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Background Paper: SFA 02

Results of the Catch Assessment Survey (CAS) 2008 and Research Activities for Artisanal Fisheries

Prepared by the Fisheries Research Section, SFA[1], Oct 2009

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1. Artisanal fisheries statistics 2008

1.1 Catch and effort

1.1.1 Catches

The total artisanal catch for 2008 is estimated at 4777.1 Mt, representing an increase of 14% over the 4181.4 Mt estimated for the previous year (figure 1).

A remarkable increase of 75% was recorded in catches landed on Praslin corresponding to an increase of 19 vessels on the island. The total catches on Mahe increased slightly by 5%.

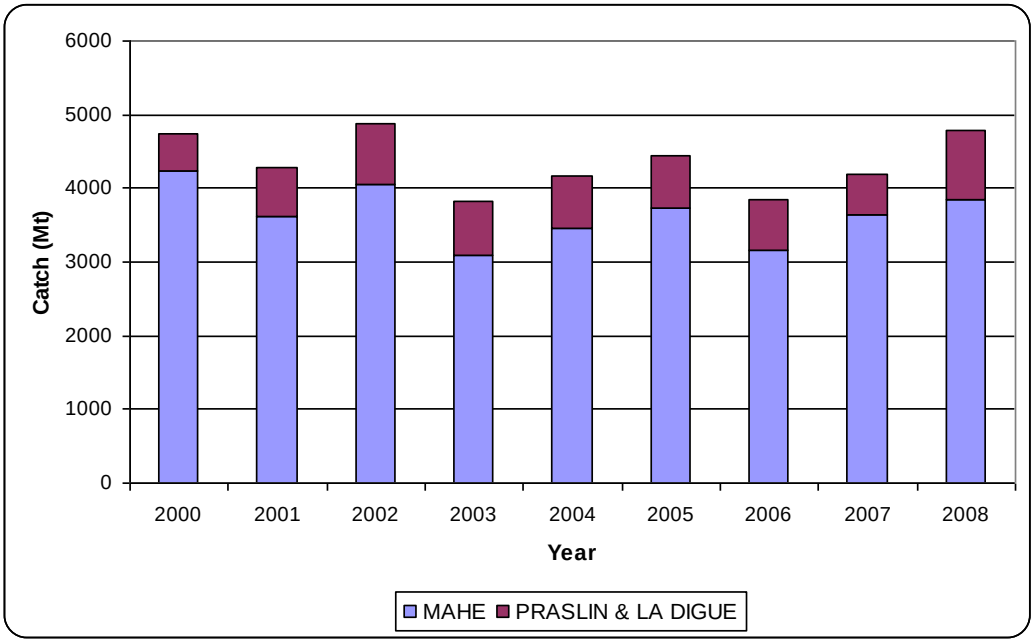
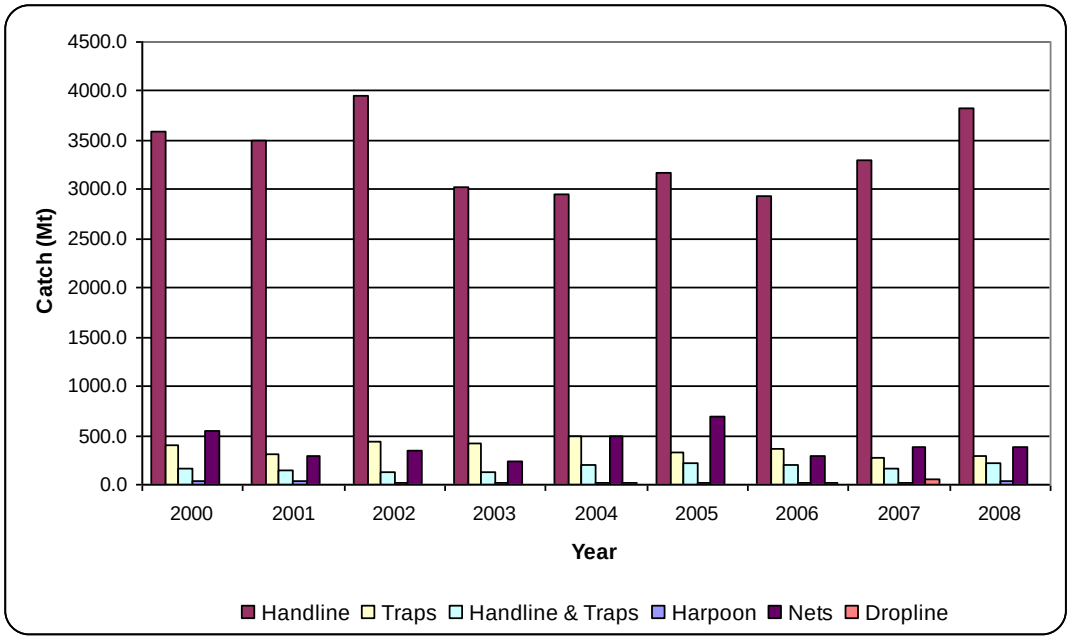


Figure 1. Artisanal catch (t) for Mahé and Praslin/La Digue: 2000 to 2008.

In terms of gear categories, the handline fishery, the trap fishery and the handline and trap fishery all recorded increase of 16%, 9% and 39% respectively. A remarkable increase of 186% was recorded in the harpoon fishery (Figure 2: left). On the other hand catches by dropline decrease significantly (-95%) in 2008 whilst that of the net fishery decrease by a slight 1%.



The composition of the total artisanal catch by vessel category was dominated by whalers (64.2%), followed by outboard (25.4%), (Table 2).

Table 2. Percentage (%) of annual catch landed by major vessel types, including foot fishermen: 2000 – 2008.

