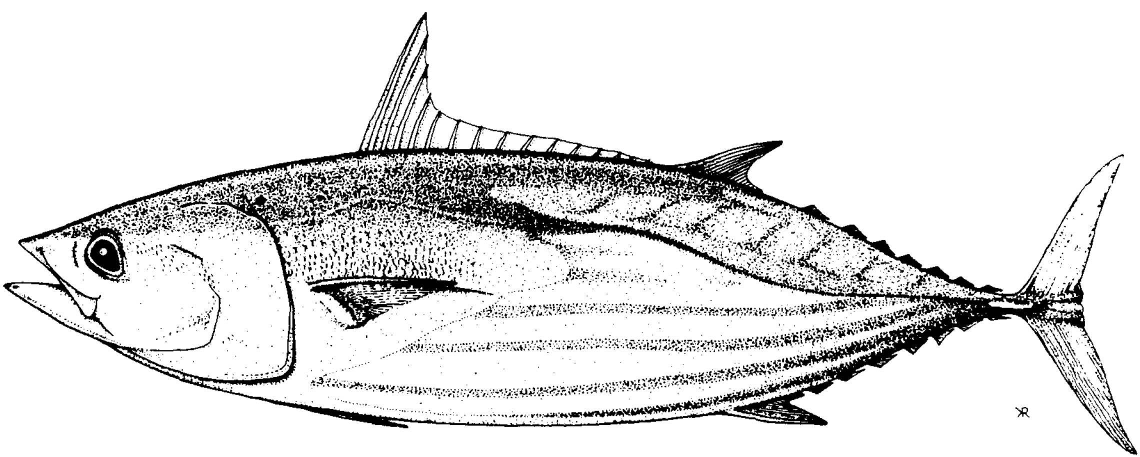
AN ASSESSMENT OF THE SKIPJACK AND BAITFISH RESOURCES OF KIRIBATI

P. Kleiber
and
R.E. Kearney



Skipjack Survey and Assessment Programme
Final Country Report No. 5

South Pacific Commission
Noumea, New Caledonia
January 1983

AN ASSESSMENT OF THE SKIPJACK AND BAITFISH RESOURCES OF KIRIBATI

P. Kleiber
and
R.E. Kearney

Skipjack Survey and Assessment Programme
Final Country Report No.5

South Pacific Commission
Noumea, New Caledonia
January 1983

PREFACE

The Skipjack Survey and Assessment Programme was an externally funded part of the work programme of the South Pacific Commission. Governments which provided funding for the Programme were Australia, France, Japan, New Zealand, United Kingdom and the United States of America.

The Skipjack Programme has been succeeded by the Tuna and Billfish Programme which is receiving funding from Australia, France, New Zealand and the United States of America. The Tuna Programme is designed to improve understanding of the status of the stocks of commercially important tuna and billfish species in the region. Publication of final results from the Skipjack Programme is continuing under the Tuna Programme. Papers referred to as manuscripts in this final country report will be released over the duration of the Tuna Programme.

The staff of the Tuna Programme at the time of preparation of this report comprised the Programme Co-ordinator, R.E. Kearney, Research Scientists, A.W. Argue, C.P. Ellway, R. Farman, R.D. Gillett, P.M. Kleiber, W.A. Smith and M.J. Williams; Research Assistants, Susan Van Lopik and Veronica van Kouwen; and Programme Secretary, Carol Moulin.

The Skipjack Programme is indebted to staff of the Ministry of Natural Resources in Kiribati, and in particular, Mr Brendan Dalley, Chief Fisheries Officer, for assisting staff of the Skipjack Programme in many aspects of the Kiribati surveys.

Tuna Programme
South Pacific Commission

CONTENTS

LIST OF TABLES

LIST OF FIGURES

AN ASSESSMENT OF THE SKIPJACK AND BAITFISH RESOURCES OF KIRIBATI

1.0 INTRODUCTION

The Skipjack Survey and Assessment Programme was conceived and carried out in response to a growing interest in the development and management of tuna fisheries in the waters of the countries and territories of the central and western Pacific. The objectives of the Skipjack Programme were to survey skipjack (*Katsuwonis pelamis*) and baitfish resources within the area of the South Pacific Commission and to assist with the assessment of the status of the stocks and the degree of interaction between individual fisheries within the region and beyond. These assessments would provide a basis for rational development of skipjack fisheries throughout the region and sound management of the resources.

The Skipjack Programme carried out tagging and survey operations in the central and western Pacific for almost three years, from October 1977 through August 1980. The total study area included all of the countries and territories in the area of the South Pacific Commission and also New Zealand and Australia (Figure A). The Skipjack Programme survey of Kiribati consisted of three visits to the Gilbert Group during the periods 5-25 July 1978, 22 November-1 December 1979, and 9-11 July 1980 as well as one visit to the Phoenix Group from 2-5 December 1979. In addition, the Skipjack Programme transited Gilbert Group waters for three days from 15-17 November 1978 and Phoenix Group waters for one day on 18 November 1978. Interim presentation of results from all but the last visit to the Gilbert Group have been given by Kearney and Gillett (1978) and Hallier and Kearney (1980). This report is a summary and analysis of the results of all visits to Kiribati by the Skipjack Programme.

1.1 Kiribati Geography

The country of Kiribati consists of three separate island groups. The westernmost group is the Gilbert Group which comprises the archipelago stretching from Arorae in the south to Little Makin in the north and Banaba (Ocean Island) to the west. In the middle is the Phoenix Group, which is composed of eight islands, including Kanton and Enderbury Islands. The Line Group to the east consists of all the islands in the Line Island archipelago except the United States possessions of Jarvis Island, Palmyra Island and Kingman Reef. The land masses in Kiribati are all low-lying islands and atolls except for Banaba. The land areas are 279, 28.7, and 516 square kilometres for the Gilbert Group, Phoenix Group and Line Group respectively (Carter 1981). The areas included in the 200-mile economic zone are approximately 97,000, 77,000 and 1,700,000 square kilometres respectively (Skipjack Programme, unpublished data).

1.2 The Kiribati Fishery

Commercial exploitation of tuna in Kiribati is only a recent endeavour, but artisanal fishing for tuna has long been an important aspect of traditional culture. In the Gilbert Group this tradition is continuing at the present time in the form of trolling with small sail- or outboard-powered craft. The annual artisanal tuna catch in 1981 was approximately 200 tonnes (Forum Fisheries Agency, unpublished data).

Prior to independence, prospects for developing tuna fishing on a commercial scale in Kiribati were originally viewed with pessimism (Devambez 1960), then with optimism (Powell 1967; UNDP/FAO 1969), and finally with urgency in the face of the termination of revenues from the phosphate reserves on Banaba (Anon, undated a).

Kiribati policy following independence has been one of commitment to development of local commercial tuna fishing operations as well as licensing of foreign fleets to fish in Kiribati waters. To date, two pole-and-line fishing vessels have been acquired, which is far short of earlier hopes for a 12-boat fleet (Anon, undated a). These vessels caught 780 tonnes of tuna in 1981 (Anon 1982), an average of 65 tonnes per month, which is within sight of a projected 800 tonnes per boat per year (Anon, undated a).

Foreign fishing fleets operating in Kiribati consist primarily of Japanese long-range pole-and-line boats and Japanese, Korean and Taiwanese longliners. For the years 1972 to 1978, the annual catch by Japanese pole-and-line boats varied between 313 and 29,377 tonnes of skipjack and between 2 and 226 tonnes of yellowfin (Skipjack Programme 1980a). Annual catches by Japanese, Korean and Taiwanese longliners in the years 1972 to 1976 fluctuated between 5 and 30 tonnes of skipjack and between 1,300 and 7,000 tonnes of yellowfin, out of a total annual catch of all tuna and related species ranging between 4,000 and 14,000 tonnes (Klawe 1978).

1.3 Fisheries Surveys and Research in Kiribati

Various research efforts connected with tuna fishing have been carried out in Kiribati previous to, and concurrently with, the Skipjack Programme. During the years 1950 to 1961 a large number of survey cruises were carried out by the Pacific Ocean Fishery Investigations (POFI) of the United States Fish and Wildlife Service. Many of these cruises covered the Phoenix and Line Group portions of Kiribati. The surveys included experimental longlining, trolling, pole-and-line fishing, and purse-seining. A summary of the sighting results from all POFI cruises has been prepared by Waldron (1964). The results showed a quite variable rate of sighting of tuna schools in the regions of the Phoenix and Line Groups, but, on average, no obvious difference between the two areas was apparent.

A pole-and-line survey carried out by Van Camp Sea Food Company in 1972 in the Gilbert and Line Groups had some success in catching tuna but was limited by availability of bait (Van Camp, unpublished data). The results were not conclusive as the survey was prematurely terminated by a cyclone. In 1974 a purse-seining survey sponsored by the Pacific Tuna Development Foundation (PTDF) made one unsuccessful set on a skipjack school in the Line Group (Anon, undated b). The Japanese International Co-operation Agency (JICA) conducted two pole-and-line surveys of bait and tuna fishing in the Gilbert Group during the periods November 1977 to February 1978 and June 1978 to October 1978 (JICA 1978; B. Dalley, personal communication). A final extended survey under the auspices of the Food and Agriculture Organization/United Development Programme (FAO/UNDP) was carried out in 1979 and 1980 in the Gilbert Group just prior to the formation of Te Mautari Ltd., the Kiribati fishing corporation (B. Dalley, personal communication).

Research related to the feasibility of culturing milkfish (*Chanos chanos*) was initiated in Tarawa, Gilbert Group in 1974 by FAO/UNDP. A principal aim of this project was to investigate the feasibility of supplementing the natural baitfish resources in support of commercial scale tuna fishing (Gopalakrishnan 1977).

2.0 METHODS

2.1 Vessels and Crew

Two Japanese commercial live bait pole-and-line vessels were chartered at different times by the Skipjack Programme from Hokoku Marine Products Company Limited, Tokyo, Japan. Details of both vessels are given by Kearney and Hallier (1980). The 192-tonne *Hatsutori Maru No.1* was in use during the first visit to Kiribati, and the 254-tonne *Hatsutori Maru No.5* during subsequent visits.

The *Hatsutori Maru No.1* was operated with at least three Skipjack Programme scientists, nine Japanese officers and twelve Fijian crew. For the *Hatsutori Maru No.5*, an additional three Fijian crew were employed. Kiribati government fishery staff, Kiribati fishermen and other interested residents of Kiribati and elsewhere observed operations on board the tagging vessels for varying times throughout the Kiribati surveys. Lists of all personnel and details of the times scientists and observers spent on board are given in Appendix A.

2.2 Skipjack Fishing, Tagging and Biological Sampling

Skipjack and other tunas were captured by the technique of live bait pole-and-line fishing. However, the fishing strategy was dominated by the objective of maximising the number of tagged fish as opposed to maximising the catch. Gillett and Kearney (1982) describe in detail the tagging techniques and alterations to normal fishing procedures.

Samples of tuna and other fish which were poled or trolled, but not tagged and released, were measured, and weighed. In addition, their sex, weight and stage of maturity of gonads, and stomach contents were noted. A log of all fish schools sighted throughout the survey was also maintained. Where possible, the species occurring in each school was recorded as well as the biting response of each school chummed. Argue (1982) details the methods and procedures used for collecting these data.

Blood samples for biochemical genetic analysis were collected according to the methods of Fujino (1966) and Sharp (1969). The samples were frozen, packed on dry ice and air freighted to the Australian National University, Canberra, Australia, where they were electrophoretically analysed according to the methods described by Richardson (MS).

2.3 Baitfish

Most baitfishing activity was carried out at night using fish attraction lights and a bouki-ami net. Some beach seining during daylight hours was also carried out in Kiribati. In addition to natural bait, cultured milkfish kindly supplied by the Atoll Aquaculture Project were taken on board at Tarawa and utilised for bait during the Kiribati survey, as were cultured mollies obtained in American Samoa. Details of all baitfishing and bait handling techniques are given by Hallier and Gillett (1982).

2.4 Data Compilation and Analysis

At the headquarters of the South Pacific Commission in Noumea, information collected by the Programme was entered into computer accessible data files. The data processing methodology utilised for entering, verifying and accessing information in computer files is described by Kleiber and Maynard (1982).

3.0 RESULTS AND DISCUSSION

A daily summary of the surveying and tagging activities for the 42 days spent in Kiribati waters is given in Table 1. Table 2 gives the baitfishing locations, gear type, number of hauls and dominant and common species caught. A complete species list for all bait hauls is given in Appendix B. Figure 1 is a map showing the areas surveyed and the baitfishing locations.

3.1 Baitfish

3.1.1 Wild bait

Baiting operations were carried out in lagoons of Tarawa and Butaritari, but not in other possibly productive baiting locations in the Gilbert Group. Baitfish have been surveyed elsewhere in the Gilbert Group by other programmes (JICA 1978). Baiting was not attempted by the Skipjack Programme in the other island groups of Kiribati.

Table 3 gives the yield in terms of kilograms per haul obtained in two visits to the Gilbert Group and in three other countries that have well-established pole-and-line fisheries that rely on wild bait. The yield with the bouki-ami net was low. The beach seine was spectacularly productive in one of the visits, however, one haul accounted for 56 per cent of the beach seine catch in that visit. Both baiting techniques were considerably less productive in the second of the two visits. This variability appears to be a feature of baitfish populations in atoll lagoons where the productivity necessary to support large and diverse fish populations is probably more limited than in high island lagoons. Similar low and variable yields have been obtained by the Skipjack Programme in other atolls (Skipjack Programme 1981a) and have also been noted by Johannes (1981) and Hida and Uchiyama (1977).

Table 4 summarises the species composition for the most abundant species in the catch and includes results from a JICA survey in the Gilbert Group (JICA 1978). It can be seen that the beach seine yielded predominantly gold-spot herring, Herklotsichthys punctatus, whereas the species composition of catches with the bouki-ami technique was more variable. Apogon cypselurus dominated the bouki-ami catch in the first visit and the blue sprat, Spratelloides delicatulus, dominated in the second. Because of the prominence of H. punctatus in both beach seine and bouki-ami catches, it should be noted that this species is itself an important food resource for residents of the Gilbert Group. Thus, a serious conflict of interest could arise if commercial-scale baiting operations impinge on this resource.

TABLE 1. SUMMARY OF DAILY FIELD ACTIVITIES IN THE WATERS OF KIRIBATI. Schools sighted are given by species: SJ = skipjack or skipjack with other species except yellowfin; YF = yellowfin or yellowfin with other species except skipjack; S+Y = skipjack with yellowfin or skipjack with yellowfin and other species; OT = other species without skipjack or yellowfin; UN = unidentified.

