

## Support and Promotion of the Marine Environment of the Bahamas



## Introduction

The Bahamas Reef Environment Education Foundation (BREEF) is a Bahamian NGO set up to support and promote conservation of the marine environment through education, research and management.

BREEF and the Department of Fisheries are well aware that the fishing industry of the Bahamas has been changing and developing rapidly over the last decade, partially in response to successful fisheries development policies implemented by the Department. Both BREEF and the Department of Fisheries were keen to have an objective overview of the present status of the most important fisheries and stocks. Such a review could help support the Department in taking management decisions and the Government in deciding on resource allocation to fisheries management.

BREEF therefore decided to employ MacAlister Elliott & Partners Ltd. to undertake a study, looking at the key fisheries : grouper and other reef fish, queen conch (*Strombus gigas*) and particularly Caribbean spiny lobster (*Panulirus argus*), known in the Bahamas as "crawfish", which makes up more than 95% of the value of fisheries exports and about 70% of the value of landings in the Bahamas.

Some facts and figure about the crawfish fishery in the Bahamas are presented here.

If you would like to know more about BREEF, or help out with its work, please contact:  
Sir Nicholas Nuttall (Chairman), PO Box N-7776, Nassau, Bahamas (email : [breef@bahamas.net.bs](mailto:breef@bahamas.net.bs)).

### 1. Economic importance of fisheries

The traditional mainstays of the Bahamian economy are tourism and offshore banking, with the tourism industry directly and indirectly employing about 40% of the work force and generating an estimated 50% of Gross Domestic Product (GDP).

The fisheries sector is important to the Bahamian economy in terms of its contribution to GDP. According to GoB figures the sector contributed between 2.3% and 2.5% to GDP between 1994 and 1996, about the same as the insurance sector, half as much again as banking and almost three times agriculture.

**Table 1.1: Contribution to GDP in 1995 of various sectors of the Bahamian economy.**

Sector	Contribution to GDP (B\$ million)	% contribution to GDP
Wholesale and retail trade	409.7	14.9
Hotels	269.85	9.82
Real estate	227.05	8.27
Communications	106.28	3.87
Manufacturing	85.11	3.10
Electricity	75.56	2.75
Business activity	74.27	2.70
Construction	73.31	2.67
<b>Fisheries</b>	<b>61.67</b>	<b>2.25</b>

Insurance	60.22	2.19
Restaurants	48.38	1.76
Banking	48.36	1.76
Air transport and allied services	45.87	1.67
Transport (excluding shipping and air)	42.37	1.54
Shipping and allied services	38.12	1.39
Mining and quarrying	25.76	0.94
Agriculture	25.75	0.94
<b>Total*</b>	<b>2746.13</b>	

\*Also includes other elements such as the public sector

In 1997 total landings of fishery products were valued at B\$ 69.5 million (first sale price to fishermen), with 84% of this value being attributable to landings of frozen "crawfish" tails. **Note: "crawfish" is the Bahamian term for the Caribbean spiny lobster *Panulirus argus*.**

Total fishery exports during the same period were recorded at B\$ 62.7 million (from processors records) with 95% of this total value being derived from exports of frozen crawfish tails.

Preliminary results of the 1995 Fisheries Census show that there were 4,050 Bahamian vessels active in the commercial fishery employing approximately 9,300 fishermen representing 6.8% of the total workforce. Around 16% (652) of the vessels were greater than 20 feet in length and approximately 1,500 smaller dinghies were used in conjunction with these larger vessels mainly in crawfish mothership operations.

The Census also indicated that 500 people were employed in processing factories or buying plants. In 1995, processing plant permits were issued to 17 enterprises and in 1996, 19. It has also been estimated that there are around 12,000 part-time fishermen (8.8% of the total workforce) for whom fishing one of several means of generating income.

The fishing industry is important to the Bahamian economy in terms of geographic spread, as well as contribution to GDP, exports and employment. The majority of fishermen are located in New Providence, however the crawfish fishery is also particularly important in Eleuthera and Abaco. Scalefish and conch fishing is of great socio-economic importance in all Bahamian islands and on the Family islands there is substantial subsistence fishing for food and informal sale to friends and neighbours.

## 2. Landings, values and exports

### 1. Total landings

The value of the Bahamian fishery has expanded almost ten-fold over the last 20 years, mainly due to increasing exploitation of the crawfish resource for export. The most important species landed in terms of volume in decreasing order are crawfish, snapper, conch, grouper and jack. In terms of value the relative importance in decreasing order is crawfish tails, conch, Nassau grouper, snapper and crawfish whole.

