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Fisheries for Large Coastal Pelagics in Fiji

by

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Introduction

1. Large coastal pelagic fishes, a heterogenous grouping of predatory species which inhabit lagoon and near shore oceanic waters, support important artisanal and recreational fisheries in Fiji. Overlapping to a limited extent with the industrial offshore fishery for surface-schooling tunas (skipjack and yellowfin), the multi-gear multi-species fishery produced a nominal catch of over 700 tonnes of large coastal pelagics in 1986, with a market value in excess of F$ 1.5 million (Anon, 1987).

2. Based in the main on species of the families Scombridae, Carangidae and Sphyraenidae, the fishery has artisanal, recreational and subsistence elements. The recreational fishery, essentially light-gear game fishing centred on tourist resorts and the capital Suva, contributes significantly to tourism services. As with the subsistence sector, few data are available on catches, and these two sectors are not considered. Catches are thought, however, to be relatively small.

3. This paper reviews available data on the diverse artisanal fishery, discusses management requirements and considers prospects for future development. Emphasis is placed on species typically caught trolling and those recently made more available by the development of FAD-associated fisheries.

Resource Biology

Species taken

4. Table 1 lists the main species taken (approx. 35) with typical sizes, habitat normally occupied, gear type used for their capture and landed catches for 1986. The billfishes (F. Istiophoridae), taken almost exclusively in the recreational fishery in small numbers, are not listed, neither are sharks.

5. Three families, as noted earlier, account for the great majority of the catch (Table 1). The Scombridae include inshore reef-associated species (Scomberomorus, Grammatorcynus, Gymnosarda) as well as neritic species (Euthynnus) and oceanic species occasionally venturing inshore (Acanthocybium, Katsuwonus, Thunnus) and often made more accessible by the deployment of FADs

6. The Carangidae (trevallies) are primarily inshore species, and include bottom feeding omnivorous species (Trachinotus, Gnathanodon) which do not fall strictly within the coastal pelagic category. Some are primarily lagoon pelagics (most Caranx, some Carangoides, Megalaspis) whereas others are reef-associated (some Caranx, some Carangoides) or oceanic (Elagatis).

7. The Sphyraenidae (barrracudas) include lagoonal and reef-associated species of varying sizes, one of which (S. barracuda) ranges far offshore.

8. Other primarily demersal families are included as some members of these families (Serranidae, Lutjanidae) rise readily off the bottom to trolled baits. Longtoms (F. Belonidae), whilst not attaining large sizes, are trolled, netted or speared, and are of limited commercial importance. Dolphin fish (F. Coryphaenidae) are an important component of the FAD and offshore troll catch.

Geographical distribution

9. All the species listed are widely distributed throughout the Indo-Pacific and many are cosmopolitan in distribution. Several species occur no further east than Fiji on a regular basis, notably Scomberomorus commerson, but also Caranx tille and Plectropomus truncatus. On the basis of troll survey data, there is evidence of differential distribution within Fiji itself. Some species are essentially restricted to the larger high islands eg. S.commerson, Sphyraena genie, Caranx papuensis, whereas most coastal pelagics are ubiquitous.

General biology

10. Tunas of the commercially important genera Thunnus and Katsuwonus excepted, the biology of large coastal pelagics of tropical areas has generally been little studied. Few of the species concerned aggregate in quantities sufficient to attract targeted commercial activity and the taxonomy of some families (eg. Sphyraenidae, Carangidae) has long been unsatisfactory. Trolling surveys (eg. Williams, 1965; Lewis et al., 1983) have provided much of the few data available.

11. Table 2 summarises biological data available for Fiji coastal pelagics. This is drawn primarily from Lewis et al. (1983), with the addition of published parameters from elsewhere. Separate data are provided on the most important large coastal pelagic species in the catch, Scomberomorus commerson.

12. Coastal pelagic species are, with few exceptions, piscivorous predators feeding on a range of schooling pelagic (Clupeidae, Exocoetidae, Carangidae) and reef-associated mid-water species (Caesionidae). Species of the oceanic genera Katsuwonus, Thunnus and Elagatis inhabiting less productive oceanic waters, are of needs more omnivorous.