Date	General Area	Principal Activity	Bait Carried (kg)	Hours Fishing and Sighting	Schools Sighted (numbers) SJ	YF	S+Y	OT	UN	Fish Tagged (numbers) SJ	YF	OT	Fish Caught (kg) SJ	YF	Total Catch (kg)
05/07/78	S Gilbert Group	Fishing	195	10	5	1	0	0	1	485	0	0	1433	3	1436
06/07/78	Nonouti-Maiana	Steaming	0	12	6	0	0	0	18	-	-	-	-	-	-
07/07/78	Tarawa	In Port	0	0	-	-	-	-	-	-	-	-	-	-	-
08/07/78	Tarawa	In Port	0	0	-	-	-	-	-	-	-	-	-	-	-
09/07/78	Tarawa	In Port	0	0	-	-	-	-	-	-	-	-	-	-	-
10/07/78	Tarawa-Maiana	Fishing	509	3	1	0	0	0	0	104	0	0	346	0	346
11/07/78	Tarawa	Baiting	0	10	1	0	0	0	20	-	-	-	-	-	-
12/07/78	Butaritari	In Port	0	0	-	-	-	-	-	-	-	-	-	-	-
13/07/78	Butaritari	Fishing	260	11	6	2	1	0	5	869	31	0	2488	240	2764
14/07/78	Little Makin	Fishing	86	7	4	0	0	1	0	305	0	0	878	0	882
15/07/78	Butaritari	Fishing	189	9	5	1	1	2	0	14	13	0	58	59	141
16/07/78	Butaritari	Fishing	63	3	1	0	0	0	0	573	0	0	1787	0	1787
17/07/78	Butaritari	Fishing	506	1	1	0	0	0	0	251	0	0	663	0	663
18/07/78	Abaiang	Fishing	156	9	3	0	0	0	11	40	0	0	214	0	214
19/07/78	Tarawa	In Port	0	0	-	-	-	-	-	-	-	-	-	-	-
20/07/78	Tarawa	In Port	0	0	-	-	-	-	-	-	-	-	-	-	-
21/07/78	Tarawa	Steaming	78	0	-	-	-	-	-	-	-	-	-	-	-
22/07/78	Butaritari	Fishing	149	4	2	0	0	0	0	853	0	0	2187	0	2187
23/07/78	Butaritari	Fishing	179	5	7	0	0	0	0	659	0	0	1978	0	1978
24/07/78	Butaritari	Fishing	192	9	5	0	1	0	1	250	0	0	772	4	782
25/07/78	N Gilbert Group	Fishing	161	10	0	0	0	0	5	0	0	0	0	0	0
15/11/78	N Gilbert Group	Steaming	20	0	-	-	-	-	-	-	-	-	-	-	-
16/11/78	E Gilbert Group	Fishing	14	1	1	0	0	0	1	16	0	0	327	0	327
17/11/78	E Gilbert Group	Steaming	0	10	0	0	0	0	37	-	-	-	-	-	-
18/11/78	W Phoenix Group	Steaming	0	11	1	0	0	0	15	-	-	-	-	-	-
22/11/79	W of Butaritari	Steaming	0	11	0	0	0	0	8	-	-	-	-	-	-
23/11/79	Tarawa	In Port	0	0	-	-	-	-	-	-	-	-	-	-	-
24/11/79	Tarawa	In Port	0	0	-	-	-	-	-	-	-	-	-	-	-
25/11/79	Tarawa	In Port	0	0	-	-	-	-	-	-	-	-	-	-	-
26/11/79	Tarawa	Baiting	0	8	1	0	0	0	14	-	-	-	-	-	-
27/11/79	Butaritari	Fishing	47	4	3	1	1	0	1	39	8	0	119	20	140
28/11/79	Butaritari	Fishing	86	6	5	0	0	0	3	111	0	0	208	0	208
29/11/79	Tarawa	Baiting	12	0	-	-	-	-	-	-	-	-	-	-	-
30/11/79	E of Tarawa	Steaming	194	11	0	0	1	1	3	0	0	0	0	0	0
01/12/79	E Gilbert Group	Steaming	168	12	2	0	0	0	3	0	0	0	0	0	0
02/12/79	W Phoenix Group	Fishing	161	10	1	0	1	0	10	184	4	0	321	17	339
03/12/79	Kanton	Fishing	120	8	5	1	0	0	4	182	12	0	347	86	433
04/12/79	Enderbury	Fishing	30	7	2	0	0	0	12	1	0	0	12	0	12
05/12/79	E Phoenix Group	Steaming	0	12	4	0	0	0	18	-	-	-	-	-	-
09/07/80	S Gilbert Group	Steaming	0	11	2	1	0	0	38	0	0	0	4	0	4
10/07/80	Tarawa	In Port	0	1	0	0	0	0	3	-	-	-	-	-	-
11/07/80	N Gilbert Group	Steaming	0	8	1	1	0	0	20	-	-	-	-	-	-
TOTALS				234	75	8	6	4	251	4936	68	0	14145	430	14644

TABLE 2. SUMMARY OF BAITFISHING ACTIVITIES FOR TWO VISITS TO THE GILBERT GROUP

	Anchorage	Gear Type	Number of Hauls	Dominant Species	Est. Av. Catch per Haul (kg)	Mean Length (mm)	Other Common Species
	Tarawa	bouki-		Spratelloides delicatulus	9	55	Bregmaceros sp.
	01°23'N	ami	3	Archamia lineolata	3	36	Sp. of Siganidae
	172°58'E			Apogon(Rhabdamia) cypselurus	3	36	Sp. of Lutjanidae
July	Butaritari	bouki-		Apogon(Rhabdamia) cypselurus	25	39	Herklotsichthys punctatus
1978	03°06'N	ami	13	Hypoatherina ovalaua	19	62	Sp. of Caesiodidae
	172°47'E			Dussumieria sp.	18	135	Spratelloides delicatulus
	Butaritari	beach		Herklotsichthys punctatus	341	49	Gerres argyreus
	03°06'N	seine	5	Pranesus pinguis	4	71	Sp. of Labridae
	172°47'E			Scomberoides sp.			Sp. of Apocryptidae
	Butaritari	beach		Herklotsichthys punctatus	6	62	Hypoatherina ovalaua
	03°02'N	seine	1	Pranesus pinguis	2	61	Sp. of Apogonidae
	172°48'E			Spratelloides delicatulus			Sp. of Gobeiidae
	Butaritari	bouki-		Hypoatherina ovalaua	15	51	Apogon fragilis
	03°03'N	ami	2	Apogon(Rhabdamia) cypselurus	3	29	Pranesus pinguis
	172°48'E			Spratelloides delicatulus	1	35	Herklotsichthys punctatus
November	Butaritari	bouki-		Spratelloides delicatulus	16	31	Archamia lineolata
1979	03°05'N	ami	2	Apogon(Rhabdamia) cypselurus	6	30	Hypoatherina ovalaua
	172°49'E			Herklotsichthys punctatus			Apogon fragilis
	Butaritari	beach		Herklotsichthys punctatus	39	65	
	03°01'N	seine	1	Pranesus pinguis			
	172°47'E			Hypoatherina ovalaua			
	Tarawa	bouki-		Caranx sp.	3		Upeneus vittatus
	01°22'N	ami	1	Scomberoides sp.	2		
	172°56'E			Selar crumenophthalmus			

Explanatory Notes

Anchorage : Recorded positions are truncated to the nearest minute. For large bays there may be more than one position tabulated.

Number of Hauls : Number of hauls at the anchorage position. A haul is defined as any time the net was placed in the water.

Species : Those species that made up at least one per cent of the numbers caught from one or more bait hauls at a particular location.

Average Catch (species) : The average catch in kilograms per haul is given for the dominant three species for each anchorage and gear type. This average catch is the product of the total catch in kilograms for the particular anchorage and gear type and the weighted proportion of the particular species in this catch. The weighted proportion of each species was determined from the numerical proportion in the catch multiplied by the cube of the mean standard length for that species, anchorage and gear type, and by a scaling factor. The scaling factor was chosen so that the sum of weighted proportions would equal the sum of numerical proportions. If the mean standard length was unknown, the numerical proportion was used. Since the average catch per haul is given for only the dominant three species, the total of the three is in general less than the total catch for the anchorage and gear type.

Mean Length : Weighted by numerical abundance when there were multiple hauls at the same location.

FIGURE 1. AREAS SURVEYED AND BAITING LOCATIONS IN THE GILBERT AND PHOENIX GROUPS FOR ALL VISITS TO KIRIBATI

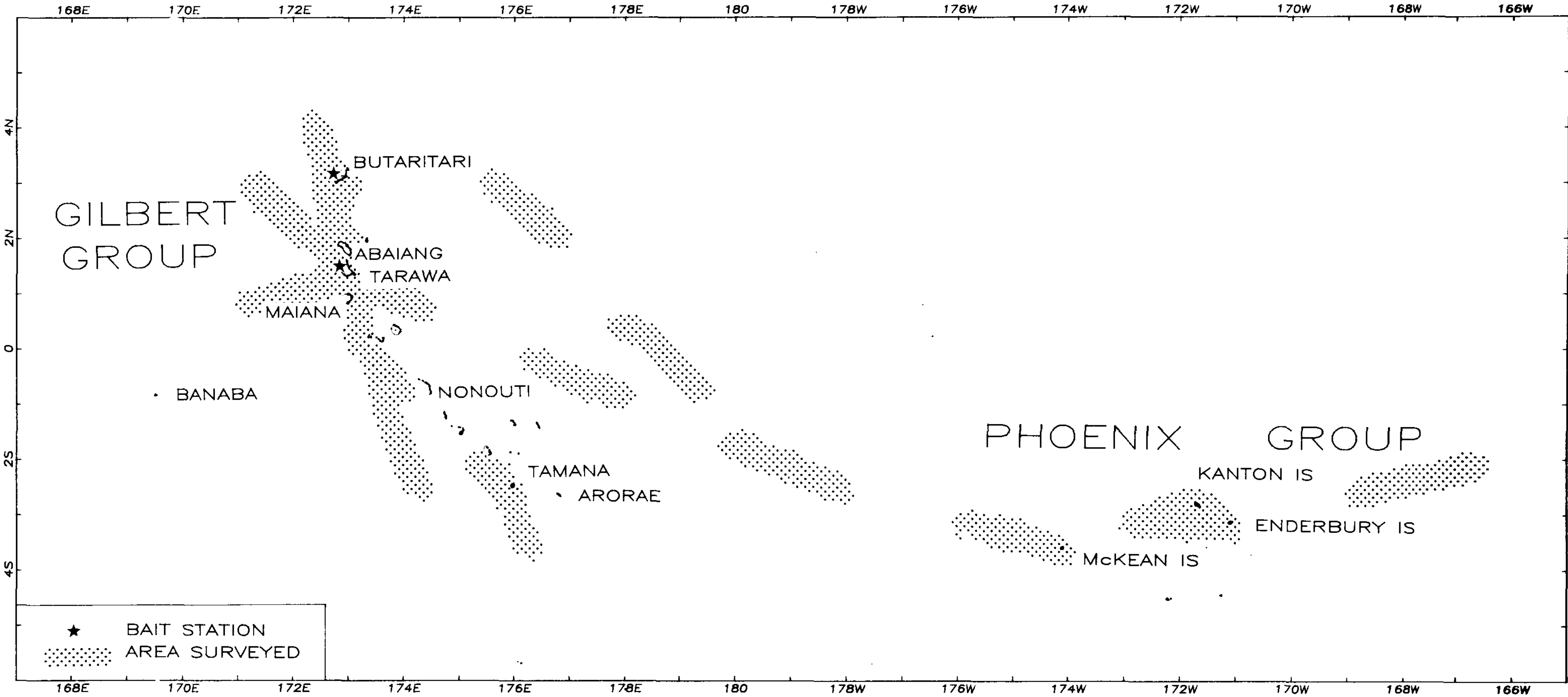


TABLE 3. BAITING SUCCESS IN THE GILBERT GROUP AND IN THREE OTHER COUNTRIES WITH ESTABLISHED POLE-AND-LINE FISHERIES

	Bouki-ami		Beach seine	
	Hauls	Kg/haul	Hauls	Kg/haul
Gilbert Group July 1978	16	69	5	347
Gilbert Group November 1979	5	19	2	24
Papua New Guinea	57	120	4	24
Solomon Islands	60	148	-	-
Fiji	71	180	1	0
Skipjack Programme Average	567	121	74	45

TABLE 4. SPECIES COMPOSITION FOR COMMON SPECIES FOR TWO SKIPJACK PROGRAMME (SPC) VISITS AND A JAPANESE INTERNATIONAL CO-OPERATION AGENCY (JICA) VISIT TO THE GILBERT GROUP

	Bouki-ami		Beach seine	
	Species	Per cent	Species	Per cent
SPC July 1978	*Apogon cypselurus*	30	*Herklotsichthys punctatus*	98
	Hypoatherina ovalaua	22	*Pranesus pinguis*	1
	Dussumieria sp.	21		
	Herklotsichthys punctatus	9		
	Spratelloides delicatulus	5		
SPC November 1979	*Spratelloides delicatulus*	37	*Herklotsichthys punctatus*	94
	Hypoatherina ovalaua	37	*Pranesus pinguis*	2
	Apogon cypselurus	18		
	Caranx sp.	5		
JICA November 1977-February 1978	*Herklotsichthys punctatus*	81		
	Spratelloides delicatulus	10		
	Hypoatherina ovalaua	7		

3.1.2 Cultured bait

On arrival in Gilbert Group waters in July 1978 for the first visit to Kiribati, the *Hatsutori Maru No.1* carried cultured mollies (*Poecilla mexicana*) which had been obtained in American Samoa. Thirty kilograms of these were utilised in the vicinity of Tamana and Onotoa in the Gilbert Group in combination with 47 kilograms of wild bait (*S. delicatulus*) captured in Tuvalu. In July 1978, 78 kilograms of cultured milkfish, *Chanos chanos*, from the Atoll Aquaculture Project located in Tarawa were taken on board the *Hatsutori Maru* and utilised along with 77 kilograms of wild bait (primarily *H. punctatus*) to capture two tonnes of tuna. In November 1979, 183 kilograms of milkfish obtained from the same source were carried to the Phoenix Group. The surviving 150 kilograms were used to capture 0.8 tonnes of skipjack and yellowfin, partly alone and partly in combination with 8 kilograms of *Apogon cypselurus* which had also been carried from the Gilbert Group.

3.1.3 Baitfish effectiveness

The bulk of the wild bait species obtained and used in Kiribati consisted of *H. punctatus*, *A. cypselurus*, and *S. delicatulus*. These species have been shown in the experience of the Skipjack Programme in Kiribati and elsewhere to be effective bait species in terms of various measures of attractiveness to tuna and in terms of survival in bait wells (Skipjack Programme 1981b). The other common bait species obtained in the Gilbert Group, *Hypoatherina ovalaua*, was found to be less effective than the others in attracting skipjack.

Reports on fishing trials with cultured bait in Kiribati and elsewhere are given by Skipjack Programme (1980b, 1981b), Kearney and Rivkin (1980), and Bryan (1980). The results for mollies were equivocal. They generally survived well in the bait tanks, but were not particularly attractive to tuna. Milkfish on the other hand were found to compare favourably with wild bait for capturing tuna, and their survival in bait tanks was also very good. These findings were corroborated by the JICA survey in 1977-78 (JICA 1978).

3.2 Tuna Fishing and Sighting

Table 5 summarises the Skipjack Programme tuna catch results for the Gilbert Group, the Phoenix Group and for the Skipjack Programme overall. The catch per unit effort (CPUE) is corrected for the effect of tagging operations on catch efficiency using the factor of 3.47 (Kearney 1978).

TABLE 5. CATCH, EFFORT AND CATCH PER UNIT EFFORT (CPUE) FOR THE SKIPJACK PROGRAMME IN TWO AREAS OF KIRIBATI AND OVERALL. CPUE is corrected for catch inefficiency due to tagging operations as described in text.

	Catch (tonnes)	Per cent Skipjack	Fishing Days	Corrected CPUE (tonnes/day)
Gilbert Group	13.9	97	15	3.2
Phoenix Group	0.78	87	3	0.9
Total Study Area	509	91	515	3.4

The tuna fishing success in the Gilbert Group (3.2 tonnes/day) compares well with the overall Skipjack Programme results (3.4 tonnes per day) and with the CPUEs of three well-established commercial fisheries in the region (Table 6). In comparing the Skipjack Programme results with other commercial fisheries, it should be noted that the Skipjack Programme's research vessels were larger than most of the vessels in the commercial fisheries included in the table; however, the crew of the research vessels did not have the benefit of extended experience in Kiribati waters as do the crews of commercial vessels.

TABLE 6. CATCH PER UNIT EFFORT (CPUE) FOR THREE LOCALLY BASED POLE-AND-LINE FISHERIES IN THE SOUTH PACIFIC COMMISSION REGION

	Per cent Skipjack	CPUE (tonnes/day)	Years	Reference
Papua New Guinea	90	2.5 - 4.9	1972-78	Wankowski (1980)
Solomon Islands	99	2.8 - 4.7	1973-80	D. Evans, Ministry of Natural Resources, Solomon Islands, personal communication
Fiji	89	3.1 - 4.0	1977-79	Anon (1979)

The result in the Phoenix Group would seem discouraging except that it is based on only three fishing days, and was not due to lack of tuna schools. The problem was that the tuna responded poorly to the bait. This could easily be a temporary phenomenon as has been observed in areas with well-developed pole-and-line fisheries such as Solomon Islands (Argue and Kearney 1982).

