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BIOLOGICAL AND STOCK ASSESSMENT STUDIES RELATING PRINCIPALLY TO THE DEMERSAL FISHERIES OF SEYCHELLES.

A brief review of past activities and future requirements

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1. INTRODUCTION

Following completion of the Co-operative programme between Seychelles Fishing Authority and ORSTOM relating to the biological study of certain key species from the Seychelles artisanal fishery, this report reviews past activities in this field and identifies future requirements.

2. PREVIOUS ACTIVITIES

2.1 RESEARCH CRUISES : DEMERSAL TRAWLING

A number of research cruises were conducted between 1968 and 1979 which employed demersal trawls. These have been reviewed by Tarbit (1980). Species compositions and catch rates were related to hydrological conditions and fishing grounds. The most commonly caught species was Lutjanus sebae (Bourgeois).

2.2 MISCELLANEOUS DATA. Between 1976 and 1984 Length and weight measurements were made on a large number of species. Sample sizes tended to be too small or irregular for stock assessment purposes. However, this data has been compiled along with other information available in the literature (such as the above research cruises) and is presented in a report by Moussac (1988a). This report summarises the information available in relation to:

a) Length, weight, reproduction and feeding behaviour, by species.
b) Estimates of biomass/density of fish (total) by area.
c) Summary of Catch and Effort data.

Species covered in section (a) include, for the demersal fishery, 10 species of Lethrinidae, 10 species of Lutjanidae and 6 species of Serranidae. For section (b) Tarbit (1980) has estimated the trawlable biomass of certain selected species, including: Lutjanus sebae, Aprion virescens, Lutjanus bohar and Lutjanus lineolatus.

2.3 SPECIES DATA. Analyses of the data available have been conducted in relation to two demersal species: Lutjanus sebae and Epinephelis chlorostigma.

L. Sebae: growth, mortality and reproduction were estimated employing length frequency data from research cruises, and estimates of the density of this fish and potential yield were given. Details were related to the commercial schooner fishery. (Lablache and Carrara, 1988).

A preliminary estimate of growth and mortality was made using data collected as part of the recent ORSTOM study, but this paper is not available and may not have been published. (Bach, in prep.).

E. Chlorostigma: preliminary estimates of growth, mortality and spawning activity were made based on catches by handline from schooners betwen 1983 and 1986 (Sanders et. al. 1988). Evidence that the species is a protogynous hempaphrodite has been presented (Moussac, 1986).

2.4 ORSTOM STUDY. The ORSTOM/SFA programme to examine the biology of key species from the artisanal demersal fishery identified the following species: Lutjanus sebae, Epinephelis chlorostigma, Aprion virescens, and Pristipomoides filamentosus. The objectives were:

- to collect statistics on landed catches
- to collect otoliths (for age determiantion)
- to examine reproduction
- to estimate natural and fishing mortality
- to apply classical stock assessment models to assess stock sizes.

The data collected is discussed below (see 3).

At the end of the study period the ORSTOM representative did not produce a final report summarising what data had been collected or what analyses were intended. The only current account of the work conducted is that referred to above (Bach, in prep) which is not available. Further analyses are anticipated: the contract allows for a 6 month analysis and writing up period in France. Details of what is intended have been requested and are necessary to ensure that full use if made of the data available, and to plan for future requirements.

2.5 OTHERS

a) Ranina ranina. The spanner crab (or kona crab or crabe girafe) has been fished commercially from the Mahe plateau since 1987. Preliminary estimates of growth and mortality (Moussac, 1988b) and details of biology and exploitation (Moussac 1988c) have been presented in relation to details collected from the commercial fishery. Length frequency data continues to be collected and research cruises aimed at assessing the distribution and abundance of this species have been conducted. These data remain to be analysed.

b) Deep water crustaceans and fish, species compositions, catch rates and distribution by depth are reported from a research cruise by N.O. Alis (Intes and Bach, 1989).

c) Lobsters. A study of the distribution of lobsters by species was conducted throughout the islands of Seychelles (Intes, et al. n.d).

