

Spiny Lobster Fishery of the Saba Bank

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ABSTRACT

Over the past 12 months a comprehensive assessment has been made of the fish stock of the Saba Bank. The assessment was initiated by the Environmental Department of the Government of the Netherlands Antilles in Curaçao, whereby the condition of the fisheries resources of the Saba Bank was to be determined.

Over the past 12 months the Saba Bank fishermen engaged in two types of fishery: spiny lobster (*Panulirus argus*) fishery, and snapper fishery, with two main target species: silk snapper (*Lutjanus vivamus*) and blackfin snapper (*Lutjanus buccanella*). The main fishery activity on the Saba Bank is the lobster fishery; snappers are only targeted sporadically.

The objective of the fish stock assessment program was to collect fishery dependent data on the different target species of the Saba bank.

Alongside data on catch per unit of effort of the lobster fishery, biological data, such as, length frequency, length weight relationship, sex, number of females carrying eggs, and the number of lobsters in ecdysis, were collected.

During the study it became apparent that a high percentage of lobsters landed were under-sized and a substantial percentage of berried lobsters were landed. Furthermore a considerable number of traps were lost, due to passing by traffic and hurricanes. None of these traps were fitted with a biodegradable panel and the lost traps are extremely damaging to the ecology and consequently the fish stock of the Saba Bank.

As a result of this study, the following regulations are now being strictly enforced:

- i) Presence of a biodegradable panel in each trap.
- ii) Legal size limits for lobsters.
- iii) Prohibition to land berried lobsters.
- iv) Prohibition to land lobsters in ecdysis.
- v) Prohibition to fish without a licenses in both the Saban territorial waters and the Economic Fishery Zone (EFZ) of the Netherlands Antilles.

Collecting fishery data alongside enforcement of the fishery regulations will enable successful management and will in the end result in sustainable exploitation of the fishery resources of the Saba Bank.

KEY WORDS: Spiny lobster, Saba Bank, stock assessment

BACKGROUND AND JUSTIFICATIONS OF THE RESEARCH

The Saba Bank (Figure 1) is a large, totally submerged shallow, marine area off the island of Saba. The Bank is important as a fishery resource for fishermen from Saba, St. Eustatius and St. Maarten.

Frequent reports of decreasing fish stocks, destructive fishing activities of foreign vessels, anchoring of oil tankers and tank cleaning, has raised concerns about the environmental state of the Bank. Meesters et al. (1996), commissioned by the Environmental Section reviewed the Saba Bank in 1996 in combination with a short study on location. He concluded that the habitat of the Saba Bank is particularly important for several reasons:

- i) The significance of the sea-current patterns suggest that the reefs are potentially an important source of fish and shellfish larval disposal to the islands of Saba, St Maarten and to the islands in the eastern Greater Antilles;
- ii) The coral reefs of the Saba Bank are relatively remote from intense human impact and may not only provide important scientific information on the status of reefs in relatively unspoiled condition, but are also a reserve of biodiversity for the region;
- iii) The reefs of the Saba Bank are potentially a resource for dive-tourism and an essential resource for fishing.