13. Spawning has rarely been observed, but aggregation for spawning does occur in some species (Johannes, 1983) and lengthy migrations have been documented for others (eg. McPherson, 1981). In Fiji, most coastal pelagics appear to spawn in summer (Table 2) but the season appears to be extended in many cases. Coastal pelagic species are invariably highly fecund, with small pelagic eggs and larvae susceptible to wide dispersal. Growth can be extremely rapid under favourable conditions (eg. Coryphaena-Uchiyama et al., 1986) but in most cases is poorly known. Trolling often produces biassed sex ratios (Table 2), presumably due to behavioural differences between sexes. In one genus (Plectropomus), protogyny is the primary reproductive strategy (Goeden, 1978).

14. Coastal pelagics in fact provide some of the best examples of the ecological inter-relationship between various coastal zone habitats. Juvenile carangids, sphyraenids and Scomberomorus utilise estuaries and inshore areas as nurseries (carangid sub-adults are regularly found even in fresh water in Fiji) before moving to the lagoon and even offshore (S. barracuda) as adults.

15. With few exceptions (eg. Plectropomus), individuals comprising populations would be regarded as highly mobile, moving as individuals or in aggregations according to food availability and/or environmental factors.

Biology of Scomberomorus commerson (walu)

16. Scomberomorus commerson, the only spanish mackerel occurring in Fiji, is widely distributed in the tropical and sub-tropical Indo-Pacific, from South Africa to Fiji, with occasional individuals taken further east eg. Tonga, Western Samoa. Growing to at least 40kg in size, it is a strictly neritic (continental shelf) species which is rarely taken far from the reef edge. Within Fiji, it is uncommon throughout most of the eastern (Lau) islands (Lewis et al., 1983), most landings originating from the western parts of the main islands, Viti Levu and Vanua Levu.

17. Like most coastal pelagics, walu is primarily piscivorous, feeding on a variety of small pelagic (Exocoetidae, Carangidae, Clupeidae) and reef-associated mid-water species (Caesionidae), as well as squid. It feeds throughout the water column.

18. Spawning appears to occur in Fiji over an extended period between late October to February peaking in December-January (Lewis et al., 1983). It is suspected that spawning takes place in specific locations inside the reef, rather than throughout the group, with minor migrations to these areas occurring. This is supported by the regular capture of ripe females in particular areas (eg Vomo Island) and the seasonal"runs" of fish well known to local fishermen, and has been noted elsewhere. Sizes at first maturity for males and females of 65 and 70 cm LCF respectively have been recorded (Table 2) with most fish of both sexes having spawned by 75-80 cm.

19. Larvae apparently drift inshore, where the early life stages are spent in productive turbid inshore waters (estuaries, coastal flats). Juveniles gradually move offshore as they grow. Given the distribution of walu throughout the group, it is probable that self sustaining populations can be maintained only where larvae and juveniles have access to turbid inshore waters, usually associated with mangroves and estuaries.

20. Females predominate at larger sizes and grow considerably faster than males. The largest male recorded by Lewis et al. (1983) in a sample of 370 fish was 97 cm, as opposed to 127 cm for females. This has been recorded by numerous other workers eg. McPherson (1987), Frusher (1985). The growth rate of Fiji fish, estimated from otoliths collected during trolling surveys is considerably slower than that recorded elsewhere (Tables 3 and 4). Reasons for this are not clear; it may have an underlying genetic basis (see later) or reflect the inability to undertake lengthy feeding migrations (eg. McPherson, 1981) imposed by the small size of the Fiji group and the species' neritic habitat.

21. Electrophoretic analysis of genetic variation in spanish mackerel populations throughout the SW Pacific and E India Ocean, including Fiji, has revealed the presence of discrete, non-inter breeding stocks in the region. (Shaklee, 1986, and pers.comm.). Fiji material exhibited considerable less genetic variation than east Australia and PNG material, consistent with its probable status as an isolated founder population at the eastern edge of the species range. Of the nine variable loci examined, significant variation between QLD and Fiji samples was found in every case ($P < 0.025$). Fiji walu stocks can therefore be regarded as an independent unit for management purposes.

