WESTERN SAMOA FISHERIES RESOURCES PROFILES

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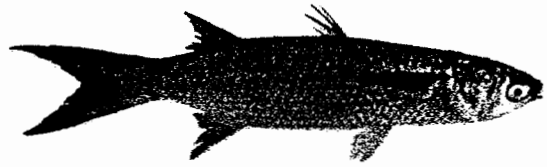
3.4 Mullet - *aua, anae*

3.4.1 The Resource



anae - *Crenimugil crenilabis*

Species present: Mullet species occurring in Western Samoa have not been properly identified. Fowler (1963) listed mullet species in Samoa as *Mugil trihilus* and *M. macrolepis*. In addition, Garlovsky (1972) listed *Liza caeruleomaculata, L. troscheli, M. seheli* and an unidentified *Mugil* sp. (*afa*). *Afa* (*utuali'i*) has been identified as *Liza vaigiensis*. Wass (1984) listed seven mullet species in American Samoa. The same species were listed by Zann (1991a) as those in Western Samoa. These are: *Chaenomugil leuciscus* (acute-jawed mullet), *Crenimugil crenilabis* (warty-lipped or fringelip mullet), *Liza macrolepis* (big-belly mullet), *L. subviridis* ?, *L. vaigiensis* (yellowtail mullet), *Valamugil engeli* (Engel's mullet), *V. seheli* (bluespot mullet). *Mugil cephalus* (sea or grey mullet) probably also occurs in Western Samoa but has not been listed because species have not been scientifically identified. Myers (1989) listed *Liza melinoptera* (the giant scale mullet) as occurring in the Ino-Pacific from E. Africa to Samoa, n. to the Philippines, s. to Tonga, and in Palau.

With the exception of *'afa* (*utuali'i*), the general Samoan name given for *L. vaigiensis*, all mullet species are generally known in the Samoan language according to their sizes. However, Wass (1984) also gave Samoan names, as known in American Samoa, of the different *'afa* (*L. vaigiensis*) sizes as follows:

fuitogo < 10 cm TL; *'afa* 10-25 TL; *'anaeafa* > 25 cm TL.

Samoan names given for different sizes of mullet have been estimated to correspond to the following approximate lengths:

poi (*poipoi*) <8 cm; *aua* 8-12 cm; *matapona* 12-20 cm; *anae* >20 cm.

Distribution: *C. crenilabis* occurs in the Indo-Pacific from the Red Sea to the Line and Tuamotus Islands, north to south of Japan, south to Lord Lowe Islands; Ifaluk, Marianas and Marshall Islands in Micronesia (Myers, 1989). It is commonly found in sandy lagoons and on shallow seaward reef flats (Randall. *et. al.*, 1990).

L. vaigiensis occurs in East Africa to the Tuamotus, north to south Japan, south to the south Great Barrier Reef and New Caledonia. It is found throughout Micronesia in lagoons and on reef flats where it is most common along protected sandy shorelines (Myers, 1989). This species forms large schools frequently in mangrove areas (Randall *et. al.*, 1990).

V. engeli occurs from E. Africa to the Marquesan and Tuamotu Is., n. to the Yaeyamas; Ifaluk, Marshalls, and Marianas in Micronesia; introduced to the Hawaiian Is. (Myers, 1989). The same author noted that this species species was found to be the most common mullet of shallow protected sandy to muddy areas of reef flats and shallow lagoons in Marianas.

V. seheli occrs in the Red Sea to Samoa, n. to s. to New Caledonia; Marianas in Micronesia (Myers, 1989).

C. leuciscus occurs in Mariana and Bonin IS. to the Hawaiian, Line, and Ducie Is.; Ifaluk, Marianas, and Marshalls in Micronesia (Myers, 1989). The author noted that this is the most common mullet in lagoon and seaward reef in the Marshalls.

Sea mullet, *M. cephalus*, inhabits coastal waters and estuaries in tropical and temperate waters of all

seas of the world, and are distributed mainly between the latitudes 42° N and 42° S. It has a strong tendency to school as juveniles, and during the spawning season, as adults. Juvenile schools commonly disperse over sand and mud flats of estuaries when feeding during high tide, but re-form on the ebb tide (Kailola *et al.*, 1993).

In Western Samoa, mullet is generally found through-out the country, especially near mangrove estuaries but are also caught in lagoons and on coral reefs and in reef channels. Mangrove areas serve as nursery areas for mullet juveniles. Mullet fishery during their spawning migration through the lagoons during September-December is well known in the villages of Luatuanu'u and Moata'a on Upolu, Pu'apu'a on Savai'i and Manono Island. The mullet species at Pu'apu'a is known as red-lipped. The red-lipped mullet species was also known to migrate from offshore around September and remain between Manono Island and Nu'ulopa islet for three months (Tuilaepa Puava, Apai village, 1993, *pers. comm.* to A. Mulipola, Fisheries Officer). This particular stock had been subjected to heavy dynamite fishing and is known to be almost non-existant.