When the survey vessels were at sea, a school sighting watch was usually maintained even when fishing was not in progress. The numbers and estimated compositions of schools sighted in Kiribati are detailed in Table 1. The results in terms of schools sighted per hour spent sighting or fishing is 1.5 in both the Gilbert and Phoenix Groups, considerably higher than the overall Skipjack Programme average of 0.77 schools per hour.

The school sighting frequencies reported by Waldron (1964) for the POFI cruises are generally much lower than 1.5 per hour in the Phoenix Group, the Line Group and elsewhere. This is probably because on the POFI cruises only one person, the helmsman, sighted schools, whereas in the Skipjack Programme, between two and seven crew members were assigned to the job of school sighting.

3.3 Skipjack Tagging

The Skipjack Programme released a total of 140,443 tagged skipjack in the total study area, of which 4,752 were released in Kiribati. Table 7 gives the distribution of skipjack and yellowfin releases by area within Kiribati. The great bulk of the tagging occurred in the Gilbert Group in the neighbourhood of Butaritari. Figure 2 shows the length distribution of tagged skipjack compared with the distribution for the total study area. The skipjack tagged in Kiribati were of about the same average size as the skipjack tagged in the total study area, but were in a narrower size range.

A complete list of tag returns by school for tuna tagged in Kiribati is given in Appendix C.

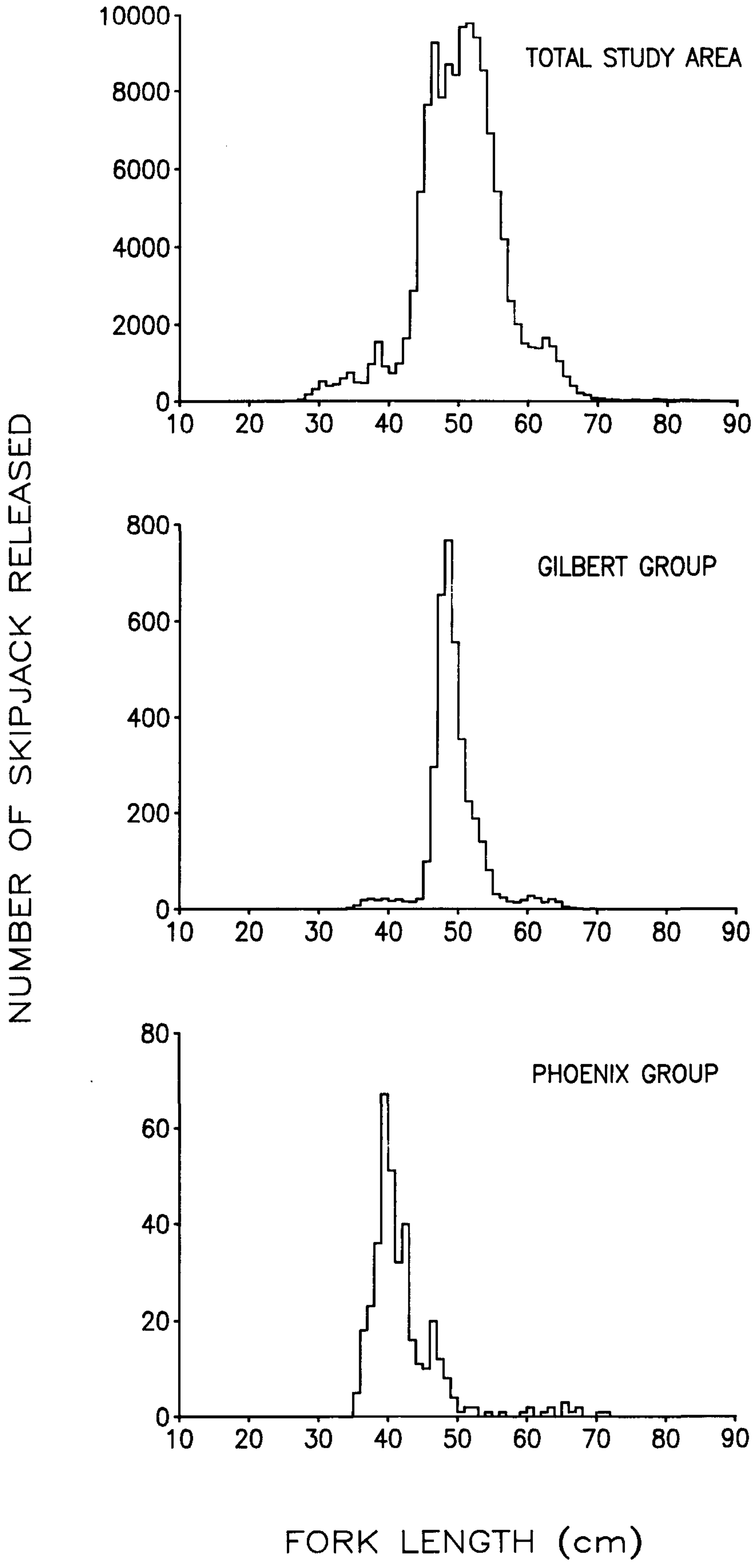
TABLE 7. DISTRIBUTION OF TAG RELEASES WITHIN KIRIBATI

		Skipjack	Yellowfin
Gilbert Group	Butaritari	3940	52
	Abaiang	40	
	Tarawa	104	
	Tamana	485	
	Total	4569	52
Phoenix Group	Kanton	182	16
	Enderbury		
	W. Phoenix Group		
	Total	367	
	GRAND TOTAL	4936	

3.4 Tag Attrition

One of the major reasons for tagging tuna was to enable estimates to be made of various parameters of population dynamics which are crucial in assessing the magnitude and resilience of the skipjack resource to fishing pressure. The parameters considered here are: (1) the population, which is the standing stock of fish that is vulnerable to the fishery; (2) the attrition rate, which in steady state conditions is the population turnover rate, or in other words the proportion of the population cycling through the area (per unit time) due to immigration, emigration, local productivity and mortality; (3) the throughput, population times turnover rate, which is the tonnes of fish cycling through the area (per unit time); and (4) the exploitation rate, which is the proportion of the population that is harvested (per unit time). Of the four parameters, throughput is the most appropriate measure of the magnitude of the skipjack resource because it is a rate against which catch can best be compared. A high throughput relative to catch is evidence, though not proof, that the fishing pressure is having slight impact on the fish stocks. The population size alone gives limited indication of the harvest rate which the population can support without becoming depleted.

FIGURE 2. DISTRIBUTION OVER BODY LENGTH OF SKIPJACK RELEASES IN THE TOTAL STUDY AREA, AND IN THE GILBERT AND PHOENIX GROUPS



Estimates for the above parameters were determined by examining the rate at which tags were returned as a function of time following the date of release. Table 8 summarises, by month of recapture, the returns of skipjack recovered in the Gilbert Group and released during the first Kiribati visit in July 1978. Two lots of tag returns are included in Table 8, one resulting from the Japanese long-range pole-and-line catch, and the other from the efforts of a JICA survey vessel and an FAO/UNDP survey vessel. The Japanese pole-and-line catch was broadly distributed over the 200-mile economic zone of the Gilbert Group through December 1978. After that time, catch information for this fleet is lacking. The JICA+FAO/UNDP catch was much more localised than the Japanese pole-and-line catch, being mostly limited to an area close to Butaritari. Returns from skipjack released during later Skipjack Programme visits to Kiribati are not included in Table 8 because they consisted of only one return, a migrant from the Phoenix Group to the Gilbert Group.

TABLE 8. DISTRIBUTION BY RECOVERY SOURCE AND MONTH OF RECAPTURE OF 385 TAG RETURNS FROM 4,403 SKIPJACK TAGGED IN THE GILBERT GROUP IN JULY 1978 AND RECOVERED THEREIN. The monthly catch by the JICA and FAO/UNDP survey vessels and by the Japanese pole-and-line fleet is given where available. The other recovery category includes ten recoveries by the SPC survey vessel and two by artisanal fishermen. None of the tags released in the Gilbert Group at other times were recaptured in the Gilbert Group.

Month of Recapture	JICA + FAO/UNDP Surveys		Japanese Pole-and-Line		Other
	Returns (numbers)	Catch (tonnes)	Returns (numbers)	Catch (tonnes)	Returns (numbers)
07/78	26	22.6[1]		17	10
08/78	159	49.5	1	438	1
09/78	82	63.5	11	1240	
10/78	78	76.3	4	1110	
11/78			3	410	
12/78			3	913	
01/79			2	NA	
02/79		.80	1	NA	
03/79		3.76		NA	1
04/79	1	9.44		NA	
05/79		8.30		NA	
06/79		26.8		NA	
07/79		8.82		NA	
08/79		12.1	1	NA	
09/79		6.77	1	NA	
10/79		5.05		NA	
TOTAL	346		27		12

1 Catch in July prorated for portion of month during which tags were at large. Total catch for July 1978 was actually 31.8 tonnes.

NA Data not available

In order to obtain parameter estimates and confidence ranges for the estimates, a tag recapture and attrition model (Kleiber MS) was fitted by a non-linear least-squares regression technique (Conway, Glass, Wilcox 1970) to the observed monthly tag returns and corresponding catches from the JICA+FAO/UNDP survey (Table 8). The monthly JICA+FAO/UNDP tag returns and the predicted tag returns from the fitted model are plotted in Figure 3. For comparison, Figure 4 (from Kleiber MS) gives a similar plot for returns of skipjack from tagging throughout the total study area. The figures only include returns of skipjack for which precise date of recovery information were available (Table 8 gives a definition of acceptable precision). The returns included in Figure 4 are aggregated into month-at-large categories, so that the plot represents the distribution of returns over time-at-large rather than the actual number of tags returned in specific calendar months.

The model described above was fitted to the total returns using an estimated average catch for the total study area of 17,000 tonnes per month (200,000 tonnes per year) for the major skipjack fishing fleets operating in the area (pole-and-line vessels and purse-seine vessels). Because a constant monthly catch rate was assumed, the logarithmic plot of the theoretical tag return rate in Figure 4 is a straight line whereas the theoretical tag return rate in Figure 3 reflects the vagaries of the catch rate in the small fishery made up of one survey vessel (JICA+FAO/UNDP surveys did not operate concurrently).

Estimated values and confidence intervals for turnover, throughput, population size (standing stock), and exploitation rate are given in Table 9 for the two sets of data plotted in Figures 3 and 4. In addition, average catch per month is given for the total study area and for the JICA+FAO/UNDP surveys. It is evident for the region as a whole, and for the Gilbert Group in particular, that the skipjack catch at the time of the tagging experiment represented only a small fraction of the total throughput of the available population. The exploitation rate is a similar small fraction of the turnover rate. The small JICA+FAO/UNDP fishery displays a higher exploitation rate than that obtained by aggregating all the fisheries in the total study area. This means that the JICA+FAO/UNDP fishery was harvesting more intensively in its small area of operation than was the case, on average, throughout the total study area. This is not really surprising considering the more diffuse nature of some of the major fisheries in the region, notably the Japanese pole-and-line fishery, and also considering the vast areas of the total study area that have close to zero exploitation.

Since the JICA+FAO/UNDP tag returns and catch occurred in only a small portion of the 200-mile zone of the Gilbert Group (see footnote, Table 9), the Japanese pole-and-line catch in the Gilbert Group, which averaged 688 tonnes per month in the second half of 1978, cannot appropriately be compared with the 340 to 710 tonnes per month of throughput estimated from the JICA+FAO/UNDP returns. Clearly throughput and population in the whole of the Gilbert Group zone would be considerably larger than in the JICA+FAO/UNDP survey area.

An attempt was made to subject the Japanese pole-and-line returns from Table 9 to the analysis described above. This proved impossible because of the lack of Japanese catch statistics beyond 1978. This is extremely unfortunate because, as noted above, the Japanese catch was spread widely over the 200-mile zone of the Gilbert Group, and parameter estimates derived from this catch would have been more representative of the whole zone.

FIGURE 3. TAG ATTRITION IN THE GILBERT GROUP. Stars are the observed number of tag returns for skipjack tagged in the Gilbert Group and recovered by the JICA+FAO/UNDP surveys. The line is the theoretical number of tags returned by month based on the best fitting tag recovery and attrition model. There was no fishing by the JICA+FAO/UNDP survey fishery from November 1978 through January 1979.

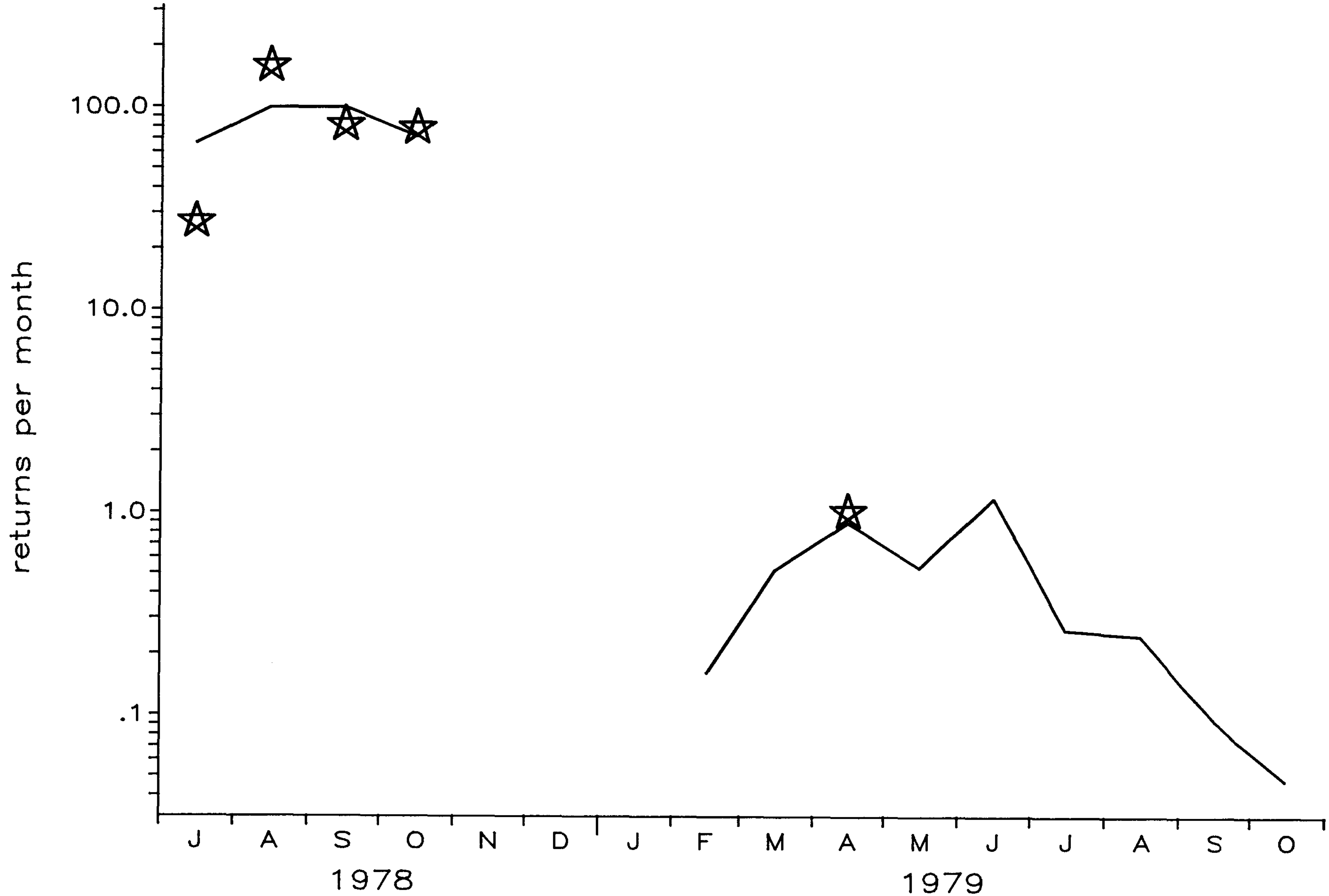


FIGURE 4. AGGREGATE TAG ATTRITION. Stars are the observed return rates for skipjack tagged throughout the total study area, recovered anywhere, and with precise date of recovery information, excluding recoveries by the Skipjack Programme. The line is the theoretical tag return rate based on the best fitting tag recovery and attrition model.