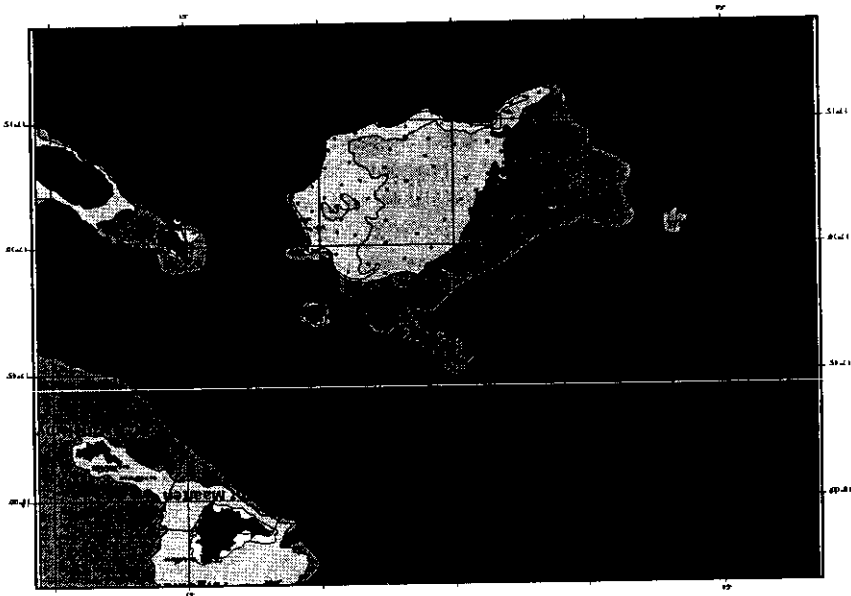


Figure 1. Map of the Saba Bank (Scale 1:550,000)

Meesters's study also recommended that a management plan should be developed in order to preserve this unique marine habitat. The National Policy paper "Contours of Environmental & Nature Conservation Policy for the Netherlands Antilles" incorporated this recommendation, and again in the National Nature Policy Plan of 2000 the development of a management plan for the Saba bank is stated as an important objective. As a first step to realize such a management plan, the Environmental Section initiated a comprehensive fishery catch assessment survey in order to get an impression of the fisheries resources of the Saba Bank.

During the time of the assessment (from April 23rd, 1999 to May 30th, 2000) an abundance of fishery dependent data was collected, which will contribute to formulation of an adequate management plan for sustainable exploitation of the fishery resources of the Saba Bank.

MATERIALS AND METHODS

The Saba Bank Fish fishery monitoring program has collected fishery-dependent data of the Saba Bank fishery from April 23, 1999 to May 30, 2000 commissioned by the Environmental Division of the Department of Public Health and Environmental Hygiene of the Netherlands Antilles, which is located in Curaçao. In an exploited fishery, assessment involves determining the current state of the resource, including the degree of exploitation. Extensive data had to be collected from the Saba Bank fishery in order to estimate population parameters. The monitoring program required several different types of information from the fisheries survey.

Before the program started a schedule was prepared, outlining all activities for the coming period, and establishing the standard way of measuring. Data were collected in the Saba harbor on length-frequency of the catch, collected during daily sampling from the stock, as well as data on total catch and effort. The lobsters (*Panulirus argus*) were measured as consistently and accurately as possible. In Saba harbor the carapace length (CL) of lobsters was measured to the nearest millimeter and 150 male and female lobsters were measured and weighed in order to obtain a reliable length-weight relationship. A kitchen-scale was used for this purpose. The length of the carapace of the lobsters was measured with a caliper.

During sampling, data were collected to obtain specific biological parameters useful in either estimating yield, or providing a basis for fisheries management strategies. In addition to the catch and effort data of the lobster fishery, biological data, such as, length frequency, length-weight relationship, sex, number of females carrying eggs, and the number of molting lobsters (lobsters in ecdysis) were collected.

Catch and effort data were collected on a daily basis in Saba harbor, including also the fishing grounds and species composition of the catch.

The data were entered on a data form, and later entered into Microsoft Excel, and/or MS-Access. Catch and effort data of landings on Saba and St. Maarten were stored in a central database (MS-Access) located in Saba, while length-frequency

data were stored in MS-Excel files. The required information included date, boat name, fishing hours, number of gear hauled, soak time, weight of catch and by-catch. Furthermore the monitoring program included a frame survey. The frame survey was conducted to detect the landing practices and to count the number of boats, the number of gear types, and the number of fishermen. The fishermen were interviewed in order to obtain this information.

An important part of the monitoring program consisted of giving feedback to all parties involved. At regular intervals the preliminary results and progress of the program were presented, which resulted in an excellent participation of the fishermen in the monitoring program. The collected fishery dependent data are now available at the Department of Public Health and Environment in Curaçao.