Zann (1991), from surveys and interviews conducted through-out Upolu, recorded the following important fish species within zones indicated, in order of importance. Mullet are in **bold**.

Zone	Major reef fin-fish species
Apia East (Vaipuna-Letogo & Apia west (Vaiala-Vaigaga)	surgeonfish, **mullet**, scad
Faleula (Saina-Tuana'i)	surgeonfish, **mullet**, parrotfish, sweetlips, snappers, trevally
Ututali'i (Leauva'a-Fasito'outa)	surgeonfish, parrotfish, sweetlip, soldierfish (trevally, **mullet**)
Fasito'otai (Vaialua-Faleolo)	surgeonfish, parrotfish, soldierfish, sweetlip (trevally, **mullet**)
Apolimafou-Faleolo	**mullet**, surgeonfish, soldierfish, sweetlip, rock cod, (trevally)
Manonouta and Apolimafou	**mullet**, surgeonfish, rockcod, soldierfish, trevally (unicornfish, parrotfish, scad)
Manono and Apolima Islands	surgeonfish, **mullet**, soldierfish, parrotfish, coral cod, scad
Falelatai (Si'ufaga-Fagaiofu Bay)	**mullet**, surgeonfish, soldierfish, rockcod, trevally, parrotfish, emperor, angelfish, (unicornfish)
Lefaga (Mata'afa-Matautu)	surgeonfish, parrotfish, rockcod, soldierfish, **mullet**, coralfish
Sa'anapu (Salamumu-Lotofaga)	**mullet**, surgeonfish, rockcod, sweetlip, soldierfish, (scad)
Safata (Vaie'e-Siumu)	**mullet**, surgeonfish, trevally, parrotfish, goarfish, majorras, herring, (coral cod, scad)
O le Pupu (Aganoa-Togitoniga)	surgeonfish, rockcod, parrotfish, **mullet**, coralfish (trevally, unicornfish)
Falealili (Iliili-Satalo)	surgeonfish, rockcod, **mullet**, sweetlip, soldierfish, parrotfish, scads
Salani (Sapunaoa-Lotofafa)	major groups not recorded (surgeonfish, trevally)
Lepa (Vavau-Saleapaga)	surgeonfish, soldierfish, rockcod, sweetlip, snapper, **mullet** (trevally, unicornfish)
South Aleipata (Lata-Satitoa)	snappers, parrotfish, surgeonfish, soldierfish (trevally)
North Aleipata (Malaela-Amaile)	surgeonfish, parrotfish, sweetlip, **mullet**, soldierfish, ponyfish, trevally, moray eels, coralfish (unicornfish)
Uafato (East point-Tiavea)	groups not recorded but scad reputed to be common
Fagaloa Bay (Samamea-Sauano)	surgeonfish, parrotfish, angelfish, rockcod, **mullet**, sweetlip, scad
Saluafata (Falefa-Solosolo)	surgeonfish, scad, parrotfish, barracuda, wrasses, milkfish, rockcod
Luatuanu'u (Utumau'u-Lauli'i)	**mullet**, scad, surgeonfish, parrotfish

Biology and ecology: Mullet feed on detritus, diatoms, algae and microscopic invertebrates in estuarine waters, which they filter from mud and sand through their mouth and gills (Kailola *et al.*, 1993). Fish eggs may also be consumed (Randall *et al.*, 1990). Most mullet species can tolerate a wide range of salinities, with some ranging into purely fresh-water, and are important in aquaculture. A few species are most at home on coral reefs (Myers, 1991).

Spawning migrations of certain mullet stocks in Western Samoa are well known in certain villages, as mentioned above, which occur during the September-November period every year. However, no biological aspect of the mullets has been studied in Western Samoa.

3.4.2 The Fishery

Utilization: Mullet is of high value in the Samoa tradition. The mullet fishery has been one of the major resources in Western Samoa in the subsistence level. Buck (1930) describes the mullet hand net

(*alagamea*) as that used to catch mullet as they jump over a seine net by which they are enclosed. Long nets (*tolomatu*) were usually employed to catch mullet. Because of the sizes of these nets and of the fish schools involved, fishing using *tolomatu* was a community effort. It was normally used as a surround net and used together with *alagamea*. *Tolomatu* and *alagamea* were specifically used to catch the migrating spawning aggregations of the red-lipped mullet (*anae gutu mumu*), whereas the "other" mullet were caught with ordinary nets. The many-pointed spear (*tao fuifui*) was especially used for throwing into the midst of a shoal, such as the young mullet.