The Fishery

22. Coastal pelagics are taken by a variety of specific gears, as well as incidentally in gillnet and handline catches. Trolling is the most widely used technique, typically along the reef drop-off (Chapman and Lewis, 1982) but more recently around FADs (Preston, 1982a). A variety of lures and live bait is used, the gear size imposing catch selectivity. Offshore trolling for wahoo and tuna, as practised throughout Polynesia/Micronesia, is not widely undertaken by artisanal fishermen in Fiji.

23. Live bait fishing for walu is carried out seasonally, in north-western Viti Levu and western Vanua Levu, with lights attracting baitfish (*Amblygaster*, *Rastrelliger*) to gillnets suspended over the gunwale. These live bait are then carefully removed from the net and used to catch walu, as well as less desirable *Sphyraena* and *Caranx* species.

24. Large mesh gillnets (4"plus) are not used to catch adult *Scomberomorus*, as is the case in other countries, but coastal pelagic sub-adults are taken incidentally in the gillnets (2", 3") typically used. This is also true of the reef and lagoon bottom handline fishery.

25. The deployment of FAD's has opened up several new capture possibilities. As well as early morning/late afternoon trolling for a variety of surface species, vertical longlining (50-150 fathoms, approx 95-285 m) has produced bigeye to 105 kg, yellowfin in the 15-60 kg range and large albacore (20-25 kg) (Mead, in press), with likely seasonal variations in species composition of the catch indicated by the limited data. Gillnet trials, and on occasions trolling, have been hampered by shark activity.

26. FAD's have of course considerably enhanced catches of pole-and-line vessel and purse-seiners in Fiji waters (Preston, 1982b). FADs fished by the industrial fleet are however deployed some distance offshore and do not contribute directly to the artisanal catch of coastal pelagics. During the operations of two small (350 t) purse seiners in Fiji, quantities of rainbow runner and dolphin fish were landed as by-catch.

27. The development of deep-water snapper fisheries has seen an increase in landings of coastal pelagics as by-catch, either during line retrieval (Seriola, Thunnus) or surface trolling in transit between fishing localities (Thunnus albacares, Acanthocybium). One of these vessels has recently deployed conventional longlines in near-shore waters with considerable success to catch yellowfin tuna for international sashimi markets (Southwick, pers. comm.).

Landings and catch rates

28. Table 1 provides available data on landings of coastal pelagic species for 1986. These have shown a gradual increase for most species since the early 1980's. In the case of the most-sought-after species, walu, total landings have remained relatively constant in recent years, at around 200 mt p.a. (Figure 1a).

29. Very little information is available on catch rates, and the relationship between catch rates and abundance. Trolling average catch rates of between 3.7 and 29.7 kg/vessel hour were recorded for five areas surveyed (Lewis et al., 1983) and 12.9 kg/vessel hour in Vanua Levu by Mead (in press). Preston (1982a) records an average catch rate of 24.4 and 29.5 kg/hr for skipjack, yellowfin and other pelagics species around two productive FADs near Suva.

30. Troll catch rates are believed to provide little more than a gross estimate of abundance, being subject to a range of variables including physiological state of the fish, lures used, time of day, previous exposure of fish to lures, lunar and tidal cycles, prey abundance, skill of the fisherman etc.

31. Catch rates of most species appear to have a strong seasonal component (see, for example. Figure 1b-walu). This is probably related to the peak in spawning activity in mid-summer observed for most species and the associated increase in energy demands. This also coincides with periods of good weather. The main exception to this general pattern appears to be wahoo (Acanthocybium) which is most abundant during the winter months in Fiji.

Marketing of the catch

32. Most coastal pelagics are sold whole, fresh and frozen, on local markets, with prices fluctuating according to seasonal supply. Small quantities of walu are exported annually to expatriate Fijian communities overseas. Small quantities of walu are also smoked for local sale, and this high quality product has export potential.

33. Increasing quantities of chilled yellowfin tuna (T. albacares) and wahoo (A. solandri) are being shipped to markets in Hawaii and mainland USA. Trial shipments of the former, with bigeye (T. obesus), have also been made to Japan. With vertical longline-caught tuna, "burn", the discolouration of the flesh during capture and handling (Yuen, 1979) has proved to be a problem. This has however not been the case with wahoo or fish recently taken by coventional longlining. The fat content of Fiji fish is probably low relative to colder-water fish competing in the difficult Japanese market.

