7 ASPECTS OF FISHING FOR SNAPPER (*Lutjanus purpureus*) ON THE NORTH COAST OF BRAZIL

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7.1 Background

Snapper fishing started as a subsistence fishery in the Northeast Region of Brazil, around 1961 with small boats and primitive gears. From 1961 onwards, Portuguese fishermen started to use manual longlines (*linhas "pargueiras"*). In the 1970s, a gear called *bicicleta* (literally "bicycle") began to be used as ancillary equipment for line recovery. Between 1974 and 1978, *linha pargueira* use expanded, but at that time it was used on board boats launched from a mother vessel.

Between 1980 and 1992, boat fishing was at its peak, but landed fish of poor quality due to poor handling of the catch. Subsequently, *linha pargueira*, operating with the *bicicleta*, expanded again and now combines productivity with good quality through improved handling of the catch. In 1997, snapper trap fishing started in the North Region with a small fleet, aiming at increasing productivity and quality.

The snapper fishing area in Brazil can be divided into three zones: the Oceanic Banks, the Northeast Continental Shelf and the North Continental Shelf. The North Continental Shelf, where the landings of the fleet are made in the State of Pará, is located between 46°20'W and 51°30'W. This area became important during the 1980s, having as its base the port of Bragança.

Presently, fisheries in the Northern Region use two different gears: "espinhel vertical" or "pargueira" (longline) and "covo" (trap). Longline "pargueira" is made with PA monofilament lines, 2mm diameter and 2330 DB (flatted shank) hooks, size 613 to 618 and it has 15 to 20 hooks per mother line (Fig. 7.1), with a lead weight of approximately 1.5kg. The gear to collect the main line is the bicycle ("bicicleta"). The "covo" or "manzuá" is a type of trap in the shape of a basket, with an iron structure surrounded by a PE screen (Fig. 7.2). The "sanga" (mouth) is funnel shaped and the lid, where the caught fish is kept, has a hinge, which facilitates removing the fish. The "covo" also has a bag where the bait is stored.

Comparing the two fishing systems above, traps appear to have some advantages. They appear to have a higher catch efficiency, although this should be verified through further analysis and they are more selective, allowing smaller individuals to escape, depending on the size of the funnel. Also, trap fishers land fish that is still alive, while with the "pargueira" fish die due to injuries caused by the hooks and/or to stress.

Among the species caught using "pargueira" longline and/or "manzuá" trap, there are: pargo piranga (*Rhomboplitis auroubens*), arabaina (*Elgatis bipinnulatus*), serigado (*Mycteroperca bonaci*), cioba (*Lutjanus analis*), ariacó (*Lutjanus synagris*), cangulo (*Balistes vetula*), cavala (*Scomberomorus cavalla*), garajuba (*Caranx barholomaei*), piraúna (*Cephalopholis fulva*), mariquita (*Holocentrus ascensionis*), garoupa (*Epinephelus morio*), sapuruna (*Haemulon aurolinatum*) and urbana verdadeira (*Elops saurus*).

There are three different types of vessels fishing snapper:

- Small Size Vessels ("Barco de Pequeno Porte – BPP") – engine powered boats (average of 24 HP), made of wood, with a total length ranging from 8 to 12 m and total hold capacity of 6 t. The boats are equipped with compass and echosounder, generally use longline and have trips up to 15 days at sea, fishing an average of 8 days and landing fish on ice. Usually the number of crew is 6.
- Medium Size Vessels ("Barco de Médio Porte – BMP") – engine powered boats (average 50HP), made of wood, with a total length above 12 m and a total hold

capacity of 8 t using ice. The boats are equipped with compass, GPS, VHF radio and echosounder and use longline or traps (“manzuá/covo”), with trips up to 25 days at sea, fishing an average of 11 days. When traps are used, the number of traps is usually 6. The usual number of crew is 8.

- Industrial Vessels (“Barco Industrial – BIN”) – engine powered boats (average of 150HP), with a steel hull, total length above 15m and a total hold capacity of 45t, using ice. The boats are equipped with compass, GPS-plotter, VHF radio, SSB radio and echosounder, using longline or traps (“manzuá/covo”). When traps are used, the number of traps is usually 10. The boat can make trips up to 60 days at sea, but currently, the trips for fresh fish last 10 to 20 days (average 15 days) and the usual number of crew is 19 (linha pargueira) or 12 if using traps.