The traditional belief concerning the origin of the mullet fishery in Pu'apu'a is appended to this profile as taken from Buck (1930).

Current traditional methods of catching mullet include hand-thrown spear during night-fishing (*lama*) from a canoe with a pressured gas lantern. With the advent of cash-based economies, the resource has been subjected to severe utilisation in the artisanal/commercial sectors. As such, various methods, some destructive and very effective, have been employed in efforts to catch as much for short term needs. Schooling mullet has been the main target of dynamiting fishing which has been common and is still practised, in Western Samoa. Gill netting as well as fish weirs have also been used to catch mullet as well as other reef fish species. Mullet juveniles have been the target of most of the cast net fishery.

The major existing traditional mullet fishery is in Luatuanu'u where every year before September, a large V-shaped fence, made of chicken wire, is set at right-angles to the shore to catch the schools migrating to spawn. This particular mullet fishery sometimes last from September to December.

Production and marketing: There is no recent information available on the level of mullet consumption in the subsistence sector. Buck (1930) reported that red-lip mullet catches during its run at Moata'a were up to 3,000 at one catching. The nation-wide Fishery Catch Assessment conducted by the Department of Statistics in 1978 estimated reef fish landings of major groups in Western Samoa as presented in Table 3.4.1. Information on mullets are in bold. For the overall Western Samoa landings, mullet and milkfish constituted 5.4 per cent (30 mt) of the inshore fin-fish landings of 554 mt, 3.1 per cent of all fin-fish landings (including inshore and offshore deep-water and pelagic species) of 968 mt, and 2.8 per cent of all landings (all fin-fish and invertebrates) of 1,089 mt.

Table 3.4.1: Fishery product landings in Western Samoa as estimated during the Fishery Catch Assessment in 1978. (Source: Department of Statistics, undated).

Department of Statistics, Fishery Catch Assessment in 1978														
Island	Inshore Fin-fish					Total Inshore	% mullet Inshore	Total Deep-	Total Offshore	Total	% mullet All	Inverte-	Fin-fish + Inverte.	% mullet finfish +
Stratum	Reef fish	Caran-gidae	Mugil-idae	Eel	Others	Fin-fish	Fin-fish	water	Pelagics	Fin-fish	Fin-fish	brates Total	Total	Inverte.
I														
Inshore	38,010	237	644	5,183	3,224	47,298	1.36			47,298	1.36	30,816	78,114	0.82
Offshore								6,359	1,724	8,083			8,083	
Total	38,010	237	644	5,183	3,224	47,298	1.36	6,359	1,724	55,381	1.16	30,816	86,197	0.75
II														
Inshore	80,184	929	10,086	2,639	36,403	130,241	7.74			130,241	7.74	27,510	157,751	6.39
Offshore								11,800	25,937	37,737			37,737	
Total	80,184	929	10,086	2,639	36,403	130,241	7.74	11,800	25,937	167,978	6.00	27,510	195,488	5.16
III														
Inshore	37,489	733	503	6,518	1,876	47,119	1.07			47,119	1.07	17,114	64,233	0.78
Offshore								7,934	45,106	53,040			53,040	
Total	37,489	733	503	6,518	1,876	47,119	1.07	7,934	45,106	100,159	0.50	17,114	117,273	0.43
IV														
Inshore	169,402	10,954	4,585	5,781	2,143	192,865	2.38			192,865	2.38	26,129	218,994	2.09
Offshore								143,271	9,325	152,596			152,596	
Total	169,402	10,954	4,585	5,781	2,143	192,865	2.38	143,271	9,325	345,461	1.33	26,129	371,590	1.23
V														
Inshore	35,939	10,454	2,401	1,510	4,770	55,074	4.36			55,074	4.36	6,497	61,571	3.90
Offshore								23,528	30,165	53,693			53,693	
Total	35,939	10,454	2,401	1,510	4,770	55,074	4.36	23,528	30,165	108,767	2.21	6,497	115,264	2.08
VI														
Inshore	61,528	3,825	11,784	1,811	2,271	81,219	14.51			81,219	14.51	14,315	95,534	12.33
Offshore								29,704	78,913	108,617			108,617	
Total	61,528	3,825	11,784	1,811	2,271	81,219	14.51	29,704	78,913	189,836	6.21	14,315	204,151	5.77
TOTAL														
Inshore	422,552	27,132	30,003	23,442	50,687	553,816	5.42			553,816	5.42	122,381	676,197	4.44
Offshore								222,596	191,170	413,766			413,766	
Total	422,552	27,132	30,003	23,442	50,687	553,816	5.42	222,596	191,170	967,582	3.10	122,381	1,089,963	2.75

I. =Upolu northeast - Fagalii to Uafato; II. =Upolu southeast - Tiavea to Saaga; III. =Upolu southwest - Siumu to Matafa'a; IV. =Upolu Northwest - Falevai to Vailoa, including Manonon and Apolima; V. =Savai'i North - Samalaeulu to Falelima; VI. =Savai'i south - Fagafau to Pu'apu'a.

