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The Fijian Baitfishery

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Introduction

1. The Fijian skipjack fishery, modest in size relative to others in the Pacific, makes an increasing important contribution to the economy of the country. Established in 1976 as a means of increasing and diversifying the supply of tuna to the joint venture cannery at Levuka, the skipjack fishery has shown steady, rather than spectacular, growth to the point where 6507 tonnes were landed by 14 vessels during calendar year 1981. This year also marked the peak for baitfish catches logging an estimated 140 tonnes. At present IKA Corporation has 3 IKA owned and 2 chartered Japanese vessels fishing for them. There are also 3 private vessels, two from Kiribati and one local who are also pole-and-line fishing. This year one vessel from New Zealand has also joined pole and line operations.

2. Despite the success of purse seining in other areas of the tropical Pacific, pole and line fishing remains a viable economic enterprise and well within national development objectives. There are several issues facing the Fijian Government with regards to managing the multi-use aspects of fish resources, baitfish species being among them. This paper presents the characteristics of the fishery, research activities of the Fijian Fisheries Division, and presents a discussion on the management concerns with respect to traditional fishing rights and the concept of a permit system. Much of the information presented in this report appears in other publications from the Fisheries Division of Fiji (e.g. Lewis et al. 1983). Some preliminary investigations on the multi-species nature of the fishery is also presented.

* With analytical assistance from James Ianelli, SPC Tuna and Billfish Assessment Programme.

The Fishery

Geographic and Climatic Conditions

3. Three distinct climate zones are generally recognized: the wet zone on the windward side of the more mountainous islands, the dry zone on the leeward side of the larger islands, and the small island zones. From April to November the wet zone receives considerable rain from the tradewinds, the small low islands receive somewhat less rain and the dry zone very little.

4. The region lies within the southeast tradewind belt. Spells of northerly and northwesterly during the hurricane season between December to March, when light and variable winds predominate. Strong tradewinds in September and October often restrict fishing operations.

Baitfishing Areas

5. The Fijian islands are chiefly volcanic in origin although some consist of raised limestone, volcanic-limestone are coral atolls. The coastlines of the islands are indented by numerous bays and inlets and in many places long stretches of fringing or barrier reefs are present. Many are surrounded by barrier coral reefs, but with few exceptions there are passages through the reefs into the bays or lagoons. The areas between the reef and shore offer safe and good anchorages for ships although numerous coral heads may be present. The shoreline of many islands consists of small stretches of sandy beach broken at places by cliffs, coral reefs, rocky outcrops and dense stands of mangrove. The continental shelf is limited with the seabed falling fairly sharply into deepwater from the reefs fronting the coastlines. The major area of shallow water extends from the west-southwest to the north of Viti Levu and continues to the northwest of Vanua Levu. This area is partially enclosed by a barrier reef which stands out to sea a maximum of about 50 miles from the coastlines. There are numerous rivers and streams on the larger islands that empty into the sea throughout the year. The bottoms of most of the bays on the major islands are covered with silt or mud. Frequent rains keep the small streams running and feeding the main rivers. These features are considered important when defining habitat types for baitfish species.

6. Over one hundred baitfishing sites have been used by vessels at one time or another. As vessels operate individually rather than on a fleet basis, effort is rather widely distributed, although it naturally centres on productive areas adjacent to areas of skipjack abundance. The large number of individual baitfishing sites are grouped into eleven zones in which reflect administrative boundaries as well as showing some internal conformity in habitat type (Figure 1.). Salient features of these zones and the more important individual sites within them are summarised below.

Characteristics of the major baitfishing zones

ZONE		CHARACTERISTICS	IMPORTANT SITES
Ovalau	(O)	Deep lagoon within fringing reef.	Levuka, Rukuruku, Nasova
Lomaiviti	(L)	Sheltered lagoon anchorages on less side of islands.	Sawaieke, Nawaikama (Gau); Nabuna (Koro), Namena,Makogai.
Central Viti Levu	(CVL)	Mainland bays, plus the extensive Beqa lagoon.	Lami Bay, Serua, Deuba(Viti Levu), Vaga Bay, Malumu Bay (Beqa).
Kadavu	(K)	Large sheltered harbours in south,lee shore in north.	Galoa, Soso, Yauravu (South), Namara, Kavala.
Southern Vanua Levu	(SVL)	Deep mainland bays.	Kubulau, Naisonisoni, Savarekareka, Vatulele, Valaga Bay (Savusavu Bay).
Northern Vanua Levu	(NVL)	A large area inside the Great Sea Reef and amongst various islands.	Kia Is., Bekana Harbour, Sausau Bay, Cukini Is.,Udu Point/Nakusa,Mali Is.
Eastern Vanua Levu	(EVL)	Sheltered waters in lee of islands.	Qamea, Kioa, Viani Bay.
Northern Lau	(NL)	Vanuabalavu lagoon and smaller island lagoons.	Qilaqila, Vanuabalavu, other; Qelelevu, Wailagilala.
Southern Lau	(SL)	Island lagoons.	Moala, Yagasa, Ogea, Matuku, Oneata.
Western Viti Levu	(WVL)	Shallow bays in Viti Levu's lee.	Nawala Pt.(Nadi), Momi Bay.
Western Vanua Levu	(WVL)	As for NVL, but access more difficult.	Rukuruku Bay.

