close cooperation in the conservation, management, and sustainable use of the resource (Claro et al. 2001).

Regional landings have shown a decreasing trend since 1995, indicating that most local fisheries are either fully or over exploited (Cochrane and Chakalall 2001). Declining adult stocks have forced small scale fishermen to increasingly target lobsters during their juvenile stages to avoid moving to new grounds farther offshore or diving deeper; meanwhile, on the industrial scale, declines have led fishers to target spawning adults in deeper waters, where they often catch many berried females and larger, more fecund, animals (Martinez et al. 2007). Ehrhardt (2005) argues that not only have most fisheries driven down local stocks through heavy exploitation, but also pushed them to dangerously low population fecundities.

Production and Domestic Use

In the Wider Caribbean Region, the fishery for *P. argus* has evolved from circumstantial operations in the early 1960s to an industrial, heavily capitalized fishery by the mid-1990s (Ehrhardt et al. Unpublished ms.). This increased fishing effort is reflected in the total landings for the region that steadily increased from about 2,000 metric tons (mt) whole weight in the mid-1950s to about 29,000 mt whole weight in the early 1980s. After reaching an average of 36,055 mt from the mid-1980s until 1995, regional landings decreased 55% in the 2000s (Figure 2), likely a result of intensive exploitation and environmental changes in spiny lobster habitat (Ehrhardt et al. Unpublished ms.).

Fishing methods/gear types are quite varied amongst CARICOM nations, and even within the same country (Chavez 2001). They include: SCUBA, hookah, drop nets, trammel nets, spears, hooks, nooses, Z-traps, bamboo traps, wooden lath traps, shades, casitas, Caribbean traps and collection by hand. No single country uses all gear types (Gittens and Haughton Unpublished ms.).

International Trade

Among the CARICOM countries, the Bahamas has the greatest export earnings from its spiny lobster fishery, earning up to US \$87 million (Gittens and Haughton, Unpublished ms.). The percentage of landings exported varies greatly between countries; for example, the Bahamas and Barbuda export over 90% of lobster landings, while in Dominica most of the catch is consumed within the local market. Much of the lobster that is not exported is used in hotels and restaurants to support the tourism industry.

The major market for Caribbean *P. Argus* is the United States but also the European Union, Asia, and Canada. During the last 10 years, over 88,000 tons of the species has been imported within the U.S., worth a value of

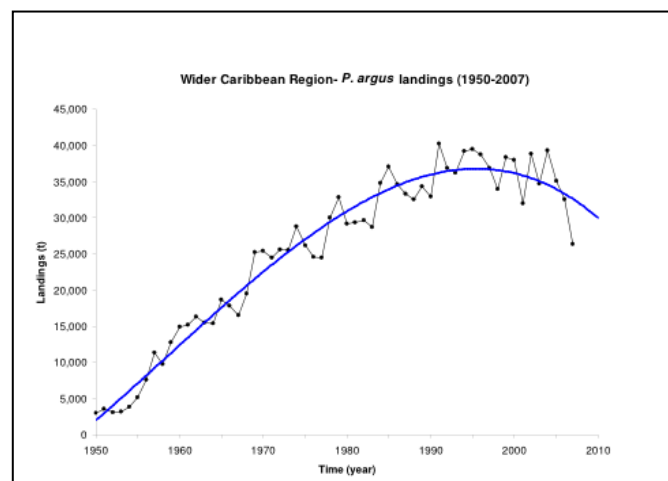


Figure 2. Total annual landings of *P. argus* for the entire Caribbean region including Brazil (Munoz-Nunez 2009).

Table 1. Top 15 countries harvesting *P. argus*, as measured by average annual landings from 2000–2007 inclusive, and the percentage of the total average landings (34,578 t) by all countries over the same period of time (adapted from Munoz-Nunez 2009).