RESULTS

Catch and Effort Data

During the project a lobster catch of 89,235 kilograms was recorded. Although this is the great majority of the catch, not all lobsters caught were recorded. In order to obtain the approximate total lobster catch a raising factor is used to correct the recorded catch. An estimated 11.5 % of the lobster catch was not included in the records. This percentage is based on the number of days no data was collected. Total catch then comes to about 100 tons.

(Figure 2) displays the total lobster catch and effort distributed over the time of the project. The lobster catch and effort over the year fluctuates considerably (Figure 2). The hurricane season (from July till December) had a great impact on the lobster catch and effort. Lobster catch and sale were fairly good from May, 1999 till August, 1999. September is considered the month most hurricanes occur, and consequently tourism decreases during this month. September, October and November are considered low season months for tourism and as a result there is only limited sale for lobsters. On October 20, 1999 hurricane José passed over the Windward islands, followed by hurricane Lenny on November 18-19. These hurricanes had a negative influence on the lobster catch and fishing effort, since most fishermen took their boats out of the water before the hurricanes, and lost a considerable number of gear. Although the fishermen suffered great losses i.e. gear, boats, etc., the lobster catch increased substantially within two months after the hurricane season, in an attempt to meet the demand for lobsters, since the months of December to May are considered high season months for tourism.

Biological Data

Size—The carapace length (i.e. the distance from the base of the supraorbital horns to the posterior edge of the carapace) is the usual measure of body length in spiny lobster. The fishery law of the Netherlands Antilles forbids catching of lobsters with a carapace length smaller than 9.5 cm. This carapace length is approximately equivalent to a total body length of 25 cm, and a weight of 680 gram. This minimum

length originated from the Harmonized Fisheries Legislation Project, guided by the FAO, which had the objective to match the fisheries legislations of the islands of the Lesser Antilles.

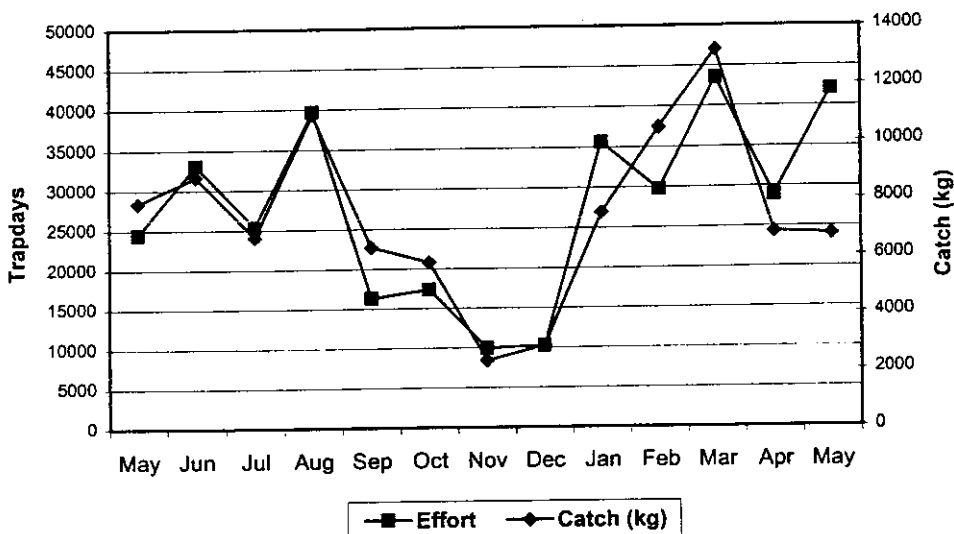


Figure 2. Distribution of the monthly lobster catches and effort from May, 1999 to April, 2000.