Figure 1.1 shows the growth in total landings since 1980 (from DoF figures) while figure 1.2 gives the DoF breakdown of 1997 landings by volume and figure 1.3 gives 1997 landings by value highlighting the overall dominance and importance of the crawfish fishery.

Figure 1.1: Total Value of Exports and Landings (1980-97)

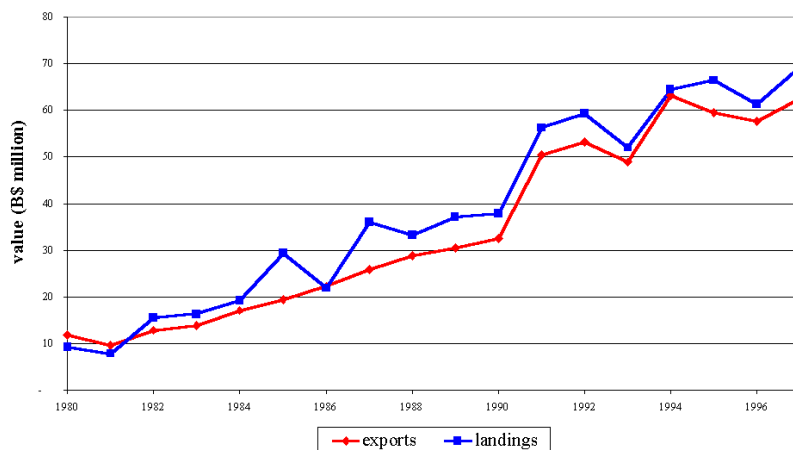


Figure 1.2: 1997 Landings - main species

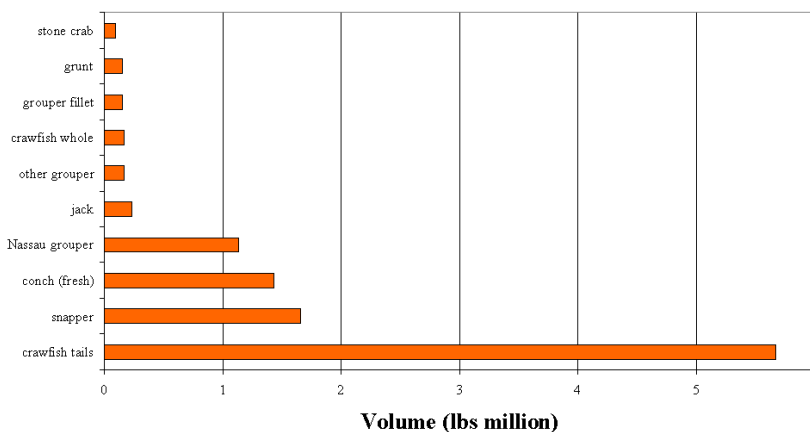
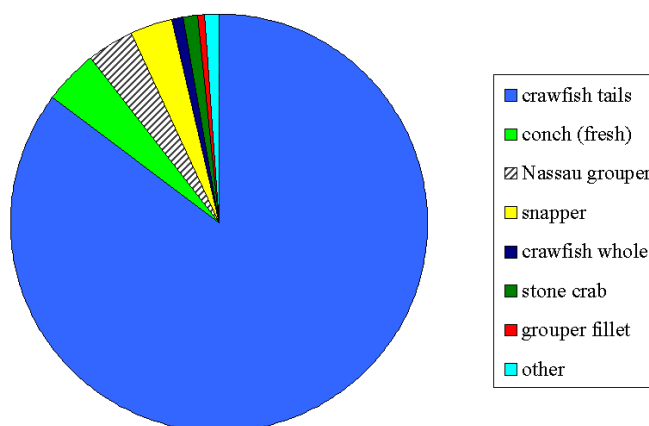


Figure 1.3: 1997 Landings by Total Value (BS)



2.

3. **Crawfish Landings**

Bahamian landings from the crawfish fishery rank the fourth largest in the world, after Australia (*Panulirus cygnus*), Brazil (mainly *P. argus*) and Cuba (*P. argus*).

Catches in the Bahamian crawfish fishery increased rapidly throughout the 1980s, peaking at 6,450 metric tonnes live weight in 1992, since when they have declined slightly and levelled

off. Capture is currently limited to an eight month season running from August 1 - March 31 and in 1997 5.67 million lbs of frozen tails were landed along with 0.17 million lbs of frozen whole crawfish.

Approximately 92% of crawfish tail landings volume was exported in 1997 with an export value of B\$ 59.5 million as reported by processors. Of this total around 60% by volume goes to the US, 35% to France and 5% to Canada. A new market is being developed for whole crawfish exports to Japan which has an export value of approximately B\$ 0.058 million in 1997.