3. DATA COLLECTION

Data collected through the ORSTOM study whilst supervised by P. Bach was as follows:-

3.1 LENGTH FREQUENCY DATA

The length, sex and maturity stage were recorded for each of the key species thus:

L. sebae. Measurement started 05/02/86
Measurement ceased 15/08/89.
Total 42 months.

5,813 fish were measured in 1987, 20,866 in 1988 and 3,305 in 1989. All data was entered onto a computer data-base. Length was measured to the nearest millimetre.

A.virescens. Measurements started 04/05/88
Measurements ceased 18/08/89.
Total 15 months.

Length was measured to the nearest millimetre. No data was entered onto database.

P.filamentosus. Measurements started 04/05/88
Measurements ceased 18/08/89.
Total 15 months.

Length was measured to the nearest millimetre. No data was emtered onto databse.

E.chlorostigma. Measurement started 04/01/88
Measurement ceased 18/08/89.
Total 18 months.

Length was measured to the nearest centimetre. No data was collected regarding sex or maturity stage. No information was entered onto database.

The above data was collected from fish at the SMB fish division in Victoria. Owing to the fact that fish from district collection centres arrives in bulk it was not possible to identify the fishing grounds from which individual specimens were caught. Data was collected in relation to landing site (collection centre) but this can only provide a very rough indication of fishing-grounds, if any at all. Boats landing directly to SMB Victoria offer some opportunity to obtain data specific to the fishing areas, but generally more than one boat lands at any one time and the fish are mixed as they enter the sorting/handling area. It is thus difficult to obtain fishing area-specific data.

Some length data was also collected by Fisheries Field Workers directly at the landing sites. If these fish were sold to the SMB collection centre there is a possibility that tney could have been measured twice.

All fish sold to SMB are gilled and gutted. However, remnants of the gonads remain in most fish allowing assessment of sex and maturity stage. The latter was only recorded for females, and a scale of 1 (immature) to 5 (spent) was employed.

3.2 BIOMETRIC AND OTHER STUDIES

Length-Eviscerated Weight relationships were derived for L. sebae and E. chlorostigma, otherwise, only L. sebae was selected for further studies. These included egg counts, general information relating to the condition of the fish, otolith studies and biometric details. Fish for these studies were purchased directly from the boat and so it was possible to relate the information to a specific fishing location (as far as the fishermen would provide it). 30 to 35 fish were usually purchased on each occasion, and in total 1,280 fish were studied between 18/09/87 and 27/08/89.

The following details were recorded for each fish: fish number, date, fishing location, Total length, fork length, standard length, whole-weight, Length of first dorsal spine, distance between lateral line and 1st dorsal spine, distance between the first dorsal spine and mouth, diameter of the eye, pre-opercular width, opercular width, sex, gonad weight, maturity stage, liver weight. In addition, after evisceration the total, fork and standard lengths were remeasured and the gutted weight recorded.

Reproduction studies included a description of the gonad, total gonad weight and 3 sample weights used for egg counts and measurements. The three samples were each removed from different areas of the ovary. Data was related to the fish number. Similarly, removed otoliths were related to the fish number.

Data from the biometric studies may be used to establish whether the population of L.sebae on Mahe plateau consists of a single homogenous population or several discrete populations.

The data from biometric and reproductive studies of L.sebae has been entered onto database.

4. IDENTIFICATION OF KEY SPECIES

Table 1 indicates the volume of demersal fish caught by species (or species-group) by boat-type between 1985 and 1988. Table 2 indicates the proportion of the total demersal catch represented by each species, whilst Table 3 indicates the proportion of the demersal catch of each species group landed by each boat-type. The separation by boat-type is an indirect way of assessing the fishing grounds: Schooners have the greatest range and tend to fish on the edge of the Mahe plateau and in the Amirantes; Whalers can fish the edge of the Mahe Plateau in good weather but mostly will fish in Sector I (defined previously, see Lablache and Carrara 1988), within about 10 miles of the main islands; whilst the outboards and pirogues (others) tend to fish in nearshore coastal areas.