Boat Type	2000	2001	2002	2003	2004	2005	2006	2007	2008
Pirogue	1.7	1.2	0.6	1.1	1.3	1.6	2.1	0.6	0.6
Outboard	32.5	25.0	25.4	27.4	34.3	36.2	28.3	25.0	25.4
Whalers	60.9	66.8	68.9	64.1	54.2	50.4	56.9	63.3	64.2
Schooners	4.1	6.0	4.5	6.8	9.0	11.1	11.5	9.3	8.9
Foot Fishers	0.9	1.1	0.6	0.6	0.9	0.7	0.6	0.4	0.8
Dropline vessels	0.0	0.0	0.0	0.0	0.3	0.0	0.6	1.4	0.1

1.1.2 Effort

As determined from monthly mean estimates of the number of vessels in operation, whereby the maximum monthly value is used as an indicator of fleet activity for the year, the number of outboard increase from 244 vessels in 2007 to 294 vessels in 2008. The number of pirogue decrease by 14% whilst that of whaler and schooner remained the same when compared to the previous year (Table 1).

In terms of fishing effort, the handline and net fishery both recorded a decrease of 1% and 9% respectively. A significant increase of 126% was recorded in the harpoon fishery whilst the trap fishery recorded an increase of 21%.

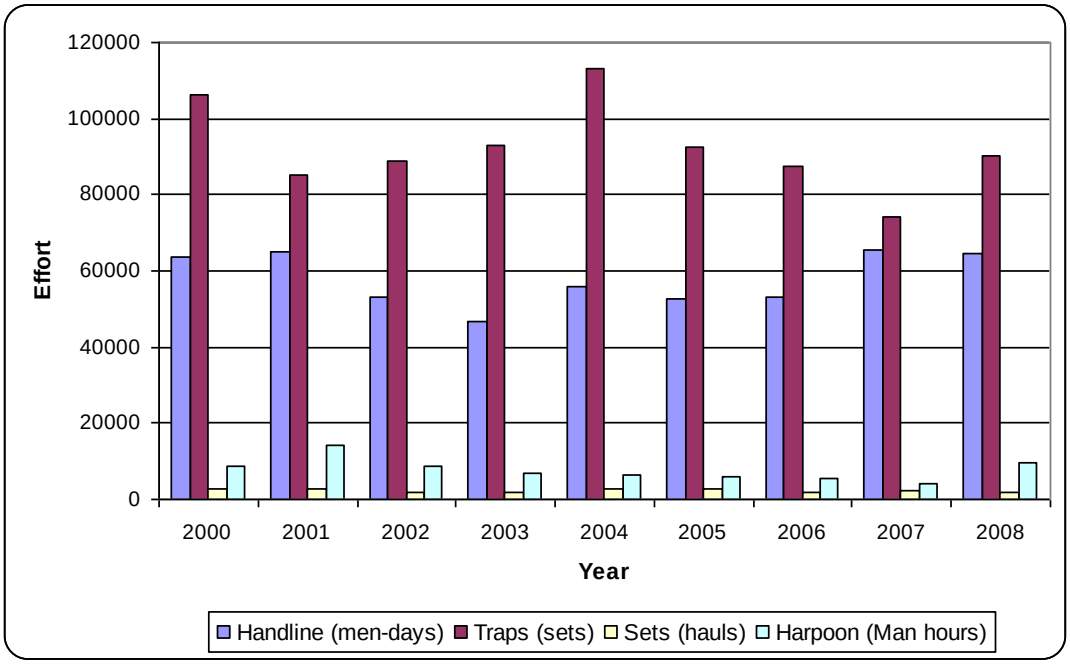


Figure 2. Total catches (left) and fishing effort (right) for the major gear types.

Table 1. Maximum monthly fishing vessels in operation: 2002 to 2008.

Vessel Type	2002	2003	2004	2005	2006	2007	2008
Pirogue*	31	30	33	30	27	22	19
Outboard*	234	250	239	234	242	243	294
Whaler	96	109	93	83	94	105	107
Schooner	13	16	20	18	26	22	22
Sport	38	21	**	**	**	**	**
Dropline	1	0	4	2	4	5	2

*Includes part time fishing vessels. **Data not available due to poor logbook returns.

1.2 Catch Rates

Catch rates (CPUE) for the handline fisheries increased slightly from 53.4 kg/man day in 2007 to 65 kg/man day in 2008 (Figure 3a). The whaler handline fishery continued to outperform other vessel types in terms of CPUE. Increase was also observed in both the net fishery (figure 3c) and the harpoon fishery (figure 3d). For the trap fishery the average yearly CPUE has fluctuated between 4 and 6 kg/trap. In 2007 and 2008 they were slightly above 4kg/trap (figure 3b).