Lobster Harvesting Country	Average Landings (t) 2000 - 2007	% of Total
Bahamas	8,211.0	23.7
Brazil	6,944.3	20.1
Cuba	6,263.1	18.1
Nicaragua	4,192.3	12.1
U.S.A	1,954.4	5.7
Dominican Republic	1,209.5	3.5
Honduras	888.9	2.6
Mexico	833.4	2.4
Haiti	771.3	2.2
Venezuela	696.4	2.0
Belize	520.0	1.5
Jamaica	394.1	1.1
Colombia	325.4	0.9
Turks and Caicos Islands	314.0	0.9
Puerto Rico	167.8	0.5

approximately \$2.27 billion (Figure 3) (CFMC et al. 2008). Approximately 20 U.S. importers receive 90% of the exports from Central and South American countries.

The commercial value of a Caribbean spiny lobster is found virtually entirely in its tail; as such, most international trade of the species has been in frozen lobster tails. However, whole cooked frozen lobsters, live lobsters, and meat are traded as well (CFMC et al. 2008). All exporting processing plants follow Hazard Analysis and Critical Control Point (HACCP) protocols.

The lobster chain, from harvest to distribution, is wide ranging throughout the Caribbean (Monnereau 2007). Apart from retailers and restaurants, the principal chain actors are the importers, processors/exporters located in the Caribbean, various types of intermediaries and fishers (Monnereau and Helmsing 2010). Lobsters (whole or tails) are sold to intermediaries or directly to processing plants by fishers and the plants then process, weigh, pack, and export frozen lobster to its final market (Monnereau and Helmsing 2010).

The number of processors differs per country involved, depending on the volume and organization of the industry. For instance, in Belize there are two certified processors who export lobster, and fishers either sell directly to these processors (which are fishing cooperatives) or to collection points for these co-ops. In Jamaica there are officially only two processing plants; however, the fisheries department believes that as many as 20 smaller processors lacking official permits are in operation in the country (Monnereau and Helmsing 2010.).

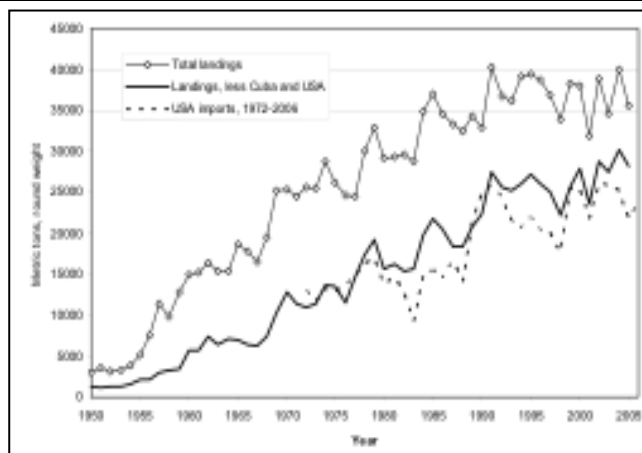


Figure 3. Global landings of Caribbean spiny lobster and U.S. imports of frozen spiny lobster (FAO Fishstats).

The 2008 economic crisis severely affected the lobster fishery in the Caribbean Basin: demand dropped as consumers opted for cheaper marine products or reduced their consumption of seafood. According to Urner Barry's Seafood Price-Current prices dropped from US\$21–22 per pound in 2007 to \$13.50 in December 2008, while the same happened with US lobster prices, which fell to an all-time low of \$3.50 per pound, down 21 per cent from 2007 (Monnereau and Helmsing 2010).

The potential for overfishing *P. argus* is relatively high because a lucrative market exists for all sizes of this species (CFMC et al. 2008). Ehrhardt et al. (Unpublished ms.) report that illegal size lobsters are often transshipped to international markets, usually via third party countries. Additionally, they indicate that sophisticated markets have developed to dispose of the very large quantities of illegal size lobsters landed throughout the region (e.g. Chinese restaurants). A positive step forward is newly enacted legislation in the United States (as of 2009) that bans all imports of spiny lobsters that do not meet U.S. minimum size or weight regulations.