Mullet landings comprised about 4 per cent (or 15,818 kg) of the total Upolu inshore landing (415,328 kg), and about 9.2 per cent (or 14,185 kg) of the total Savai'i inshore landing (153,966 kg). Of the total Upolu fin-fish (inshore and offshore) landing of 668,979 kg, mullet made up 2.4 per cent and of the total fin-fish landing of 265,476 kg in Savai'i, mullet made up 5.3 per cent. These are summarised as follows:

	Total Inshore (kg)	Total Mullet (kg)	mullet %	Total Finfish (kg)	mullet %
Upolu	415,328	15,818	3.8	668,979	2.4
Savaii	153,966	14,185	9.2	265,476	5.3
Western Samoa	546,935	30,003	5.5	967,582	3.1

In a preliminary survey between December, 1983 and February, 1984, of the inshore fisheries of Upolu Island, Zann *et al.* (1984) estimated coral reef fin-fish production to the 8 m isobath on Upolu to be 5,593.8 mt per year and invertebrates to be 7,613.9 mt per year. Based on answers for fish consumed the day before the survey, mullet was estimated to make up 4.4 per cent of the rural production (consumption). The results are presented in Table 3.4.2 for fin-fishes, as reproduced from the same reference.

Table 3.4.2: Percentage of fish types eaten (caught) on the day before the survey. (Source: Zann *et al.*, 1984).

Taxon & habitat	Samoan name	Apia	North west	North east	South east	South central	South west	Manono Is.	Rural average
OCEANIC PELAGICS									
Skipjack	atu	28	6		6	36 (25)	13	18	8.6
Yellowfin	asiasi	11			6	2 (6)			2.1
Dolphinfish	masimasi					(3)			0.2
Rainbow runner	samani					10 (12)			1.8
CORAL REEF									
Snappers		6	8	4 (5)	33 (38)	3 (3)	(11)		9.2
Emperor	mataeleele	5	5		22 (46)	5 (6)	4 (11)	12 (7)	10.2
Coral cods	gatala		6	4 (5)	11 (8)	2	13 (8)	(7)	5.3
Moray eels	pusi	5		4			4 (12)		2.1
Goatfish	i'a sina etc				6		2		0.6
Parrotfish	fuga		20	20 (23)			6 (11)	6 (7)	7.7
Squirrelfish	malau		26	4 (5)	(8)	8 (9)	13 (31)	6	9.1
Surgeonfish	pone etc	22		40 (33)		18 (22)	21 (31)	41 (50)	21.3
Angelfish	tifitifi		6	(5)	6		(4)	12 (14)	3.1
Butterflyfish	tifitifi						(4)		0.3
REEF & LAGOON									
Barracuda	saosao, sapatu	11							
Trevally	lupo, malauli	11		(5)	6		4 (8)		1.9
Silver biddy	matu						4		0.3
Mullet	**anae**			**4 (5)**		**10 (3)**	**6 (12)**	**6 (7)**	**4.4**
Herring	pelupelu		6			2 (3)			0.9
DEEP WATER									
Jobfish	utu					(3)			0.2

King (undated) estimated species or taxa collected in the artisanal fisheries in Western Samoa using coastal ecosystems. Reef and lagoon fish estimates are given in Table 3.4.3 as reproduced from the same reference. The total artisanal annual catch (vertebrates and invertebrates) o be about 4,600 mt uming survey results depict typical fishing weeks. The mullet annual catch was estimated to be 326 mt for the whole country.

Table 3.4.3: Major fish groups collected in artisanal fisheries in Western Samoa estimated in 1989. (Source: King, undated).

English Name	Western Samoan Name	Fringing coral reef		Lagoons and a barrier reef		Lagoons, reefs and mangroves		All ecosystems
		Total Annual Catch* 1,435 mt		Total Annual Catch* 2,420 mt		Total Annual Catch* 738 mt		Total Weight
		%**	Weight (mt)	%**	Weight (mt)	%**	Weight (mt)	mt
Mullet	**anae**	**8.8**	**126.280**	**5.4**	**130.680**	**9.3**	**68.634**	**325.594**
Bigeye scad	atule	1.2	17.220	2.5	60.500	0.2	1.476	79.196
Goatfish	ulaoa	1.1	15.785	0.1	2.420	3.3	24.354	42.559
Rabbitfish	lo	2.7	38.745	5.2	125.840	4.4	32.472	197.057
Emperor	mataeleele	9.7	139.195	18.6	450.120	11.7	86.346	675.661
Trevally	lupo, malauli	1.8	25.830	14.2	343.640	4.7	34.686	404.156
Surgeonfish	pone	17.9	256.865	5.2	125.840	13.2	97.416	480.121
Parrotfish	fuga	7.8	111.930	4.8	116.160	3.4	25.092	253.182
Unicornfish	ume	5.7	81.795	1.5	36.300	1.9	14.022	132.117
Soldierfish	malau	4.4	63.140	6.6	159.720	13.2	97.416	320.276
Rock cod	gatala	7.3	104.755	4.5	108.900	2.1	15.498	229.153
Moray eel	pusi	2.1	30.135	3.9	94.380	0.5	3.690	128.205
		70.5		72.5		67.9		