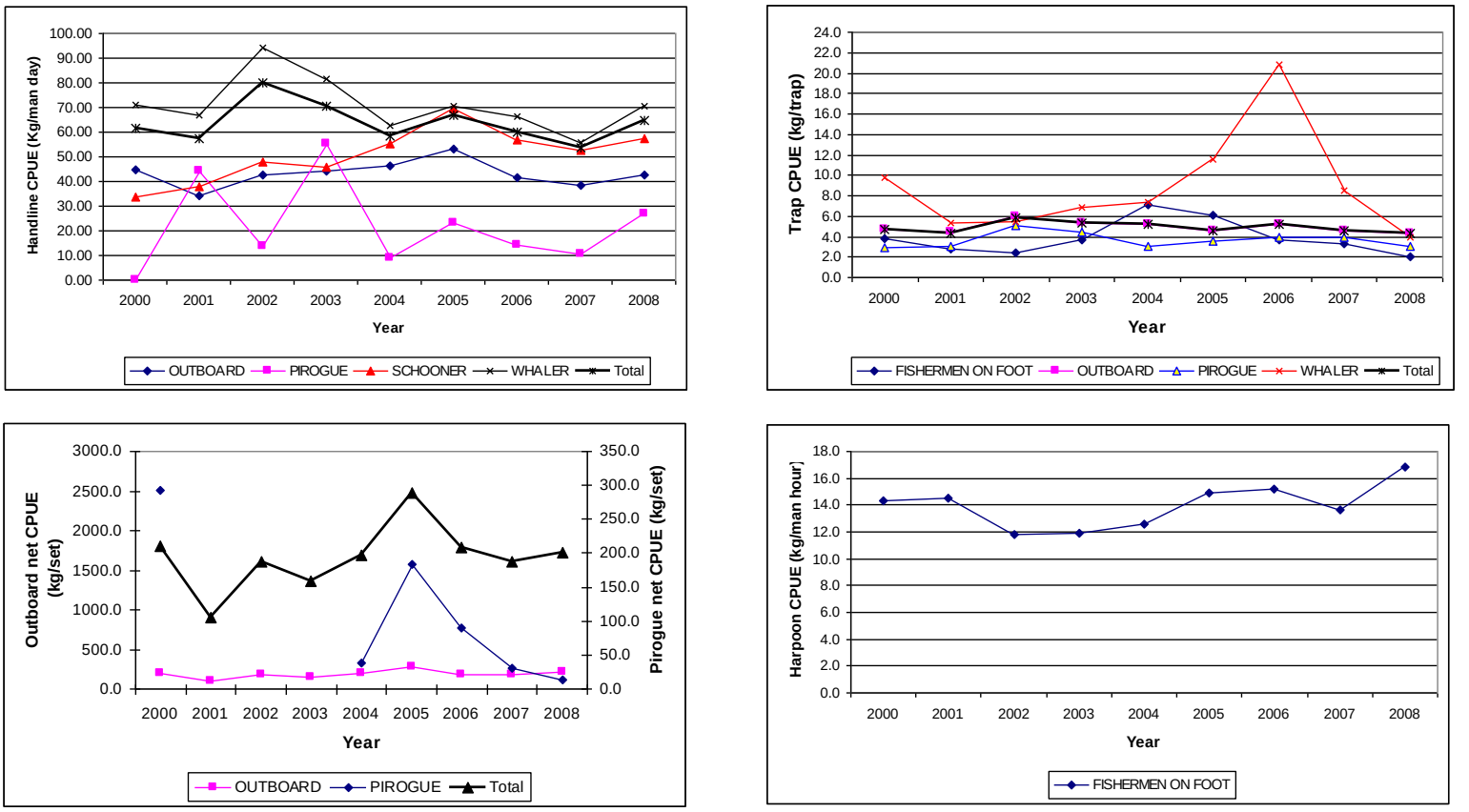


Figure 3. Trends in catch rates (CPUE) for the major vessel and gear combinations in the (a) handline fisheries, (b) trap fisheries, (c) gill net fishery and (d) the harpoon (octopus) fishery for the period 2000-2008.

1.3 Species composition

In 2008 significant increases were recorded in the cath of emperors (*Lethrinus* spp.) (78%), Trevally (*Carangoides* spp.) (57%) and other trap fish (63%). Increase were also observed in the catches of Jobfish (*Aprion virescens*)(15%), and other pelagics (18%). Only Rabbitfish (*Siganus* spp.) and Red snapper (*Lutjanus* spp.) recorded significant decrease of 11% and 15% respectively (figure 4).

In 2008 Trevally (*Carangoides* spp.) was the dominant species caught accounting for 26% of the total catch followed by Red snapper (*Lutjanus* spp.) (22%) and Jobfish (*Aprion virescens*)(15%) (table 3).

Table 3. Percentage (%) species/species-group composition of artisanal catch for the period 2000-2008

Species Group	Percentage (%) of total annual catch								
English/Scientific	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Trevally (*Carangoides* spp.)	37.1	30.1	41.7	33.6	28.2	24.8	19.7	18.7	25.7
Red snapper (*Lutjanus* spp.)	8.7	13.9	10.0	11.6	17.0	22.3	26.7	29.6	22.0
Jobfish (*Aprion virescens*)	11.6	16.4	12.5	15.8	12.5	11.2	15.5	15.7	15.8
Emperors (*Lethrinus* spp.)	8.9	11.2	6.9	6.1	6.2	5.1	4.4	4.6	7.1
Groupers (*Epinephelus* spp.)	3.2	2.5	1.5	2.4	2.3	2.1	3.2	3.8	3.2
Rabbitfish (*Siganus* spp.)	3.7	2.1	4.2	6.6	7.6	5.4	7.3	5.1	4.0
Mackerel (*Rastrelliger* sp.)	9.9	6.2	7.1	5.8	11.0	15.4	6.6	9.2	7.9
Other Pelagics	8.1	8.9	8.8	10.8	7.4	7.5	8.6	7.7	8.0
Other Trap Fish	4.5	3.6	3.7	3.5	3.7	2.6	3.3	2.4	3.4
Others	4.3	5.1	3.6	3.8	4.2	3.5	4.9	3.1	2.8
Total annual catch (MT)	**4748.4**	**4285.0**	**4889.1**	**3835.7**	**4174.0**	**4433.3**	**3845.0**	**4181.4**	**4777.1**

