

## Status of Spiny Lobster Fisheries in the "Archipiélago de los Roques" National Park, Venezuela

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### ABSTRACT

The spiny lobster, *Panulirus argus*, represents the most important fishery resource in the "Archipiélago de Los Roques" National Park. The archipelago provides 95% of the total Venezuelan lobster production, which totalled 87 MT in 1988-89. The spiny lobster fishery in the archipelago was followed during four seasons: 1983-84, 1984-85, 1986-87 and 1987-88. Assessments were made of catch-per-unit-effort, estimated catch, official landings (between 1976-77 and 1990-91), length distribution and economic aspects of the fishery. Official landings of lobster in the archipelago ranged from 156,756 kg in 1982-83 falling to 35,303 in 1990-91, indicating a dramatic decline. Lobsters are caught by lobster traps (81.4%), skin diving (17.6%) and trammel nets (1.0%). Management regulations include restricted season (close from May 1 to October 31), minimum size (120 mm CL) and effort restrictions (200 traps/licence/season). However, these regulations are not well respected, and as a result, *P. argus* is overexploited.

**KEY WORDS:** *Panulirus argus*, fishery, production, management, Venezuela.

### RESUMEN

La langosta espinosa, *Panulirus argus* representa el recurso pesquero más importante en el Parque Nacional Archipiélago de Los Roques. El archipiélago provee casi el 95% de la producción total nacional, la cual totalizó 87 TM en la temporada 1988-89. La pesquería de la langosta fue monitoreada durante cuatro temporadas de pesca: 1983-84, 1984-85, 1986-87 y 1987-88. Se determinaron parámetros de captura por unidad de esfuerzo, producción estimada, desembarques oficiales (entre 1976-77 y 1990-91), distribuciones de frecuencia y aspectos económicos de la pesquería. Según las estadísticas oficiales, la producción de langostas en el archipiélago osciló entre 156.756 kg en la temporada 1982-83 y 35.303 en 1990-91, indicando un dramático descenso. Las langostas son capturadas por medio de nasas (81.4%, en numero), buceo a pulmón libre (17.6%) y tren emmallador (1.0%). Algunas de las regulaciones pesqueras existentes son: temporada de veda (desde en 1 de mayo hasta el 31 de octubre), talla mínima de captura (120 mm de LC) y un máximo de artes de pesca (200 nasas/licencia/temporada). A consecuencia de que dichas

regulaciones no están siendo respetadas, el recurso *P. argus* se considera en fase de sobre explotación en el archipiélago.

### INTRODUCTION

The spiny lobster, *Panulirus argus*, represents a very important fishery resource for the 23 countries in the Western Atlantic region. However, the importance of the fishery in terms of gross national income varies considerably between countries. Venezuela, with a production of 87 MT (in 1988-89, official statistics, Ministry of Agriculture, M.A.C.), is considered a minor producer in the region. The "Archipiélago de Los Roques" National Park provides 95% of the total production of Venezuelan lobster, and lobster is the most important fishery activity within the archipelago. Several technical reports, such as Cobo de Barany *et al.* (1972), Ginéz *et al.* (1978), Hauschild y Weil (1983), and Hauschild y Laughlin (1985) present information about the biology and fishery of this species in the national park. González (1987) evaluated the bycatch of fish to the lobster traps.

As a principal objective of a general program conducted by the Los Roques Scientific Foundation, the spiny lobster fishery in the archipelago was followed during four seasons: 1983-84, 1984-85, 1986-87 and 1987-88. Assessments were made of reported landings, estimated true catch, catch-per-unit-effort, and length distribution of the catch. This paper presents the results of these evaluations; these were used to reform the national management plan for spiny lobster.

### MATERIALS AND METHODS

The "Archipiélago de Los Roques" National Park is a complex reef system situated 155 km north of the central coast of Venezuela (11°44'/11°58' N and 66°33'/66°57' W, Figure 1). The archipelago is formed by 42 keys and more than 200 sand banks. These form an irregular oval surrounding a shallow water internal lagoon with a mean depth of 5 m. As a whole the archipelago covers an approximate area of 1,250 km<sup>2</sup>.

Fishing villages (Figure 1) were visited monthly from November 1 to April 31 for a period of four seasons (1983-84, 1984-85, 1986-87, 1987-88). Fishing trips were undertaken with fishermen to witness the process of fishing. On each trip information on the type and number of gear used and fishing location were obtained. All lobsters in the catch were counted, sexed, measured and weighed. Fishermen were interviewed to determine the number of days per month they spent actively fishing.

In addition, economic aspects of the fishery, such as costs and prices, were recorded.