*includes vertebrates and invertebrates; **percentage of whole catch, vertebrates and invertebrates.

King (cited above) noted that because of the intensive nature of the survey, species which are important seasonally are absent or poorly represented. Seasonal fin-fish species are mullet and ***atule***. Likewise, the species which are large and caught occasionally, e.g. sharks and turtles, may be under-represented. [However, if the surveys were during the mullet and ***atule*** seasons, then these species could be over-estimated]. Data collected from Luatuanu'u during the mullet run in 1989 indicate that up to 800 kg of mullet were caught per day in the village fence (trap). The mullet run during that year started in September and lasted about December. Total catch for the period was not available. [Assuming an average of 400 kg are caught per day in two 26-day months, the total mullet landing would be more 20

mt for those two months.]

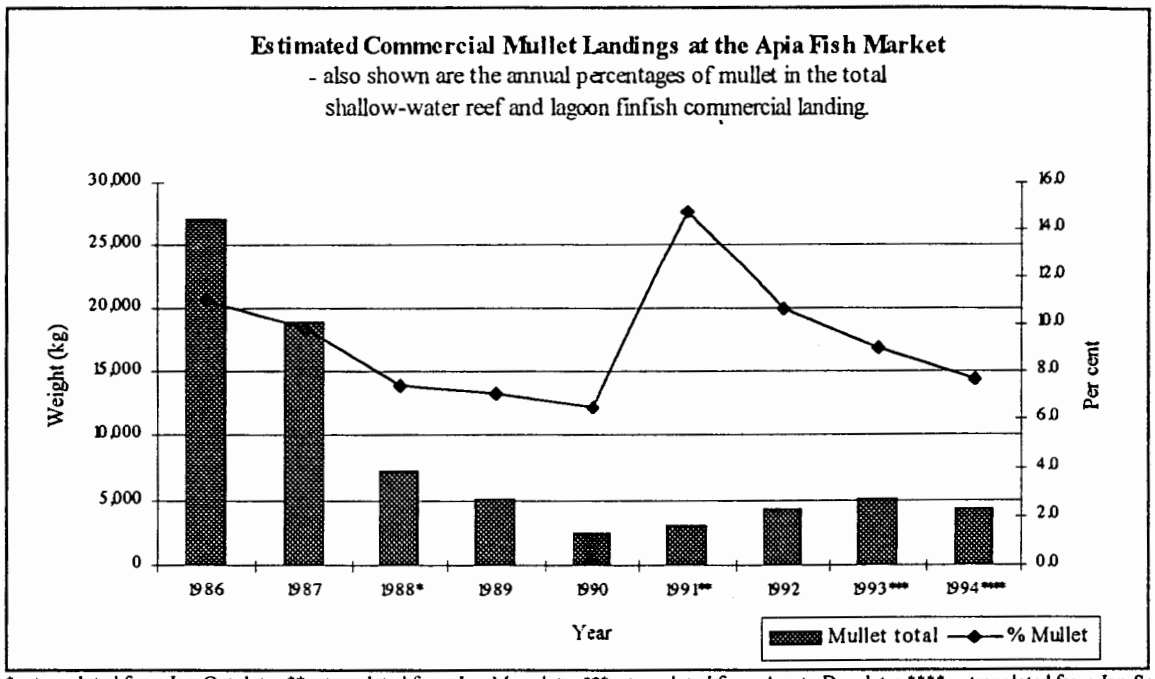
Estimated reef fish landings at the Apia Fish Market for the 1986-1994 period are given in Table 3.4.4 Figures indicate that the most important fish families in the commercial fishery are the surgeonfishes, emperors, mullet, parrotfishes, trevallies, goatfishes, unicornfishes, big-eye scads and groupers. The overall landings from 1986 to 1993 indicate that on the average, mullets make up about 9 per cent of the total commercial shallow-water reef and lagoon landings at the Fish Market and the fourth most important reef/lagoon fish resource. Figure 3.4.1 gives the general mullet landings trends at the market. It is obvious from the figure that mullet percentages are not reflective of relative composition in terms of weight. For example, in 1991, mullet landing was the second lowest in terms of weight, but it was the highest mullet composition of reef fish. This is an indication of more drastic declines in other fish groups landings. Drastic and continuous declines of commercial mullet landings can be seen from a very high landing recorded in 1986 (27,000 kg) to the lowest landing (2,500 kg) recorded in 1990. Landings gradually increased again to about 5,000 kg in 1993 but dropped again to a little over 4,000 kg in 1994. It must be noted though that estimates for some years were extrapolated from several months data and that reliability and completeness of data collected would greatly affect the estimates.