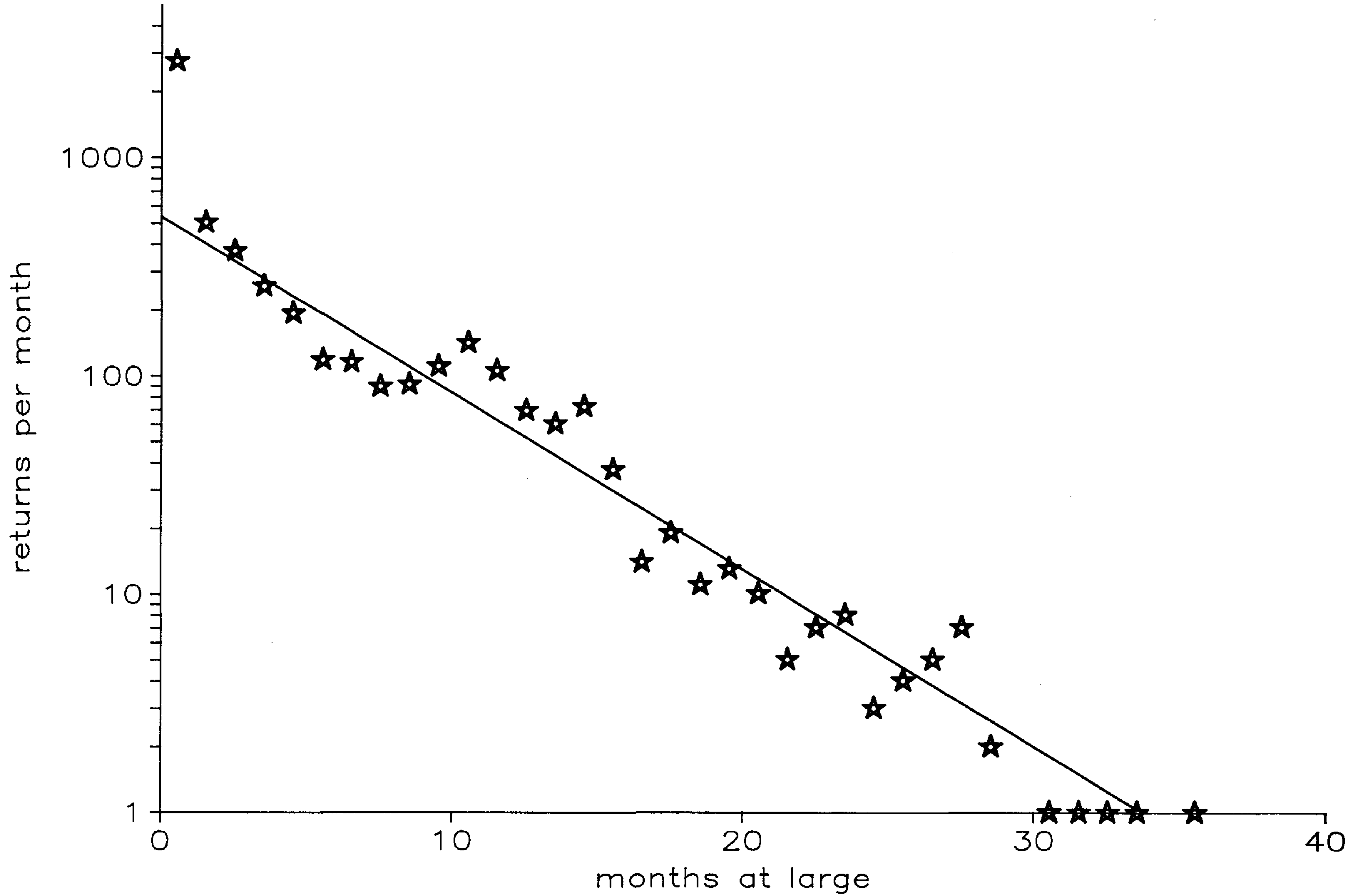


TABLE 9. SKIPJACK POPULATION PARAMETERS ESTIMATED FROM TWO SETS OF TAG RETURNS. The JICA+FAO/UNDP returns are those given in Table 8. The aggregate set includes skipjack returns from anywhere of all releases by the Skipjack Programme. Numbers in brackets give the 95 per cent confidence ranges. The Gilbert Group catch is the average catch by the JICA+FAO/UNDP survey vessels over the period July 1978 through April 1979. The catch in the total study area is the average monthly catch by all gears for the central and western Pacific region excluding Japanese waters. The factor, p, corrects for the recaptured tags that are not returned with useable recapture information or not returned at all and for short-term mortality due to tagging. It is a value between 0 and 1 (ideally close to 1).

	Turnover (months^{-1})	Population/p (tonnes)	Throughput/p (tonnes/month)	Average Catch (tonnes/month)	Average Exploitation·p (months^{-1})
JICA+FAO/UNDP[1] Returns	.37 (.16-.69)	1.2 (.6-2.6) ($X10^{3}$)	460 (290-780)	20	.016(.007-.031)
Total Study Area Returns	.17 (.15-.20)	5.0 (4.2-6.2) ($X10^{6}$)	870 (770-980) ($X10^{3}$)	$19X10^{3}$	.0038(.0031-.0046)

1 Eighty-nine per cent of the tag releases, 100 per cent of the tag recoveries, and a large portion of the catch considered in this analysis were concentrated in the Tarawa-Butaritari area (mostly within 60 miles of Butaritari). The parameter estimates therefore are relevant to only a small part of the 200-mile fisheries and economic zone of the Gilbert Group.

3.5 Growth Rate of Individuals

Information on the growth rate of skipjack is of great interest in assessing the skipjack resource. Tagging of post-recruits, as was done by the Skipjack Programme, does not allow reliable estimation of the time taken for juveniles to grow to recruitment size, but the pattern of growth of recruited fish does represent productivity or input of biomass to the fishery stock that is not included in estimates of recruitment based solely on numbers of tags returned.

Of the 385 returns of skipjack tagged in the Gilbert Group (Table 8), 220 include reliable information on body length at time of release and time of recapture. The length data are included in the tag return listing in Appendix C. The growth increments for these returns, as well as for returns from other parts of the study area, have been analysed by Lawson and Kearney (MS).

Figure 5 shows the observed growth rates from skipjack returns from the Gilbert Group and from the total study area plotted against size at release. Table 10 summarises the growth results for several countries including the Gilbert Group portion of Kiribati.

It is evident from Figure 5 that the growth rate drops dramatically with the length of the fish. It would appear that this phenomenon is more pronounced in the Gilbert Group than throughout the total study area. However, if the two negative points are disregarded (since skipjack probably do not shrink), then the rest of the Gilbert Group points are not as easily distinguishable from the total study area results. From Table 10, the growth rates of skipjack clearly vary in different parts of the region. This variability presumably reflects variability in food availability and possibly other ecological variables that could affect growth (Lawson and Kearney MS).

The productivity which the growth of post-recruit skipjack represents is of significance in relation to the problem of maximising the biomass of the harvest and to the question of whether to try to harvest new recruits immediately or whether to wait and let them grow for a while. The answer, strictly in terms of maximising yield per recruit, depends on a trade-off between the growth of individuals in a cohort of new recruits and depletion of the number of individuals in the cohort. If the total biomass of the cohort is increasing, then it might be worthwhile delaying the harvest, but if the biomass is decreasing, then harvest should begin immediately. In Figure 6, regions of increasing biomass and decreasing biomass are indicated for various combinations of mortality and growth rate for a cohort of 40 cm skipjack. This is an approximate mean length of first recruitment to most of the pole-and-line fisheries in the region. The range of possible mortalities and growth rates for skipjack in Kiribati and in the total study area would indicate that there is no increase in yield to be gained by delaying the harvest of new recruits.

An additional consideration is that the exploitation rate is low relative to the turnover (see Section 3.4), which means that the harvest pressure on a young cohort will have limited effect on the future biomass of that cohort. Therefore, from a biological point of view, unless the exploitation rate is considerably higher than it was during this tagging experiment, the harvest may just as well go ahead on young recruits. In the case of a greatly increased exploitation rate the decision as to what size to begin harvest should be influenced by additional concerns, e.g. the maintenance of adequate brood stock.

FIGURE 5. GROWTH RATES (GROWTH INCREMENT/TIME-AT-LARGE) FOR SKIPJACK RETURNS FROM THE TOTAL STUDY AREA AND FROM THE GILBERT GROUP AS A FUNCTION OF LENGTH AT RELEASE

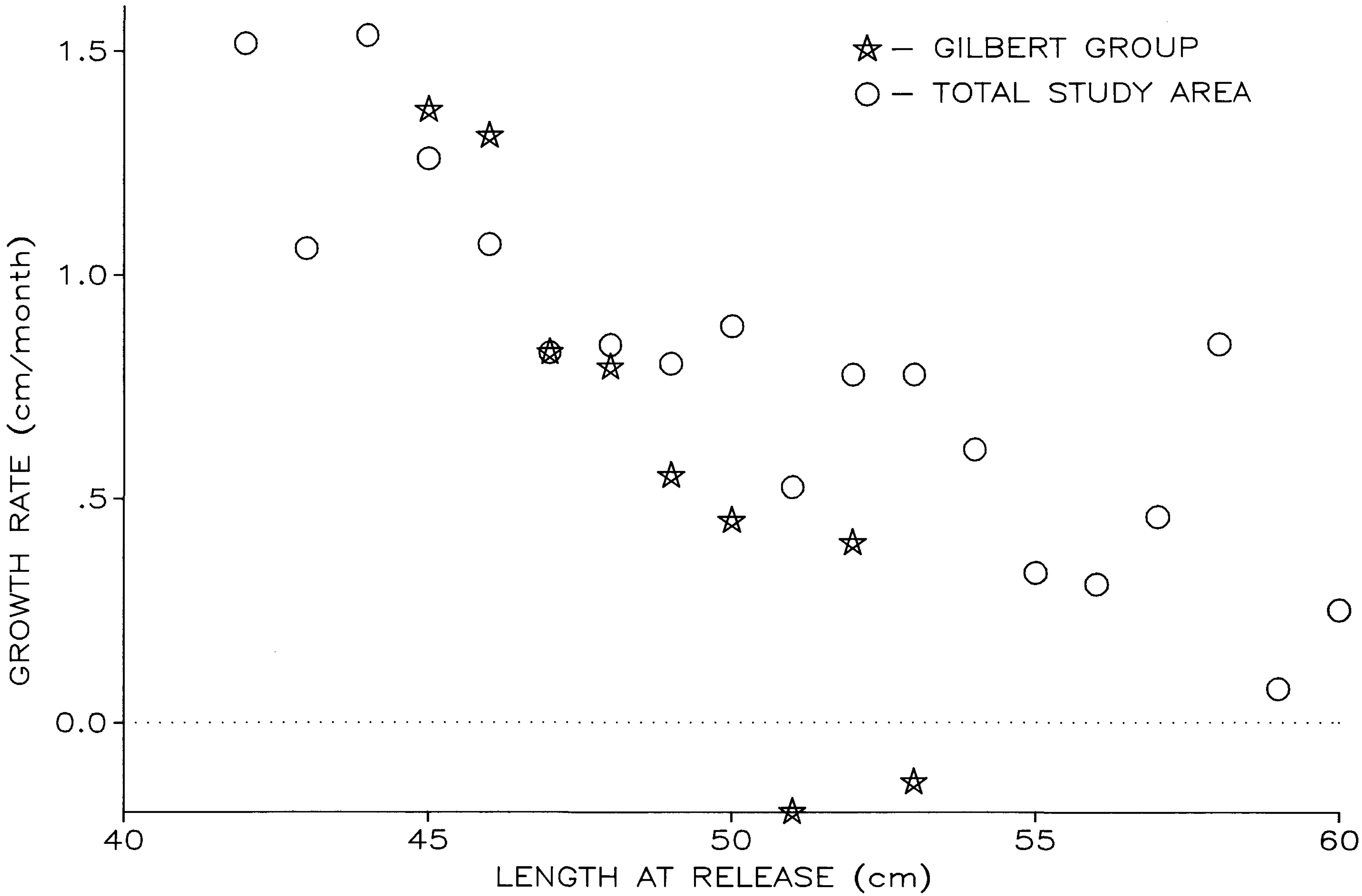
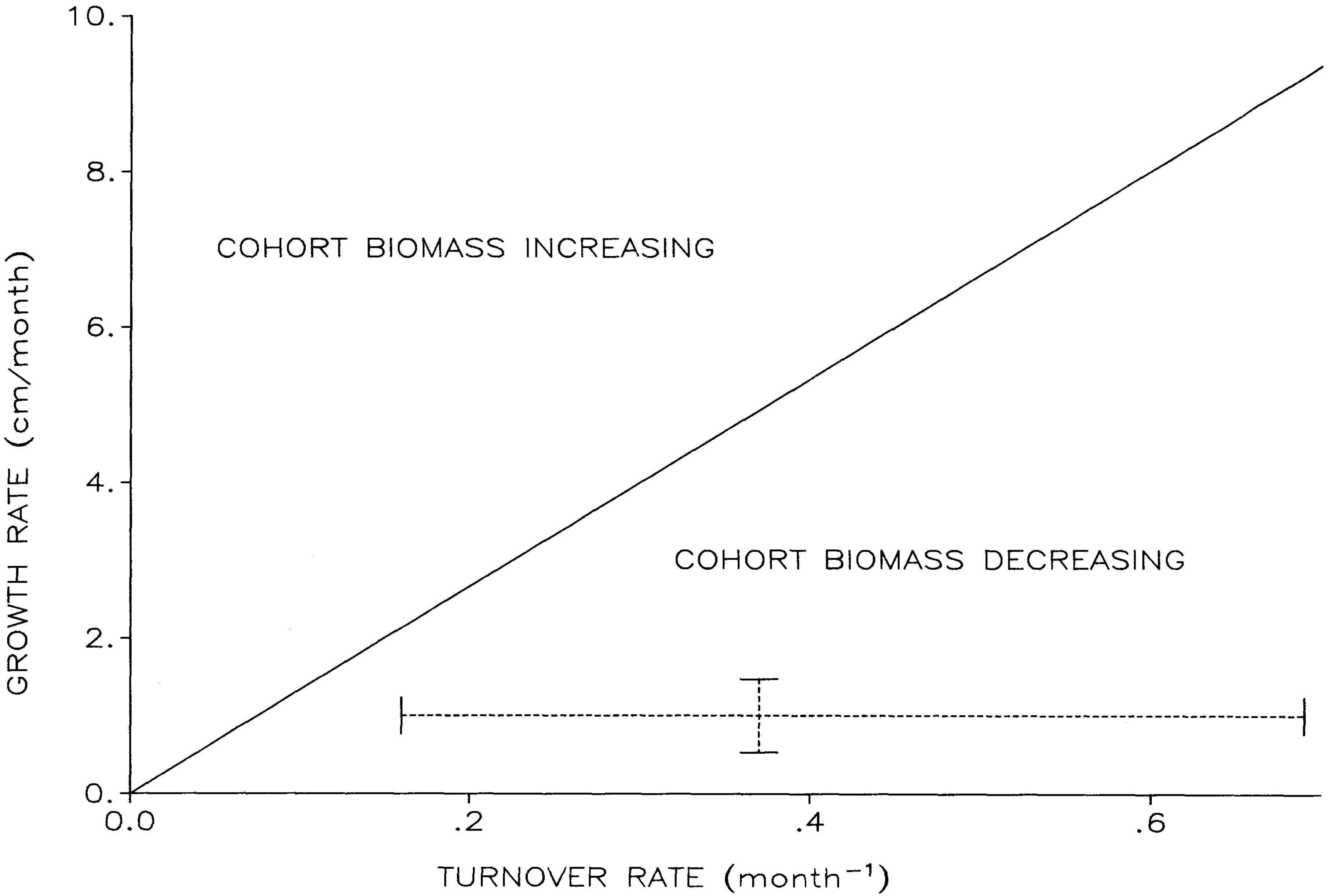


TABLE 10. AVERAGE GROWTH RATES BY AREA, SIZE AT RELEASE, AND TIME-AT-LARGE. Estimates with standard errors greater than 3.0 cm/yr or from samples of less than six fish are considered unreliable and are given in brackets. Biweights are marked with an asterisk. Average release length and average days at large are weighted averages, using weights used to estimate average growth rate.