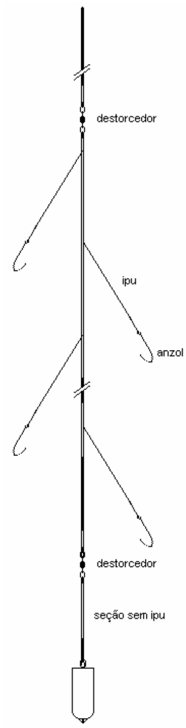

Figure 7.1 *Linha pargueira* used in the North Brazil Red Snapper fisheries

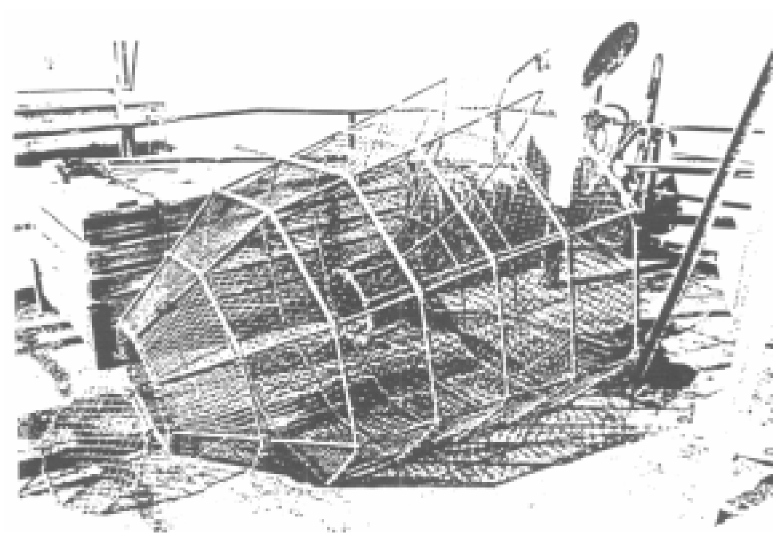

Figure 7.2 - Traps (*covo*) used to catch red snapper in North Brazil

7.1.1 Landing ports

In the North Region, all snapper is landed in the State of Pará at 11 different landing points. The main ports are Belém, Vigia, São João de Pirabas and Bragança (Fig. 7.3), which account for an average of 98% of the total landings.