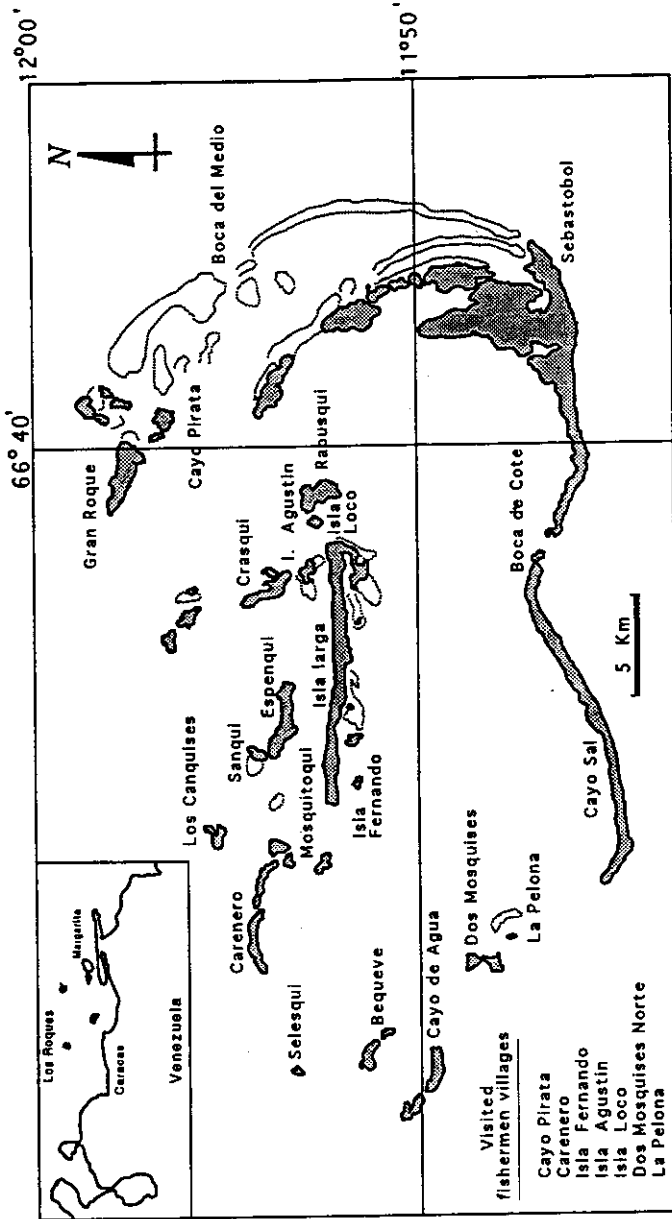


Figure 1. Location of the visited fishing villages at the "Archipiélago de Los Roques" National Park, Venezuela.

## RESULTS

### Description of the Fishery

The lobster season comprises a period of six months, from November 1 to April 31. Fishermen prefer the internal areas of the archipelago for fishing and cover practically all the area. Only a few visit the open-sea areas at the northeast, where depths range between 90 and 100 m.

Lobster is captured mainly by traps (81.4%, by number) and skin diving (17.6%); trammel nets are used by a few fishermen and landings are limited to 1% of the total production. Figure 2 shows the principle fishing areas in relation to the type of gear used. Traps and trammel nets are located on sand grounds, fringes between coral reefs and on seagrass beds to take advantage of the nocturnal movement of lobsters between shelter areas and feeding zones (Baisre, 1977). Skin diving is conducted directly within areas of shelter located in barrier reefs close to the keys and in the shallow internal lagoon.

### Fishing Effort and Catch Per Unit Effort

Table 1 shows the values of effort and catch per unit effort for each gear. The average number of licensed fishermen operating traps was estimated to be 42; the number of permits have remained about the same since the 1980-81 season. Fishermen work about 275 traps each (minimum 150, maximum 400) and pull about 60 traps per day. Each licensed fisherman operates with an average crew of three. At 30 days per month, the active fishing period is 180 days (six months). Thus, total effort for the whole archipelago is estimated at 11,550 traps. Catch per unit effort shows a clear decline since the 1984-85 season, with catch rate dropping from 3.69 kg/trap/month to 1.91 kg/trap/month in 1987-88 (Table 1).

An average of 2.5 divers per boat fished for lobster, from an estimated 34 vessels. Divers work about twenty days a month (3 hrs/day) during the first three months of the season. Reasons given for stopping fishing included a worsening in sea conditions and a decline in the capture rate throughout the season. Divers subsequently switch to harvesting queen conch, *Strombus gigas*. Divers harvested an estimated 127.3 kg/diver/month during the 1987-88 season. As for traps, there was a decline in the catch index from 1983-84 to 1987-88 (Table 1).

Only two fishermen use trammel nets to catch lobsters. Each operates an average of 1,140 m<sup>2</sup> of net for five months at 20 days/month. The trammelnet fishery was evaluated only during the 1986-87 and 1987-88 seasons, and the catch rates were estimated at 146 and 163 kg/1,000 m<sup>2</sup> net/month, respectively.