	Fish at large 31-180 days											
	40-49 cm at release						50-59 cm at release					
Area	Sample Size	Average Release Length (cm)	Average Days at Large	Average Growth Rate (cm/yr)	Standard Error (cm/yr)	Standard Deviation (cm/yr)	Sample Size	Average Release Length (cm)	Average Days at Large	Average Growth Rate (cm/yr)	Standard Error (cm/yr)	Standard Deviation (cm/yr)
Fiji	38	46.0	67	17.23*	2.42	14.89	12	52.4	66	(11.95)*	6.00	20.79
Kiribati	180	47.6	65	9.46*	0.74	9.96	39	51.6	65	1.42	2.05	12.78
New Zealand	2	45.0	52	(-6.75)	6.92	9.78	3	53.5	62	(14.55)	1.88	3.26
Papua New Guinea	16	46.7	68	(20.85)*	3.62	14.47	292	55.0	65	5.40*	0.69	11.75
Ponape	1	48.0	170	(21.06)	-	-	9	52.6	100	13.67*	2.05	6.15
Solomon Islands	87	44.9	104	12.72*	1.20	11.23	42	53.2	96	5.75*	2.84	18.43
	Fish at large 181-450 days											
Fiji	20	46.7	316	16.16*	0.87	3.91	10	53.0	316	7.01	1.93	6.10
Kiribati	1	46.0	408	(5.43)	-	-	0	-	-	-	-	-
New Zealand	11	46.4	330	8.41*	0.86	2.85	3	50.8	322	(13.44)	0.55	0.95
Papua New Guinea	3	44.2	271	(19.38)	4.44	7.70	15	53.8	368	8.23*	0.63	2.45
Ponape	3	48.5	196	(13.78)	1.76	3.06	4	50.9	217	(12.89)	1.57	3.13
Solomon Islands	77	45.3	267	11.37*	0.90	7.90	50	53.2	303	4.08*	0.90	6.35

FIGURE 6. REGIONS OF INCREASING AND DECREASING BIOMASS FOR A COHORT OF 40 CM SKIPJACK FOR COMBINATIONS OF GROWTH RATE AND POPULATION TURNOVER RATE. The vertical dashed line indicates the range of growth rates given in Table 10 and the horizontal dashed line indicates the range in the turnover rate estimated from the JICA+FAO/UNDP tag returns (Table 9).



3.6 Skipjack Migration

Table 11 summarises the recoveries from skipjack released throughout the total study area for which the country or area of recovery is known. It is in the form of a matrix in which the rows represent the country or area of release and the columns represent the country or area of recovery. It can be seen, for example, that of the 4,569 skipjack released in the Gilbert Group, 463 were returned, and of these, 385 were recovered in the Gilbert Group and the rest went to 10 other areas. Not included in the table are two additional returns for which the country or area of recapture was unknown.

A selection of skipjack migrations throughout the total study area are plotted on a map in Figure B.

3.6.1 Local migration

Figure 7 is a map showing a selection of internal skipjack migrations in Kiribati, i.e. the fish were both released and recovered within Kiribati waters. The bulk of these are internal to the Gilbert Group, and furthermore, within the Gilbert Group the bulk of the returns originate in the neighbourhood of Butaritari. This merely reflects the distribution of tagging (Table 7), and recovery effort by JICA+FAO/UNDP vessels. Three of the migrations within Kiribati must have transited waters external to Kiribati because they originate and terminate in different island groups within Kiribati. It is of course also possible that some of the fish released and recovered wholly within the Gilbert Group actually departed the waters of the Gilbert Group and returned there before they were recovered.

3.6.2 Emigration

Figure 8 shows migration arrows for emigrants from Kiribati. All of these originated in the Gilbert Group. The destination countries or areas are the Marshall Islands, Nauru, Kosrae, Ponape and Howland Island northwest of Phoenix Islands, Palmyra and American Samoa further afield. Most of the returns from international waters were recovered in the region between the Gilbert Group and the Line Group and north of the Phoenix Group. Two came from the enclosed slot of international waters to the southwest of the Gilbert Group.

The apparent radiation of tags away from Butaritari in Figures 7 and 8 is somewhat misleading since the great majority of the returns from Butaritari tagged skipjack were recovered close to the release point and do not show up well in these figures. However, these returns were for the most part also recovered after only a few months at large (Table 8). Figure 9 gives the distribution over migration distance for the Butaritari releases for three different categories of time-at-large. Figure 10 shows the distance and time-at-large distribution for returns from releases throughout the total study area.

TABLE 11. RELEASE AND RECAPTURE SUMMARY FOR ALL TAGGED SKIPJACK RELEASED BY THE SKIPJACK PROGRAMME IN OTHER COUNTRIES. Data for returns up to September 28, 1982. For explanation of country abbreviations see Appendix E.

NUMBER OF RELEASES BY COUNTRY		COUNTRY OF RECAPTURE																																								
		AMS	CAL	FIJ	GIL	GUM	HAW	HOW	IND	INT	JAP	KOS	LIN	MAQ	MAR	MAS	NTS	NAU	NCK	NOR	NSW	PAL	PAM	PHL	PHO	PNG	PON	QLD	SOC	SOL	TOK	TON	TRK	TUA	TUV	VAN	WAK	WAL	WES	YAP	ZEA	TOTAL
775	AMS	3																																					1			4
10219	CAL		18		1					2					1											2	2			10			1									37
20094	FIJ		1	1949	1					5								1							4				1			2			6		1	2	2		3	1978
174	GAM																																									
4569	GIL	1			385			24		32		1	1			14		1					2		1		1															463
108	JAP				1				2	3	7				1	1																										15
297	KOS									3						2																										5
20282	MAQ				1			1		4				42											1				1													50
195	MAR									2	1				2		1										1						2									9
327	MAS									2						1		1																								4
1229	NCK																		1																							1
91	NIU																																									
1113	NOR		2	1																										1												4
4322	NSW	1	6	2						1											2								1	8									1		9	31
7233	PAL				3				28	67		3			1	6						104		5		77	7			2			23							30		356
367	PHO				1																																					1
59	PIT																																									
8550	PNG				1	1		5	7	18		1				7						2	2			958	3	1		28			11							3		1048
5518	PON				1			2		17	2	23			1	29								1		1	58			1			13							10		159
2651	QLD		3																									2		25			1			2						33
48	SCK																																									
1725	SOC																												36													36
6221	SOL			1	1				1	2																15				525												545
64	TOK																														1											1
1969	TON																								1				1			10							1			13
1054	TRK									4		5				5											19						16							2		51
5528	TUA																												5					25								30
2904	TUV			2	2		1	1		7		1				4		1					1		1	1				2					2				1	1		28
1254	VAN																									1				4						2						7
16065	WAL		1	14	5			5		10						3									24	2			3				1		1			66	11		6	152
1926	WES	1																											1	1									19		1	23
778	YAP				2				3	7	1				3							1					1						3							5		26
12734	ZEA		5	31						3										1	2								5		1	1			1	1			5		1003	1059
140443	TOT	6	36	2000	405	1	1	38	41	189	11	34	1	42	9	72	1	4	1	1	4	107	5	6	32	1057	92	3	54	605	2	13	71	25	10	5	1	68	41	51	1022	6167

FIGURE 7. MIGRATION ARROWS FOR MOVEMENT OF TAGGED SKIPJACK WITHIN THE WATERS OF KIRIBATI. Returns received with precise date and position of recapture totalled 388. Of these, 31 were selected for plotting by only choosing one example of movement in each direction between any pair of 0.5 degree squares and only one example of movement wholly within any 0.5 degree square. Tick marks represent time-at-large, with one tick mark per 30-day interval.

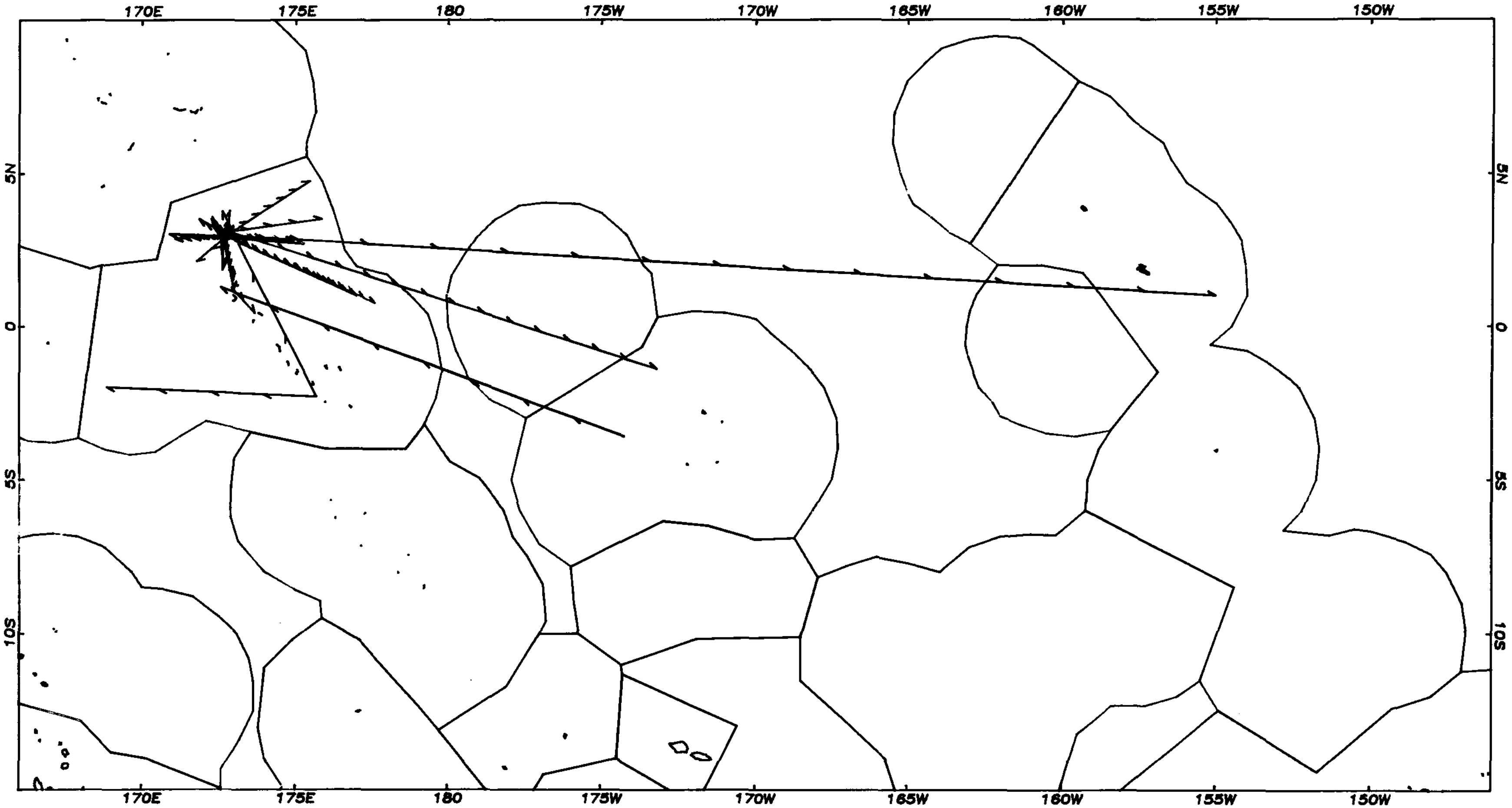


FIGURE 8. MIGRATION ARROWS FOR TAGGED SKIPJACK EMIGRATING FROM THE WATERS OF KIRIBATI. Returns received with precise date and position of recapture totalled 75. Of these, 23 were selected for plotting by choosing one example of movement in each direction between any pair of 5 degree squares. Tick marks represent time at large, with one tick mark per 30-day interval.

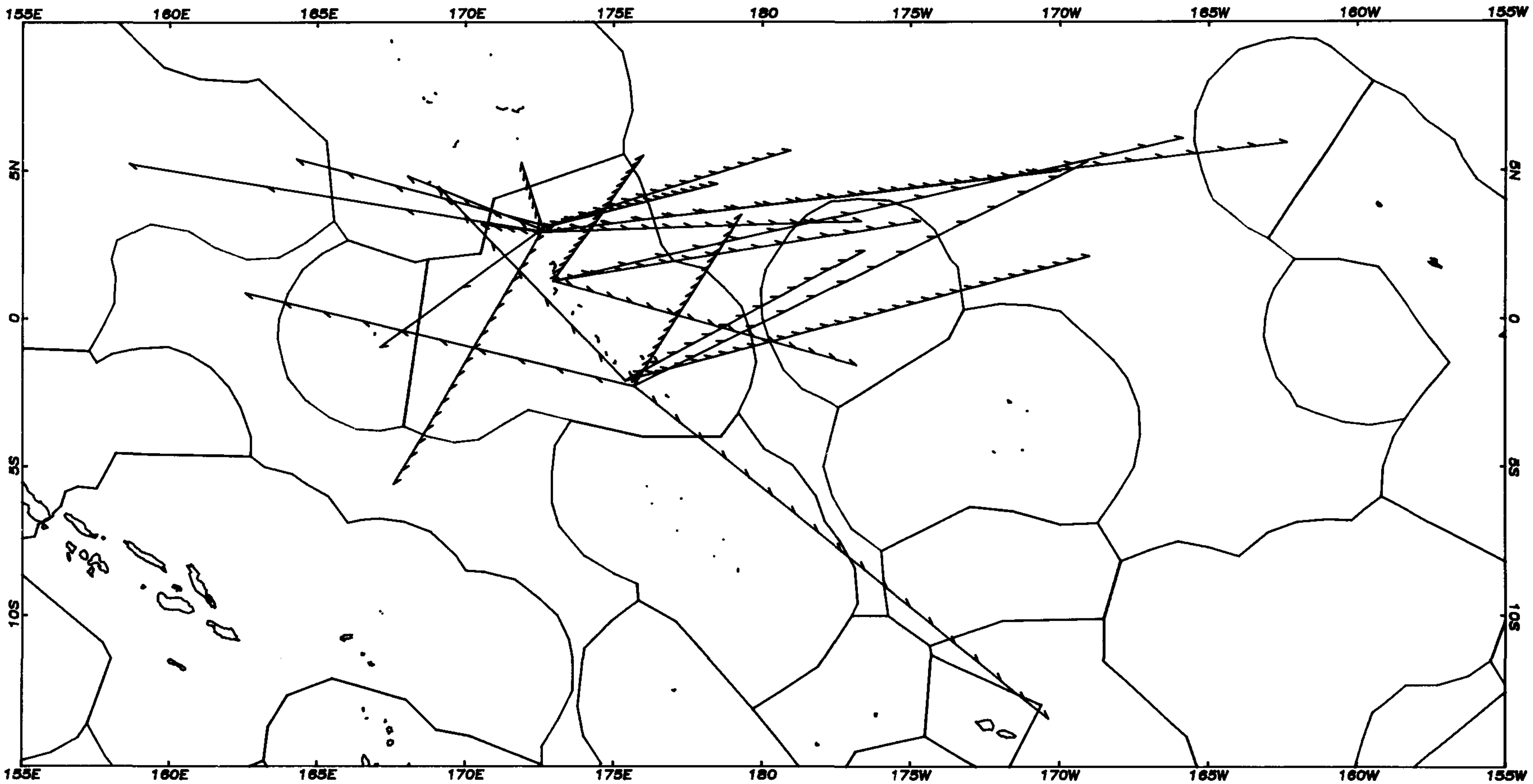


FIGURE 9. DISTRIBUTIONS OF RETURNS FROM BUTARITARI RELEASES OVER DISTANCE TRAVELLED FOR THREE CATEGORIES OF TIME-AT-LARGE. Data are for tag returns received by November 4, 1982. Recaptures for two fish, which were at large for more than 180 days and which travelled more than 1,500 nautical miles, are included in the sample size, but not shown in the figure.