34. Ciguatera has generally not proved to be a problem with the marketing of coastal pelagics in Fiji. Unlike Queensland, there are few reports of poisoning associated with Scomberomorus, although large specimens of Plectropomus laevis and the inshore barracuda, Shpyraena jello are known to be higher risk species.

Stock assessment

35. There are no catch per unit effort data available for any coastal pelagic species in Fiji other than that for skipjack and yellowfin tunas taken by the industrial pole-and-line fishery. In this diverse multi-gear, multi-species fishery, acquisition of such data would only be possible through the commitment of an unrealistic amount of resources relative to the value of the fishery, except possibly in the case of walu.

36. Age and growth estimates are almost totally lacking for most species (Table 2), either within Fiji or elsewhere. Some length-frequency data are available, from the commercial catch (walu) and from troll surveys (several spp). The latter sets, from virtually unexploited populations, might be used to derive preliminary estimates of M/K and L_∞, but in all cases, the data set is relatively small ($n<400$). With the recent finalisation of Fijian walu age and growth estimates based on otoliths (McPherson, pers. comm.), construction of age structured or length converted catch curves will be possible for both commercial and survey data for the first time.

37. Experience with several voracious semi-sedentary species, Gymnosarda unicolor (dogtooth) and coral trout (Plectropomus spp) has shown that catches decline rapidly at even modest levels of fishing. It is possible that estimates might be obtained from intensive fishing trials, leading ultimately to biomass estimation (Polovina, 1987). The response of protogynous Plectropomus to high fishing mortality is unknown (Goeden, 1978).

38. The possibility of obtaining yield estimates for this fishery remains remote. Collection of meaningful catch statistics and standardised measures of effort is a daunting task, complicated by the difficulty in separating species in the catch and continuing taxonomic uncertainties in some cases (eg.Sphyraenidae). It is possible that an approach as suggested by Munro and Fakahau (1986) may be worth attempting, at least in the case of walu, where elements of the proposed four-year assessment strategy are already in place.

Regulation and management

39. No management measures currently impact on the coastal pelagics fishery, other than minimum size regulations which apply under the Fisheries Act (cap. 158, para. 18 and Sixth Schedule). The following species groupings and minimum fork lengths are listed.

Barracuda (Sphyraenidae)	12" (30 cm)
Trevally (Carangidae)	12" (30 cm)
Longtom, (Belonidae)	12" (30 cm)
Rock cod (including coral trout) (Serranidae)	10" (22.5 cm)
Snapper (Lutjanidae)	12" (30 cm)

40. Leaving aside the rationale of imposing such minimum size regulations, the difficulty of enforcing them and the confusing use of incorrect local names in the schedule, the limits themselves are imposed on a family basis, and as such, include species with widely varying length maximum and minimum sizes at first maturity, eg. Sphyraena forsteri, an important inshore gill net species with approximately $L_{max.}$ of 60 cm (2kg), as against S.barracuda with $L_{max.}$ of 150 cm (30 kg) and size at first maturity of 70 cm or less. Numerous other examples could be given.

41. Alternatives would seem to be either expanding the schedule to more precisely define species groupings of differing length maximums (this is done to some extent with the lethrinids, where 3 categories with 3 different minimum size limits are recognised) or scrapping the system entirely. The first approach would need to be judiciously applied, taking into account the ability to be able to readily distinguish species. This approach is however intuitively attractive to politicians, administrators and concerned fishermen. As such, the second option (no regulation) is unlikely to be acceptable. The schedule is currently under revision.

42. Minimum gillnet sizes are applied. This measure should afford some protection to juveniles of coastal pelagics, many of which move out from inshore nursery areas as they mature. In response to pressure from several quarters, the existing 2" stretched mesh minimum is soon to be increased to 3". Catches of juvenile coastal pelagics in the generalised gillnet fishery are incidental, but may be considerable for those species with nursery areas inshore eg. Caranx spp.