#### 4. Fishing techniques

Crawfish are fished in three ways in the Bahamas:

##### *Artificial habitats or "condominiums"*

Condos (also known as casitas elsewhere in the Caribbean) are large rectangular sheets of aluminium with 3 wooden and one open side, which are laid by divers to provide artificial shelters for crawfish. Once a condo is down, it may be moved around by divers, but it is not brought up. A condo is therefore deemed to be a permanent feature on the seabed (like an artificial reef), and is not legally owned by anyone, no matter who put them there. A condo lasts around 3 years on the seabed before disintegrating.

It is not clear whether condos enhance crawfish populations by reducing predation, or whether they simply relocate crawfish from the reef. It is likely that both effects occur, but fishermen report that if condos are left for a period of several months to a year in an area of the banks where there have not formerly been crawfish, crawfish will arrive in that area, implying that the artificial habitats are enhancing survival in areas far from major reef areas.

The use of condos has increased rapidly in recent years from their introduction in the late 1980s, since they have been found to be a more efficient means of catching crawfish than either trapping or spearing in natural habitats. The 1995 DoF fisheries census estimated that around 650,000 condos were in place at that stage.

##### *Spearfishing*

Divers use free diving or compressors to search for crawfish on the reef, where they are hooked out of crevices and speared. Usually these are day fishermen, who increasingly also set condos.

This fishery has been associated with the use of bleach, used to force crawfish out of crevices in the reef (also sometimes used with condos). This destructive practice has reduced recently, although it is reported that other substances such as detergent and gasoline are in use.

##### *Trapping*

Crawfish traps are made of wooden slats, set in strings and baited with cowhide. A big trapping boat will fish around 1-2,000 traps. Once on board the crawfish are tailed and frozen, although a low quantity of whole crawfish are brought ashore, also frozen. A major problem for trap fishermen has been theft from traps.

#### 5. Ecology of crawfish *Panulirus argus*

The Caribbean crawfish *Panulirus argus* is nocturnal, sheltering in crevices and holes in the reef during the day and coming out at night into shallow water bank / seagrass areas to feed on invertebrates and detritus. It is social, sheltering in groups.

In the Bahamas, the spawning season is thought to peak between April and July, and adults migrate to deeper waters, sometimes en masse, to mate and spawn. The male deposits sperm on the female's thorax in the form of a "tar spot", and the female uses this to fertilise

her eggs, which she carries under her tail until they hatch ("berried" female). The spawning season is the summer, with females first commonly found with unlaidd eggs around March, and berried females are found until August or September, mainly in deeper water and on the edges of the banks.

The pelagic larval phase (phyllosome phase) is long compared to most marine species, lasting from 3-4 months up to a year. This means that larvae may be carried long distances by ocean currents and there is some debate about the extent to which Caribbean stocks are mixed or distinct. It is probable that the Bahamas both retains some of its own larvae and receives larvae from upstream areas (the Turks and Caicos Islands and potentially the wider eastern Caribbean and Brazil). Some work suggests that circulation in Exuma Sound may well act to retain larvae, hence crawfish populations around the Sound could be a genetically and ecologically distinct population. Work in the TCI also suggests that a gyre may exist between the Caicos bank, the southern Bahamas and eastern Cuba, possibly retaining larvae in that area .

After 4-12 months, crawfish phyllosome larvae metamorphose into a "puerulus" stage, which migrates inshore. The pueruli settle in inshore shallow water "nursery" areas, usually algae and seagrass areas, where they metamorphose into juvenile crawfish.

As the juvenile crawfish grow they migrate further offshore to the reef area. Spawning success increases with age, and Cuban scientists predict that female fertility is proportional to the carapace length to the power of 2.97, ie. that fertility increases exponentially with length, at least in the early stages of maturity.

## 6. Crawfish conservation status

*"Typically, either of two patterns prevails in the spiny lobster fisheries... Both involve a sharp increase in catch with rather limited effort during the development of the fishery. Subsequently either catch rates drop, sometimes precipitously with increases in effort (eg. New Zealand, Mexico, parts of the Caribbean), or catch rates remain somewhat stable despite major increases in effort (e.g. Florida, Western Australia) .*

### 1. Caribbean-wide conservation status

Concern about over-exploitation of *P. argus* is widespread in the Caribbean. The table below shows the current conservation status of crawfish fisheries across the region, the majority of which are over-exploited or fully exploited. These Caribbean-wide levels of exploitation are of concern in the context of the wide dispersion of larvae which means that there is a possibility that stocks across the Caribbean are connected through larval transport, and downstream areas (such as the Bahamas) may hence be dependent to some extent on upstream areas for recruitment.