From Table 2 it may be seen that the most important species are (in descending order): Bourgeois (L. sebae, 31.6% of demersal catch); Job gris (A. virescens, 11.3%); Lascar (Lethrinus enigmaticus, according to Smith, and L. crocineus, 9.39%); Maconde (E.chlorostigma, 9.11%); Vieille Platte (Epinephelus flavocaeruleus and E. multinotatus, 8.80%); Job jaune (Aphareus rutilans, but SMB call Pristipomoides filamentosus job jaune and it is also called Batrican and Kal Kal, 7.51%); Vara vara (Lutjanus bohar, 6.87%). The remaining species all represent less than 5% of the demersal catch. Note that these figures relate to schooner catches only, since grouped data is provided for the other boats. The species-group distribution is similar for schooners and the other boats and it must therefore be assumed that species distribution is also similar.

By boat type, red snappers, vara vara and other vielle are caught mostly by whalers and schooners indicating they may not be so abundant in coastal waters. By contrast, capitaine are caught more by the small boats, then whalers, and little by the schooners. Vielle maconde is caught equally by all boat types, whilst whalers catch the most job. This information may be of some use in targeting where to collect data if sample sizes are small.

Table 4 indicates the proportion of demersal fish purchased by SMB represented by each species group during 1987 and 1988, and the proportion of each species-group which was subsequently exported. Table 5 indicates the proportion of exports of demersal fish represented by each species group.

From Table 4 it may be seen that the volumes of fish purchased by SMB are almost in direct proportion with those caught (Table 2). There is a slight tendancy to purchase more vielle and red snapper but this is not pronounced. The only major difference between catches and purchases is that Capitaine represent 24.7% of the catch but only 13.8% of purchases. However, this may be more due to the fact that they are caught predominantly by small boats (Table 3) and sold directly, rather than purchasing policy of SMB.

From Table 5 it may be seen that the volume of demersal fish exported by species is not in proportion with either catches (Table 2) or purchases (Table 4), and that red snappers predominate (41.64% of exports) followed by Maconde 21.76%) and Job (15.28%). Table 4 indicates that 88.5% of all maconde purchased are exported, 52.9% of red snapper and approximately one third of each of the remaining species with the exception of vara vara of which only 8.3% is exported. The red snapper are predominantly L. sebae.

From the above analyses it would seem that the key species are:

Catch: L.sebae > A.virescens > L.enigmaticus > E.chlorostigma > Vielle platte (2 species) > P. filamentosus (Job jaune, maybe more than one species) > L. bohar

Exports: L. sebae > E.chlorostigma > Job (A.virescens and P. filamentosus) > Other vielle (several species) > Capitaine (several species).

The species presently regarded as 'Key-species' are L.sebae, E.chlorostigma, A.virescens and P.filamentosus. The above analysis would not tend to indicate otherwise, although L.enigmaticus (Lascar) could possibly be included though it is of lesser commercial value.

Maconde is of particular economic value through exports, but due to its hermaphroditic nature, stock assessments based on Length frequency analysis and estimates of natural and fishing mortality are difficult to achieve. Energy normally put into growth is utilised in sex change and egg production making the definition of distinct size (age) classes difficult. Furthermore, gutted maconde at SMB do not tend to have remains of gonads making sexing impossible.

Job jaune is Aphareus rutilans whilst Batrican is Pristipomoides filamentosus. It is the latter species which SMB calls Job Jaune (B. Vidot, pers. comm.).

However, this should be verified since P. filamentosus tends to be caught in deeper water (see Intes and Bach, 1989) and would not therefore tend to be associated with catches including L.sebae, A.virescens. Similarly E.chlorostigma is reported to be caught in deep water (200-250m, Intes and Bach, 1989). Other deep water snappers recently appearing in catches include Etelis marshi and E.carbunculus (both called Job rouge) and these may be worthy of investigation should the deep water fishery develop in the future.