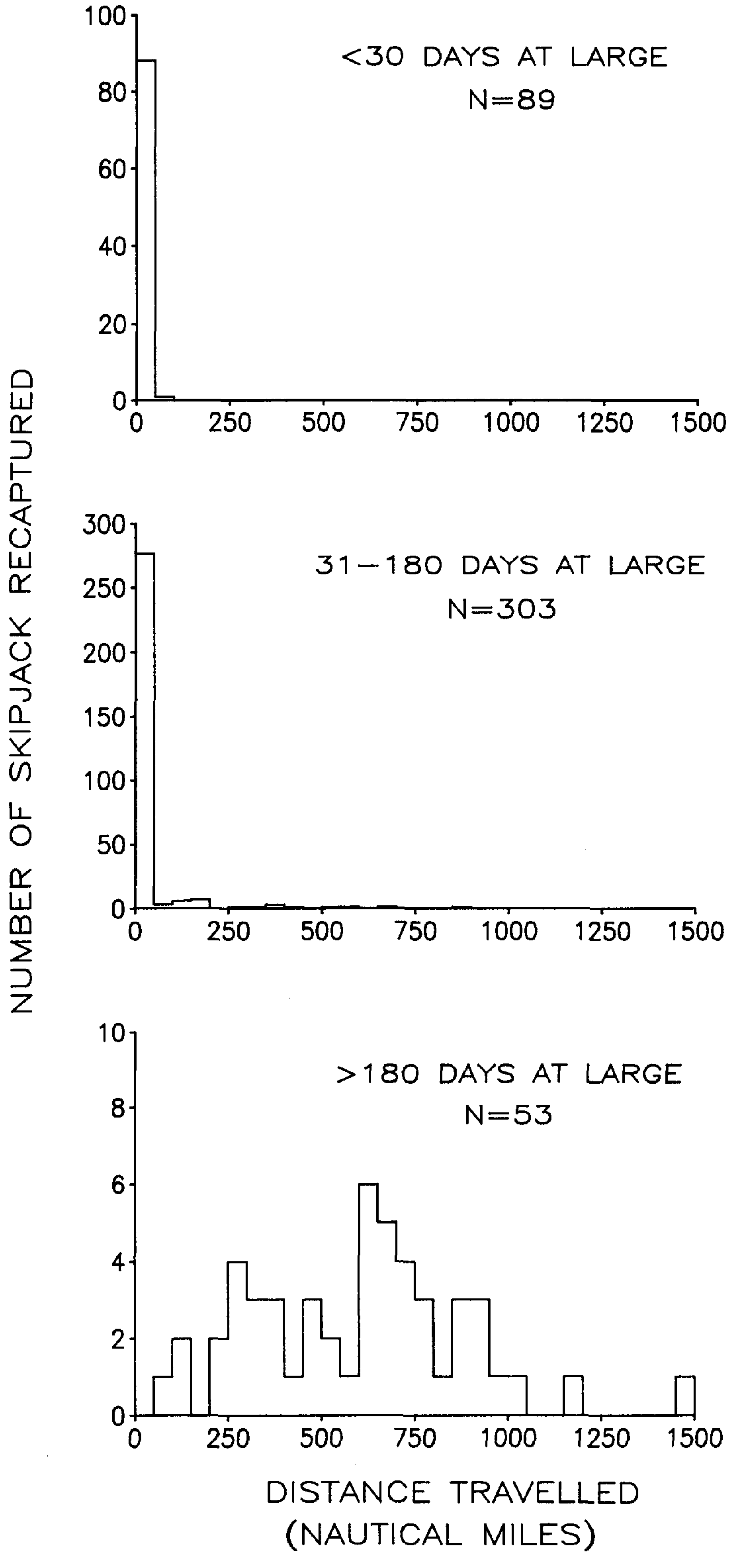
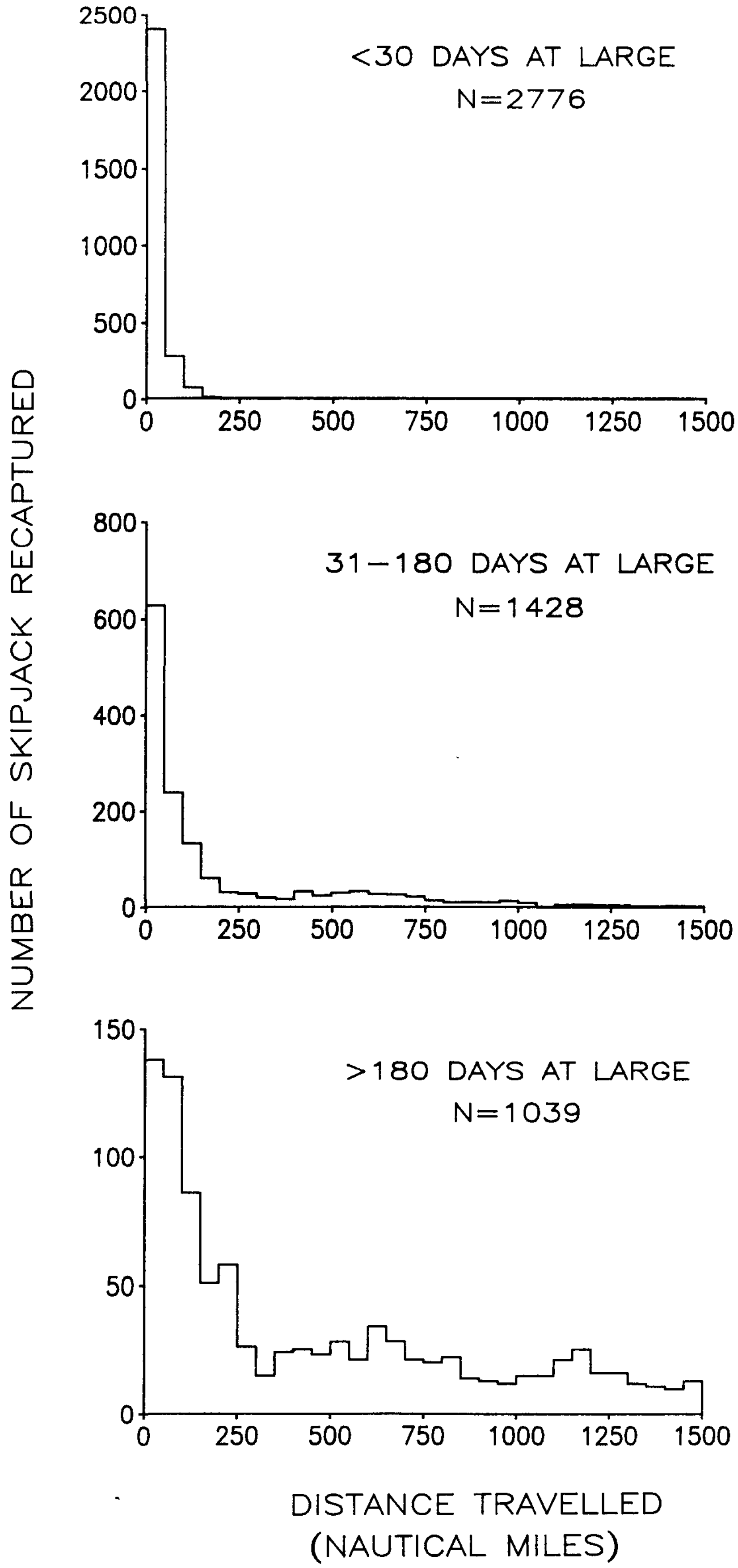


FIGURE 10. DISTRIBUTIONS OF RETURNS FROM RELEASES THROUGHOUT THE TOTAL STUDY AREA OVER DISTANCE TRAVELLED FOR THREE CATEGORIES OF TIME-AT-LARGE. Data are for tag returns received by November 4, 1982. Recaptures for 96 fish, which travelled more than 1,500 nautical miles, are included in the sample sizes, but not shown in the figure.



3.6.3 Immigration

Appendix D lists release and recovery information for all fish recovered within, but released outside, the waters of Kiribati. Figure 11 shows the migration arrows for skipjack immigrating into Kiribati waters. They come from almost all directions in which significant numbers of tags were released. The countries or areas of origin are the Bonin Islands north of the Mariana Islands, Palau, Yap, Ponape, Papua New Guinea, Solomon Islands, New Caledonia, Fiji, Tonga, Wallis and Futuna, Tuvalu, and the Marquesas Islands (see Table 11). No tagged fish were recovered in Kiribati from the Marshall Islands just to the north of the Gilbert Group, but only 327 skipjack were released in the Marshall Islands. All but one of the immigrant tags were recovered by the Japanese pole-and-line fleet. The single exception was a recovery by a Japanese purse-seiner.

Of the 50 tagged skipjack immigrating to Kiribati, 19 were recovered in the Gilbert Group and 31 in the Phoenix Group. None were recovered in the Line Group, although as seen above, one skipjack did migrate from the Gilbert Group to the Line Group.

3.7 Skipjack Fishery Interactions

One of the objectives for releasing tagged skipjack was to investigate the degree of actual or potential interaction among skipjack fisheries throughout the Pacific. The results are, of course, only indicative of interaction in terms of exchange of post-recruit fish between fishing areas. It should be noted that other forms of interaction are possible, e.g. harvest in one fishery of brood stock which is destined to supply the next generation of recruits to another fishery. At low levels of exploitation, effects such as this are not likely to be significant, and could not be demonstrated for the most intense skipjack fisheries (Joseph and Calkins 1969; Kearney 1979).

From preliminary analysis of skipjack mortality in progress, it appears that for an area the size of the Gilbert Group's 200-mile zone, mortality accounts for most of the population turnover. Therefore losses of skipjack due to emigration, whether or not the emigrants are destined for another fishery (see Section 3.6.2), would seem to be insignificant relative to mortality losses within the zone.

It is possible to quantify the rate of movement of fish (tonnes per month), moving from one area to another, by analysis of tag recoveries in the destination area resulting from releases in the donor area if catch information for fisheries in both areas is available (Skipjack Programme 1981c; Kleiber MS). Unfortunately, all 50 immigrant tags to Kiribati were recovered by Japanese vessels, and of the immigrants originating in areas for which appropriate catch data are available, only 2 were returned in months for which Japanese catch statistics have been provided to the Skipjack Programme.

There were four pairs of countries or areas in the Skipjack Programme study area for which it was possible to obtain quantitative estimates of interaction due to skipjack movement. These were Papua New Guinea - Solomon Islands, New Zealand - Fiji, New Zealand - Society Islands, and New Zealand - Western Samoa. In all cases, immigration from other fisheries was only a small fraction of the throughput in the destination fishery (less than 15 per cent).

FIGURE 11. MIGRATION ARROWS FOR TAGGED SKIPJACK IMMIGRATING INTO THE WATERS OF KIRIBATI. Returns received with precise date and position of recapture totalled 50. Of these, 26 were selected for plotting by choosing one example of movement in each direction between any pair of 5 degree squares. Tick marks represent time-at-large, with one tick mark per 30-day interval.