### Fishery Production

Our estimates of total catch greatly exceeded (by 60-200%) those obtained from reported landings (Figure 3). However, similar tendencies were shown in total production. The differences between official landings and our estimates are

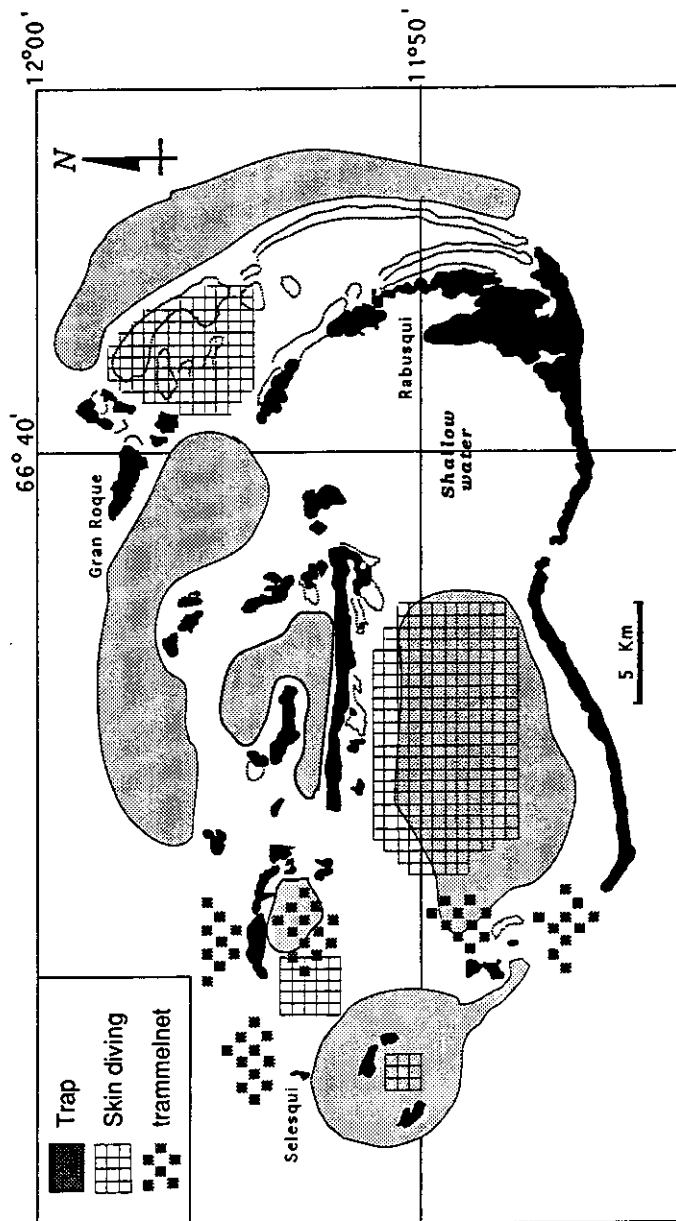


Figure 2. Principle fishing areas in relation to the type of gear used.

**Table 1. Fishery parameters (fishing effort and catch per unit effort) estimate by gear used in the "archipiélago de los Roques" National Park, Venezuela.**

Gear	Time		Fish Effort Licences					
	(month)	Gear Effort	Unit Effort	1983-84	1984-85	1986-87	1987-88	
Trap	42	6	275 trap/licence	kg/trap/month	3.52	3.69	2.67	1.91