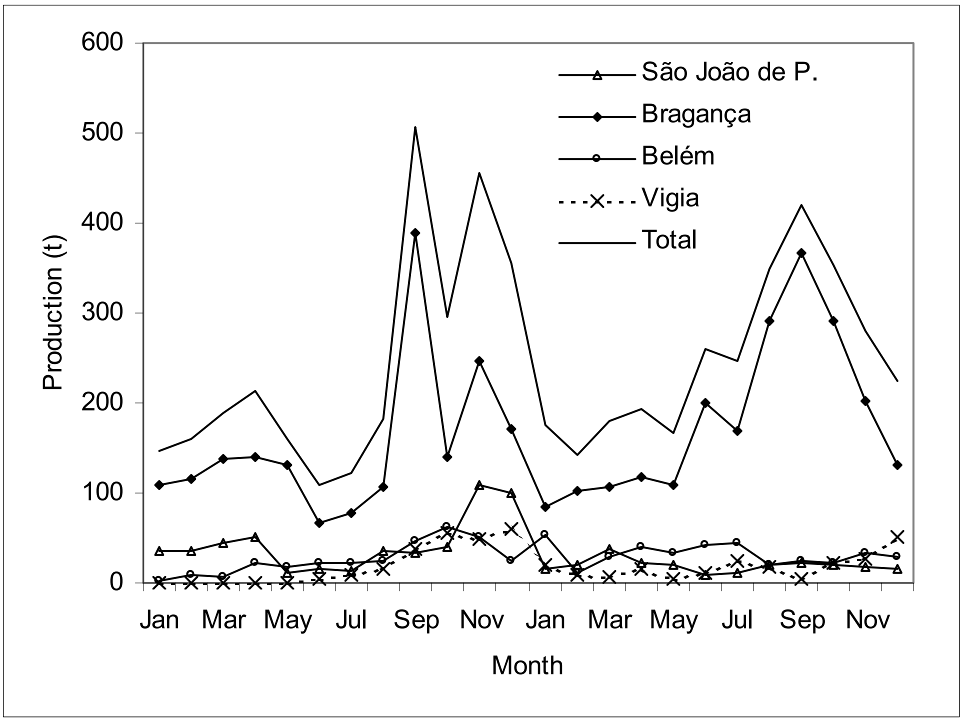

Figure 7.3 Landing production in 4 different landings sites in 1997-98

Belém

Presently, there are 4 fishing companies in Belém, with 5 steel boats, all of them using traps targeting fresh fish. Three of these companies catch, process and market the product and one of them is limited to catching fish only.

In 1998, the city of Belém accounted for a total landing production of 295.72 t of fresh snapper, with an average price of R$ 2.2 kg^{-1} (approximately US$ 1.35 kg^{-1}, using the present exchange rate). All the production is sold in the Brazilian Northeast region, mainly in the States of Ceará and Pernambuco.

Vigia

There is only one company fishing for snapper in Vigia. It has two steel boats, both operating with traps and also processes and markets the product. In 1998, Vigia accounted for the landing of 214.50 t of fresh snapper, which was mainly exported.

São João de Pirabas

There is only one fishing company located in São João de Pirabas fishing for snapper. It has a fleet of 20 wooden boats, although only 4 boats catch snapper and they use traps. This company does not process fish, but exports all landings to the Northeast Region. In 1998, São João de Pirabas accounted for landings of 232.62 t of fresh snapper.

Bragança

The city of Bragança is the largest landing area of the North Region, accounting for 62% of the total annual production. There is one ice plant, but no record of fishing companies operating in the city. Vessels come from other cities in the State, but land at Bragança.

All landings are exported to the Northeast Region, where intermediate companies acquire it. In 1998, Bragança accounted for the landing of 2 166.9 t of snapper. The records show a fleet of 58 boats, 93% of which operate with longlines and the remainder use traps.

7.1.2 Data collected in the north of Brazil

Landings and effort data in the North Region, from 1996 on, were obtained through the Estatpesca Project, carried out by the Centro de Pesquisa e Extensão Pesqueira do Norte do Brasil (CEPNOR/IBAMA), supported by the Superintendence for the Development of the Amazon (SUDAM) and the REVIZEE Program (Program for Assessment of Potentially Sustainable Resources in the Exclusive Economic Zone). Up to 1995, the Ministry of Agriculture collected the data on the snapper landings in Brazil only through inspections of the landed catch.

At present, data collection consists of forms filled out by data collectors on landings in each of the locations with fishing activities. The completed forms contain information on the species caught, prices, catch and fleet.

Biological data collection by SUDEPE began in the North Region of Brazil in early 1978 and continued until 1988. In August 1997, CEPNOR/IBAMA undertook this task, concentrating on samples taken at 4 landing points (Belém, Vigia, São João de Pirabas and Bragança). A sub-sample of 150 individuals to study reproduction and feeding cycles has been taken from the length samples. This project is also part of the REVIZEE Program.

7.1.3 Production

From 1995 to 1998, snapper fishing in the North Region had a total production ranging from 493 to 2 900 t year^{-1}. It has been suggested that in 1995 the production was underestimated due to the absence of a consistent sampling programme. In 1996, the sampling programme was adjusted to reflect more closely the characteristics of the region, but total production for this year was probably still underestimated (Fig. 5.1.7). Therefore for statistical purposes, only the years 1997 and 1998 may be used, as during these years collection was reliable.

For these last two years, snapper production has been stable, with landing peaks in October (Fig. 7.4). In Belém, snapper landings have remained stable over the last two years, despite a reduction in the number of boats. In Vigia, production decreased by 16.62 t, probably due to a relocation of BMP boats. In S.João de Pirabas, there was a reduction of 291 t in production also due to the decrease in the fleet size (BMP boats). In Bragança 1998, production increased to 337 t compared with previous years; this may be due to an increase in the fleet size (BPP boats) and the switch to traps by the end of 1997.