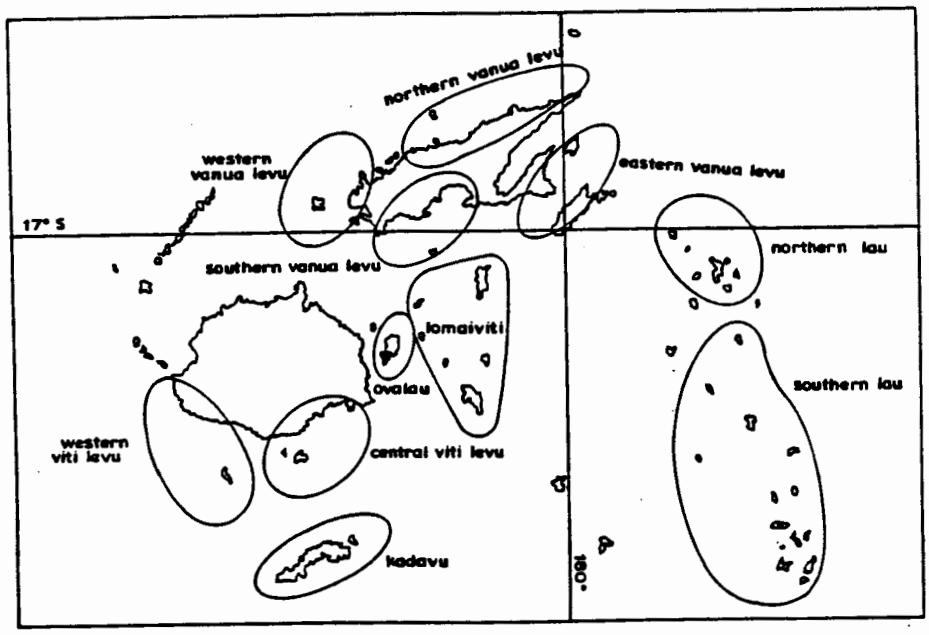

Figure 1. Baitfishing areas for Fiji.

Fishing Method

7. Baitfishing is normally carried out on a nightly basis with the exception of the brief period in 1978 when one vessel used a lampara net, fine mesh stick-held dip nets (Boke Ami) have been the standard method of capture. For a detailed description of Boke Ami fishing refer to Hallier et al., 1982. The nets are generally 25m X 25m in size, but the depth of nets have been steadily increased recently to catch bottom-hugging bait. One net 45m in depth is now reportedly in use, and 35m nets are now becoming common.

8. Light attraction arrangements vary from vessel to vessel; 2-3 underwater tungsten filament lights (1000 - 2000w) are normally used, but recently some vessels have been switching to mercury vapor lights, used above or below the water surface. These provides more light output (candle power) with less energy expenditure.

9. It is unclear how these changes in fishing technique have effected the units of efforts used (i.e., the set, the night's fishing). Although it seems reasonable to assume that baitfishing power on a per set basis has increased to an unknown degree, and that bottom-hugging species may figure more prominently in the catch.

Species Composition of the Catch

10. Species which contribute significantly to the boke ami catch in Fiji have been documented in previous surveys (FAO, 1984; Kearney, 1978; Kearney, 1982; Ellway & Kearney, 1981, and Annual Reports). These estimates of the importance of various species are summarised in the attached Appendix. Lewis et al. (1983) in a field guide to the baitfishes of the region provide listings of the various baitfish species which have been recorded in Fiji, as well as Keys to their identification. Seven species groups dominate the catch. These are as follows:

(1) Sprats - blue sprats (Spratelloides delicatalus), with smaller quantities of silver sprat, S. gracilis.

(2) Sardines - spotted sardine (Sardinella sirm), with small percentage of blue sardine (S. clupeoides).

(3) Herring - gold spot herring (Herklotsichthys quadrimaculatus).

(4) Hardyheads - Two species, Atherinomorus lacunosus, still widely known as Pranesus pinguis, and the more desirable Hypoatherina ovalaua, dominate catches.

(5) Mackerels - Rastrelliger kanagurta predominates, with the more estuarine R. brachysoma contributing in some areas. R. faughni also occurs.

(6) Cardinals - Rhabdamia gracilis, with smaller amounts of R. cypselurus.

(7) Anchovies - various species dominate this grouping in different areas at different times, including Stolephorus heterolobus, S devisi, S. indicus, S. bataviensis, S. buccaneeri and Thryssa baelama.

11. Other species, notably fusiliers (Caesionidae), weak herrings (Dussumieria spp), and scads (Selar, Decapterus) also make occasional contributions to the catch.

Catch and Effort Data

Data Collection

12. All pole and line vessels are required to supply, on forms provided by the Fisheries Division, details of bait and tuna catches. In June, 1981, the existing three form system, giving details of catches, bait catch by species, and tuna length frequency, was replaced by a single form bound in booklet form. This form is shown in Appendix 1.

13. Information recorded on baitfishing activity includes date, position, catch per set of the net (in buckets), total bait catch, and estimated species breakdown (%) by seven groupings listed earlier, plus an "others" category. The number and weight of fish per bucket varies according to the size of the fish. A bucket of bait contains from 1.6 to 2kg of fish, or an average of 1.82kg.

14. To avoid any misunderstanding about the baitfish species groupings and to improve the accuracy of catch composition data, each vessel was supplied with plastic-coated colour photographs of the main species within the groupings, each having English Linnean, Japanese and Fijian names on the reverse side. Preserved specimen were also shown to the recorders.

15. Unit of effort recognized are the set (or haul) of the net (usually one to three per night) and the fishing night. As discussed previously, there is difficulty in equilibrating effort amongst vessels and between years due to technical improvements, but probably overshadowing this is variation in the skills of the individual fishing masters. Forms as generally submitted when vessels return to the port at full moon period and are analysed by the Fisheries Division staff in the computers using the programs designed by SPC (Tuna Program).

Overall Trends

16. Catch rates have remained fairly stable among the years the fishery has been in operation (Table 1). An average 33 buckets of bait are caught per set. Catch versus effort plots (Figure 2) indicate that the baitfishery may not have been depleting the resource hard enough to begin to show some leveling off of catches at the higher effort levels. The strongly linear appearance of the data points may reflect some underlying assumptions on apparent abundance as discussed by Wetherall, 1977. The fleet of boats can be relatively dispersed or concentrated depending on availability of good tuna schools, weather conditions, steaming time, etc. There is also a problem of considering the aggregate data when in fact, more discrete geographic and species units would be more appropriate.