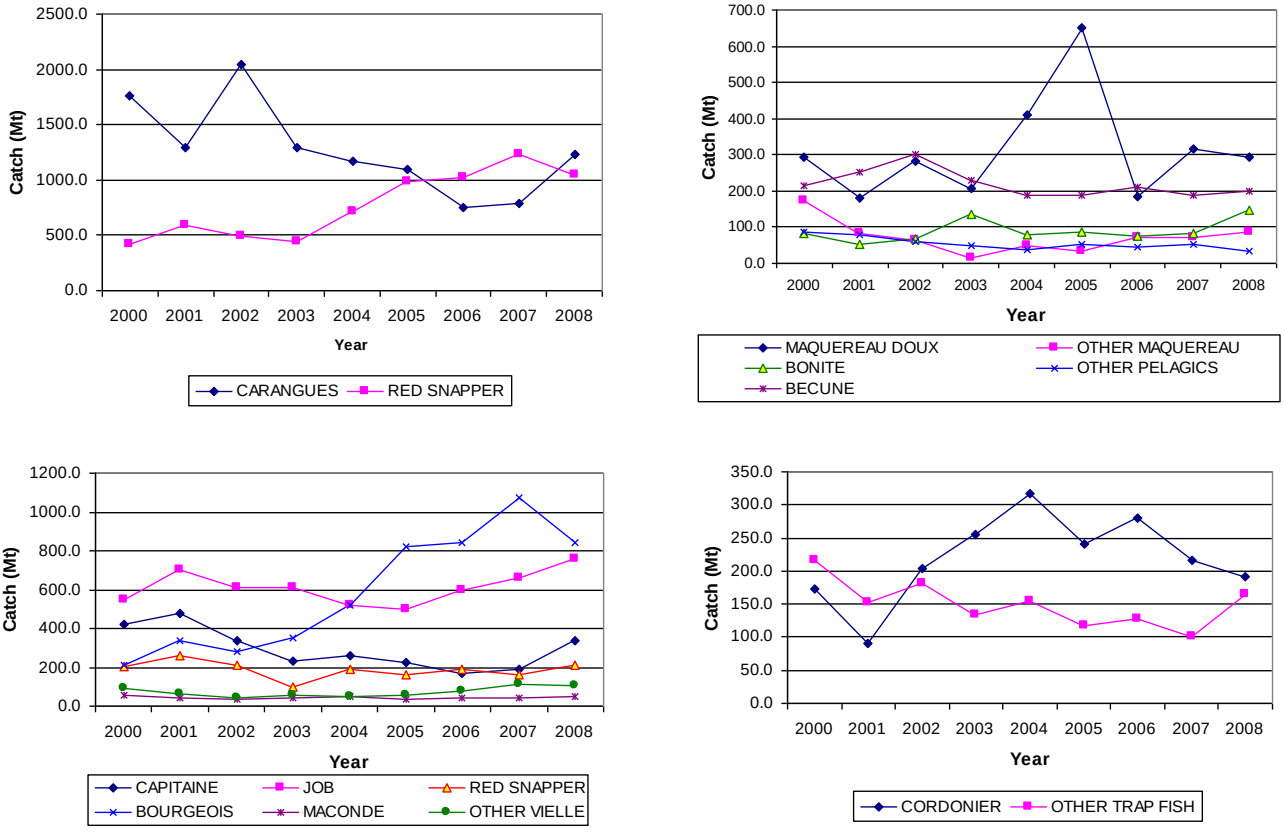


Figure 4. Trends in catches (Mt) for the major species and species groups for the periods 2000-2008, in terms of (a) comparison of the dominant species/groups in the artisanal catch, (b) semi-pelagic fisheries, (c) demersal, and (d) trap fisheries.

1.4. Wholesale and exports

Purchases by Oceana Fisheries Co. Ltd. and Sea Harvest were equivalent to 7.4% (351.8 MT) of total landings. Major species groups purchased were carangue (143 MT), bourgeois (100.1 MT), other pelagic (44.7 MT), job (29.3 MT) and other vielle (15.4 MT).

Fish purchases from foreign longline and purse seine vessels by Oceana Fisheries Co. Ltd and Sea Harvest totaled 190.46 MT during 2008. Major species purchased were the common dolphin fish/dorad (130.9 MT) and wahoo(36 MT). Other species include marlin, sailfish groupers and jobfish.

In 2008, fish and fish product exports from the artisanal fishery amounted to 397.8 MT. The bulk (75%) were exported fresh on ice to the EU and countries of the region, while most dried product was destined for Asian markets. These exports were valued at SCR 27.8 million (C.I.F). The main markets were the Mauritius (109.2 MT), South Africa (50.2 MT), and United Kingdom (46.7 MT). The 'other snapper' group constituted 40.1% of the total export followed by tuna (18.5%), carangue (10.1%) and sea cucumber (10%).

Table 4. Export of artisanal catches by preservation type for the year 2008

Species	Fresh On Ice	Chilled	Frozen	Dried	Grand Total
Carangues	0.0	0.0	11.3	0.0	**11.3**
Other Carangues	0.0	0.0	19.0	0.0	**19.0**
Becune	0.1	0.0	1.6	0.0	**1.7**
Tuna	30.2	0.0	12.5	0.0	**42.6**
Other pelagic	42.5	0.0	49.9	0.0	**92.5**
Capitaine	7.1	1.3	1.4	0.0	**9.8**
Other Snapper	1.4	0.0	6.6	0.0	**8.0**
Bourgeois	123.2	6.4	3.1	0.0	**132.6**
Job	15.2	3.0	4.3	0.0	**22.5**
Maconde	2.3	0.1	0.0	0.0	**2.3**
Other Vielle	5.4	0.1	1.1	0.0	**6.6**
Cordonier	0.0	0.0	0.0	0.0	**0.0**
Other Trap fish	0.0	0.0	0.5	0.0	**0.5**
Shark & Rays	0.7	0.0	6.2	0.0	**6.9**
Shark Fin	0.0	0.0	0.0	3.7	**3.7**
Black teatfish	0.0	0.0	0.0	23.8	**23.8**
Prickly Redfish	0.0	0.0	0.0	3.1	**3.1**
White teat	0.0	0.0	0.0	8.3	**8.3**
Other Sea Cuucmber	0.0	0.0	0.0	2.1	**2.1**
Crab	0.1	0.0	0.3	0.0	**0.4**
Others	0.0	0.0	0.0	0.0	**0.0**
Grand Total	**228.2**	**10.8**	**117.9**	**41.0**	**397.9**

1.5. Update on the sea cucumber fishery

In 2008, the SFA started the implementation of a new Sea cucumber Management Plan that was approved by Cabinet in September 2008. This management plan entails the introduction of a yearly closed season from July 1st to October 31st. To ensure the sustainability of the resource, the sea cucumber fishery is being controlled through a limit of 25 licenses, which is issued to fishermen based on a number of criteria which has been set by the Seychelles Fishing Authority.

Given that it is only the first year that we have such a fishing season that extends from one year into another, for comparison only data for the first semester have been included. Future analysis will compare fishing seasons.

During the first semester of 2008, the total catch of sea cucumber reported stands at 181,597 pieces, representing 9% decrease from the 198,849 pieces recorded for the same period the previous year (table 5 and figure 5). Significant increase was observed in sandfish, prickly red and others whilst black teat and pentard recorded a decrease of 4% and 16% respectively.

Table 5. Reported number of sea cucumbers caught between January to June 2001 to 2008.