There are currently two fishing methods for snapper: "pargueira" (longline) is responsible for 50% of catchings in the area and is used by the larger number of vessels. Traps started to be used in August 1997 by a steel boat based in the city of Vigia (Fig. 7.5). During the last two years (1997-98), wooden vessels with longline accounted for 60% of the total catch, steel vessels with longlines for 22%, wooden vessels with traps for 13% and steel vessels with traps for 5%.

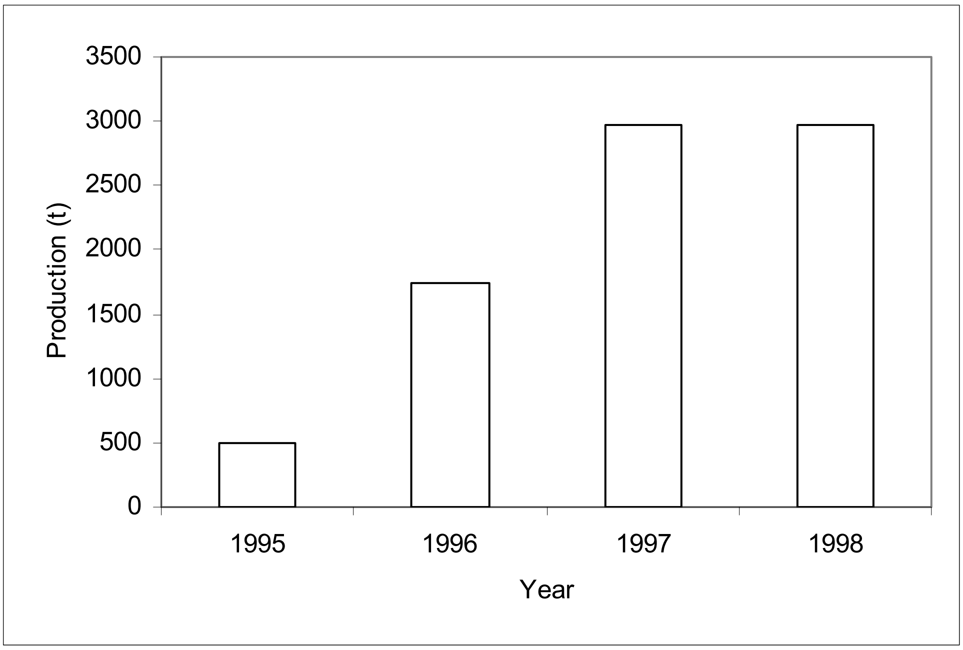

Figure 7.4 Annual production of snapper in northern Brazil. The increase in estimates from 1995 to 1997 is probably due to improvements in the sampling programme rather than any real increase in production