Table 1. Summary of baitfish catch and effort by locally operating pole-and-line boats, 1976-87.

Year	Catch(bkts)	Nights	Sets	Sets/Night	Catch/Set
1976	41,249	436	681	1.562	60.571
1977	60,116	840	1,259	1.499	47.749
1978	46,987	755	1,041	1.379	45.136
1979	29,302	1,005	1,231	1.225	23.803
1980	54,301	1,968*	1,314*	1.230	41.325
1981	80,485	1,777	2,482	1.397	32.427
1982	78,901	1,741	2,294	1.318	34.395
1983	58,052	1,322	1,837	1.390	31.602
1984	54,888	868	1,208	1.392	45.437
1985	33,305	723	1,068	1.477	31.184
1986	25,776	566	799	1.412	32.260
1987	38,011	720	990	1.375	38.395

*These data questionable
Sources : Before 1983-Fisheries Division annual Reports, 1983-87 data are from the latest statistics coming from the Division's data-base.

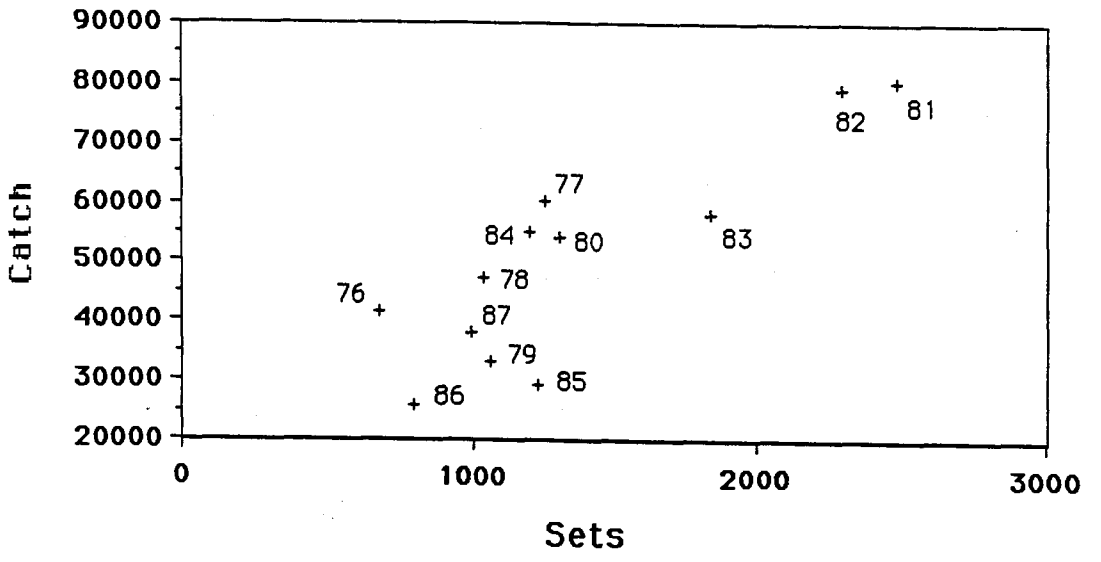

Figure 2. Catch in buckets verses effort in sets for all of Fiji, 1976-87.

Seasonal Variation in the Catch

17. Both the average monthly catch/set and monthly total catch (Annual Reports) show distinct seasonal patterns, with catch rates generally increasing steadily from low levels in October-November to a peak in April-May, then declining over the June-August period. This seasonal fluctuation has been quite regular since the fishery began, and within any given year is strongly correlated with mean monthly sea surface temperatures.

Catch by Area

18. Several factors influence the geographical distribution of baitfishing effort, but the proximity of potential tuna fishing grounds is the most important of these. As the experience of the fishing masters has increased along with their understanding of patterns of tuna availability, changes in the distribution of effort have occurred. In general, the following conditions influence where boats will fish at any one point in time :

- the proximity of good tuna fishing;
- expected weather conditions;
- distance from unloading site (and vessel fullness);
- the location of productive fish aggregation devices or payaos;
- access agreements with traditional owners.

19. All the major islands in the group have a bait resource. The best baiting in recent years was recorded from Northern Vanua Levu with 23% of the baitfish catch, followed by Lomaiviti with 21%, and Southern Viti Levu and Northern Lau each with 13% of the bait catch. Eastern Vanua Levu, Southern Lau, Southern Vanua Levu and Kadavu at times support important and huge quantities of baitfishes but generally provide supplemental bait quantities either in transit to productive grounds or for practical reasons.

20. In order to focus on more fine-scale issues on the condition of baitfish stocks and their population patterns, I have selected some of the more consistently fished zones (Table 2) for closer examination. These areas include Northern Vanua Levu and Lomaiviti, are regularly fished and contribute to nearly 50% of all baitfish catches in Fiji. To examine the variability in catch rates and the relative amount of effort, I have plotted quarterly catch rates with circles proportional to the amount of effort in that zone for a particular quarter (Figure 3). This is presented as an exploratory step to finding patterns, if any, to catch rates and fishing intensity.

21. For Lomaiviti the amount of effort rarely continues to the next quarter in similar magnitudes indicating that the fleet tends to have a preferred time of year to fish in this area. For the Northern Vanua Levu data, two sets of three continuous quarters have similar levels of fishing. Starting in the first quarter of 1984, in Northern Vanua Levu the catch per set is more than 90 buckets. In the second quarter the average catch per set drops to about 40, followed in the third quarter by an average catch per set of less than 20 buckets. The catch per set declined 50% while the effort increased over these 3 quarters.