Table 3.4.4: Shallow-water reef fish landings at the Apia Fish Market for the 1986-1993 period. Figures are in kg. (Sources: Mulipola, 1993; Mulipola, 1994; Helm, 1987; Fisheries Database).

Fish family	1986	1987	1988*	1989	1990	1991**	1992	1993***	1994****
Acanthuridae-surgeonfish	27,100	28,600	12,042	6,790	10,767	2,605	5,200	6,787	6,568
Scaridae-parrotfish	27,100	31,500	17,235	4,996	4,867	2,569	6,100	6,650	8,054
Acanthuridae-unicornfish	15,000	16,400	11,085	6,888	5,120	1,857	5,000	6,778	5,310
Serranidae-grouper	6,900	12,000	1,616	1,671	591	579	1,800	3,374	2,343
Siganidae-rabbitfish	2,500	2,100		6,769			700	1,507	1,493
Lutjanidae-snapper	5,200	3,400		2,096			1,700	3,134	2,261
Mullidae-goatfish	18,000	16,800	820	4,701		542	3,000	4,466	3,620
Holocentridae-soldierfish	2,700	6,500		650			1,400	2,580	2,849
Lethrinidae-emperor	59,000	28,700	12,962	5,681	5,893	2,060	7,500	7,608	6,963
Gymnothorax?-moray eel	8,400	4,600	7,483	1,924	1,375	284	1,000	2,086	2,987
Mugulidae-mullet	**27,100**	**18,900**	**7,234**	**5,101**	**2,542**	**3,056**	**4,400**	**5,093**	**4,393**
Carangidae-jacks and trevally	19,900	5,000	2,699	11,079	1,019	891	2,000	2,177	2,210
Gerreidae-silver biddy	2,000	400	1,588			89	200	1,536	1,460
Carangidae?-scad	12,500	600	3,529	497		1,200	200	48	4,864
Labridae-wrasses	2,000	1,500							
Other	10,800	15,100	19,089	198	6,997	4,950	1,300	1,982	1,549
Chanidae-milkfish				7,776				864	418
Kyphosidae-drummerfish				222					
Ponyfish				5,060					
Shallow-water reef fish total	246,200	192,100	97,382	72,099	39,171	20,682	41,500	56,671	57,342
Mullet total	**27,100**	**18,900**	**7,234**	**5,101**	**2,542**	**3,056**	**4,400**	**5,093**	**4,393**
% Mullet	11.01	9.84	7.43	7.07	6.49	14.78	10.60	8.99	7.66

*extrapolated from Jan-Oct data; **extrapolated from Jan-May data; ***extrapolated data from Aug to Dec data; **** extrapolated from Jan-Sept data. The 1994 Lutjanidae were all savane & malai.

Figure 3.4.1: Trends in the commercial mullet landings in the Apia Fish Market. Mullet percentages are mullet composition of the total shallow-water reef anf lagoon fin-fish landings at the market.



*extrapolated from Jan-Oct data; **extrapolated from Jan-May data; ***extrapolated from Aug to Dec data; **** extrapolated from Jan-Sept data.

Brotman (1989) estimated the shallow-water reef and logoon fin-fish landings at wholesalers, retailers and hotels to be about 56 mt. Mullet was noted as one of the major groups contributing to the estimated landing. However, the author did not give relative estimates for each fish group.

The survey on the roadside from Apia to Faleolo recorded the following statistics for reef fish in 1992:

Fish	Wt (kg)	Fish	Wt (kg)
Surgeonfish	1,069	Snapper	328
Parrotfish	1,192	Soldierfish	273
Unicornfish	603	Emperor	5,430
Grouper	566	Trevally	359
Rabbitfish	212	**Mullet**	**1,913**
Moray eel	270	Silver biddy	4
Scad	104	Other fish	1,970