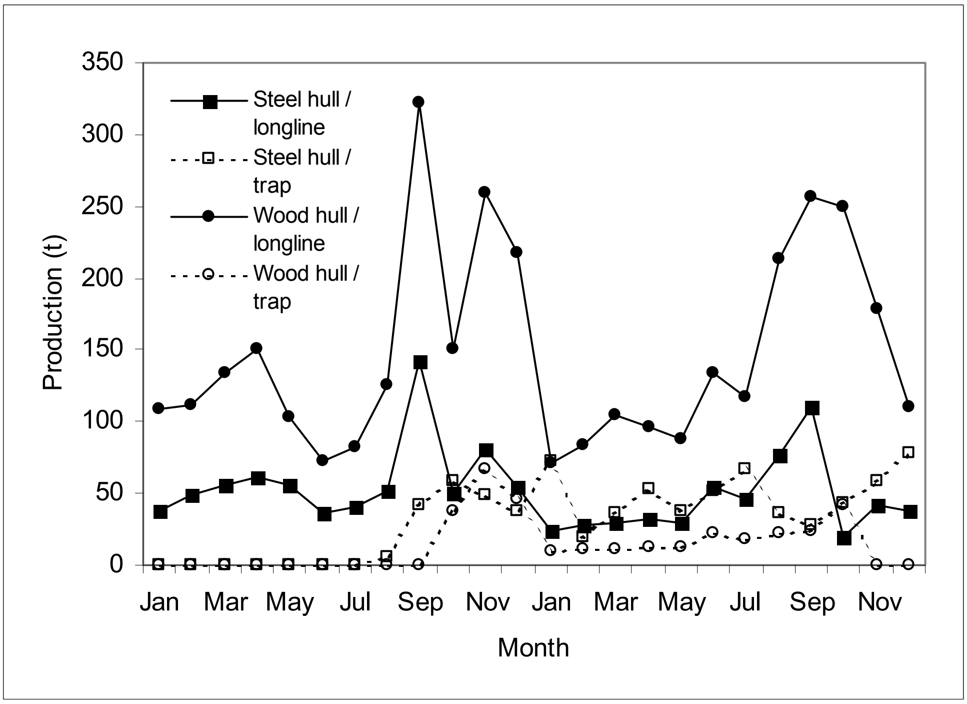

Figure 7.5 Production in North Region for different gears 1997-98

7.1.4 CPUE

CPUE for this analysis was calculated as metric tonnes per day (t day^{-1}). Calculations were performed to verify the CPUE behaviour during the years of 1997 and 1998, for the different fishing systems and fishing boats in the 4 ports reporting snapper landings. CPUE was calculated as follows:

CPUE = Landing (t)/Days at sea

CPUE (average) = Total Landed (t)/Total days at sea

The highest CPUE was found in the steel vessels fishing with traps (Fig. 7.6). The longline fishing showed an average CPUE of 0.569 (steel boat) and 0.389 t day^{-1} (wood boat) in the year of 1998. The traps showed an average of 0.688 (steel boat) and 0.371 (wooden boat) t day^{-1} in spite of having a smaller number of vessels.

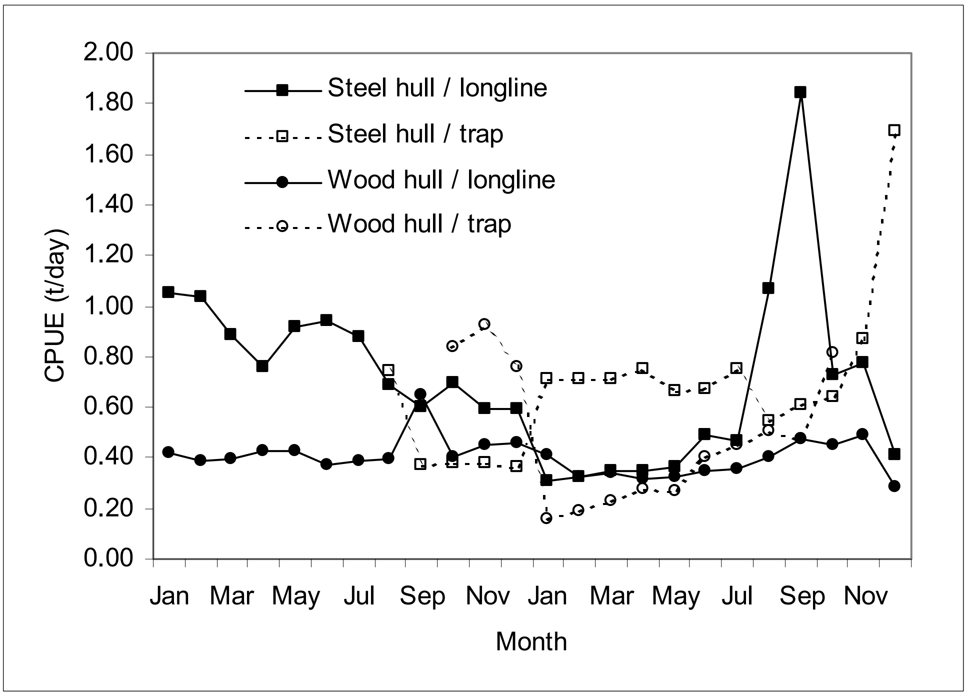

Figure 7.6 Average catch rates for each vessel / gear type 1997-1998

During the last two years, a transition in the fishing system was observed, with a switch from longline to trap. Two of the four landing points, Belém and Vigia, with the exception of only one wood boat in Belém, do not use the longline any more. Snapper fishing in these two cities is carried out only by steel boats with traps and has shown a growth in CPUE during the last two years, which may continue to increase even further into 1999.