Conservation and Management

There are no standardized management measures specific to the *P. argus* fishery at a regional level within the Caribbean community; rather, management of the resource is unilaterally attempted in most countries. Regulations on minimum size, spawning season closures and no-take of berried females are among the most popular management strategies implemented in Caribbean spiny lobster fisheries (Ehrhardt 2005). However, the minimum size adopted in these fisheries varies from one country to another (mostly due to market-driven factors), which in many cases, does not correspond with the minimum size required for 50% maturity and can lead to growth overfishing (Cochrane & Chakalall 2001, IOCARIBE 2007).

Some nations have implemented country-specific conservation or management measures that go beyond seasonal closures or minimum size limits. For instance,

Antigua and Barbuda have amended fishing regulations in 2010, so that the lobster fishery will move from an open access to a limited entry management regime through the use of special permits. The removal of the tar spot or spermatophore from the lobster will become an offence under the regulations. In addition, a closed season shall commence from the 1st day of May to the 30th day of June of every year. These measures are to improve management of total fishing effort and offer some protection during the peak spawning period, thereby contributing to long term sustainability. The Fisheries Division will issue lobster gauges to fishers so that they can readily determine undersize lobster (Fisheries Division 2010).

Antigua and Barbuda has also recently established two reserves: the Codrington Lagoon National Park (CLNP) and Northeast Marine Management Area (NEMMA). CLNP is a primary nursery site for lobsters and fish species (Environment Division of Antigua and Barbuda, 2009). NEMMA was established in 2005 and is located on the North-east coast of Antigua; it protects mangroves, coral reefs, seagrass beds, as well as some terrestrial ecosystems (Jackson 2007).

In Jamaica, regulations specific to the Caribbean spiny lobster fishery according to the Fishing Industry Act include minimum size limits and a defined closed season, but also limit the access system for industrial fisheries by controlling the number of vessels. Also, Jamaica declares the end of lobster season via inspections of fish processing plants, hotels, beaches and restaurants.

Lobster management in the Caribbean has been widely recognized by institutions such as the Gulf & Caribbean Fisheries Institute (GCFI), FAO/WECAFC, Caribbean Regional Fisheries Mechanism (CRFM) and the Caribbean Fishery Management Council (CFMC). FAO/WECAFC has organized five workshops, held from 1997 - 2006, on spiny lobster, in cooperation with most regional agencies and institutions. Over the course of these workshops, countries have agreed to:

- i) Minimum harvest size of 74 mm cephalothorax length (though nations with size limits greater than 76mm were encouraged to retain the larger limits),
- ii) Manage fishing mortality so as to achieve sustainable use of the resource, and
- iii) Taking more action to implement and enforce existing regulations, especially in regards to the high catches of juvenile lobsters.

In 2009, under the auspices of OSPESCA (Central American Fisheries and Aquaculture Organization), Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, and Panama signed a lobster agreement that established new lobster management regulations, including minimum tail weights, a harmonized closed-season from March 1-June 30, escape gaps on lobster traps, trap limits, and prohibition of sale of lobster tail meat without the shell,

amongst other management measures (OSPESCA 2005).

Ministers of CARICOM member states have requested that CARICOM countries adopt a similar agreement to harmonize and strengthen regulations. The Caribbean Regional Fisheries Mechanism endeavors to help push such an agreement forward in the next year.

Research and Data Collection

Management of lobster fisheries in the CARICOM region faces serious problems because of limited knowledge of the fishery, biology and ecology of the species (CFRAMP 1997). The majority of countries in the region are unable to organize and carry out regional programs for lobster research and management.

However, assessments undertaken under the auspices of the Western Central Atlantic Fisheries Commission (WECAFC) have revealed widespread deficiencies in available data, which create problems in undertaking reliable assessments and in subsequent provision of management advice (Cochrane and Chakalall 2001).