5. FUTURE REQUIREMENTS

5.1 OBJECTIVES

The primary objective indicated by the Research Director relates to stock assessment and thus in descending order of importance objectives of the future programme are:

(i) - to collect catch and effort data (by species) on the landed catches

(ii) - to estimate natural and fishing mortality, and growth rates

(iii) - to apply stock assessment models to assess stock sizes

(iv) - to verify age estimates employing otoliths

(v) - to employ morphometric studies to establish whether populations are discreet

(vi) - to examine reproduction

The extent to which such a programme of research can be achieved is dependent upon staff and funding. Assessment of catch of effort is presently catered for through the Catch Assessment Survey conducted by SFA. Two Research Technicians have been assigned to the other tasks, but during 1990 both will leave the project temporarily, although it is hoped to replace one or both of them for the period they are absent.

The collection of length frequency data is considered to offer the best opportunity to achieve objectives (ii) and (iii) in conjunction with catch and effort data, and can be achieved easily with the staff available for a number of species. Otoliths (objective (iv) may also be collected from a small number of fish covering the size range observed for each species.

Their analysis, however, is a specialised task and whilst attempts should be made with some specimens to count the growth rings (for training purposes and to develop the skills of the Research Technicians) it is suggested that use be made of commercial laboratories for accurate assessment. Funding would need to be sought for this.

Sought of the morphometry and reproduction of the fish require a greater amount of time. These specimens should be ungutted and detailed information is necessary in relation to the fishing area (and if possible, depth). It is suggested that given the manpower constraints only one species should be studied in depth.

5.2 PROPOSALS FOR THE DEMERSAL FISHERY

It is proposed that the Key species for study remain unchanged i.e. L.sebae, E.chlorostigma, A.virescens, P.filamentosus. Length frequency data should be collected on all of these fish (Note that the size class for E.chlorostigma should be reduced from 1cm to at least 0.5cm and possibly 1mm; the possibly of increasing all intervals to 0.5cm should be examined). Use should be made of the historical data already collected.

Morphometry and reproduction should be studied for A.virescens; L.sebae having been comprehensively studied by ORSTOM, and E.chlorostigma having previously been studied in relation to reproduction by Moussac (ORSTOM/SFA). Time permitting, specimens of E.chlorostigma should be studied to examine the feasibility of establishing morphometric differences with this hermaphroditic fish. Specimens for these studies obtained from commercial catches should be supplemented with fish caught on research cruises by the SFA vessel ETELIS. These fish, caught by a variety of different gears, may exhibit different size distributions to the fish caught commercially by handline (note that measurements for morphometric studies should be accurate to 1mm).

5.3 OTHERS

a) CRABE GIRAFFE (Ranina ranina). Length frequency data should continue to be collected for the commercial catches. Analysis of this data and that from research cruises is necessary.

b) ETELIS sp. Steps should be taken to ensure that catch statistics are collected from SMB and in the field in relation to these species which are beginning to appear in catches. Should the volume become significant similar studies to those for the demersal fish above should be conducted, even if the proportion of the catch represented by Etelis sp. is small: they represent a different fishery based on the deep-slopes of the plateau.

c) LOBSTERS. The reopening of the lobster fishery during November 1989 and lack of any detailed information of Seychelles lobster fishery suggests that priority should be given to assessing this fishery. Catch and effort statistics should be collected (new data collection forms may be necessary) and length frequency, length weight, and morphometric relationship should be established. The Research Technician and Senior Field Worker assigned to the Catch Assessment Survey should conduct this work. In addition, since samples will be biassed with respect to size and sex, and no specimens with eggs should be collected, an independant programme of research should be devised not only to enable collection of representative samples, but also to examine factors such as seasonal settlement of lobsters from the planktonic larval stage, and possibly their geographic distribution in relation to prevailing currents.

Separate detailed descriptions of the work programme to be conducted by Research Technicians are necessary for all of the above proposals, and for the lobster research. Project funding submissions will be necessary for the otolith studies, morphometric studies involving purchase of fish and the lobster research.