Year	Black teat	Sandfish	White teat	Prickly red	Pentard	Others	Total
2001	4056	112	14665	2729	2784	2361	26707
2002	4620	695	31087	3902	4086	34797	79187
2003	5169	25	14858	9624	33408	36839	99923
2004	5889	460	21488	7323	40949	28318	104427
2005	4619	78	25409	8819	47989	29594	116508
2006	7956	265	24808	12062	94486	83744	223321
2007	4441	139	28821	9702	113433	42313	198849
2008	4276	1737	42514	16570	95523	20977	181597

1Data from January to June only. Fishery was closed for the rest of the year.

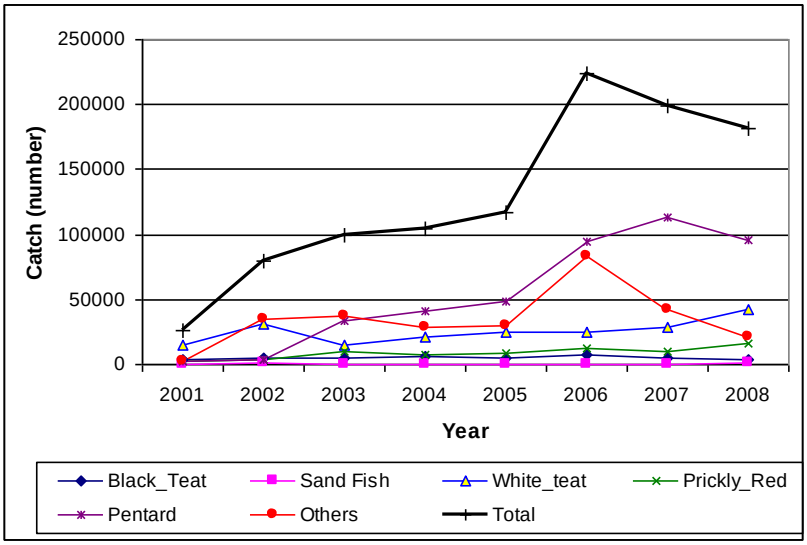


Figure 5. Trends in catches of sea cucumber during the first semester of the year, 2001 to 2008.

According to export statistics from the Department of Finance, a total of 30.6 MT or an equivalent of 122,826 pieces of sea cucumbers were exported in 2008 for a total value of SR 4.440 million. This represents a decrease of 38% in net weight of sea cucumber exported in 2008 compared to the previous year. The value of the exported sea cucumber however showed an increase 12% over the SR 3.950 million realized in 2007.

Table 6. Comparison of TAC (No.) against the estimated catch of 2007.

Common Name	Status	TAC (No.)	Estimated Catch 2008
Black teatfish	Under exploited. Some localised depletion	228,000	4,276
Sandfish	Over exploited	0	1,737
White teatfish	Under exploited	94,000	42,514
Prickly redfish	Under exploited	87,000	16,570
Pentard	Over-exploited	71,000	95,523

The data indicate that black teatfish, white teatfish and prickly redfish are all underexploited against the TAC (Table 6). As for sandfish, catches reflect the relatively small exploitable stock, which was used to justify a zero TAC for this species. Pentard has been overexploited against the TAC. The management plan for the sea cucumber fishery has been approved by the Cabinet. However, TACs are not operational as a management measure; this is highly due to the fact that TACs are highly disputed amongst fishermen. There are plans for a new stock assessment in 2009 which will be done in conjunction with the sea cucumber licensees and will lead to revised TACs.

1.6. Update on the lobster fishery (see background paper SFA04).

2. Research Activities

2.1. Stock assessments

The number of size frequency samples collected in 2008 was higher than 2007. Assessments were undertaken for three key indicator species of the demersal handline fishery.

2.1.1. *Aprion virescens*

In 2008, 409 samples were taken for this species. However, almost three quarters of the samples could not be traced to their respecting fishing vessel, preventing robust analyses at a fine spatial scale. The same growth parameters were used as in previous years: age-based growth parameters derived in FMSP Project R6465 were used in FiSAT II (K=0.1, L_∞=89.9, t0=-2.3) to provide estimates of mortality (Z, F, M) and length at first capture (L_{c50}). Two estimates of natural mortality (M) were used, the first (M1) from Pauly (1980) with a temperature of 22°C. Since this method tends to overestimate M for slow growing species, we also used the derivation from Jenson (1996; reviewed in Hoggarth et al., 2006), where M = 1.5K, to estimate this parameter (M2).

Table 7. *Aprion virescens*: Estimates of fishing mortality, and related parameters, for two different estimates of natural mortality (M1 and M2), and corresponding estimates of length at first capture (L_{c50}). Length at first maturity (L_{m50}) estimates and sample sizes (n) also provided.

Parameter	2004	2005	2006	2007	2008
Z	0.49	0.32	0.23	0.32	0.33
CI of Z	0.43-0.55	0.14-0.49	0.1-0.35	0.28-0.35	-0.28-0.93
r^2	0.99	0.99	0.98	0.99	0.98
M1	0.26	0.26	0.26	0.26	0.26
F	0.23	0.06	-0.02	0.06	0.07
E	0.47	0.18	-0.09	0.18	0.21
L_{c50} (cm) – Logistic	73.47	69.98	71.17	70.70	69.70
L_{c50} (cm) – Running av.	68.37	67.67	67.97	68.48	68.54
F/M	0.88	0.23	-0.08	0.23	0.27
M2	0.15	0.15	0.15	0.15	0.15
F	0.34	0.17	0.08	0.17	0.18
E	0.69	0.53	0.35	0.53	0.55
L_{c50} (cm) – Logistic	73.82	70.09	68.53	70.73	69.71

L_{c50} (cm) – Running av.	69.34	67.62	66.69	68.45	68.52
F/M	2.27	1.13	0.53	1.13	1.2
L_{m50} (Mees 1992; MRAG 1999)	62-64; 65 cm				
n	377	1142	169	88	409

In 2008 and based on the lower estimate of M (M2), L_{c50} was greater than $L_{m50,}$ as was the case in previous years. Combined with an F/M ratio of 1.2, this suggests that overfishing is unlikely. However, total mortality (Z) estimates were subject to large range in CI leading to considerable uncertainty in estimates of F (Table 7). Based on these results, YPR analyses were not conducted for this species. Larger sample sizes that are traceable to their respective fishing vessels are being obtained in 2009, which may permit analyses at the level of sector and highlight any concerns at a finer spatial scale.