Data that can play a significant role in successful sustainable management of lobster fisheries can be generally categorized as socio-economic, statistical (i.e. catch & effort) and biological (Gittens and Haughton Unpublished ms.). Catch and effort constitute the minimum requirements for a simple assessment of a fishery (FAO 1980). Data that is inconsistent or missing remains a problem in the region, which could be related to data control and management, as well as to research and monitoring capacity (CRFM 2009). Data management needs to be standardized across the region to ensure consistency and accuracy (CRFM Secretariat 2009).

While some forms of data were collected at some point by most of the governments in the CARICOM region, a number of problems were noted, including: lack of manpower, lack of training, shortage of equipment, uncooperative fishers, lack of transportation and distance of sites; however, no country cited all of the problems mentioned (Gittens and Haughton Unpublished ms). The overriding constraints were identified as shortage of staff and/or funding.

DISCUSSION

Management Issues

Scientists and fisheries managers all concur *P. argus* is fully or overexploited throughout its entire range (WECAFC 2006). While a few Caribbean countries have made significant strides in improving the assessment and management of their lobster fisheries, numerous authors such as Chakalall and Cochrane (2007), Martinez and others (2007), and Ehrhardt and others (Unpublished ms.) argue that a substantial number of management problems need to be urgently addressed across the region.

The trans-boundary nature of the resource, mobile fishing fleets and international aspects of the lobster trade

closely link spiny lobster fisheries throughout the Caribbean; all of these require that utilization and management of lobster fisheries be undertaken in a cooperative and coordinated manner at the regional level (Chakalall and Cochrane 2007). Because sustainable fisheries are largely dependent on good governance, the importance of improving management measures in the CARICOM region cannot be overstated. Currently, control of fishing capacities and landings are rare, and a region-wide lack of enforcement and illegal fishing prevent effective management of the resource (Ehrhardt et al. Unpublished ms.).

The open access nature of the fishery (primarily a concern in the artisanal sector) continues to be a region-wide problem, allowing fishing effort to grow at an uncontrollable and unsustainable pace in a number of countries (with the possible exceptions of Cuba and Florida) (Chakalall and Cochrane 2007). In Cuba, centrally planned fishing operations are based on a projected and sustainable strategic biological catch and effort quota used to control fishing capacity; and, Florida has a number of well-enforced size and effort regulations in place, including a limit on the number of traps in the fishery over the past decade (Ehrhardt, Puga, and Butler Unpublished ms.). Despite attempts to reduce fishing effort, neither Cuba nor Florida has reversed the continued decline in landings.

Additionally, lobsters are being harvested below respective minimum size limits and below the size at first maturity, adversely impacting recruitment throughout the species' range (CFMC et al. 2008). Undoubtedly, the widespread violation of minimum size is one of the most serious factors undermining the sustainable management of *P. argus* in the Caribbean (Ehrhardt et al. Unpublished ms.). A high proportion of sub-adults in total catch can only be sustained at low fishing mortality rates; therefore, when determining maximum allowable fishing effort, countries need to take into account the catch of juveniles. A related issue is the preservation or building of lobster spawning stocks via the protection of large individuals. The exponential relationship between female lobster size and egg production is well established for *P. argus* (Ehrhardt, Puga, and Butler, Unpublished ms.). In addition, there is evidence for *P. argus* that male size may also affect reproductive success via sperm limitation (Ehrhardt et al. Unpublished ms.). Thus, there is good reason for some degree of protection for large lobsters, of both sexes, which together contribute far greater to egg production than smaller individuals (Bertelson and Mathews 2001). Concerns have also been raised about the increasing use of artificial habitats (condominium and casitas) in some countries, which leads to a higher proportion of juvenile lobsters being caught (Chakalall and Cochrane 2007).

According to Ehrhardt (2005), minimum size violations are rampant and most likely impacting the reproductive capacity of the local populations. For example, in the Honduran fishery, about 60% of the landings (by weight) are undersized spiny lobsters while in Nicaragua the figure is about 30%.