From April 23, 1999 to May 30, 2000 53,522 lobster traps were hauled and 70,914 spiny lobsters, (*Panulirus argus*) with a corresponding weight of 89,235 kilograms were recorded caught. The carapace length (CL) of 29,802 lobsters was measured. The total amount of lobsters sampled, the percentage of lobsters with a CL of less than 9.5, the average length and average weight of the sampled lobsters are shown in Table 1. The average CL displays a fall in the months of April to September. Length-frequency analysis of the lobster catch shows that this maybe due to recruitment of small lobsters.

As shown in the table, 28.0 percent of the lobsters sampled over the past 12 months had a CL of less than 9.5 cm. The high percentage of under-sized lobsters has been reason for serious concern, because it could indicate that the lobster stock of the Saba Bank was being over-harvested. The latter was reason for the Government to take action to halt the high percentages of under-sized lobsters. The Coast Guard of the Netherlands Antilles has started to enforce the fishery regulations. After the first control on 21st of March one could notice that the fishermen practically stopped landing illegal size lobsters. Consequently, the average CL increased as the number of under-sized lobsters landed decreased.

Table 1. Number of lobsters measured per month, number of lobsters with a carapace length (CL) less than 9.5 cm and average CL sampled

	# Measured	# CL < 9.5	% CL < 9.5	CL avg. (cm.)
April	1,377	203	14.7	11.5
May	2,562	607	23.7	11.0
June	3,518	1109	31.5	10.6
July	2,245	830	37.0	10.5
August	3,468	1,420	40.9	10.2
September	2,191	924	42.2	10.0
October	1,857	598	32.2	10.4
November	681	180	26.4	10.9
December	1,655	468	28.3	10.7
January	2,930	750	25.6	10.8
February	1,892	480	25.4	10.8
March	3,230	540	16.7	11.1
April	1,146	76	6.6	11.7
May	1,050	81	7.7	11.7
Total:	29,802	8,266	28.0	10.7

In the size composition of the catches, length-frequencies of male lobsters exceed those of female lobsters. Furthermore both absolutely and relatively more under-sized females than under-sized males are captured. A length-converted catch curve (assuming $L_{\infty} = 19.00$ and $k = 0.3$) for males and female lobsters gives a Z (total mortality) males = 0.97 and a Z females = 1.9. This indicates a much higher fishing mortality of female lobsters with an equal natural mortality ($M = 0.4 - 0.5$). In other words female lobsters are much more liable to enter the traps than males. In Florida males attain the size of 7.6 mm CL in an average of 23 months, whereas females require an average of 30 months (Muller et al. 1997). Catches on the Saba Bank consist for a large part of lobsters of 3 -5 years of age. Legal sized lobsters (9.5 mm CL) have the approximate age of 4-5 years, whereas 3 years old lobsters are predominantly under-sized.

The percentages of under-sized lobsters captured are particularly high in the relative shallow parts of the Saba Bank.

Analysis of the monthly length-frequency graphs shows that on the relative shallow fishing grounds in particular, the smaller lobsters were more frequently being

captured than on the other fishing grounds. It is possible that the shallower parts of the Bank are the habitat of the sub-adults (7.0 - 9.0 mm CL), which migrate to the deeper parts of the Saba Bank as they grow bigger. Recruitment is visible particularly in the shallow parts of the Bank in the months June-September/October and less in the deeper fishing grounds.

Reproduction

Male/Female ratio — In general the percentage of male lobsters exceeds the percentage of female lobsters. During the winter months however the percentage of female lobsters among the lobsters sampled increased substantially, and in the month of February even surpassed the percentage of male lobsters.