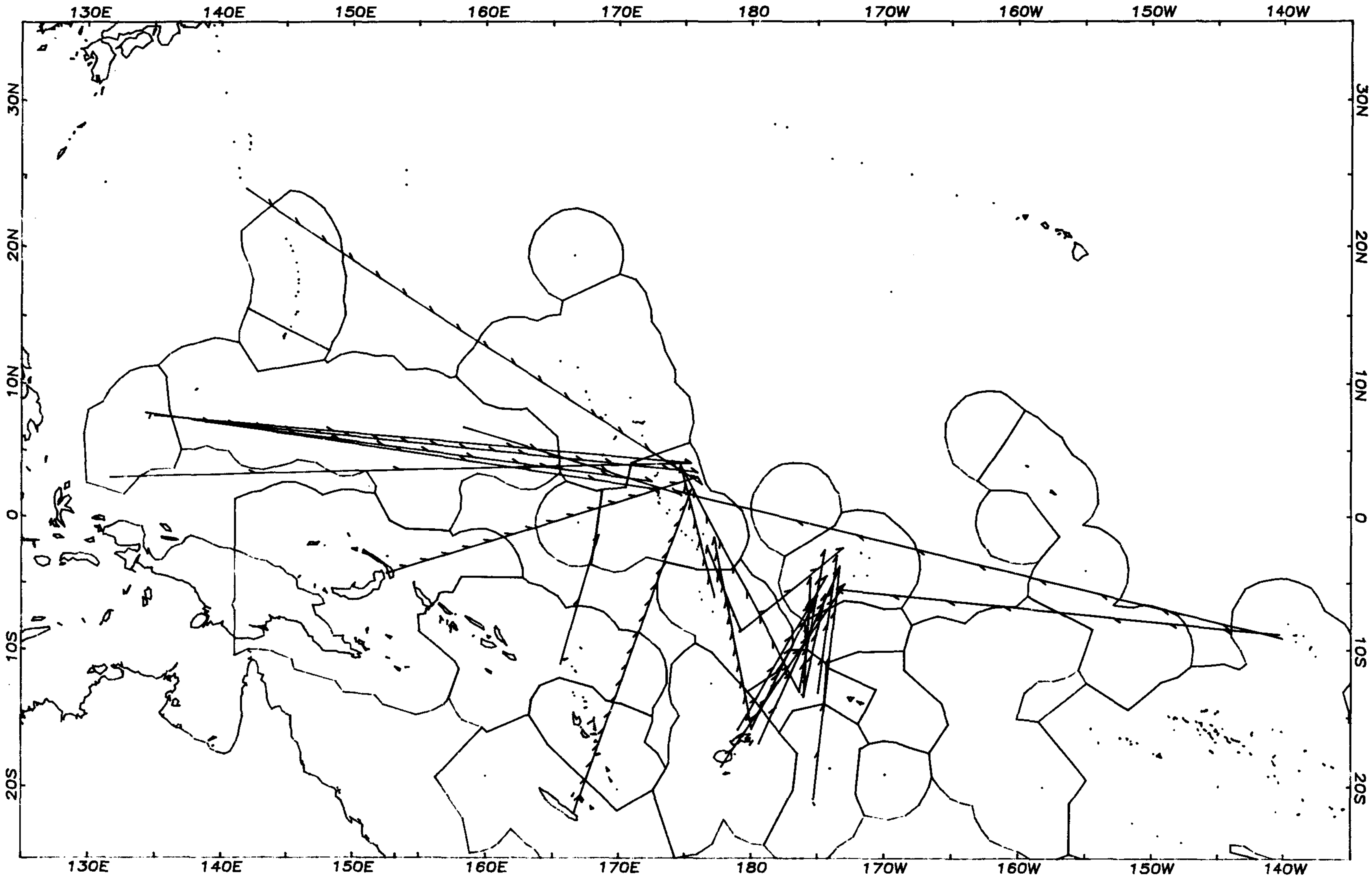
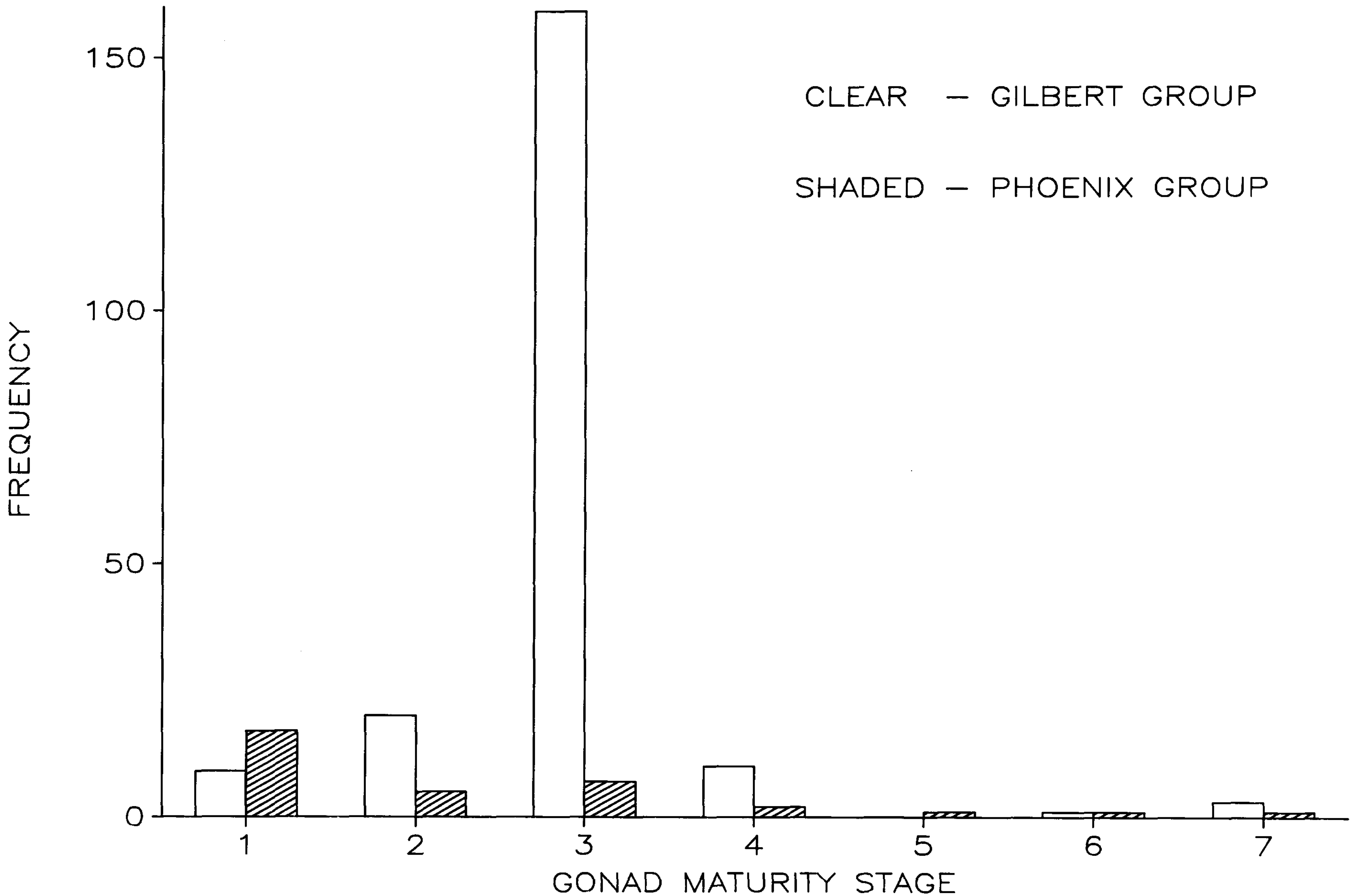


FIGURE 12. DISTRIBUTION OVER GONAD STAGES FOR FEMALE SKIPJACK SAMPLED IN THE GILBERT AND PHOENIX GROUPS



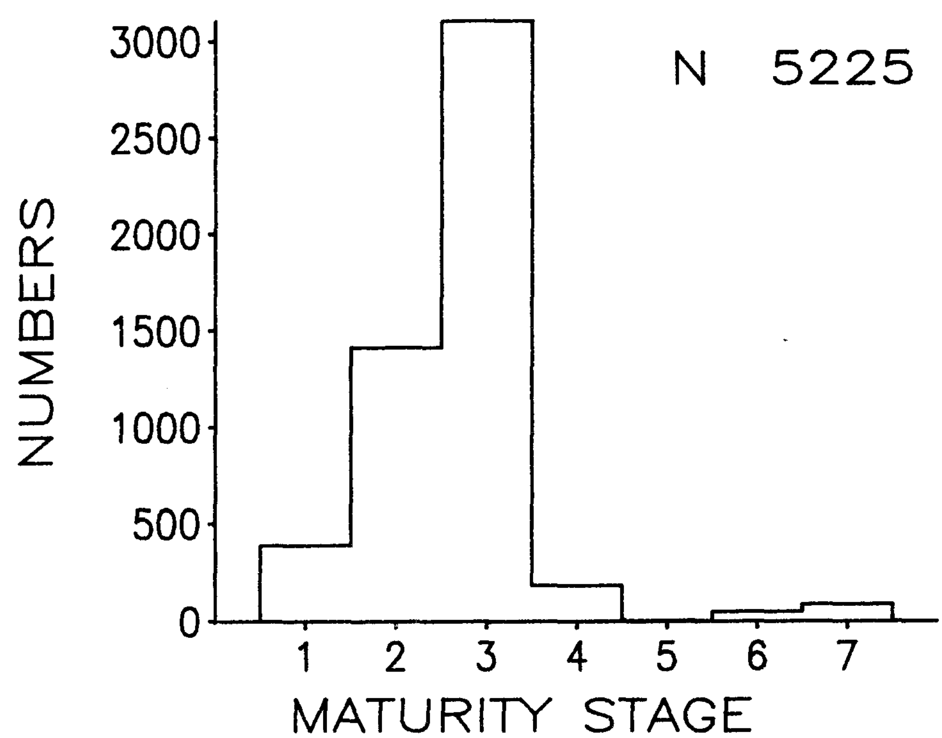
It has been pointed out (Skipjack Programme 1981c) that if fisheries in neighbouring countries were to expand their areas of operation to include waters adjacent to the common borderline between the countries, then the degree of interaction could be expected to increase. Furthermore, if fisheries such as purse-seine and pole-and-line fleets operating in the same waters of a country were to develop in overlapping areas, such as purse-seine and pole-and-line fleets operating in the same waters of a country, then the degree of interaction could be very much higher. These inferences are assumed to be applicable also to the waters of Kiribati.

3.8 Additional Aspects of Skipjack Population Biology

In addition to the information derived from tagging results, several other aspects of skipjack population biology were considered by the Skipjack Programme, including maturity, juvenile ecology, feeding, and genetic population structure.

Gonad maturity data for the Gilbert and Phoenix Groups are presented in Figure 12. Most females sampled in the Gilbert Group were at maturity stage 3. The females in the Phoenix Group were predominantly stage 1; however, one of the two cases of stage 5 gonads encountered by the Skipjack Programme was found in the Phoenix Group. Stages 2 and 3 are pre-spawning stages, and are those typically present in pole-and-line catches. Figure 13 shows numbers of females sampled in each maturity stage during the entire Skipjack Programme. Stages 2 and 3 are by far the most represented; later stages, including post-spawning stages 6 and 7, are present in much lower numbers. Skipjack are capable of developing rapidly, and pre-spawning fish have been induced to spawn in captivity seven to eight hours after capture (Anon 1980). At present, it is not understood why the later maturity stages are rarely found. Among the possible reasons are that spawning fish might not generally respond to chum, they might not tend to school at the surface, or the last seven to eight hours of development might occur at night.

FIGURE 13. DISTRIBUTION OVER GONAD STAGES FOR ALL FEMALE SKIPJACK SAMPLED BY THE SKIPJACK PROGRAMME



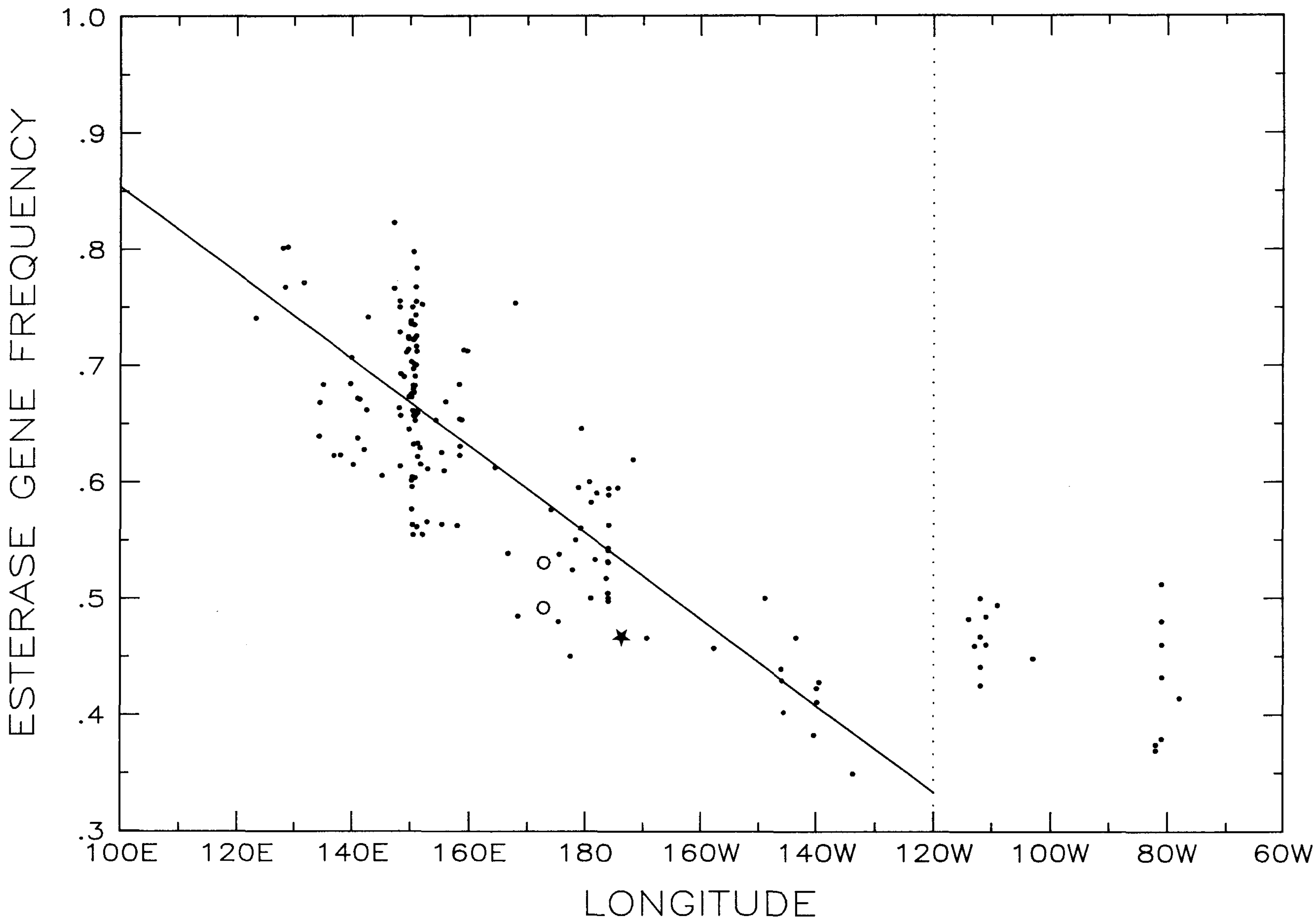
Perhaps a better index of recent spawning activity is given by the incidence of skipjack juveniles observed in the stomachs of their predators. From examination of 267 skipjack stomachs in the waters of Kiribati, an average of 0.4 skipjack juveniles per 100 predator stomachs was observed. This level is well below the high incidences of over 25 juveniles per 100 stomachs found in Vanuatu, Wallis and Futuna Islands, and the Marquesas Islands, and is similar to low levels of 0-4 juveniles per 100 stomachs found in countries and territories of the north equatorial countercurrent, and in the Society Islands. Virtually nothing is known about the movements of juveniles and sub-adults, therefore it cannot be said with confidence to what extent recruitment to stocks of skipjack in Kiribati is the result of local spawning.

Common diet items of skipjack in Kiribati, other than chum, were fish remains, squid, surgeonfish (Acanthuridae) and the pelagic anchovy _Stolephorus buccaneeri_ (Table 12). The wide variety of diet items observed confirms that skipjack are highly opportunistic feeders.

TABLE 12. STOMACH CONTENTS OF SKIPJACK TAKEN THROUGHOUT THE WATERS OF KIRIBATI

Item No.	Diet Item Fish and Invertebrates	Number of Stomachs	Percentage Occurrence
1	Chum from _Hatsutori Maru_	137	74.46
2	Fish remains (not chum)	61	33.15
3	Squid (Cephalopoda)	28	15.22
4	Acanthuridae	26	14.13
5	_Stolephorus buccaneeri_ (Engraulidae)	19	10.33
6	Empty stomach	19	10.33
7	Shrimp (Decapoda)	17	9.24
8	Alima stage (Stomatopoda)	16	8.70
9	Holocentridae	14	7.61
10	Balistidae	13	7.07
11	Megalopa stage (Decapoda)	12	6.52
12	Juvenile fish	8	4.35
13	Exocoetidae	8	4.35
14	Amphipoda	6	3.26
15	Gempylidae	6	3.26
16	Gastropoda	3	1.63
17	Unidentified fish	3	1.63
18	Pteropoda (Gasteropoda)	2	1.09
19	Chaetodontidae	2	1.09
20	_Dactylopterus orientalis_ (Dacylopteridae)	1	.54
21	Stomiatidae	1	.54
22	Stomatopoda	1	.54
23	Echeneidae	1	.54
24	Bramidae	1	.54
25	Phyllosoma stage (Decapoda)	1	.54
26	_Decapterus_ sp. (Carangidae)	1	.54
27	Nomeidae	1	.54
28	Octopus (Cephalopoda)	1	.54
29	Heteropoda (Gastropoda)	1	.54
30	Tuna juvenile (Scombridae)	1	.54
	Total Stomachs Examined	184	

FIGURE 14. SERUM ESTERASE GENE FREQUENCY FOR BLOOD SAMPLE SCHOOLS AS A FUNCTION OF LONGITUDE. All samples west of 120°W were collected by the Inter-American Tropical Tuna Commission. The open circles represent the two samples from the Gilbert Group and the star represents the sample from the Phoenix Group.



Two blood samples of at least 100 specimens were taken in the Gilbert Group and one in the Phoenix Group as part of a complete region-wide attempt to define breeding subpopulations on the basis of genetic markers. The most significant result was a longitudinal gradient in serum esterase gene frequency across the study area (Figure 14) with no sharp steps evident as would be expected if the population structure consisted of a mosaic of non-mingling and non-interbreeding subpopulations. However, the fact that a gradient exists at all indicates that region-wide genetic mixing does not occur within a generation. In the absence of information about possible homing behaviour in skipjack, and the lack of details regarding the selective genetic properties of serum esterase in skipjack, further analysis of the genetic data would be of limited value.

4.0 CONCLUSIONS

4.1 Baitfish Assessment

The Skipjack Programme results concerning baitfish in Kiribati are limited to the Gilbert Group as this was the the only area in Kiribati where baitfish were obtained.