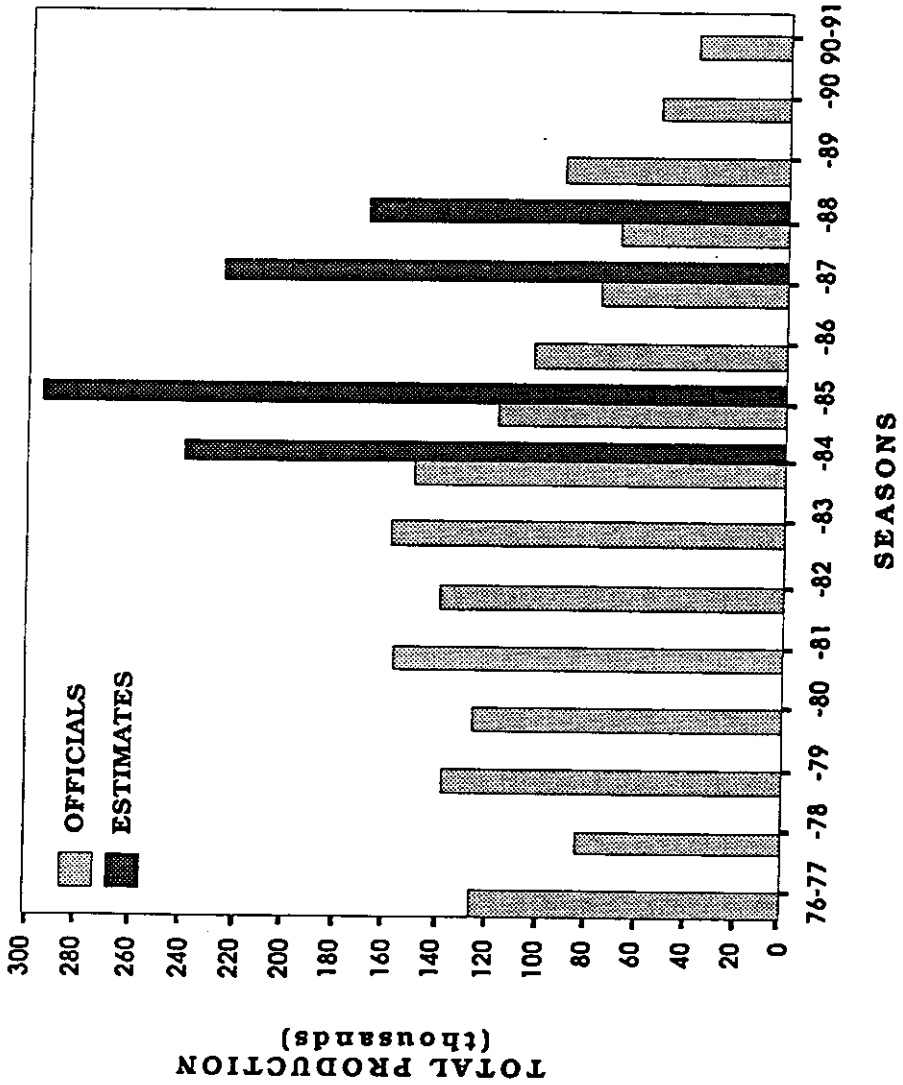


Figure 3. Variation in production between the 1976-77 and 1990-91 seasons according to our estimations and the official landings.

**Table 2.** Estimated production (kg) during the 1983-84, 1984-85, 1987-88 and 1988-89 seasons in the "Archipelago de los Roques" National Park, Venezuela.

Gear	ESTIMATED PRODUCTION (kg)			
	1983-84	1984-85	1986-87	1987-88
Trap	189,846	255,717	185,031	132,363
Skin diving	48,072	37,740	35,139	32,462
Trammel net	0	0	1,665	1,858
<b>TOTAL</b>	<b>237,918</b>	<b>293,457</b>	<b>221,835</b>	<b>166,683</b>

because of unreported landings by fishermen, illegal transportation to Caracas by private aeroplanes and yachts, or lobsters that end up in local guest houses and therefore never officially reported (Posada, in press).

Figure 3 shows the variation in production between the 1976-77 and 1990-91 seasons according to our estimations (Table 2) and the official landings (Table 3). Landings were variable but consistent between 1976-77 and 1982-83; subsequently the landings show a gradual decrease in production from 156,756 kg in 1982-83 to 35,303 kg in 1990-91. This is equivalent to a 77% reduction in the lobster fishery production of the archipelago over this time. Such a decrease in landings indicates a declining resource.

Peak landings occur at the beginning of the season (Table 3), usually because fisherman operate illegally one month before the opening of the season. The lobsters are kept alive in hidden chicken-wire cages located close to the fishing villages.

The decline in catch in recent years suggests an increase in fishing effort. The number of lobster fishermen operating in the archipelago has remained constant (controlled with an annual renewal and non-transferable licence), but for many years there has been a gradual increase in the number of traps used per fishermen. Furthermore, due to the recent increase in tourist activities in the archipelago and corresponding increased demand, skin-diving fishermen have been observed to extend their lobster fishing throughout the year.

There is an inverse correlation between landings and price per kilogram of lobster (Figure 4). This suggests that a 342% increase in price per kilogram between 1980 and 1991 resulted from the reduction in landings and the devaluation of the national currency (375%) since 1984.

#### Size at Capture

Lobsters sampled during both the 1986-87 and 1987-88 seasons (1,172 ind.) ranged between 70 and 189 mm CL (Table 4, Figure 5). The modal class was 100 to 109 mm CL, with a 30.3% of the total. Approximately 34% of the



Table 3. Fishery production (kg) per month of spiny lobster during the 1976-77 to 1988-89 seasons and lobster during the 1976-77 to 1990-91 seasons in the "Archipiélago de los Roques" National Park, Venezuela.