Berried lobsters and lobsters in ecdysis — Size of first maturity was found to be in the range 7.8-8.3 cm CL for all countries in the Western Central Atlantic Fishery (WECAF) region. In Brazil, the size at first maturity was estimated at 201 mm total length by Soares and Cavalcante (1985). For Cuba, the smallest size that a berried lobster was captured was 6.7 cm CL (Cruz and León 1991), and the estimated sizes at 50% and 100% maturity were 8.1 and 9.7 cm CL respectively. In the Turks and Caicos Islands, tar spot data were recorded from sampled landings. A logit model was used to separate seasons and size (Medley and Ninnes 1997). The results largely agree with other assessments, size at first maturity was 8.3 cm CL, 50% fecundity occurred at 9.3 cm CL and full fecundity at approximately 10.8 cm. CL. The smallest size that a berried lobster was captured on the Saba Bank during the time of the monitoring was 7.6 cm CL.

Besides legal size limits for lobsters the Fishery Law of the Netherlands Antilles also prohibits landing berried lobsters, and lobsters in ecdysis (molting lobsters). Berried lobsters and spermatophoric mass on the female's sternum (tar spot) were observed during the whole period of the project.

Table 2 shows the number of berried lobsters and the number of lobsters in ecdysis among the lobsters sampled from August, 1999 to May, 2000.

As is very clear from the table, the fishermen practically discontinued landing berried lobsters and lobsters in ecdysis after the Government commenced to enforce the fishery regulations on March 21, 2000.

Table 2. Number of female lobsters sampled, percentage of berried lobsters, and percentage of lobsters in ecdysis from April 23, 1999 to May 30, 2000.

	# Measured	# females		% berried		# lobsters		% lobsters	
		sampled	lobsters	lobsters	lobsters	ecdysis	ecdysis		
August	3,468	1,282	59	4.6	0	0.00			
September	2,191	814	49	6.0	1	0.05			
October	1,857	685	32	4.7	2	0.11			
November	681	298	5	1.7	1	0.15			
December	1,655	786	9	1.1	3	0.18			
January	2,930	1,381	19	1.4	12	0.41			
February	1,892	961	17	1.7	4	0.21			
March	3,230	1,450	162	11.2	6	0.19			
April	1,262	489	1	0.20	0	0.00			
May	1,047	405	2	0.49	2	0.19			
Total:	20,213	8,571	353	4.1	29				

DISCUSSION AND SIGNIFICANCE OF THE WORK

During the monitoring program it became evident that the Saba Bank fishery sector is of great importance to the island economy of Saba. The Saba Bank lobster fishery has developed into a viable semi-industrial fishery, and the means of production used in the fishery are among the most advanced utilized in the Netherlands Antilles. The contribution of the Saba Bank fishery sector, which generated approximately 1.1 million US\$ in 1999, is substantial to the island economy of Saba (GDP 15.7 million US\$);

- i) The sector provides employment to a relatively large number of people (8% of the economically active population). About 20 people generate a living exclusively from the fishery, while a relatively large group of approximately 30 people find part-time employment in it and so generate additional income in the fishery sector;
- ii) The added value and the generation of foreign exchange to the island economy of Saba are high.

It became apparent that a substantial part of the landings of lobsters consisted of illegal lobster catch. High percentages of under-sized lobsters and berried lobsters in the catch are a serious concern. Of all lobsters sampled during the study, 28 percent were under-sized. Practically all fishermen were landing large numbers of under-sized lobsters, which was encouraged by the restaurants, since small lobsters sell faster than large lobsters.

Throughout the course of the survey, relatively large amounts of berried lobsters were landed. It became apparent that certain fishermen were consistently landing berried lobsters, while others did not, unless there was a high demand for lobsters on the market. Most fishermen were willing to adhere to the regulations, but as others were repeatedly landing berried lobsters, they felt the "obligation" to do the same.

Although several fishery regulations have been in existence for quite some time, until recently they were not adequately enforced. The effectiveness of management measures is directly related to the extent they are accepted by the fishermen, and to the level of enforcement by the authorities. Most of the Saba Bank fishermen have the environmental awareness to exploit the resources of the Saba Bank in a sustainable manner. They are willing to adhere to the regulations, as long they are consistently and without exception enforced by the Government.