7.1.5 Biological parameters

Biological studies for snapper started in 1967, when the first growth curve was determined (Menezes and Gesteira, 1974), but at this time snapper fishing was of a low intensity (Ivo and Hanson, 1982). The von Bertalanffy growth parameters determined at that time were:

L_∞ = 98.9cm, K = 0.090 and t_0 = -2.7 years.

From 1970 to 1975, data on catch and effort were collected and biological samples were taken at landing sites. During this period, reproduction studies were done and the spawning was found to be discontinuous and periodic (biannual) and the size at first sexual maturity for females was estimated as 42 cm in total length (Gesteira and Ivo, 1973).

In 1979-82, scale readings were carried out on 430 individuals of both sexes and the following growth parameters were estimated: L_∞ = 92.9cm, K = 0.103 and t_0 = 2.8 years.

With the data from 1967-81, total mortality was estimated from a catch curve as Z = 0.835 $year^{-1}$ (Fonteles-Filho and Oliveira, 1983)

Ivo and Hanson (1982) presented two hypotheses for the snapper stock. The first one suggested the existence of only one stock, with two classes of individuals, originating from two different periods of spawning, one in March-April and the other one in October. The second hypothesis suggested the existence of two stocks because of the difference in the period of spawning, with two groups of females spawning once each year. Sales (1998) conducted a genetic analysis and observed the existence of two red snapper stocks one from the Northeastern (43°-46°) and the other from the Northern Region (47°-49°). Therefore, the second hypothesis proposed by Ivo and Hanson (1982) seems to be the correct one.

7.1.6 Preliminary analysis of the biological datat

Growth

Data on the total length from landings samples taken in 1998 were used. They were grouped in 2cm frequencies every three months. Frequencies ranged from 19 to 84cm throughout the year. The Bhattacharya method was used to determine cohort growth and ELEFAN to estimate growth parameters. Nevertheless, the analysis was not considered satisfactory and therefore published estimates were used for the calculations: L_∞ = 92.9cm, K = 0.103 and t_0 = 2.8 years (Ximenes and Fonteles-Filho 1988).

Natural mortality

An estimate of natural mortality was obtained with FISAT, through the equation of Pauly, where the value of M = 0.29 was obtained. Analyses were also repeated using an estimate from the literature for M = 0.20 (Gesteira and Ivo, 1973).

Fishing mortality

Fishing mortalities were determined by a length-converted catch curve (Table 7.1). An increase in fishing mortality in the third quarter was observed due to the increase in the fishing effort.

Yield-per-recruit (YPR) simulations were carried out using two values for natural mortality M=0.2 and M= 0.29 (Table 7.2). The analysis result shows that using M= 0.2 seems to give the most reliable results, since the values obtained represent the actual red snapper fishery stage.

Management measures may be needed to protected the spawning stock as $SBR_{40\%}$ reference point (F=0.33), since the average fishing mortality (F=0.75) is much higher than the $F_{0.1}$ (F=0.46) related to conservation reference point (Fig. 7.7). Hence, the stock is probably overexploited. Additional analyses will be necessary to verify the effect of fishing on the spawning stock and recruitment.

Table 7.1 Fishing mortality estimates for *Lutjanus purpureus* in 1997

	R^2	F (M=0.29)	F (M=0.2)
1 quarter	0.79	0.539	0.629
2 quarter	0.94	0.577	0.667
3 quarter	0.94	0.905	0.995
4 quarter	0.89	0.644	0.734
Mean		0.666	0.756

Table 7.2 Simulations of yield per recruit (YPR) and various biological reference points, using two values of natural mortality (M)