Season	Price (Bs/Kg)	PRODUCTION (KG) PER MONTH												Total
		Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.		
76-77	17	0	0	30,068	23,571	20,991	8,258	11,747	11,578	8,984	100	125,297		
77-78	19	0	10,804	20,870	13,708	10,308	10,033	7,976	9,828	0	0	83,527		
78-79	22	0	37,486	33,692	15,368	17,323	13,336	12,615	7,473	0	0	137,293		
79-80	25	12,500	31,532	25,065	17,227	14,443	11,976	11,924	0	0	0	124,667		
80-81	29	0	47,639	40,019	23,563	20,084	13,370	11,366	0	0	0	156,041		
81-82	30	0	34,495	32,689	24,619	17,387	15,402	12,708	0	0	0	137,300		
82-83	30	0	50,205	35,728	21,579	16,913	18,944	13,387	0	0	0	156,756		
83-84	37	0	48,096	27,723	19,565	19,437	16,542	16,542	0	0	0	147,905		
84-85	48	0	40,099	29,877	17,226	7,748	12,505	6,911	0	0	0	114,366		
85-86	56	0	19,073	27,128	19,831	13,676	11,585	8,204	0	0	0	99,497		
86-87	84	0	7,402	19,828	11,305	12,187	11,478	10,250	0	0	0	72,450		
87-88	142	0	0	21,572	12,890	9,413	10,482	10,029	0	0	0	64,386		
88-89	280	0	27,666	21,269	12,720	11,676	9,287	5,116	0	0	0	87,734		
89-90	317	0	16,451	8,823	5,452	8,439	6,187	3,735	352	0	0	49,439		
90-91	330	0	3,934	11,126	5,625	4,506	4,243	5,869	0	0	0	35,303		

Source: Division of fisheries statistics.  
Ministry of Agriculture (M.A.C.).

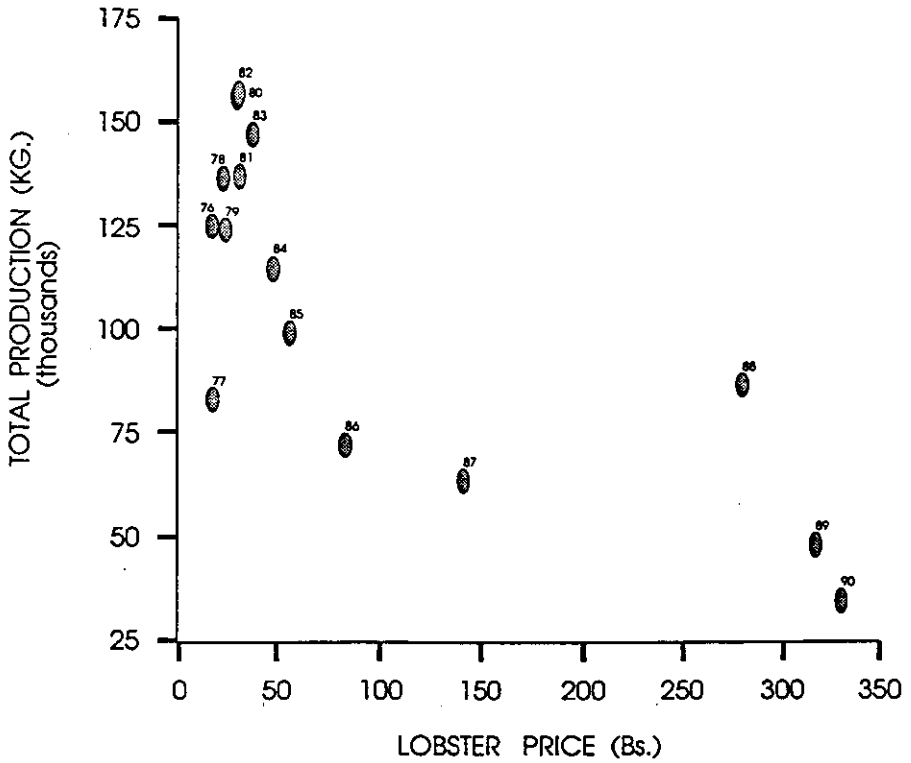


Figure 4. Correlation between landings and price per kilogram of lobster.

**Table 4.** Length-frequency distribution of females and males of *P. argus* marketed in the "Archipelago de los Roques" National Park (seasons 1986-87, 1987-88).