2.1.2. *Epinephelus chlorostigma*

In contrast to *Aprion virescens*, the sample size for this species was small in 2008. The same growth parameter were used as in previous years, based on average of 3 estimates from Grandcourt (2002), Mees (1992) and Sanders et al. (1988), where K=0.21 and L_{∞}=57.19. L_{c50} was assessed against a published maturity estimate for females (Moussac, 1996), rather than for males, since this species is suspected of protogynous hermaphroditism. Maturity was also calculated from $0.5L_{\infty}$. Estimates of M using the Pauly method led to implausible results for F (negative values), and we present only the results using an estimate of M derived from M=1.5K, with K=0.21.

Table 8. *Epinephelus chlorostigma*: Estimates of fishing mortality, and related parameters, for corresponding estimates of length at first capture (L_{c50}). Length at first maturity (L_{m50}) estimates, based on $0.5L_{\infty}$ and Moussac (1986), and sample sizes (n) also provided.

Parameter	2004	2005	2006	2007	2008
Z	1.04	0.97	0.85	0.78	0.47
CI of Z	-2.77-4.85	-4.00-5.94	-5.69-7.39	-5.04-6.6	0.17-0.77
r^2	0.92	0.86	0.73	0.75	0.99
M	0.315	0.315	0.315	0.315	0.315
F	0.73	0.66	0.54	0.47	0.16
E	0.70	0.68	0.63	0.60	0.33
L_{c50} (cm) – Logistic	30.67	31.41	31.07	31.20	34.46
L_{c50} (cm) – Running av.	32.83	32.35	31.73	31.29	34.56
F/M	2.32	2.10	1.71	1.49	0.50

L_{m50} ($0.5L_{\infty}$; Moussac, 1986)	28.95 cm TL; 31 cm TL for females				
n	991	1161	348	78	178

Compared to previous years, total mortality (Z) was much lower (0.47). Also, levels of uncertainty around Z were smaller than previous year (Table 8). Length at first capture has also increased and is above length at first maturity. It is not certain whether this has resulted from a change in hook size or changes in depth or area fished, but this should be explored. Mortality rates have declined since 2004. Measured against the indicators (L_{c50}; F/M), the status for this species was not a cause for concern in 2008.

2.1.3. *Lutjanus sebae*

In addition to analyses at the Plateau level, sample data were sufficient to perform analyses of the W-NW (sectors 9 and 10) area only.

Mortality and capture estimates

Due to problems in obtaining reliable performance of the YPR models in the Yield software using point estimates of growth parameters, similar to last year, we have used an average of 2 age-based estimates (Grandcourt et al. 2008 and Newman 2000) and 2

length-based estimates (Mees 1996), where K = 0.163; L_∞ = 88.6; t0 = -0.95. We used an estimate of natural mortality based on an average derived from two methods; M = 1.5K and an age-based estimate derived by Grandcourt et al. (2008) using the Hoenig (1983) empirical equation.

Length at first capture (61.70 cm) was equivalent to length at first maturity (62 cm) for all sectors combined in 2008, while F/M < 2, highlighting little cause for concern. Similarly, in the sector 9 and 10 area, L_{c50} was higher than L_{m50}, and showed a large increase over 2007, which will require further research to explain, especially since length at first capture declined slightly at the plateau level compared to the previous year (Table 9).

Table 9. *Lutjanus sebae*: Estimates of mortality and corresponding estimates of length at first capture (L_{c50}). Length at first maturity (L_{m50}) estimates, based on Mees (1992), and sample sizes (n) also provided.

Parameter	All sectors (2007)	W-NW (Sectors 9, 10) (2007)	All sectors (2008)	W-NW (Sectors 9, 10) (2008)
Z	0.55	0.47	0.50	0.49
CI of Z	0.39-0.71	-0.37-1.31	0.24-0.76	0.20-0.78
r^2	0.99	0.98	0.99	0.99
M	0.182	0.182	0.182	0.182
F	0.37	0.29	0.32	0.31
E	0.67	0.61	0.64	0.63
L_{c50} (cm) – Logistic	62.29	55.32	61.70	64.86
L_{c50} (cm) – Running av.	62.56	59.37	60.59	64.19
F/M	2.03	1.59	1.76	1.70
Maturity	62 cm FL			
N	807	376	1430	387

Yield per recruit

<u>All sectors</u>

YPR indicated that MSY per recruit occurs when F is around 1.2, compared to 0.9-1.1 in 2007. The SSB is reduced to less than 20% when F = 0.45, similar to the estimate in 2007 (Figure 6). From the histograms, MSY per recruit is achieved when F is around 0.6-1.4 (Figure 7). To maintain SSB per recruit at 20% of unexploited biomass, F should be in the range of 0.36-0.48 (Figure 8). While most of the range estimates of current F (0.32; range = 0.058-0.578) are below $F_{SSB20\ per\ recruit}$., the upper range of current F exceeds the upper limit of $F_{SSB20\ per\ recruit}$.

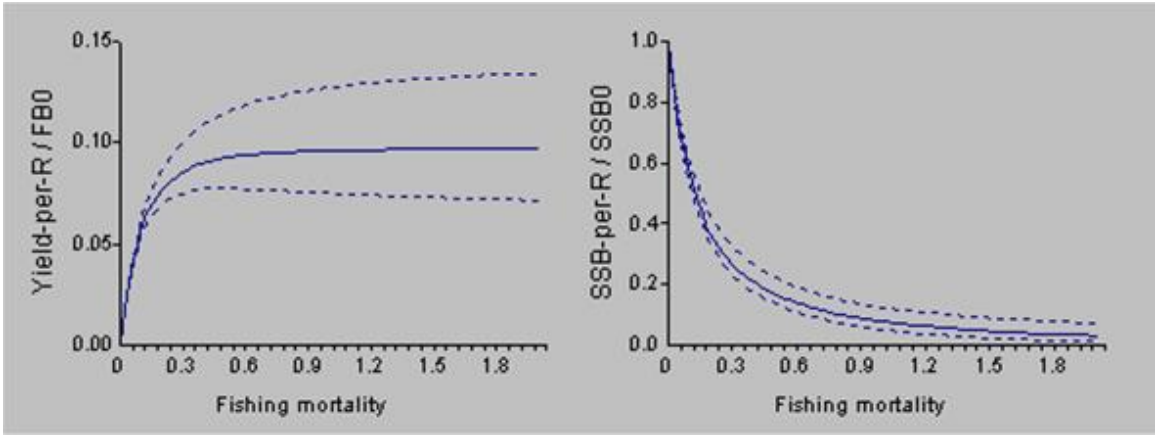


Figure 6. Yield per recruit and Spawning Stock Biomass per recruit against levels of fishing mortality for all sectors combined