	Unrecorded			E. Vanua Levu			Northern Lau			S. Lau			W. Viti Levu			W. Vanua Levu		
	Sets	Catch	CPUE	Sets	Catch	CPUE	Sets	Catch	CPUE	Sets	Catch	CPUE	Sets	Catch	CPUE	Sets	Catch	CPUE
1982	0%	0%	0	4%	3%	20	8%	8%	24	2%	3%	29	0%	0%	10	0%	0%	10
1983	0%	0%	17	12%	13%	35	14%	11%	25	0%	0%	0	1%	1%	35	0%	0%	27
1984	1%	0%	16	4%	5%	63	19%	17%	40	0%	1%	97	2%	2%	41	0%	0%	30
1985	2%	5%	70	8%	7%	26	18%	19%	33	0%	0%	21	7%	7%	29	0%	0%	28
1986	0%	1%	150	7%	7%	31	6%	8%	45	1%	1%	31	0%	1%	75	0%	0%	9
1987	1%	2%	81	8%	6%	30	22%	14%	24	0%	0%	35	0%	0%	0	0%	0%	15
All	1%	1%	61	8%	7%	33	15%	13%	31	1%	1%	34	2%	2%	33	0%	0%	23

	Ovalau			Lomaiviti			S. Viti Levu			Kadavu			S. Vanua Levu			N. Vanua Levu		
	Sets	Catch	CPUE	Sets	Catch	CPUE	Sets	Catch	CPUE	Sets	Catch	CPUE	Sets	Catch	CPUE	Sets	Catch	CPUE
1982	7%	7%	24	18%	22%	30	26%	22%	21	6%	3%	13	3%	2%	18	25%	30%	31
1983	5%	5%	30	21%	22%	32	12%	11%	28	11%	12%	35	5%	4%	24	19%	22%	37
1984	4%	5%	50	22%	22%	46	10%	12%	54	6%	4%	30	3%	5%	66	28%	27%	44
1985	11%	15%	42	22%	25%	34	15%	11%	22	4%	3%	27	5%	4%	23	6%	5%	22
1986	12%	15%	40	27%	26%	31	12%	10%	29	4%	3%	29	11%	8%	22	20%	21%	34
1987	9%	8%	33	13%	13%	40	12%	14%	45	9%	8%	35	5%	5%	34	20%	30%	57
All	8%	8%	36	21%	21%	35	14%	13%	31	7%	6%	30	5%	4%	29	20%	23%	40

Table 2. Catch and effort data by zone in percent of the annual contribution and in average catch per unit of effort (set) 1982-87. The data for 1982 include only the second half of that year.

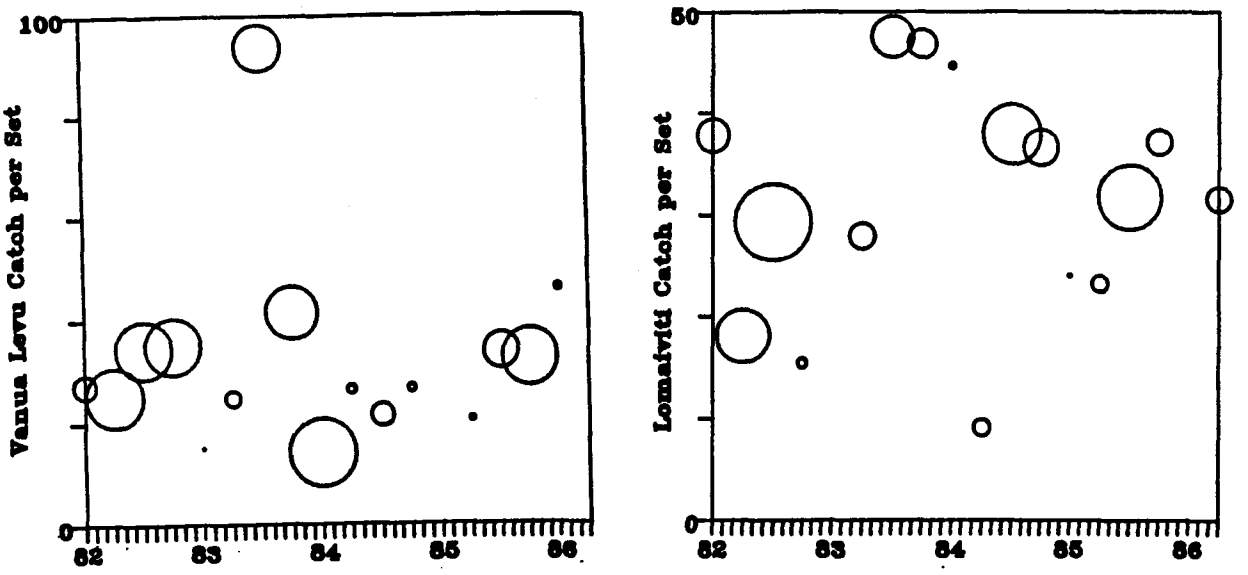

Figure 3. Catch rates for in buckets per set for Lomaiviti and Northern Vanua Levu, 1982-86. Circles are proportional to the total number of sets in a quarter.

Species Composition Patterns

22. Based on the information presented in Table 2, closer examination of the multi-species nature of the fishery was carried out in the first instance for the entire 1982-87 period for both Lomaiviti and Northern Vanua Levu. In the last part of this section I present a closer species look a the Northern Vanua Levu data during the period of the extreme drops in average catch rates. The validity of interpretations on the species composition of baitfish catches depends on the reliability of the recorder (in most cases, a fisherman) to be able to identify species categories and estimate relative abundances in the catch. The Fisheries Division has placed considerable resources into acheiving a good level of reporting, however, results presented with this data must be interpreted with caution.

23. Overall species compositions of the catch logged in these two areas are shown graphically in Figure 4. Sprats dominate the catch in both areas at about 23%. It appears that Northern Vanua Levu produces proportionately more herring and anchovy and less sardine, cardinalfish, and "other" species. This observation is in line with the more deep-water lagoon environment with large land mass runoff around Northern Vanua Levu (yielding more herring and anchovies than the more small-islands area of Lomaiviti.