TABLE 1: VOLUME OF DEMERSAL FISH CAUGHT BY BOAT TYPE 1985 - 1988

SPECIES	GROUP	1985			1986			1987			1988			TOTAL		
		SCH	WHA	TOT	SCH	WHA	TOT	SCH	WHA	TOT	SCH	WHA	TOT	SCH	WHA	TOT
BOURGEOIS		84.1			155.			188.			101.			530.		
BORDEMAR		14.2			21.2			18.7			17.8			71.9		
THERESE														0		
	RED SNAPPER	98.3	88.7	121.	177.	307.	544	207.	220.	455.	119.	10.6	283.	602.	627.	1404
VARA VARA	VARA VARA	19.5	8.3	18.2	23.3	42.8	66.5	40.3	50.6	91.5	31.9	10.5	91.5	115	112.	267.
JOB GRIS		33.5			60.5			46.5			49			189.		
JOB JAUNE		3.2			16.9			63.3			42.3			125.		
BATRICAN		3.3			0.1			0.1			0			3.5		
	JOB	40	60.5	121.	77.5	168.	298.	109.	197.	342.	91.3	38.5	371	318.	464.	1133
V. MACONDE	V. MACONDE	24.8	26.8	52.3	27.8	59.0	139.	55.6	46.4	125	44.3	1.3	97	152.	133.	413.
V. PLATTE		27.9			43.7			48.9			26.9			147.		
TIOFFE		3.6			4.2			7.9			6.2			21.9		
CROISSANT		3.2			3.8			7.1			5.6			19.7		
OTHER VIELLE		3.9			4.4			8.7			7			24		
	OTHER VIELLE	38.6	3.7	26.4	56.1	85.2	155.	72.6	40.6	122.	45.7	2	88.5	213	131.	393.
C. BLANC		8.6			11.6			13.1			13.8			47.1		
GUEELLE LONGUE		2.3			4.6			7.2			2.8			16.9		
LASCAR		26.4			24.1			54.2			52.6			157.		
C. BERRIE		0.33			1.9			3.4			3.1			8.73		
C. ROUGE		5.5			11.1			7.1			7.5			31.2		
BACSOUS		0.8			5.4			2.6			2.1			10.9		
	CAPITAINE	43.9	104.	185.	58.7	163.	397	87.6	117.	307.	81.9	12.8	300.	272.	398.	1190
TOTAL DEMERSAL		265.	292.	525.	420.	826.	1601	573.	672.	1444	414.	75.7	1232	1673	1867	4803