3.8.3 Stocks Status

There has been no attempt to assess the stocks of mullet in Western Samoa or study any biological aspect of the species present. However, observations on catches in areas where mullet are important all indicate the declining trends not only in numbers but in average mullet size captured. Mullet used to be an important resource for the gillnet fishery within Safata Bay. Gillnet is no longer used as the big mullets are absent. The traditional red-lip mullet fishery at Pu'apu'a, Savai'i has virtually disappeared. The villagers believe that this has come about "because catches were offered for sale" (Bell, 1989). Mullet catches at Luatuanu'u during spawning migrations are known to be declining both in numbers and in average sizes of individual fishes. Traditional beliefs in this particular village does not allow people from outside the village to be present during fishing operations, and mullet caught in the trap are not allowed to be sold. Even though these beliefs, in a way, may seem to help in controlling the harvesting of the migrating stocks, in reality, the village would catch as much as can be caught. Mullets that manage to jump over the trap are mostly caught by villagers standing outside the trap with mullet

hand nets (*alagamea*) individually operated. Mullets caught in this manner do not go into the village catch. Apart from catches made in the trap, villagers are allowed to fish these stocks outside the reef or nearby areas after the village catch has been made, mostly in the late afternoon. The red-lip mullet fishery at Manono Island and Nu'ulopa islet has become seriously affected by overfishing through the extensive use of gillnets and dynamiting on spawning stocks. Schools of mullet have always been the main target of the dynamite fishery. [Cases of dynamite fishing have been recorded in Toamua, Faleula, Leauva'a, Manono, Falelatai, Safata.] Zann (1991) noted that Vaiusu Bay used to be a major nursery ground for mullet but has been degraded by dumping, sand mining, industrial pollution and reclamation. Juvenile mullet schooling in nursery areas like mangroves, have been targets of the cast-net fishery in areas where they occur.

Commercial landings recorded at the Apia Fish Market indicate a drastic and continuous decline in mullet landings from 27,000 kg estimated in 1986 to 2,500 kg in 1990. This represents a decline of about eleven fold. Even though the estimated landings started to gradually increase in the following years (after 1990), a decrease was again noted from 1993 to 1994. Mullet landings for the last four years were around 4-5000 kg per year, which is about 5 to 6 times lower than that recorded in 1986. Three possible explanations or combinations of these contribute to the recorded drastic declines in commercial mullet landings, especially from 1986 to the 1990's:

(1) actual drastic declines in mullet stocks due to overfishing;
(2) development of additional distribution outlets thus product landing at the Apia Fish Market has been "thinning" out;
(3) inconsistency and inaccuracy in data collection and analysis systems employed.

It is suspected that all of the three factors mentioned above contribute in varying degree. However, it is presumed that actual declines in mullet stocks due to various type of over-fishing is the main factor affecting the declines.

3.8.4 Management

Current legislation/policy regarding exploitation: Fisheries Act 1988: Part II, 4 (1) (a) of the Act prihibits the use or attempt to use of any explosive, poison or other noxious substance for the purpose of killing, stunning, disabling or catching fish, or in any way rendering fish more easily caught. Paragraph (b) makes it illegal to carry or have in possession or control any explosive, poison or other noxious substance in circumstances indicating an intention to use such for any of the purposes referred to in (a). Under subsection (2), any explosive, poison or other noxious substance found on board any fishing vessel shall be presumed, unless the contrary is proved, to be intended for the purpose referred to in subsection (1)(a). Subsection 3 makes it illegal for any person to land, sell receive or possess fish taken in contravention of subsection (1)(a), which he knows or has reasonable cause to believe they were so taken. Part II, 5 requires local commercial fishing vessels to have a valid certificate of registration.

Fines: Contravention of Section 4(1) is a fine of 1,000 tala and imprisonment for a term not exceeding 2 years except that no sentence of imprisonment shall be imposed under this subsection for an offence committed in the exclusive economic zone. Contravention under Section 4(3) is a fine not exceeding 1,000 tala.

Proposed Local Fisheries Regulations: Part I, 3 (1) and (2) of the proposed Local Fisheries Regulations proposes to prohibit the catching and selling of mullet (genus *Mugil*) less than 200 mm in length measured from the furthermost point of the snout to the middle of the tailfin when the fish is laid flat. Part I, 4 of the same proposed regulations empowers the Director to declare a period or periods as

prohibited for fishing mullet and other fish species as follows:

Common name	Samoan name	Scientific name
Grey mullet	**anae, afa, ulupona**	**Mugil species**
Rock cods, groupers	gatala	Serranus species
Bigeye scad	atule	Selar crumenophthalmus
Hawksbill turtle	laumei (una or faiuna)	Eretmochelys imbricata
Green turtle	laumei	Chelonia mydas

Part I, 5, proposes to allow only the following fishing gear unless authorised by a license issued in accordance with the Fisheries Act 1988:

a. beachnets and castnets with a mesh size not less than 30 mm, measured when wet and stretched;
b. all other nets shall have mesh size of not less tham 50 mm, measured when wet and stretched;
c. fishfences shall have a mesh size not less than 50 mm measured when wet and stretched irrespective of the material used to make them.