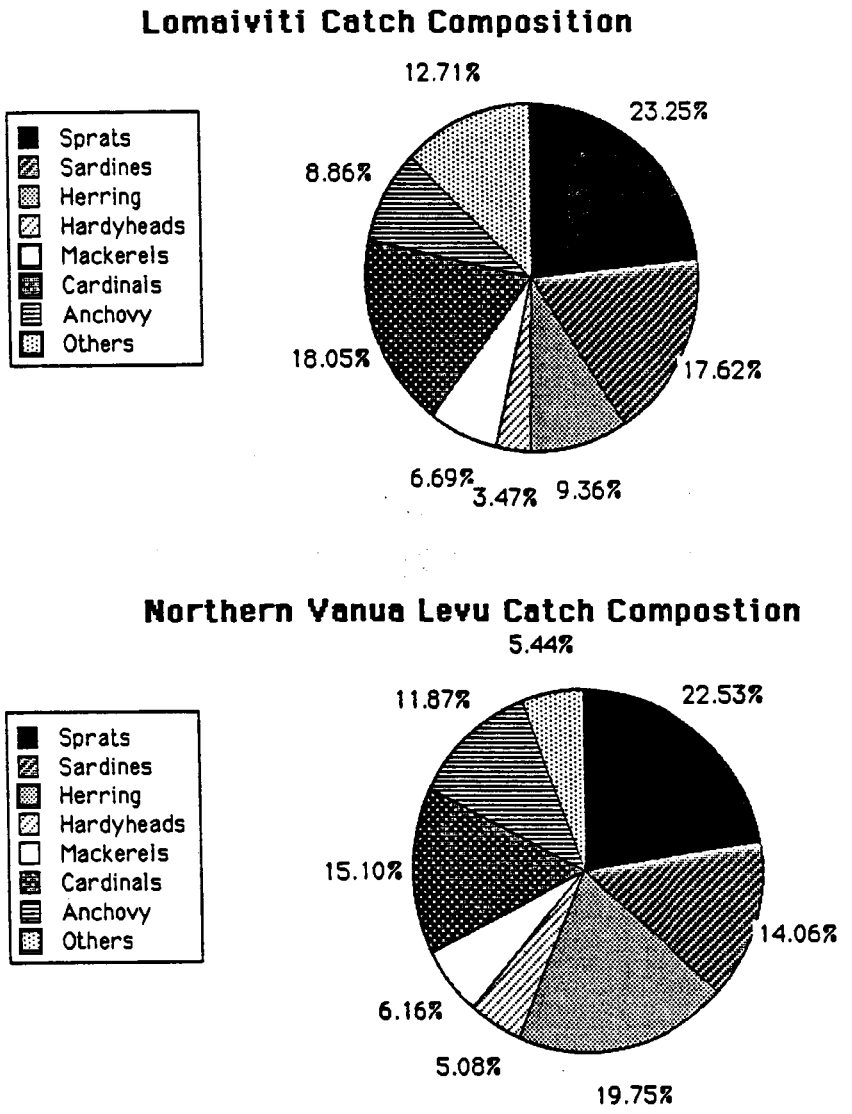

Figure 4. Catch composition by species group for Lomaiviti and Northern Vanua Levu areas, 1982-87 combined data.

24. The next step is to examine these areas for changes in species composition over time. In terms of the difficulty to manage the resource and the potential to find simple answers for difficult problems, it is useful to understand the amount that conditions change for a given area. Consequently, I examined the two zones for variability in species group catch rates averaged half-yearly from 1982-86 (Figure 5.). By aggregating the data to longer time periods I hoped to reduce some of the short term trends in catch composition. The purpose of presenting a "peaks and valleys" plot of the data was to display the variability of the species composition over time. If the species composition of the catch from an area did not change much, the graphs would not have peaks of higher than normal catch rates for a species category. Based on these figures the species composition of the catch appears to be more variable with time in Northern Vanua Levu than in Lomaiviti.