43. The single most important species in the catch, walu, is for some reason not included in the schedule of minimum sizes. This raises the issue of whether any management of the fishery for this species is required. Despite its prized status, total catches have remained relatively stable since 1980 (Figure 1a). Sub-adults are rarely caught in gillnets, and there is no directed fishery for adults (eg. large-mesh gillnets) which does not depend on a positive behavioural response from the fish for its success ie. trolling, live-bait handline.

44. There are suggestions from other troll fisheries eg. Australia-McPherson, pers.comm. that troll catchability declines with increasing fishing intensity. Added to the prevailing stability of the catch, the apparent discrete nature of exploited Fiji stocks, and in the continued use of present fishing methods, the walu fishery may be self-regulating.

References

ANON (1987) Fiji Fisheries Division. Annual Report 1986. Ministry of Primary Industries, Suva. 49p.

CHAPMAN, L.B. and A.D. LEWIS (1982) UNDP/MAF Survey of walu and other coastal pelagics in Fiji waters, 5th September 1981- 4th January 1982. Fish. Div. Fiji, 36pp.

COLLETTE, B.B and C.E NAUEN (1983) FAO Species Catalogue. Vol 2. Scombrids of the world. An annotated and illustrated catalogue of tunas, mackerels, bonitos and related species known to date. FAO Fish. Synopsis 125(2):137pp.

DEVARAJ, M (1982) Age and growth of the three species of seerfishes Scomberomorus commerson, S. guttatus and S lineolatus. Indian J. Fish 28(1-2):104-127.

FRUSHER, S. (1986) A trolling survey of large pelagic fish around Wewak, Papua New Guinea, with notes on the biology of spanish mackerel, Scomberomorus commerson lacépède. Unpublished MSc Thesis, UPNG, Port Moresby.

GOEDEN, G.(1978) A monograph of the coral trout, Plectropomus leopardus (Lacépède).QFS Res. Bull. 1: 42pp.

JOHANNES, R.E. (1981) Words of the lagoon. Univ. of California Press.Berkeley.245p.

KRAMER, S.H. (1986) Scombridae-wahoo. In: Fishery Atlas of the Northwestern Hawaiian Island. R.N UCHIDA and J.H. UCHIYAMA (eds), NOAA Tech. Rept. NMFS 38, p126-127.

LEWIS, A.D., L.B. CHAPMAN and A.SESEWA (1983) Biological notes on coastal pelagic fishes in Fiji. Fisheries Division. Fij. Tech. Rept. 4: 68pp.

LOUBENS, G. (1980) Biologie de quelques espèces de poissons de lagon néo-calédonien III. Croissance. Cahiers de l'Indo-Pacifique 2(2): 101-153.

McPHERSON, G.R. (1981) Preliminary report: Investigations of spanish mackerel Scomberomorus commerson in Queensland waters. In : Northern Pelagic Fish seminar, GRANT, C.J. and D.G. WALTER (eds), p50-58. Aust. Govt. Publ. Serv., Canberra.

McPHERSON, G.R. (in press) Age and growth of Scomberomorus commerson (Lacépède 1800) in north-east Queensland waters.

MEAD, P.D. (in prep)Report of third visit to Fiji (18 January 1984-24 April 1985).Deep Sea Fisheries Development Project.

PAULY, D. and J. INGLES (1981) Aspects of the growth and natural mortality of exploited coral reef fishes. Proc. 4th International Coral Reef Symp. 1:89-98.

PRESTON, G.L. (1982a) UNDP/Fisheries Division. Small-scale Tuna Fishing Project. Fisheries Division (Fiji). Tech. Rept. 2: 21pp.

PRESTON, G.L. (1982b) The Fijian experience in the utilisation of Fish Aggregation Devices. Working Paper 25, 14th RTMF, Noumea, August 1982. 61p.

RALSTON, S. and K.E. KAWAMOTO (1987) An assessment of one description of the status of bottom fish stocks in Hawaii. SWFC Admin. Rept. H-87-7. 55p.

SHAKLEE, J.B. (1986) Patterns of genetic variation and subpopulation structure in spanish mackerel. In: Torres Strait Fisheries Seminar, A.K. HAINES, G.C. WILLIAMS and D. COATES (eds), p165 (Abstract), Aust. Govt.Publ.Serv., Canberra.