M=0.2	F	F+0.01	SBR	YPR (F)	YPR (F+0.01)	Slope	SB 50%	SB 40%	SB 30%	0.1 Slope
F=0	0	0.01	519.57	0.00	8.28	8.28	259.79	207.83	155.87	0.83
0.1 Slope = 0.8277	0.46	0.46	143.82	162.06	162.89	0.83	71.91	57.53	43.15	0.08
SB 50% = 259.787	0.25	0.26	259.79	126.30	128.99	2.68	129.89	103.91	77.94	0.27
SB 40% = 207.8296	0.33	0.34	207.83	144.59	146.37	1.79	103.91	83.13	62.35	0.18
SB 30% = 155.8722	0.43	0.44	155.87	159.28	160.27	0.99	77.94	62.35	46.76	0.10
M=0.29	**F**	F+0.01	SBR	YPR(F)	YPR (F+0.01)	Slope	SB 50%	SB 40%	SB 30%	0.1 Slope
F=0	0	0.01	302.68	0.00	5.15	5.15	151.34	121.07	90.80	0.51
0.1 Slope = 0.5151	0.50	0.51	75.80	108.18	108.69	0.51	37.90	30.32	22.74	0.051
SB 50% = 151.34	0.25	0.26	151.34	81.03	82.81	1.78	75.67	60.53	45.40	0.18
SB 40% = 121.071	0.33	0.34	121.07	93.43	94.66	1.22	60.53	48.43	36.32	0.12
SB 30% = 90.803	0.44	0.45	90.80	103.90	104.63	0.73	45.40	36.32	27.24	0.07

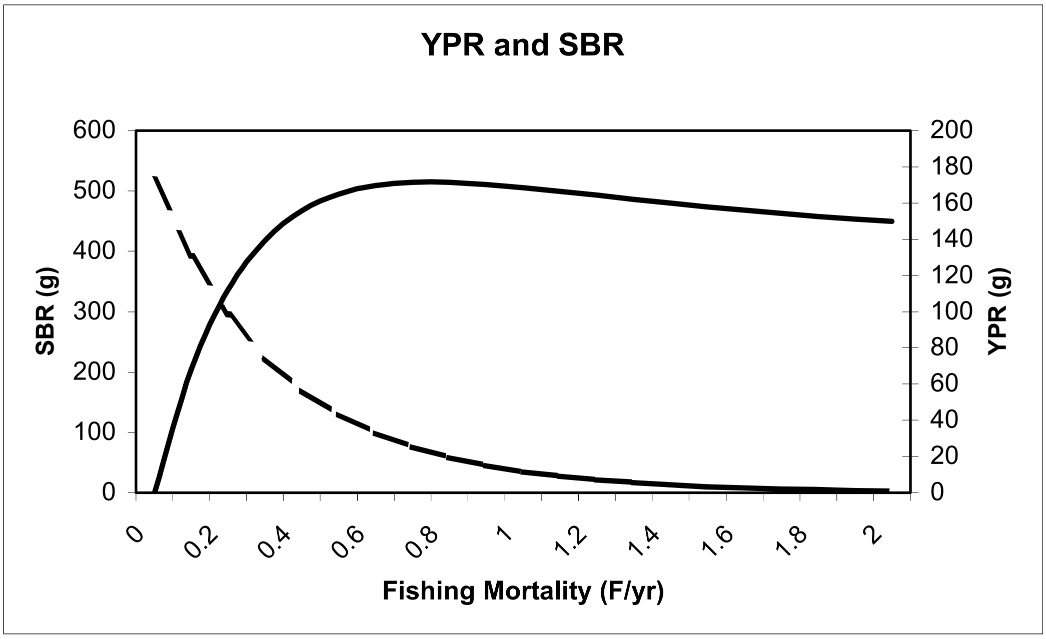

Figure 7.7 Yield-per-recruit (--) and spawning stock biomass per recruit (- -) (M=0.2)

7.1.7 Conclusions

- Total production remained stable over the last two years.
- Traps have a higher catch rate than longlines.
- There is a production peak in the third quarter of the year.
- Licences for boats operating with traps and for boats operating with longlines must be assessed separately.
- The yield-per-recruit analysis suggests that the stock may be overexploited.
- Data collected in 1997 do not permit calculation of growth parameters (L_∞, K and t_0), possibly because biological samplings come from two different stocks.

7.1.8 Recommendations

- For a better analysis of catch and effort, data collection on landings in the region must be maintained.
- For at least four more years, additional vessels should not be allowed to fish until a better bio-economic analysis can be done.
- From the total licences granted for snapper fishing, a ratio for trap fishing should be established.
- Separate analyses should be carried out for each sample representing the different stocks.
- We suggest that the $F_{0.1}$ be considered as the target reference point.