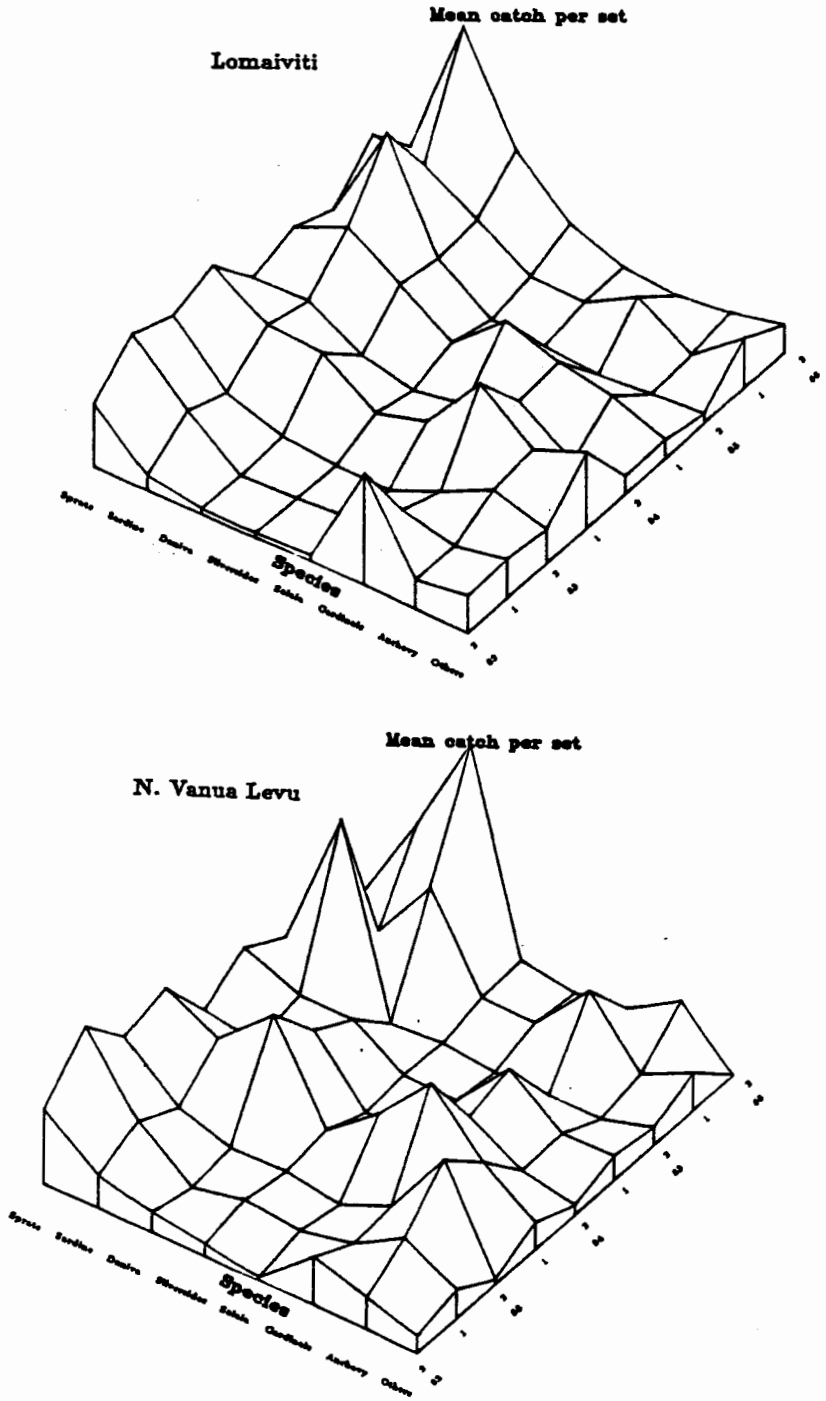

Figure 5. Graphical representation of the variability of species group catch rates over time. The right side axis is continuous over time, the left are the discrete species category groupings.

25. Taking yet a closer look at species trends in Northern Vanua Levu, I turn attention again on the period of three quarters (Figure 6) discussed in the previous section. Examining this period for species make-up it appears that, based on catches, the availability of all species groups declines markedly except for the herring, the catches of which increase in the second quarter and then drop off again in the third (Figure 7). The extremely high catch rates in the first quarter were undoubtedly due to the abundance of a variety of different species groups. Five groups--the sprats, sardine, herring, mackerels, and cardinal fish--recorded catches over 1,000 buckets each. The drop in catch from first quarter 1984 to the next was highest for sprats, followed by mackerels, cardinal fish, sardines and anchovy.

26. An explanation as to why effort remained at high levels after catch rates dropped 75% may be that during this period very effective FAD's were in place in this region that yeilded good catches for a minimum amount of bait (A.D. Lewis, pers. comm.). This period provides valuable insight on how species respond to increases in fishing intensity within a defined area.

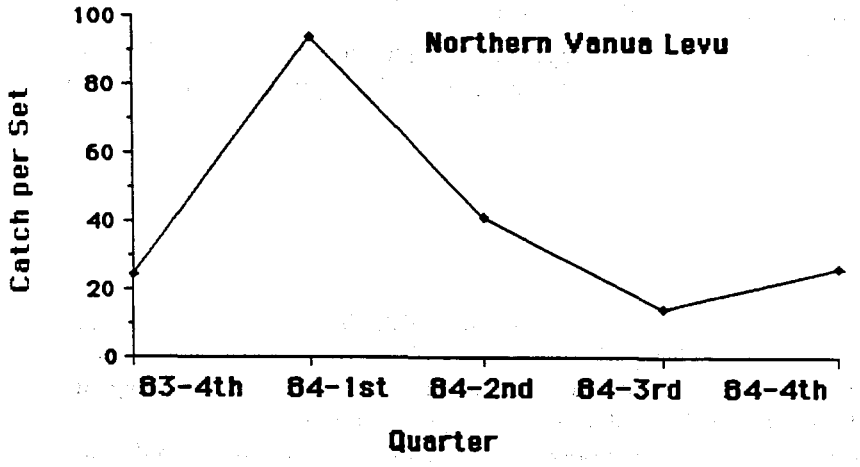

Figure 6. Catch rates from Northern Vanua Levu from the last quarter of 1983 to the end of 1984.

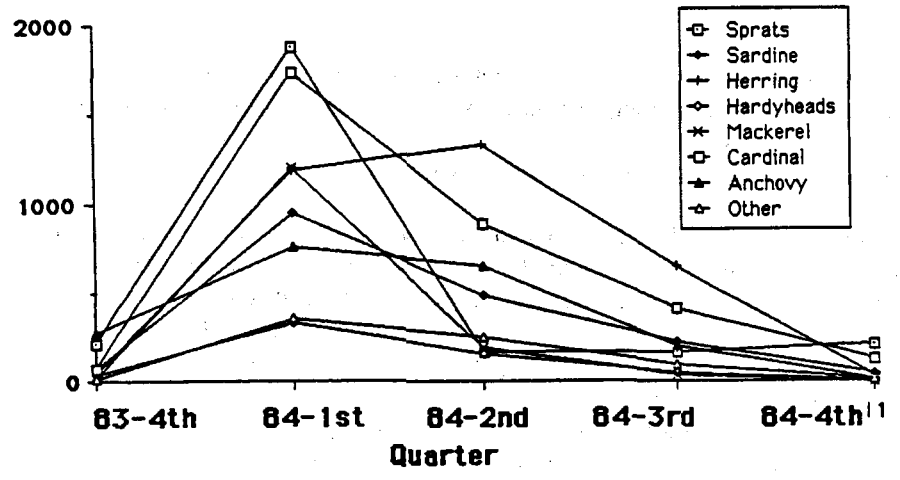

Figure 7. Species group catch patterns for a period of intense baitfishing effort in the Northern Vanua Levu area.