Size Distribution (cm)	Females		Males		Total	
	Rel. Freq.	%	Rel. Freq.	%	Rel. Freq.	%
7.0-7.9	4	1.4	2	0.7	6	1.0
8.0-8.9	29	10.1	16	5.4	45	7.7
9.0-9.9	84	29.2	65	21.9	149	25.3
10.0-10.9	97	33.6	81	27.1	178	30.3
11.0-11.9	46	16.0	63	21.1	109	18.6
12.0-12.9	18	6.3	35	11.8	53	9.0
13.0-13.9	5	1.7	18	6.0	23	4.0
14.0-14.9	2	0.7	13	4.4	15	2.6
15.0-15.9	3	1.0	2	0.7	5	0.9
16.0-16.9	0	0.0	1	0.3	1	0.2
17.0-17.9	0	0.0	1	0.3	1	0.2
18.0-18.9	0	0.0	1	0.3	1	0.2
<b>TOTAL</b>	<b>288</b>	<b>100.0</b>	<b>298</b>	<b>100.0</b>	<b>586</b>	<b>100.0</b>

**Table 5.** Length-frequency distribution of marketed *P. argus* by fishing gear used in the "Archipelago de los Roques National Park (seasons 1986-87, 1987-88).

Size Distribution (cm)	Trammelnet		Skin Diving		Trap	
	Rel. Freq.	%	Rel. Freq.	%	Rel. Freq.	%
7.0-7.9	0	0.0	6	3.2	0	0.0
8.0-8.9	0	0.0	25	13.3	20	5.6
9.0-9.9	6	15.0	63	33.5	80	22.3
10.0-10.9	13	32.5	56	29.8	109	30.5
11.0-11.9	9	22.5	27	14.4	73	20.3
12.0-12.9	3	7.5	7	3.7	43	12.0
13.0-13.9	2	5.0	2	1.1	19	5.3
14.0-14.9	4	10.0	1	0.5	10	2.8
15.0-15.9	2	5.0	1	0.5	2	0.6
16.0-16.9	0	0.0	0	0.0	1	0.3
17.0-17.9	0	0.0	0	0.0	1	0.3
18.0-18.9	1	2.5	0	0.0	0	0.0
<b>TOTAL</b>	<b>40</b>	<b>100.0</b>	<b>188</b>	<b>100.0</b>	<b>358</b>	<b>100.0</b>

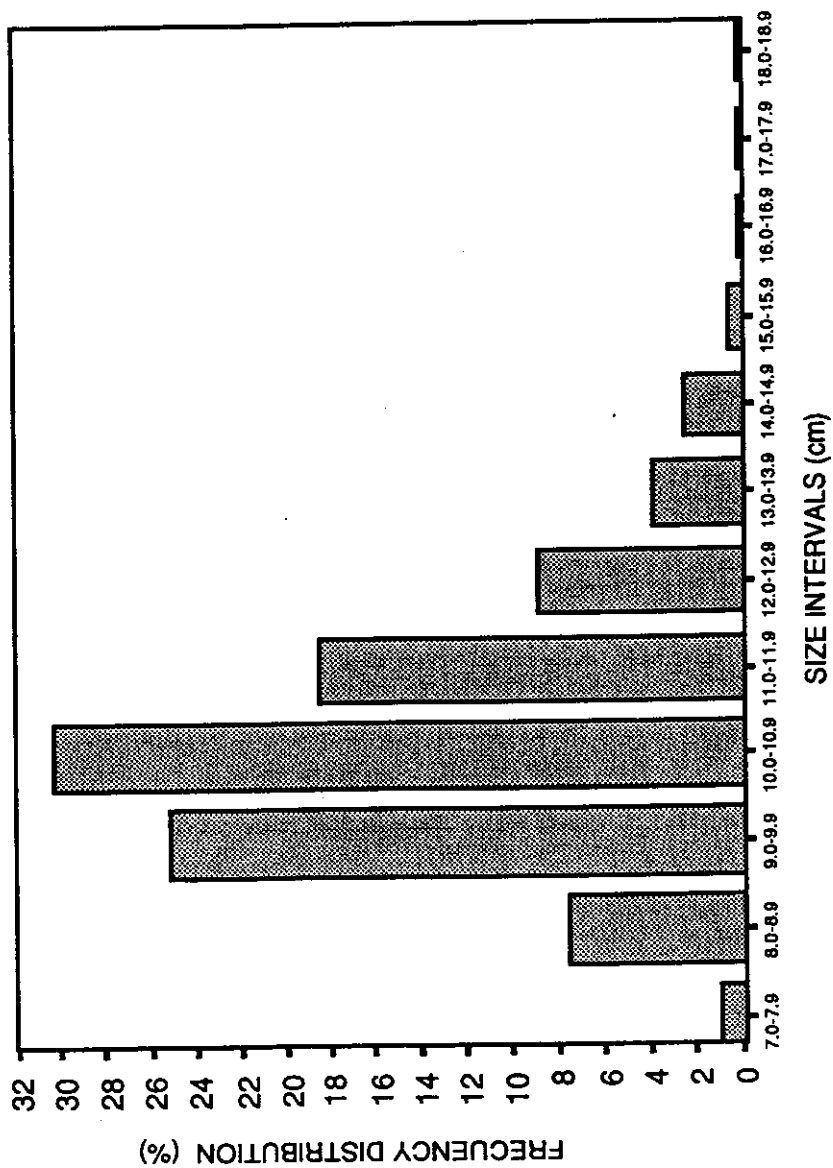


Figure 5. Length-frequency distribution of lobsters marketed.