Chakalall and Cochrane (2007) identified artisanalisation of the fishery as a regional management concern. They argued that it tends to lead to more vessels and more dispersed fishing and landing sites, making the fishery harder to regulate. Catch and effort statistics are generally difficult to collect in meaningful time and space scales in artisanal fisheries; this precludes more accurate analysis of the regional characteristic of the fisheries as well as the effectiveness of fishery management (Ehrhardt 2001). Artisanalisation and lack of alternative livelihoods can also lead to a reduction in the opportunity costs of fishing which, in unregulated fisheries, depresses the bio-economic equilibrium thereby increasing the likelihood of further reductions in the current status of the stocks (Chakalall and Cochrane 2007).

IUU fishing is a major problem in the region, particularly in the southern parts, and is often linked to illegal and unreported intraregional trade (Chakalall and Cochrane 2007). Chakalall and Cochrane (2007) stress that governments need to be aware of the fact that illegal fishing increases the total fishing mortality and argue that legal fishing mortality may need to be reduced to compensate for this in order to avoid over-exploitation.

Another significant issue the fishery faces is the practice of leaving traps in the water, where they continued to "ghost" fish during the closed season (Chakalall and Cochrane 2007). Ehrhardt and others (Unpublished ms.) argue that this cryptic mortality by ghost gear may be very large and its effect on stock productivity and reproductive potential could be substantial.

Generally, in most countries, fishers and the fishing industry try to obtain the maximum landings every season and enforcement of fishery management regulations range from limited to non-existent in most countries, with the notable exception of Florida and Cuba. This inadequate level of enforcement is largely responsible for the egregious violation of the minimum sizes and, at present, is beyond the control of regional and national management agencies (Ehrhardt, Puga, and Butler Unpublished ms.). Additionally, weak compliance across the region remains generally high (Chakalall and Cochrane 2008). No attempts to manage these valuable fisheries will succeed in the absence of adequate compliance and enforcement (Ehrhardt et al. Unpublished ms.).

Without a doubt, habitat degradation due to coastal zone development, increased levels of pollution, climate change and variability including more frequent and extreme weather events, and changes in salinity, are increasingly threatening the species' survival and add to the pressure fishing effort imposes on the species.

Finally, and very significantly, weak research and management capacity is prevalent in a number of countries throughout the region, as are deficiencies in the quality and nature of data to advise on lobster management (Chakalall and Cochrane 2007).

Management Options

CARICOM countries have begun to impose species-specific regulations and management measures for the spiny lobster fishery, and many range States have now implemented some form of management for the fishery. However, the effectiveness of these measures is largely dependent on adequate knowledge of the stock status (size, distribution, abundance, etc.), other biological and morphometric criteria (location of nurseries and spawning sites, time of the spawning period, growth and maturity, etc.), and country-specific characteristics of the fishery (CITES 2003).

Minimum size limits are typically used to protect a population's breeding stock, and are defined at a size that will allow individuals in a population the opportunity to breed at least once before being subject to harvest (CFMC et al. 2008). Because management measures throughout the Caribbean region are not uniform, and enforcement is severely lacking, the U.S. has adopted minimum conservation standards on imports. Not only should limiting imports to a minimum size protect juvenile lobsters and help stabilize the species' reproductive potential, it should also limit the market for undersized lobster and serve as an incentive for countries that do not have size limit measures (CFMC et al. 2008). The newly enacted legislation stipulates that any spiny lobsters imported into the U.S. must meet the minimum weight requirement of 5 ounces and/or the minimum size requirements of 76.2 mm cephalothorax length or 139.7 mm tail length (Kimmel and Rueter 2007).

Gear restrictions, such as banning the use of SCUBA, can be important and effective management tool for reproductive stocks as it helps to preserve deep-water populations and important spawning stock refugia (Appeldoorn 1997). However, banning SCUBA in deep-water may increase pressure on shallow-water stocks and potentially lead to increased exploitation of juveniles in shallower waters (Appeldoorn 1997).