27. Finally, on the question of species switching from the early view of the data for Northern Vanua Levu (Figure 8.) there appears to be an indication that when the herring catch rates are good the sardine catch are relatively poor. Figure shows catch by quarter for Northern Vanua Levu in terms of total sardines catch (in buckets) minus the total herring catch. This graph should be read such that when the points are near 0, the difference in catch between sardines and herring are negligible or that both are small. Negative values indicate that more herring were caught than sardines. From this it appears that sardines dominated the catch over herring in 1983 but since then, herring make up more of the catch.

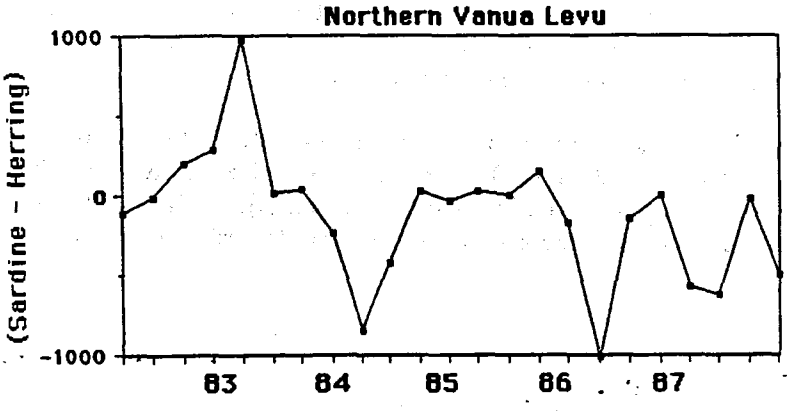

Figure 8. Catch of sardines minus catch of gold-spot herring plotted for Northern Vanua Levu over time. The purpose of this figure is to identify changes in apparent abundances of these to species groups.

Biological Studies

28. Although the successful management of multispecies fisheries for small schooling pelagics in tropical areas remains an elusive goal, an understanding of the species' basic biology is fundamental to this task. Two baitfish species were chosen for preliminary biological study, initially over the 12-month period in 1981. The blue sprat, Spratelloides delicatulus, has been the dominant species in at least one survey (Kearney, 1987) and regularly makes a major contribution to catches. The gold herring, Herklotsichtys quadrimaculatus, besides being of considerable importance to the baitfishery, also features in the subsistence catches. Characteristics of 2 species studied in Fiji follow, for more detailed information see Dalzell et al., 1987 which also contains information on the cardinalfish, Rhabdamia cypselurus.

Herklotsichthys quadrimaculatus

29. In Fiji, as elsewhere, gold-spot herring form compact shoals along sandy beaches, near mangroves (the species sometimes called mangrove sardine) and around shore installations. Apart from being exploited by subsistence and artisanal fishermen, these schools often attract larger predators inshore, rendering them more vulnerable to capture.

30. William and Clarke (MS) recorded daniva only in shallow water during the day, with both juveniles and adults moving into deeper water at night where feeding occurs. Such diurnal movements are probably typical of Fiji populations also. The species' maximum size in Fiji probably approaches 13cm. It is regarded as good bait, mainly because of its keeping qualities, and gathers near the surface under night lights (Smith,1977). It is sometimes toxic to humans in the form of Clupeotoxism. Conand (1984) observed a single spawning peak for H. quadrimaculatus in New Caledonia waters that extended from October to December and gave rise to length frequency distributions similar to those accounted in Fiji.

Spratelloides delicatulus

31. No taxonomic problems are known to exist with blue sprats (Spratelloided delicatulus), but no literature on the biology of the species apparently exists. A recent study on the biology, in PNG (Dalzell and Wankowski, 1980) however provides a useful frame of reference. Blue sprats (known locally as caru or caca in some areas) occur in smaller schools, usually in the clear deeper lagoon waters. They are rarely seen close inshore and are not well known to village fishermen. The species is strongly attracted to lights and gathers at the surface where it is easily captured. The species probably attains 7cm in length and large individuals are regarded as excellent bait. The maximum life expectancy of S. delicatulus is about 6 months. As Gulland (1983) has pointed out, the consequences of a short life span and con-commitant high natural mortality rate means that many fish will die before completing much of the growth and it will pay to fish relatively hard and with a low size at first capture so as to catch the fish before they die of natural causes. This would be a reasonable fishing tactic for S. delicatulus since observations by Lewis, et al. suggest this species has a protracted spawning period between October and June and possibly throughout the year.

Discussion and Conclusions

32. The Fijian bait resource appears sufficient to support a moderate size skipjack fishery. From the baitfish information available and from studies done in the past, it is concluded that the livebait pole and line fishing method is suitable for harvest in the surface schools of tuna frequenting Fijian waters. Furthermore, it is concluded that local bait resources are available in sufficient supply to support commercial development of such a fishery, at least on a moderate scale.

33. During 1982-1987, four zones - Northern Lau, Southern Viti Levu, Northern Vanua Levu and Lomaiviti - contributed 70% of the total catch. The increased prominence of some areas seems to be linked with FADs, as noted earlier. The continuing above-average catch rates experienced in some areas indicate that these areas are likely to continue to play a dominant role in the baitfishery.

Baitfish Management

34. The rational management of Fiji's baitfish resources, which lie almost entirely within the customary fishing areas and are the mainstay of IKA Corporation pole and line fleet, is one of the priority tasks of the Fisheries Division. The work undertaken by the Division as presented above involves maintaining detailed statistics on the baitfishing fleet for monitoring purposes, conducting biological studies on major species, and keeping the public aware of management issues.

Traditional Fishing Rights

35. In Fiji, the land under the sea is crown property. However, there is legislation to customary fishing rights which protect the Fijian Mataqali (the land owning family group) their customary supply of food from the sea. The law refers to fishing on the reefs and shellfish beds but there is general understanding among Fijians that they own all the fish in the area. The latter belief claim is disputed by many in Fiji.