**Table 2.1: 1998 status of *P. argus* stocks in the Caribbean**

Country	Stock status
Brazil	Fishing mortality estimated to be high (>0.45). Recommended FAO/DANIDA workshop that effort be reduced from 60 million around 15 million trap days for optimum economic exploitation levels.
Venezuela	Landings have increased from 400 tonnes in 1989 to 1,000 tonnes stable at around that level since then. Fishing mortality estimated high (0.68) and stock likely to be overexploited.
Honduras / Nicaragua / Colombia	These countries seem to share a common stock. The stock is likely to be fully exploited but effort by all three countries continues to increase.
Jamaica	Stocks on the southern shelf are considered to be overexploited.

	unsustainable. Catches on the San Pedro bank have recently continued with continuing increases in effort, but there is not enough data available to assess why.
Belize	Not enough information available
South Cuba	25% decline in recruitment and population size since 1982-3. Mortality estimated at about 25% above maximum sustainable yield.
Northeast Cuba	Recruitment and catches both down since 1989, despite no decrease in effort.
Mexico: South Quintana Roo	Not heavily exploited, catches probably below maximum sustainable yield.
Mexico: North Quintana Roo	Population size and recruitment have been steadily declining since the 1990s.
Mexico: Yucatan	Not heavily exploited
Florida	Fishing mortality very high, fishery fully exploited and probably dependent on larval flow from upstream populations (Mexico, Dry Tortugas) for recruitment.
Turks and Caicos	Fully exploited.

## 2. Minimum size

As well as overexploitation through excess effort and landings, there is also concern that throughout the Caribbean, minimum size limits are set too low, i.e. below the mean size at first maturity, meaning that at high levels of exploitation many lobsters will be caught before they have the opportunity to reproduce.

This issue is complicated by the fact that it is difficult to pin down a consistent conversion factor to compare tail length with carapace length. Carapace length is the most reliable measure (used as standard by biologists) but countries where tails only are landed are obviously obliged to express regulations as tail lengths. Various conversion factors have been calculated which don't always give the same results. Countries which have regulations for both tail length and carapace length will therefore find that the regulations are not consistent, but this is impossible to avoid.

Estimated mean size at first maturity (MSFM) ranges from a maximum of 93 mm carapace length in Colombia to a minimum of 82 mm in Cuba. This gives tail lengths in the ranges 6.34-6.74 inches (Colombia) and 5.63-6.00 inches (Cuba) depending on the formula that is used (see Table 2.2 below).

Table 2.2 gives minimum legal lengths for selected Caribbean countries. Two formulae are used to convert tail length to carapace length, one from the Florida Fisheries and Wildlife Service and one from the Cuban lobster management authorities. Note that the Florida formula gives consistently lower results than the Cuban one: this is probably an artifact of sampling rather than a genuine morphometric difference between populations, since the proportions of an individual crawfish vary with age, size and gender, and this within-population variation of individuals is undoubtedly greater than any variation found between populations of *P. argus* in different parts of the Caribbean. Hence it is difficult to make tail length an accurate measure of age or even size.

**Table 2.2**

Country	Tail length Lt	Carapace	Total	Minimum size	Comments
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			length Lc	length Ltot	converted to CL		
	inches	mm	mm	mm	Florida mm	Cuba mm	
Bahamas	5.5	139.7			74.6	79.9	Below n MSFM
Belize						78	"
Bermuda						92	
Brazil	5.12	130			68.9	74	"
Colombia: Guijira				210		68.9	"
Colombia: San Andres	5.51	140			74.7	80.1	"
Cuba	5.91	150	69		80.6	86.2	? Very v from dif
Dominican Republic	4.92	125			66	70.1	Below n MSFM
Honduras	5.51	140			74.7	80.2	"
Jamaica						78	
Mexico: Quintana Roo	5.31	135			71.8	77	"
Mexico: Other	5.71	145			77.7	83.2	
Nicaragua	5.31	135	75		71.8	77	"
St. Lucia			95				Above n for MSFI
TCI			83				
Florida	5.5	139.7	76		74.7	80.1	Below n MSFM
Venezuela			120				Above n for MSFI

**Conclusion:** In most countries the minimum legal size for the fishery is below the mean size at first maturity, no matter which measures or morphometric formulae are used. Populations have fluctuated in most areas in the past, but it is worrying that most areas are concerned simultaneously about overexploitation, particularly in the context of possible upstream larval supply for downstream recruitment. There is a risk that if populations in the entire Caribbean are reduced at the same time, recovery of stocks will be slow due to reduced larval supply and recruitment.