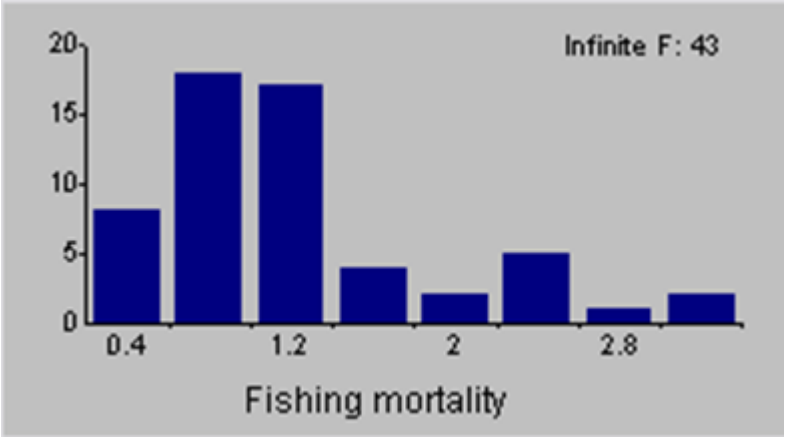


Figure 7. Frequency distribution of fishing mortality that produces maximum yield-per-recruit for all sectors combined

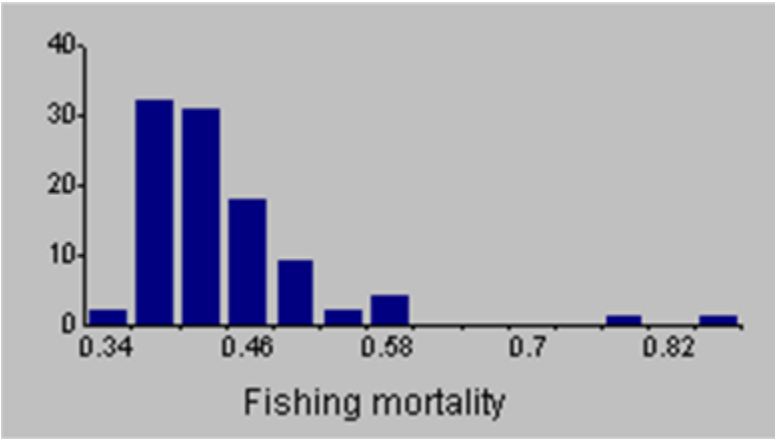


Figure 8. Frequency distribution of fishing mortality that maintains Spawning Stock Biomass at 20% of its unexploited value for all sectors combined

Sectors 9 and 10 (W-NW area)

YPR indicated that MSY per recruit occurs when F is around 1.2,but an asymptote is still not entirely reached when F is greater than 1.8. SSB is reduced to less than 20% when F = 0.7, however, the upper confidence interval is quite wide (Figure 9). From the histograms, MSY per recruit is achieved when F is around 0.25-1.65 (Figure 10). To maintain SSB at 20%, F should be in the range of 0.36-0.99 (Figure 11). The range of current F (0.31; range = 0.018-0.598) overlaps the lower boundary of $F_{SSB20\ per\ recruit}$.

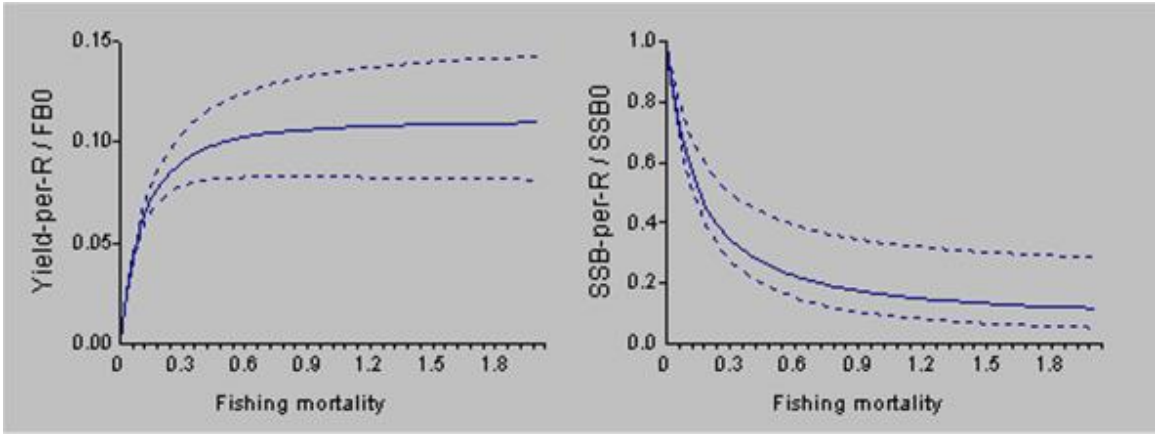


Figure 9. Yield per recruit and Spawning Stock Biomass per recruit against levels of fishing mortality for sectors 9 and 10