UCHIYAMA, J.H. (1980) Survey of the pelagic fishes of the Northwestern Hawaiian Islands. In: GRIGG, R.W. and R.T. PFUND (eds), Proceedings of the Symposium on Status of Resource Investigations in the Northwestern Hawaiian Islands, p251-263. UNIHI-SEAGRANT- MR- 80-04.

UCHIYAMA, J.H., R.K. BURCH and S.A. KRAUL, Jr. (1986) Growth of dolphins, Coryphaena hippurus and C. equiselis, in Hawaiian waters as determined by daily increments on otoliths. Fish. Bull., US. 84:186-191.

WILLIAMS, F.(1964) The Scombroid fishes of East Africa. Proc.Symp.Scombroid Fishes, Pt.1. Mar.Biol.Assoc.India, Symp.Serv.1.:107-164.

YUEN, H.S (1979) A night handline Fishery for Tunas in Hawaii. Marine Fish. Rev. 41(8): 7-14.

Table 1

Large costal pelagic species captured in Fiji waters.
(Gear types used, typical habitat and typical sizes taken are listed where available, as are nominal landings for 1986. Industrial fisheries for tunas are not included).

SPECIES	TYPICAL SIZE (kg)	HABITAT	GEAR USED FOR CAPTURE	LANDINGS (mt)
F. SCOMBRIDAE				
Scomberomorus commerson (Spanish mackerel)	3-20	L,RE	T,H	214.40
Gymnosarda unicolor (Dogtooth tuna)	5-40	RE	T	0.70
Thunnus albacares (Yellowfin tuna)	2-60	0,F;RE	T,VLL,DB	6.20
Euthynnus affinis (Mackerel tuna)	1-5	L,RE	T	0.20
Grammatorcynus bicarinatus (Scad)	1-3	RE	T	5.00
Katsuwonus pelamis (Skipjack)	1-5	0.F	T	7.60
Auxis thazard (Frigate tuna)	1	0,F	T, purse seine	-
Acanthocybium solandri (Wahoo)	4-30	0,F	T,DB	* 18.40
Thunnus obesus (Bigeye tuna)	50-100	F	VLL	-
TOTAL				**252.50**
F. CARANGIDAE				
Caranx papuensis (Brassy trevally)	1-5	L,RE	T,GN	
C. ignobilis (Giant trevally)	1-30	L,RE	T,GN,H	
C. melampygus (Bluefin trevally)	1-5	RE	T	
C. sexfasciatus (Bigeye trevally)	1-4	L,0,F	T	301.95
C. tille (Tille trevally)	1-3	L	T	
Carangoides plagiotaenia (Grey spot trevally)	1-3	RE	T	
Megalaspis cordyla (Finny scad)	1-2	L	GN,T	-
Scomberoides spp. (Queenfish)	1-1.5	L,RE	GN,T	2.95
Elagatis bipinnulatus (Rainbow runner)	2-6	0,F	T	* 6.30
Seriola rivoliana (Amberjack)	2-12	RE,0	DB	-
Caranx lugubris (Black trevally)	3-10	RE	DB,T	1.40
TOTAL				**312.60**
F. SPHYRAENIDAE				
Sphyraena genie (Dark finned barracuda) (**)	2-10	L,RE	T,H	
S. barracuda (Great barracuda)	2-15	L,RE,0,F	T,H	
S. jello (Yellow tail barracuda)	2-10	L	T,H	
S. forsteri (Forster's sea pike)	1-2	L,RE	GN,T,H	
TOTAL				**168.20**
F. SERRANIDAE				
Plectropomus - 3 spp (Coral trout)	1-10	L,RE	T,H	
Variola - 2 spp (Coronation trout)	1-3	L,RE	T,H	
TOTAL				**87.50**
F.LUTJANIDAE				
Lutjanus bohar (Red bass)	1-8	L,RE	T,H	27.20
Aprion virescens (Green jobfish)	2-5	L,RE	T,H	10.50
Aphareus furcatus (Blue jobfish)	1-2	RE	T,H	-
TOTAL				**37.70**
F. BELONIDAE				
Tylosurus - spp (Longtoms)	1-2	RE,L	GN,T	**11.20**
F.CORYPHAENIDAE				
Coryphaena hippurus (Dolphin fish)	1-15	0,F	T	**1.50**