Recommended legislation/policy regarding exploitation: Rigorous enforcement of the existing laws, e.g. dynamite fishing, is necessary. Additional considerations could include:

⇒ banning or limiting the number of fish fences that can be set up in various zones along the country's coastline. Limiting the number can be done through a permiting system in which a fisherman wanting to set up a fish fence must obtain an annual permit first. The Fisheries Division can determine the number of fish fences that can be erected in fisheries zones within the country. In addition, specific legislations must be added to limit fish fence size and to hold every fish fence permit holder responsible for the removal (disposal) of damaged or rusting fence, he/she has set up, from the sea and dispose of in a responsible manner, on land. Likewise, fences must be so placed that it will not damage any coral during the set-up and removal operations or unlikely to affect corals in the event of a cyclone or rough weather. [Specifics can include setting a minimum distance from corals and reefs, interfer with other uses of the area, such as navigation, subsistence fishing etc].

⇒ controlling the use of cast nets, by banning use or limiting numbers. Limiting numbers can be done via a permiting system in which numbers are controlled in the sales or number of fishermen involved in a particular zone.

⇒ limit length sizes of various nets.

Because there are more than one genus of mullet in Western Samoa, it would be necessary to list all the mullet genera in regulations that cover them in general. Listing *Mugil* spp. to refer to all mullet species is wrong, unless Mugil sp. is defined in the regulations to mean all genera and species of mullet. And due to the fact that different specieshave different growth rates and reach sexual maturity at different sizes, application of one minimum size limit to cover all mullets is impractical. Therefore, it might be necessary to list species with its specific corresponding minimum size limit, except for species that may have similar growth and maturity parameters.

A major problem concerning the application of and upholding national legislation for the mullet fishery in certain locations during their spawning migrations, e.g. Luatuanu'u, is the involvement of community in a traditional way. It has been documented that fishing on spawning aggregations render the fish exceptionally vulnerable to overfishing leading to possible local extinction. However, traditional fishing of spawning aggregations present opportunities for integration of traditional knowledge and management with modern scientific management tools. This of course would require education and training which can be done through extension work. Because of traditional ties to the fishery, introduction of any management strategy will have to be done through traditional means geared towards a community-based management system. Possible starting points for the introduction of some management ideas in the Luatuanu'u mullet fishery is for the village to prohibit the catching of mullet

that jump over the trap, and to prohibit fishing of the migrating stock in any other method and time except in the village trap. Gradually, and with accumulation of scientific knowledge on stock yields, migration patterns and other biological factors, limiting the number of catching days and setting a quota can be introduced, all through the community. This would mean conducting extensive research first, on migration patterns and to determine other biological parameters concerning the stocks.

In order to establish management strategies that would be appropriate to apply, especially on migrating aggregations, research is required first to determine lunar periodic, seasonal and interannual variation in aggregation sizes, their functions, and the fishing pressure on them (Johannes, 1993).

One of the most important factors that is affecting the shallow-water fishery is the destruction of mangrove through various undertakings such as reclamation, dredging for sand, pollution, and manual destruction by cutting and rubbish dumps. Any development that is likely affect the mangroves should be discouraged and be subjected to proper and thorough environmental impact assessments.

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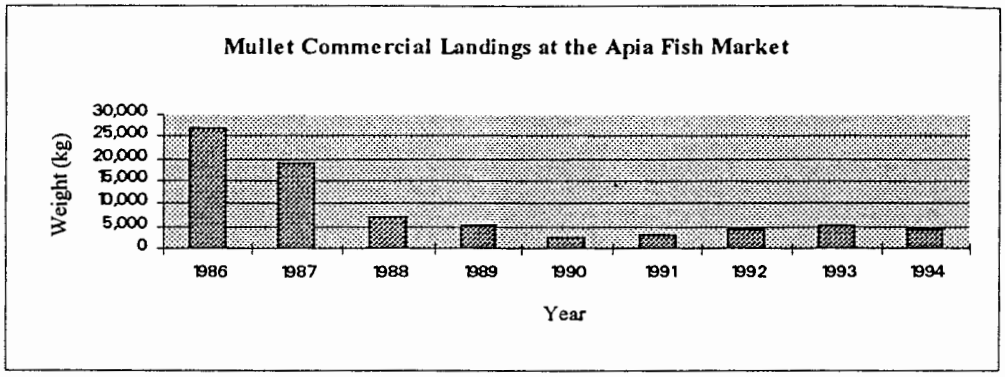
Mullet Commercial Landings at the Apia Fish Market
Weight (kg)
30,000
25,000
20,000
15,000
10,000
5,000
0
1986
1987
1988
1989
1990
1991
1992
1993
1994
Year