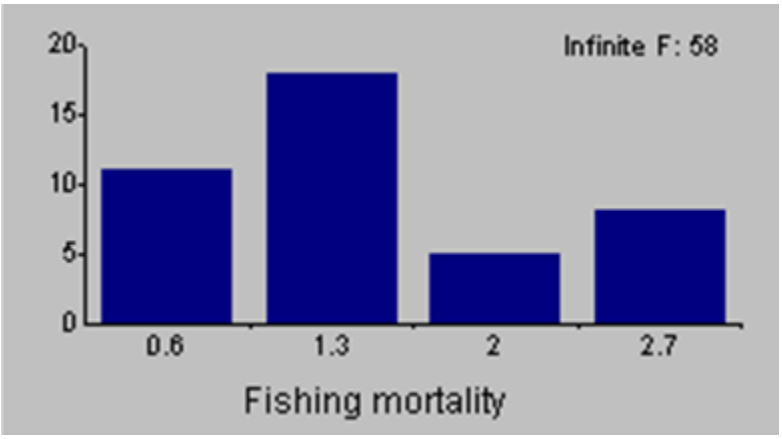


Figure 10. Frequency distribution of fishing mortality that produces maximum yield-per-recruit for sectors 9 and 10

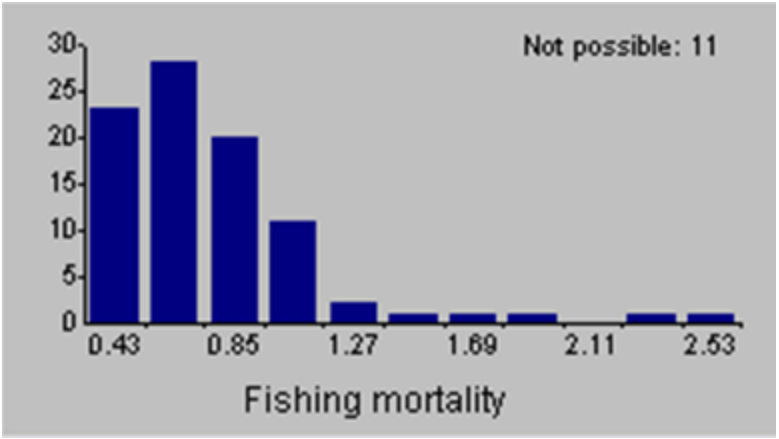


Figure 11. Frequency distribution of fishing mortality that maintains Spawning Stock Biomass at 20% of its unexploited value for sectors 9 and 10

$F_{current}$ is tending towards the lower estimates of F_{SSB20}, except for the pooled sample where there is a slight overlap of the upper $F_{current}$ above the upper boundary limit of F_{SSB20}.. Therefore, there is a possibility that this species is overexploited. However, based on the high level of uncertainty (large CI for W-NW sector $F_{MSY\ per\ recruit}$ and $F_{SSB20\ per\ recruit}$) caution should be taken in interpreting the results. In summary, the L. sebae stock status on the Mahe Plateau has shown some changes in this assessment, with declining exploitation rates and increasing length at first capture in some strata, which requires closer scrutiny. The situation with this stock may appears to be improving using these indicators, but it is still grossly overfished against other reference points (i.e. MSY, Grandcourt et al. 2008).

Table 10. Summary results of the YPR for *Lutjanus sebae*. Estimates of F required to achieve maximum yield per recruit (F_{MSYPR}) and F to maintain spawning stock biomass at 20% of unexploited biomass (F_{SSB20}).

	All sectors	**W-NW (Sectors 9, 10)**
F_{MSYPR}	0.6-1.4	0.25-1.65
F_{SSB20}	0.36-0.48	0.325-0.995
$F_{current}$ (CI)	0.32 (0.058-0.578)	0.31 (0.018-0.598)

3. References

Graham, N.A.J., Wilson, S.K., Jennings, S., Polunin, N.V.C., Robinson, J., Bijoux, J. & Daw, T. (2007) Lag effects in the impacts of mass coral bleaching on coral reef fish, fisheries and ecosystems. *Conservation Biology* 21(5): 1291-1300.
Grandcourt, E. (2002) Demographic characteristics of a selection of exploited reef fish from the Seychelles: preliminary study. Marine and Freshwater Research, 53: 123-130.

Grandcourt, E., Al Abdessalaam, T., Francis, F. & Al Shamsi, A. (2006) Population biology and assessment of the white-spotted spinefoot, Siganus canaliculatus (Park, 1797), in the southern Arabian Gulf. Journal of Applied Ichthyology, 22:1-7.

Grandcourt, E., Hecht, T., Booth, A. & Robinson, J. (in press) A retrospective stock assessment of the Emperor red snapper, *Lutjanus sebae (*Cuvier, 1816), on the Seychelles Bank (1977-2006). ICES Journal of Marine Science.

Mees, C. C. (1992). Seychelles Demersal Fishery: an analysis of data relating to four key demersal Species. SFA Technical Report (SFA/R&D/019).

Moussac. G. de. (1986) Evidence of protogynous hermaphroditism of *Epinephelus chlorostigma* (Valenciennes, 1828) in Seychelles (Pisces, Serranidae). Cybium 10(3): 249-262.

MRAG (1999). Growth parameter estimates and the effect of fishing on size composition and growth of snappers and emperors: implications for management. MRAG Ltd Final Technical Report. 373 pp.

Robinson, J., Samoilys, M., & Kimani, P. (2007) Reef fish spawning aggregations in the Western Indian Ocean: Current knowledge and implications for management. CORDIO Status Report 2007. Eds. Obura, D.O., Tamelander, J. & Linden, O. CORDIO (Coastal Oceans Research and Development, Indian Ocean)/Sida-SAREC. Mombasa.

Robinson, J., Aumeeruddy, R., Jörgensen, T.L., & Öhman, M.C (2008). Dynamics of camouflage (Epinephelus polyphekadion) and brown marbled grouper (E. fuscoguttatus) spawning aggregations at a remote reef site, Seychelles. Bulletin of Marine Science.

Sanders, M.J., Carrara, G., and Lablache, G. (1988). Preliminary assessment for the brownspotted grouper Epinephelus chlorostigma occurring on the Mahe Plateau (Seychelles). In: M.J. Sanders, P. Sparre and S.C. Venema (eds.) Proceedings of the workshop on the assessment of the fishery resources in the Southwest Indian Ocean, p. 268-277. FAO/UNDP: RAF/79/065/WP/41/88/E.