Seasonal closures to protect the stock during the most reproductively active months are in place in many CARICOM states. The Bahamas, Belize, Grenada, Haiti, Jamaica, Saint Lucia, St. Vincent and the Grenadines, and Turk and Caicos all enforce seasonal closures. However, as mentioned previously, these closures are not always harmonized at regional or sub-regional levels, which may undermine their enforcement, because spiny lobster taken illegally in one country during a closed season could be landed legally in a neighbouring country. Perhaps seasonal harvest closures could be supplemented with a seasonal ban on processing, trade and exports of spiny lobster during the closed season, as is done for the Queen conch fishery in some Caribbean states, such as the Dominican Republic and Jamaica (CITES 2003).

Closed areas in the form of "no take zones" or Marine Protected Areas (MPAs) have the potential to be a valuable ecosystem based management tool to protect spiny lobster populations. For instance, MPAs can help maintain

spawning stock size at high densities, provide refuge to older specimens (which are known to be more fecund than younger adults) and can be an important source of larvae and new recruits to exploited areas ("spillover effect") (CITES 2003). The creation of no-take marine protected areas in areas where lobsters spawn have resulted in demonstrable increases in lobster size and abundance within the MPA (Lipcius, Stockhausen, and Eggleston 2001, Ehrhardt et al. Unpublished ms.).

Trade controls are another possible management measure, such as listing *Panulirus argus* on the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES). CITES is an international treaty designed to ensure that international trade in listed species is legal and not detrimental to the survival of the species. Brazil proposed listing *P. argus* and *P. laeviscauda* (Brazil populations only) in Appendix II of CITES at the 14th meeting of the Conference of the Parties to CITES in June 2007. This listing would identify *P. argus* as a species currently not threatened with extinction, but one that may become so without trade controls. Although the proposal was withdrawn prior to consideration, CITES is a tool that may be useful for ensuring that international trade in spiny lobster is legal and sustainable (Daves and Noguchi 2007); for example, the CITES Appendix II listing of queen conch (*Strombus gigas*) has proven to be a valuable complement to national management schemes for this species (Daves and Noguchi 2007).

Given the management issues related to the spiny lobster fishery, the region and the industry will also benefit from focused and continual research on topics such as: size of first maturity, closed seasons and peak reproduction, and impacts of illegal fishing on lobster stocks.

RECOMMENDATIONS AND CONCLUSION

Upon review of available information, it is clear that scientists and fishery managers alike all concur the Caribbean spiny lobster is fully or overexploited throughout its entire range. Currently, CARICOM countries seem to lack the political will necessary to safeguard the future of the resource. Given the socio-economic importance of *P. argus* fisheries as a source of livelihood and foreign exchange earnings across the Caribbean region, the need for bold and immediate management action cannot be overstated.

At the regional level, there are many critical steps that need to be taken towards ensuring the long-term sustainability of spiny lobster fisheries in the CARICOM region.

The collection of statistical, biological, and socio-economic data needs to be strengthened across the region, as it is the foundation of a successful management system. At minimum, catch and effort data should be gathered towards the undertaking of stock assessments. Additionally, it is important that CRFM work with member countries to ensure data collection is standardized (i.e. units, indicators etc.), so that comparisons can be made across

countries and over time.

A region wide lack of harmonization of management measures may undermine enforcement, particularly with respect to minimum size regulations and closed seasons. Similar to the initiative undertaken by OSPESCA, where possible, the closed seasons and minimum size restrictions should be harmonized in the CARICOM region.

Currently, the management structure across the region is largely centralized, top-down and vertical, reducing the effectiveness of, and compliance with, fishing regulations. In order to improve the functioning of multi-level governance cycles through more effective vertical and lateral linkages, it is recommended that policy-making processes that are more collaborative and participatory, incorporating stakeholder opinions into the establishment of management measures should be established.

High market demand for undersize lobster, prompting rampant violation of minimum size regulations, is one of the most serious issues undermining the sustainable management of lobster stocks in the Caribbean (Ehrhardt et al. Unpublished ms.). Accordingly, stronger enforcement regimes as well as capacity building are needed, along with the creation of a strong disincentive program.

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