* Mostly from longliners (wahoo) or pole-and-line vessels (runners)
** includes S. putnamiae/bleekeri
Habitat key: L: lagoon; RE: reef edge; O: bluewater; F: FAD associated
Gear Key: GN: gillnet; T: trolling; H: handline (live and dead bait)
VLL: vertical longline (FAD); DB: deepwater snapper by-catch

Table 2 :

Summary of available biological data on large coastal pelagics in Fiji
(Where no Fiji data is available on growth, only published data from elsewhere in the Pacific has been quoted.)

SPECIES	APPROXIMATE L_{max} (LCF in cm)	SIZE AT FIRST MATURITY	SPAWNING SEASON	SEX RATIO (TROLLING) Females Males	AGE AND GROWTH
SCOMBRIDAE					
Scomberomorus commerson	150	65- M 70- F	Nov-Feb	2 : 1	
Grammatorcynus bicarinatus	65	40 ?	Oct-March*	2 : 1	ND
Gymnosarda unicolor	150	65	Oct-March*	2 : 1	ND
Euthynnus affinis	75	50 ?	Summer ext.	1 : 2	K = 0.42; L_{∞}= 117.8 (Uchiyama, 1980-Hawaii)
Acanthocybium solandri	200	?	Extended		Age 1-50.6 cm; 2-121.7 cm (Kramer, 1986-Hawaii)
CORYPHAENIDAE					
Coryphaena hippurus	140	55	Extended	School by sex	M: K=1.187; L_{∞}=189.9; t =0.079 F: K=1.411; L_{∞}=153.3; t =0.073 (Uchiyama et al., 1986-Hawaii)
SPHYRAENIDAE					
Sphyraena barracuda	140	70 or less	Sum., offshore	1 : 5	ND
S. genie	130	ND	Oct-March?	4 : 5	ND
S. bleekeri/putnamiae	80 ?	<50	ND		K=0.373; L_{∞}=69.2 (Loubens, 1980-New Caledonia)
CARANGIDAE					
Caranx ignobilis	120	55	Oct-Nov	1 : 2	ND
C. papuensis	70	50	Oct-Dec	1 : 2	ND
C. melampygus	70	40	Oct-Jan	1 : 2	ND
C. sexfasciatus	80 ?	40 ?	Summer		ND
Carangoides plagiotaenia	70	40 ?	Summer ?	1 : 8	ND
Elagatis bipinnulatus	90	ND	Extended	ND	ND
SERRANIDAE					
Plectropomus laevis	100	60 - M 48 - F	Oct-Nov	3 : 1	ND
P. leopardus	60	30 or less	Oct-Feb	3 : 1	K =0.25; L_{∞}=64.7 (Pauly and Ingles, 1982-Great Barrier Reef) K =0.158; L_{∞}=50.0 (Loubens, 1980-New Caledonia)
LUTJANIDAE					
Aprion virescens	105	45 ?	Oct-Feb*	1 : 3	K =0.12; L_{∞}=116.5 (Ralston and Kawamoto, 1987-Hawaii) K =0.307; L_{∞}=65.6 (Loubens,

F = Females; M = Males; ND = No data
* minimum

Table 3 :

Growth parameters for Scomberomorus commerson populations.

Area	Basis of estimates	Sex	L∞ (LCF in cm)	K	t_0	Source
Fiji	Otoliths	F	97.7	0.44	-1.4	McPherson,
	Otoliths	M	NA	NA	NA	pers. comm.
N.QLD	Otoliths	F	152.8	0.18	-1.79	McPherson,
	Otoliths	M	116.7	0.39	-0.87	in press
Wewak, PNG	Modal progression (Von B.)	F	148.3	0.25	-1.50	Frusher,
		M	132.5	0.22	-1.92	1985
India	Otoliths	Combined	208.1	0.18	-0.16	Devaraj, 1982

Table 4 :

Calculated mean length at age for Scomberomorus commerson, by sex.