lobsters were less than 100 mm CL (the minimum legal size). Catching of undersized lobsters has led some to believe the resource is overfished. However, no decrease in size has been found over time. In our study the mean carapace length was  $107.5 \pm 17$  mm. An identical value was obtained by Hauschild y Laughlin (1985), while Ginéz y Rodríguez (1979) reported a value of 101.6 mm. A significant difference (ANOVA,  $F_{11,24} = 18.41$ ,  $P < 0.01$ ) was found in the mean size captured among gears. Larger sizes were captured using trammel nets, followed by traps and skin diving (Table 5, Figure 6).

### Bycatch

The lobster bycatch constituted an important fisheries resource. For many years only the highly marketable fishes were used. Thus, practically all the fish were returned to the sea. Two factors combined to develop a commercial interest in bycatch fish: (1) the reduction in lobster landings initiated in 1982-83 more divers per boat, to compensate for catch reduction, and (2) the beginning of an export market for fish to neighboring Caribbean islands to take advantage of the high exchange rate caused by the devaluation of the national currency (Posada, in press).

González (1987) identified 72 species of fishes as bycatch in the trap fishery; 21 of these represent 82% in weight of the total fish captured (Table 6). A completely different associated fauna is captured with the trammelnets, and these species are less important economically.

### Economic Aspects

Our economic analysis is based on the same methods established by Novoa y Ramos (1978), Hauschild y Laughling (1985) and Gonzalez y Celaya (1986). It is based on the discrimination between the gross and net incomes coming from the estimated values of production.

Economic results for 1987 appear in Table 7. Gross income is estimated by multiplying the estimated value of production of each gear by the mean price per kilogram of the exploited resource (lobster or fish). Total expenses were determined by adding the cost of fishing gears, operational cost and the depreciation of the assets (gears, fishing boat, engine). Net income results from the difference between gross income and total expenses.

Unlike other resources in the archipelago, which are totally exported to other Caribbean areas (Martinique and Curacao, mainly), the total production of lobsters is sold directly to intermediaries and transported live to the Venezuelan coast where it is sold to fish shops and restaurants.

The distribution of the net income among fishermen based on a fractional system ("de partes", in Spanish) in common use in Venezuela (Salaya *et al.*, 1985). The fractions are as follows: one part for the boat owner, one part for the

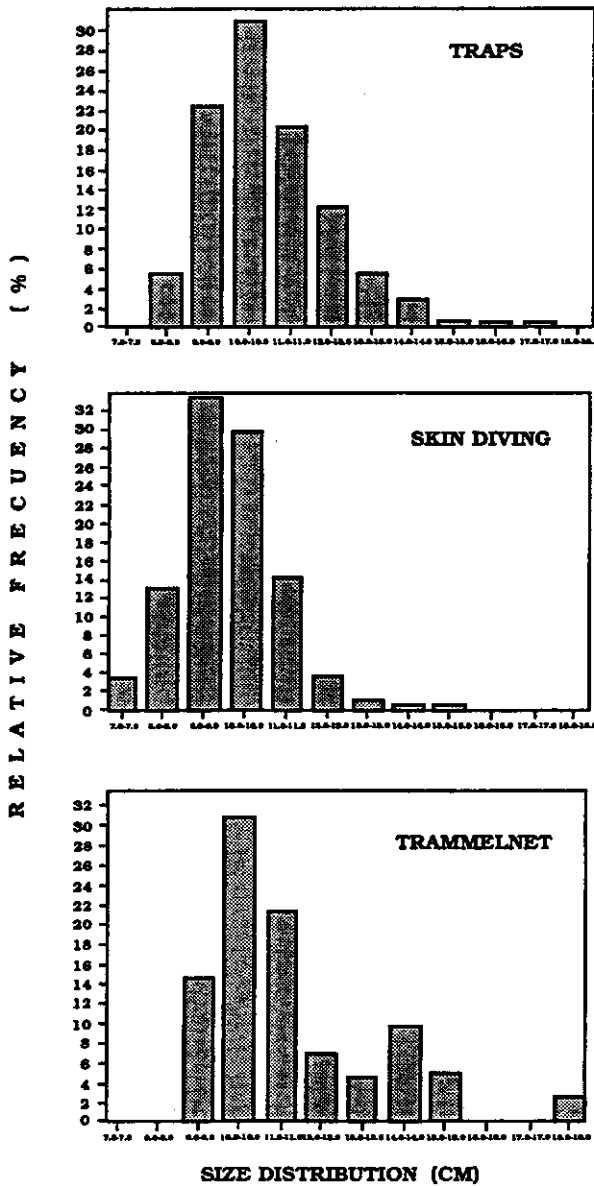


Figure 6. Length-frequency distribution of marketed lobsters by fishing gear used.