36. As baiting within customary fishing rights areas is "by way of trade or business of a fisherman" and involves gear other than hook and line or spear or portable fish trap which can be handled by one person, it can be required of IKA vessels to obtain a permit.

Bait-fishing Permit System

37. The following outlines some aspects of a suggested permit system for Fiji and points out some of the problems associated with implementation:

(a) The permits, according to the law, appear to be confined to "reefs" and shellfish beds, where "reefs", according to the Fisheries Regulation Ordinance of 1894, is defined as "such portion of the shore or reefs as is covered by the daily flow and ebb of the tide". Areas fished by IKA vessels would obviously not be included in this definition.

(b) The Attorney General ruled that the actions of owners of Fishing Rights in exacting money from commercial fishermen was illegal, although this is in practice condoned and appears to be the rule rather than the exception. To introduce a permit system which does not include some form of payment is therefore unlikely to be acceptable to people who have come to expect renumeration. At the same time, IKA as a government corporation cannot be party to unofficial and illegal "under-the-counter" payments. In many areas gifts of fish by individual vessels as a form of 'Sevusevu' have led to a good understanding being developed with the people. It is frequently also the case that one or more of the vessel crew are from the area concerned.

(c) It is clear that the ownership is vested in the crown which can grant rights and withdraw them at its pleasure. The crown (i.e. the Divisional Commissioner is obliged to consult both mataqali owners and Fisheries Division personnel prior ro issuing permits for commercial fishing but is under legal obligation to take heed of advice offered. In theory, a Commissioner could issue IKA vessels a blanket permit to fish within a Division but would obviously be unwise to push such an attitude through, were it contrary to prevailing opinion.

(d) The baitfish catch includes fish species listed in the Act which are subject to minimum size provisions, eg. kaikai, ki, etc., wherever this poses no biological problem.

38. Baitfishing at present is regularly carried out at approximately sixty sites in seven of the fourteen provinces - Lau, Cakaudrove, Macuata, Lomaviti, Kadavu, Serua and Rewa - involving three of the four Divisions. This is unlikely to change in the near future. The number of individual mataqalis would probably by close to one hundred, and to licence activities of vessels which require operational flexibility to be successful, and hence permits for all areas, would clearly be impractical at this level.

Implications for the Commercial Fishery

39. If one accepts that permits are required and that a workable system can be introduced, the implications for IKA Corporation's operation need to be considered. The reliable supply of baitfish and the ability to move freely amongst baitfishing areas in response to the changing patterns of skipjack availability are cornerstones of IKA's pole and line operations. Any impediment provided by a permit system would hinder the Corporation's development at this critical stage (eg. with permits renewable yearly on provincial basis, long term planning clearly becomes impossible unless the Commissioners themselves can provide some kind of long term assurance). A likely result of this could be redirection towards other forms of fishing currently being tried, notably purse-seining, which requires far less labour and involves a higher level of technology with increased dependence on foreign equipment and expertise.

40. On the other hand, IKA and Fisheries Division share the responsibility of ensuring that the permitted harvest of any resource within customary fishing areas proceeds responsibly and not to the detriment of any existing local fisheries. The biological management aspects of the problem are being tackled at present, both from scientific and public relations viewpoints.

41. Fisheries has suggested that a workable permit system can and probably should be introduced, preferably at the provincial level. Realistically, this alone is unlikely to solve the problem as expectations of compensation will not be met - cash payments are both illegal and inadvisable at present. IKA is strongly advised to improve its own relations with people in the baitfishing areas at the individual vessel level and regulate the catch of species other than baitfish.

Multispecies Considerations

42. For management purposes, it is important to try to assess the impact the multispecies baitfishery may have on other fisheries that target on part of the baitfish catch. In this paper I presented data from 2 zones within Fiji that are consistantly fished and for which good data exist. Based on my findings it appears that the productivity of one species compared to others varies considerably over time. Mechanisms that drive changes in apparent abundance, assuming that the data represent actual catches of bait, are undoubtedly complex interactions between the dominant species, the time of year, oceanographic features and a host of other conditions. Future analyses on baitfish would benefit by continuing examinations of particular areas, perhaps with more emphasis on describing the general productivity of the areas. At the current level of fishing the overall productivity of baitfish in Fiji could withstand higher levels of exploitation without overfishing. For given areas subjected to intense exploitation, such as for Northern Vanua Levu in 1984, the pole-and-line baitfishery has demonstrated the ability to over-fish an area at least in the short term. Cases such as these should be examined carefully when drawing up management plans or assessing permit systems in order to achieve national development goals while preserving traditional ownership rights.

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(CONFIDENTIAL)

Form	Month	Year	Boat	Fish Days	Bait Days

DAILY CATCH RECORD — POLE & LINE VESSELS : FIJI.

Vessel: ____________ Month: ____________ Recorder: ____________

Net Size: ____________ Lights (No., Total Wattage) ____________ No. of Crew: ____________ GRT ____________

BAITING INFORMATION

Day	Area Code	Baiting Position					Catch per haul (bkts)			No. of Hauls	Total bkts.	SPECIES COMPOSITION (%)							
		°	'S	°		'E/W	1	2	3			BLUE SPRAT	SARDINES	[illegible]	SILVERSIDES	SALALA	CARDINAL	ANCHOVY	OTHERS
01																			
02																			
03																			
04																			
05																			
06																			
07																			
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27																			
28																			
29																			
30																			
31																			
TOTAL																			

FISHING INFORMATION

Day	Mean Temp (°C)	Area Fished	No. of Schools		SKIPJACK			YELLOWFIN			TOTAL WT.	COMMENTS (e.g. other species caught, raft number)
			Sighted	Fished	No.	Av. Wt.	Total Wt.	No.	Av. Wt.	Total Wt.		
01												
02												
03												
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05												
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31												
TOTAL												

Appendix 1