Enforcement is a key factor to create sustainable fisheries. The benefit to the resource users will only increase if the resource is effectively protected. As a direct result of this catch assessment survey, the Coast Guard of the Netherlands Antilles has commenced to strictly enforce the fishery regulations.

The following regulations are currently being enforced:

- i) Requirement of valid fishing licenses for both the Saban territorial waters and the Economic Fishery Zone (EFZ) of the Netherlands Antilles;
- ii) Use of the biodegradable panel;
- iii) Legal size limits for lobsters;

- iv) No landing of berried lobsters;
- v) Legal mesh size;
- vi) No landing soft-shell lobsters (lobsters in ecdysis).

The implementation of the fishery regulations by the Coast Guard of the Netherlands Antilles resulted in a substantial decline in illegal fishery activities:

- i) The number of under-sized lobsters decreased, and practically no berried lobsters and lobsters in ecdysis were brought in;
- ii) Illegal (non-licensed) fishing activities from both foreign and domestic vessels have practically stopped.

Regulation practices in the Netherlands Antillean lobster fishery differ slightly from those in the region. Regulations in the region rest on three main bases; minimum legal size, limited entry, and closed season.

Legal Size

The minimum legal size regulation in the Netherlands Antilles (minimum CL of 9.5 cm) is intended to allow the lobsters to achieve sexual maturity and to have the opportunity to spawn at least once, in order to preserve the stock's reproductive capacity. Other regional minimum legal sizes include: Cuba, 6.9 cm CL, (Estela de León and Puga 1997), Mexico, 7.4 cm CL, (Sosa-Cordero et al. 1997), USA, 7.62 cm CL, (Muller 1998), Jamaica, 7.62 cm CL, (Grant 1997), Bahamas, 8.25 cm CL, (Deleveaux et al. 1998), Bermuda, 9.2 cm CL, (Luckhurst 1998), St Lucia, 9.5 cm CL, (Joseph 1997), and Venezuela 12.0 cm CL, (Fernandez 1997). One can notice that the legal size in the Netherlands Antilles is among the highest, thus most restrictive, in the region.

Countries with a high level of management and research and large stocks can reduce their legal size, and adjust total fishing effort whenever necessary; for countries that do not possess the mechanisms to quickly adjust total fishing effort when necessary, such a more restrictive legal size is needed.

Limited Entry

Most of the WECAF-nations such as Bermuda, Cuba, the USA, Mexico, Colombia, Honduras, Jamaica, Nicaragua, Brazil, and Venezuela have some system of limited entry in place, where either the number of fishermen and/or the number of fishing units is restricted. In both the Saba island territorial waters as the Netherlands Antillean waters (EFZ) no lobster fishing can take place without a fishing license, but there are no restrictions to the number of fishing units per vessel. However, within the framework of the National Fishery Law it is possible to introduce such restrictions quite easily via a National Decree.

Closed Season

The main lobster producing countries in the region have a closed season in place. The closed season regulation has three main objective:

- i) Ensure reproduction during the peak spawning period;
- ii) Protect the molting period;
- iii) Allow growth and thus increase in weight, of a major part of the population (Cruz 1998).

The Netherlands Antilles has no closed season regulation in place as yet, but it might consider either closing the lobster fishery during the spring months in order to ensure reproduction during the peak spawning period or closing the lobster fishery during the hurricane season. During the hurricane season lobster sale and, consequently, fishing effort are traditionally low.

Closing the lobster fishery during the hurricane season has the following advantages:

- i) Prevent loss of fishing gear;
- ii) Allow precise counting and tagging of the lobster traps;
- iii) Allow growth and thus increase in weight, of a major part of the population (Cruz 1998).

Furthermore, the fishery regulations in all countries include a permanent prohibition to catch or land lobsters in ecdysis and female lobsters in reproductive condition. This also applies in the case of the Netherlands Antilles.

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