Age class	Fiji		N.QLD		Wewak, PNG	
	M	F	M	F	M	F
1	65.0	64.4	58.4	55.2	63.8	66.9
2	71.9	76.2	81.3	83.2	77.8	86.1
3	77.0	84.5	90.9	95.5	87.6	99.2
4	84.3	89.0	97.1	100.4	98.0	109.5
5			102.5	109.2	104.4	118.1
6			107.7	112.7	110.0	124.2
Source:	McPherson, pers. comm.		McPherson, in press.		Frusher, 1985	

Figure 1a:

Walu landings in Fiji, 1981-1987. (Other outlets account for the great majority of the landings).

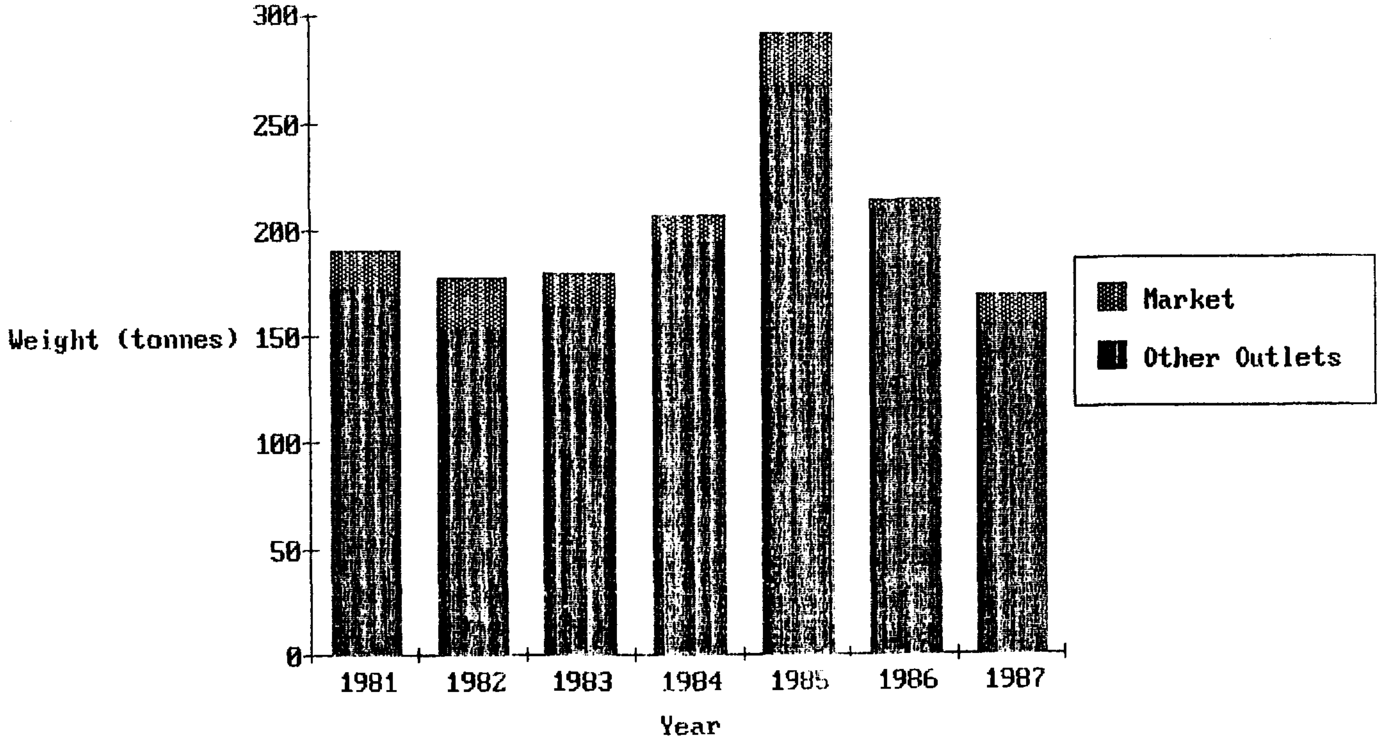

Figure 1b:

Monthly municipal market landings for Walu, 1983-1987. (Whilst markedly smaller than landings through other outlets, the strong seasonal peak during midsummer is evident).