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**Table 6.** List of the most important bycatch fishes of the lobster fishery in the "Archipiélago de los Roques" National Park, Venezuela.

SPECIES	WEIGHT (Kg)	%	ACUM. %
<i>Haemulon sciurus</i>	377.9	22.1	22.1
<i>Haemulon plumieri</i>	165.5	9.7	31.8
<i>Calamus</i> spp.	140.6	8.2	40.0
<i>Sparisoma chrysopteron</i>	121.9	7.1	47.1
<i>Lutjanus analis</i>	89.2	5.2	52.3
<i>Epinephelus guttatus</i>	62.9	3.6	55.9
<i>Holocentrus ascensionis</i>	54.8	3.2	59.1
<i>Ocyurus chrysurus</i>	49.5	2.9	62.0
<i>Balistes vetula</i>	49.3	2.8	64.8
<i>Acanthostracion quadricornis</i>	41.8	2.4	67.2
<i>Acanthurus chirurgus</i>	38.3	2.2	69.4
<i>Lachnolaimus maximus</i>	36.5	2.1	71.5
<i>Sparisoma viride</i>	35.3	2.0	73.5
<i>Lutjanus synagris</i>	31.8	1.8	75.3
<i>Archosargus rhomboidalis</i>	22.6	1.3	76.6
<i>Mulloidichthys martinicus</i>	21.8	1.2	77.8
<i>Scarus guacamaia</i>	17.7	1.0	78.8
<i>Lutjanus griseus</i>	13.6	0.7	79.5
<i>Epinephelus fulvus</i>	10.9	0.6	80.1
<i>Lutjanus mahogoni</i>	9.3	0.5	80.6
<i>Epinephelus morio</i>	7.4	0.4	81.0
<b>TOTAL</b>	<b>1399.7</b>	<b>81.1</b>	

Source: Gonzalez (1988)

engine owner, two parts for the fishing gear owner, one part for each member of the crew (captain and sailors).

Monthly net incomes are shown in Table 7. This income is usually supplemented by fishing for other resources such as the queen conch, *Strombus gigas* and the yellowtail snapper, *Ocyurus chrysurus* during the lobster season.

#### DISCUSSION

Despite the lack of a decrease in mean size at capture, the spiny lobster fishery in the "Archipiélago de Los Roques" National Park is highly overfished, since recent increases in fishing effort have resulted in decreased catch. The increased importance of the bycatch for the fishery may also indicate that the lobster resource no longer can satisfy the fishery's economic needs. Several

Tabla 7. Fishery production, gross income, cost of production and net income estimated for 1987 by gear in the "Archipiélago de los Roques" National Park, Venezuela.

Gear	Estimated production (Kg)	Gross income (Bs.)	Fishing units	Gross income per fishing unit	Cost of production per fishing unit	Income / F.U per season	Fishing activities (month)	Net income month/F.U.
Trap (lobster)	185,031	18,503,10	42	440,550	118,354	322,196	6	53,699
Trap (bycatch)	268,559	3,472,299	42	82,674	0	82,674	6	13,778
Skin diving	35,139	3,513,900	34	103,350	14,500	88,850	3	29,617
Trammelnet (lobster, bycatch)	4,791	256,068	2	128,034	16,100	111,934	3	37,311



reasons can be pointed out to explain the over fishing problem in the archipelago:

1. A growing tourist industry which demands top quality products (Sadovy, 1989);
2. Increased fishing effort (traps in excess of the number legally permitted; and,
3. Extension of fishing activities throughout the year to satisfy local tourist demand.

### Management

Regulations imposed to protect the spiny lobster have existed since 1951. The last revision (M.A.C.-113, 20-April-1990) established the following:

1. A six-month closed season from May 1 to October 31.
2. Commercial fishermen are required to renew their licence annually and not exceed the maximum number of traps permitted (200 trap/licence/season).
3. The use of lights or other lobster attractants (*e.g.* undersized obsters or "shorts") is prohibited.
4. The harvest of egg-bearing lobsters is prohibited.
5. Size regulations of a minimum carapace length of more than 120 mm and/or minimum total weight of 1 kilogram.
6. Lobsters must be transported alive; transportation of tailed lobsters is prohibited. Although several revisions have been made to the regulations, no resolutions toward enforcement have been taken. The number of traps is a poorly controlled constraint, and probably some fishermen have over 700 traps. The idea behind having a National Park in the archipelago was to protect the natural scenery and preserve to perpetuity of the resources. Combining a National Park with commercial activities is not an easy task. Tourist activities represent an economic alternative for the fishery community, but it also needs to be well organized.

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