TABLE 2: TO SHOW THE PROPORTION OF THE DEMERSAL CATCH OF EACH BOAT TYPE REPRESENTED BY EACH SPECIES

SPECIES	GROUP	1985			1986			1987			1988			TOTAL		
		SCH	WHA	TOT	SCH	WHA	TOT	SCH	WHA	TOT	SCH	WHA	TOT	SCH	WHA	TOT
BOURGEOIS		31.7			37.0			32.8			24.5			31.6		
BORDEMAR		5.35			5.04			3.26			4.29			4.29		
THERESE		0			0			0			0			0		
	RED SNAPPER	37.0	30.3	23.1	42.1	37.2	33.9	36.1	32.7	31.5	28.8	14.0	23.0	35.9	33.6	29.2
VARA VARA	VARA VARA	7.35	2.83	3.46	5.54	5.18	4.15	7.03	7.52	6.33	7.69	13.8	7.42	6.87	6.01	5.57
JOB GRIS		12.6			14.3			8.11			11.8			11.3		
JOB JAUNE		1.20			4.01			11.0			10.2			7.51		
BATRICAN		1.24			0.02			0.01			0			0.20		
	JOB	15.0	20.6	23.2	18.4	20.3	18.6	19.1	29.3	23.6	22.0	50.8	30.1	19.0	24.8	23.5
V. MACONDE	V. MACONDE	9.35	9.15	9.95	6.61	7.14	8.71	9.69	6.89	8.65	10.6	1.71	7.87	9.11	7.15	8.61
V. PLATTE		10.5			10.3			8.53			6.48			8.80		
TIOFFE		1.35			0.99			1.37			1.49			1.30		
CROISSANT		1.20			0.90			1.23			1.35			1.17		
OTHER VIELLE		1.47			1.04			1.51			1.68			1.43		
	OTHER VIELLE	14.5	1.26	5.02	13.3	10.3	9.73	12.6	6.03	8.47	11.0	2.64	7.18	12.7	7.04	8.18
C. BLANC		3.24			2.75			2.28			3.32			2.81		
GUEELLE LONGUE		0.86			1.09			1.25			0.67			1.00		
LASCAR		9.95			5.73			9.45			12.6			9.39		
C. BERRIE		0.12			0.45			0.59			0.74			0.52		
C. ROUGE		2.07			2.63			1.23			1.80			1.86		
BACSOUS		0.30			1.28			0.45			0.50			0.65		
	CAPITAINE	16.5	35.7	35.2	13.9	19.8	24.7	15.2	17.4	21.3	19.7	16.9	24.4	16.2	21.3	24.7
TOTAL DEMERSAL		100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

TABLE 3: TO SHOW THE PROPORTION OF THE CATCH OF EACH SPECIES GROUP LANDED BY EACH BOAT TYPE

SPECIES GROUP	1986			1987			1988			TOTAL		
	SCH	WHA	OTH	SCH	WHA	OTH	SCH	WHA	OTH	SCH	WHA	OTH
RED SNAPPERS	32.5	56.5	10.8	45.4	48.3	6.12	42.1	3.73	54.0	42.8	44.6	12.4
VARA VARA	35.0	64.4	0.48	44.0	55.3	0.65	34.8	11.4	53.6	42.9	41.9	15.0
JOB	25.9	56.3	17.6	32.1	57.6	10.2	24.6	10.3	65.0	28.1	40.9	30.9
VIELLE MACONDE	19.9	42.3	37.7	44.4	37.1	18.4	45.6	1.34	52.9	36.8	32.2	30.8
OTHER VIELLE	35.9	54.6	9.36	59.3	33.1	7.51	51.6	2.25	46.1	54.1	33.4	12.3
CAPITAINE	14.7	41.2	43.9	28.4	38.0	33.4	27.2	4.25	68.5	22.8	33.4	43.6

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TABLE 4: PURCHASES OF DEMERSAL FISH BY SMB AND THE PROPORTION EXPORTED.

SPECIES GROUP	PURCHASES			% EXPORTED		
	1987	1988	TOTAL	1987	1988	TOTAL
ALL SPECIES- MT	1092.	892.8	1985.	46.03	44.73	45.44
RED SNAPPER	36.88	29.01	33.34	56.32	47.82	52.99
VARA VARA	5.143	6.304	5.665	4.733	11.83	8.285
JOB	20.86	26.92	23.58	24.49	38.68	31.77
MACONDE	12.43	9.708	11.21	95.88	77.05	88.54
OTHER VIELLE	12.73	12.02	12.41	35.33	37.79	36.40
CAPITAINE	11.93	16.01	13.77	29.13	47.90	38.95

TABLE 5: THE PROPORTION OF THE TOTAL SMB EXPORTS REPRESENTED BY EACH SPECIES GROUP

SPECIES GROUP	1985	1986	1987	1988	TOTAL
ALL SPECIES- MT	148.4	184.6	502.9	399.4	1235.
RED SNAPPER	43.20	53.85	45.12	31.02	41.64
VARA VARA	4.075	1.002	0.528	1.667	1.393
JOB	17.15	7.881	11.09	23.28	15.28
MACONDE	19.91	22.90	25.91	16.72	21.76
OTHER VIELLE	14.67	12.63	9.780	10.15	10.91
CAPITAINE	0.976	1.717	7.553	17.15	8.994

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