There is no doubt that the baitfish obtainable in the Gilbert Group can be effectively used to catch skipjack and other tunas. However, the results of the Skipjack Programme imply that good supplies of natural bait are variable in the Gilbert Group. Therefore, supplementing the natural bait supplies with cultured baitfish may be essential for supporting a sustained local commercial pole-and-line operation. Whether this is an economically viable prospect remains to be proven. A review of the economic aspects of baitfish culture for pole-and-line fishing is given by Kearney and Rivkin (1980).

4.2 Skipjack Assessment

Because of lack of catch statistics since 1978 for the Japanese pole-and-line fleet, it was not possible to assess the population size or throughput for the whole of the Gilbert Group's 200-mile zone. However, estimates of population size and throughput in the neighbourhood of Butaritari revealed a population between 720 and 2,200 tonnes and a throughput between 340 and 710 tonnes per month. This population could easily sustain a fishery the size of the survey fishery operating in the area at the time as well as sustain the local commercial catch in 1981 which averaged 67 tonnes per month. To expand the fishery to the anticipated catch of 800 tonnes per month (Anon, undated a) would require expansion of the area of the fishery in order to exploit a large enough population to support such a harvest. Evidence suggests that there are ample resources for such expansion throughout the waters of the Gilbert Group.

Skipjack Programme results bearing on the Phoenix Group and the Line Group are more sketchy. The school sightings data imply that the tuna abundance is as high in the Phoenix Group as it is in the Gilbert Group. The POFI results (Waldron 1964) suggest that the abundance in the Line Group is not greatly different from the Phoenix Group.

There would appear to be little significant interaction between the small local fishery and other fisheries in the region at present. At the current low harvest levels, interaction even amongst the different fisheries operating within Kiribati waters is thought to be of little significance.

REFERENCES

ANON (undated a). Project for the development of fishing resources in Northern Gilberts. Gilbert and Ellis Islands.

ANON (undated b). Sea Treasure Cruise, 15 October-10 December 1974. Pacific Tuna Development Foundation. Manuscript.

ANON (1979). Annual Report. Fisheries Division, Ministry of Agriculture and Fisheries, Suva, Fiji.

ANON (1980). Stress triggers skipjack tuna spawning. Southwest Fisheries Center, National Marine Fisheries Service Monthly Report, July 1980:5, La Jolla, California.

ANON (1982). Country statement - Republic of Kiribati. Regional Technical Meeting on Fisheries 1982, 14 : Working Paper No.8, South Pacific Commission, Noumea, New Caledonia.

ARGUE, A.W. (1982). Methods used by the Skipjack Survey and Assessment Programme for collecting biological, tuna school and ancillary data from a pole-and-line fishing vessel. In Kearney, R.E. (ed.). Methods used by the South Pacific Commission for the survey and assessment of skipjack and baitfish resources. Tuna and Billfish Assessment Programme Technical Report No.7, South Pacific Commission, Noumea, New Caledonia.

ARGUE, A.W. and R.E. KEARNEY (1982). An assessment of the skipjack and baitfish resources of Solomon Islands. Skipjack Survey and Assessment Programme Final Country Report No.3, South Pacific Commission, Noumea, New Caledonia.

BRYAN, P.G. (1980). The efficiency of mollies, Poecilla mexicana, as live bait for pole-and-line skipjack fishing: fishing trials in the tropical central Pacific. Marine Fisheries Review 42:15-24.

CARTER, J. (ed.) (1981). Pacific Islands Yearbook, Fourteenth Edition. Pacific Publications, Sydney.

CONWAY, G.R., N.R. GLASS and J.C. WILCOX (1970). Fitting nonlinear models to biological data by Marquardts algorithm. Ecology, 51(3):503-507.

DEVAMBEZ, L.C. (1960). Report of a survey of fisheries in the Gilbert Islands. South Pacific Commission, Noumea, New Caledonia.

FUJINO, K. (1966). Instructions for collecting blood and serum samples from tuna fishes. FAO Circular 26, Food and Agriculture Organization, Rome, Italy.

GILLETT, R.D. and R.E. KEARNEY (1982). Methods used by the Skipjack Survey and Assessment Programme for tagging skipjack and other tuna. In Kearney, R.E. (ed.). Methods used by the South Pacific Commission for the survey and assessment of skipjack and baitfish resources. Tuna and Billfish Assessment Programme Technical Report No.7, South Pacific Commission, Noumea, New Caledonia.

GOPALAKRISHNAN, V. (1977). Atoll aquaculture - culture of milkfish, Chanos chanos (Forskaal), in the Gilbert Islands for the production of live baitfish and as a means of increasing the supply of protein-rich food. Regional Technical Meeting on Fisheries 1977, 9 : Working Paper No.27, South Pacific Commission, Noumea, New Caledonia.

HALLIER, J.-P. and R.D. GILLETT (1982). Baitfishing methods used by the Skipjack Survey and Assessment Programme and their comparison with those used by commercial Japanese pole-and-line vessels. In Kearney, R.E. (ed.). Methods used by the South Pacific Commission for the survey and assessment of skipjack and baitfish resources. Tuna and Billfish Assessment Programme Technical Report No.7, South Pacific Commission, Noumea, New Caledonia.

HALLIER, J.-P. and R.E. KEARNEY (1980). Second interim report of the activities of the Skipjack Survey and Assessment Programme in the waters of Kiribati (22 November - 5 December 1979). Skipjack Survey and Assessment Programme Preliminary Country Report No.20, South Pacific Commission, Noumea, New Caledonia.

HIDA, T.S. and J.H. UCHIYAMA (1977). Biology of baitfishes Herklotsichthys punctatus and Pranesus pinguis in Majuro, Marshall Islands. In Shomura, R.S. (ed.). Collection of tuna baitfish papers. United States Department of Commerce, National Oceanic and Atmospheric Administration Technical Report, National Marine Fisheries Service Circular 408:63-68.

JICA (1978). Report on the tuna and baitfish survey carried out in the Gilbert waters by the Japanese International Co-operation Agency (JICA) during the period November 1977 to February 1978.

JOHANNES, R.E. (1981). Words of the lagoon: fishing and marine lore in the Palau district of Micronesia. University of California Press, Berkeley.

JOSEPH, J. and T.P. CALKINS (1969). Population dynamics of the skipjack tuna (Katsuwonus pelamis) of the eastern Pacific Ocean. Inter-American Tropical Tuna Commission Bulletin 13(1):1-273.

KEARNEY, R.E. (1978). Interim report of the activities of the Skipjack Survey and Assessment Programme in the waters of Fiji. Skipjack Survey and Assessment Programme Preliminary Country Report No.5, South Pacific Commission, Noumea, New Caledonia.

KEARNEY, R.E. (1979). An overview of recent changes in the fisheries for highly migratory species in the western Pacific Ocean and projections for future developments. South Pacific Bureau for Economic Co-operation, SPEC(79) 17.

KEARNEY, R.E. and R.D. GILLETT (1978). Interim report of the activities of the Skipjack Survey and Assessment Programme in the waters of the Gilbert Islands (5-25 July 1978). Skipjack Survey and Assessment Programme Preliminary Country Report No.11, South Pacific Commission, Noumea, New Caledonia.

KEARNEY, R.E. and J.-P. HALLIER (1980). Second interim report of the activities of the Skipjack Survey and Assessment Programme in the waters of the Trust Territory of the Pacific Islands (2-21 November 1979). Skipjack Survey and Assessment Programme Preliminary Country Report No.19, South Pacific Commission, Noumea, New Caledonia.

KEARNEY, R.E. and M.L. RIVKIN (1980). An examination of the feasibility of baitfish culture for skipjack pole-and-line fishing in the South Pacific Commission area. Skipjack Survey and Assessment Programme Technical Report No.4, South Pacific Commission, Noumea, New Caledonia.

KLAWE, W.L. (1978). Estimates of catches of tunas and billfishes by the Japanese, Korean, and Taiwanese longliners from within the 200-mile economic zone of the member countries of the South Pacific Commission. South Pacific Commission Occasional Paper No.10, South Pacific Commission, Noumea, New Caledonia.

KLEIBER, P.M. (Manuscript). Estimation of production, mortality and migration of skipjack (Katsuwonus pelamis) in the central and western Pacific Ocean. Tuna and Billfish Assessment Programme Technical Report, South Pacific Commission, Noumea, New Caledonia.

KLEIBER, P.M. and C.A. MAYNARD (1982). Data processing procedures of the Skipjack Survey and Assessment Programme. In Kearney, R.E. (ed.). Methods used by the South Pacific Commission for the survey and assessment of skipjack and baitfish resources. Tuna and Billfish Assessment Programme Technical Report No.7, South Pacific Commission, Noumea, New Caledonia.

LAWSON, T.A. and R.E. KEARNEY (Manuscript). Estimates of growth rates and length measurement errors for skipjack (Katsuwonus pelamis) from the western Pacific Ocean based on tagging data. Tuna and Billfish Assessment Programme Technical Report, South Pacific Commission, Noumea, New Caledonia.

POWELL, R. (1967). Possibilities of developing a tuna fishing industry in the Gilbert and Ellice Islands colony. South Pacific Commission, Noumea, New Caledonia.

RICHARDSON, B.J. (Manuscript). The distribution of protein variation in skipjack tuna (Katsuwonus pelamis) from the central and south-western Pacific. Department of Population Biology, Research School of Biological Sciences, Australian National University, Canberra.

SHARP, G.D. (1969). Electrophoretic study of tuna hemoglobins. Comparative Biochemistry and Physiology 31:249.

SKIPJACK PROGRAMME (1980a). Skipjack fishing effort and catch, 1972-1978, by the Japanese pole-and-line fleet within 200 miles of the countries in the area of the South Pacific Commission. Skipjack Survey and Assessment Programme Technical Report No.2, South Pacific Commission, Noumea, New Caledonia.

SKIPJACK PROGRAMME (1980b). A preliminary comparison of fishing effectiveness between cultured and natural baitfish species used by tuna pole-and-line fishing gear. Regional Technical Meeting on Fisheries 1980, 12 : Working Paper No.17, South Pacific Commission, Noumea, New Caledonia.

SKIPJACK PROGRAMME (1981a). An assessment of baitfish resources in the South Pacific Commission area. Regional Technical Meeting on Fisheries 1981, 13 : Working Paper No.12, South Pacific Commission, Noumea, New Caledonia.

SKIPJACK PROGRAMME (1981b). Further observations on fishing performance of baitfish species in the South Pacific Commission area. Regional Technical Meeting on Fisheries 1981, 13 : Working Paper No.13, South Pacific Commission, Noumea, New Caledonia.

SKIPJACK PROGRAMME (1981c). Skipjack migration, mortality and fishery interactions. Regional Technical Meeting on Fisheries 1981, 13 : Working Paper No.9, South Pacific Commission, Noumea, New Caledonia.

UNDP/FAO (1969). South Pacific Tuna Mission 1969 Report. Annexe III, Gilbert and Ellice Islands Colony.

WALDRON, K.D. (1964). Fish schools and bird flocks in the central Pacific Ocean, 1950-1961. United States Fish and Wildlife Service Special Scientific Report: Fisheries No.464.

WANKOWSKI, J.W.J. (1980). Recent history and summarized statistics of the industrial fisheries for tuna-like species in the area of the Papua New Guinea declared fisheries zone, 1970-1979. Research Bulletin No.24, Department of Primary Industry, Port Moresby, Papua New Guinea.

APPENDIX A. SCIENTISTS, OBSERVERS AND CREW ON BOARD THE RESEARCH VESSELS

South Pacific Commission Scientists

Bob Gillett	7-25 July 1978
Jean-Pierre Hallier	5-7 July 1978 22 November - 5 December 1979 9-11 July 1980
Pierre Kleiber	19-25 July 1978
Charles Ellway	5-7 July 1978 22 November - 5 December 1979
Christopher Thomas	5-25 July 1978
James Ianelli	7-25 July 1978 22 November - 5 December 1979 9-11 July 1980
A.W. Argue	9-11 July 1980

Observers

Patrick Bryan, Manager American Samoa Baitfish Project	5-7 July 1978
Herman Taai, Kiribati Fisheries Assistant	7-25 July 1978
Temone Tekeeke, Kiribati Fisheries Assistant	21-25 July 1978
Uaati Batiku, Fisherman	17, 23, 24 July 1978
Nakoro Uaati, Fisherman	17 July 1978
Tataa Itaka, Fisherman	17 July 1978
Beiabure Uauaa, Fisherman	23, 24 July 1978
Kohachi Hayashi Fisheries Biologist Fisheries Resources Division Tohoku Regional Fisheries Research Laboratory	22 November- 5 December 1979
Toshitaka Suzuki Planning Officer Fisheries Resource Division Japanese Fisheries Agency	22 November - 5 December 1979
Takaeang Reiti Fisheries Trainee Ambo Fish Farm, Tarawa	25-29 November 1979
Maruia Kamatie Fisheries Assistant Ambo Fish Farm, Tarawa	25-29 November 1979

Naakoi Tiotake President Butaritari Island	27 November 1979
Paul Enoka Benson Executive Officer Butaritari Island	27 November 1979

Japanese Crew
Cruise One

Masahiro Matsumoto, Captain
Yoshio Kozuka
Yoshikatsu Oikawa
Ryoichi Eda
Sakae Hyuga
Mikio Yamashita
Yoshihiro Kondoh
Akio Okumura
Kohji Wakasaki

Japanese Crew
Cruises Two and Three

Mitsutoyo Kaneda, Captain
Tsunetaka Ono
Mikio Yamashita
Yashikazu Oikawa
Seima Kobayashi
Kenji Arima
Yukio Sasaya
Koji Wakasaki
Yoshihiro Kondoh

Fijian Crew
Cruise One

Eroni Marawa
Ravaele Tikovakaca
Samuela Ue
Lui Andrews
Vonitiese Cakau
Samuela Delana
Jona Ravasakula
Jone Manuku
Lui Diva
Kitione Koroi
Taniela Verekila

Fijian Crew
Cruise Two

Eroni Marawa
Ravaele Tikovakaca
Samuela Ue
Lui Andrews
Kitione Naivaurerega
Samuela Delana
Jona Ravasakula
Josua Raguru
Veremalua Kaliseiwaga
Eroni Kolodai
Metuisela Koroi
Luke Kaidrokai
Aminiasi Kuruyawa
Napolioni Ravitu

Fijian Crew
Cruise Three

Eroni Marawa
Kitione Naivaurerega
Samuela Ue
Lui Andrews
Samuela Delana
Jona Ravasakula
Josua Raguru
Eroni Dolodai
Metuisela Koroi
Luke Kaidrukiya
Aminiasi Kuruyawa
Jovesa Buarua
Sovita Lequeta
Tuimasi Tuilekutu

APPENDIX B. LIST OF ALL SPECIES* CAUGHT IN BAIT HAULS IN THE GILBERT GROUP IN ORDER OF PREVALENCE BY WEIGHT

Herklotsichthys punctatus
Apogon(Rhabdamia) cypselurus
Hypoatherina ovalaua
Dussumieria sp.
Spratelloides delicatulus
Sp. of Caesiodidae
Pranesus pinguis
Archamia lineolata
Caranx sp.
Scomberoides sp.
Sp. of Labridae
Pterocaesio pisang
Pterocaesio tile
Sp. of Tetrodontidae
Sp. of Crustacea
Bregmaceros sp.
Sp. of Siganidae
Caesio coerulaureus
Pterocaesio diagramma
Sp. of Lutjanidae
Sp. of Holocentridae
Pseudamia polystigma
Sp. of Chaetodontidae
Sp. of Priacanthidae
Sp. of Carangidae
Sp. of Hemirhamphidae
Gerres argyreus
Sp. of Apocryptidae
Sp. of Pomacentridae
Upeneus vittatus
Euthynnus affinis
Apogon fragilis
Sp. of Apogonidae
Sp. of Gobioidei
Sp. of Crustacea
Decapterus macrosoma
Selar crumenophthalmus
Rastrelliger kanagurta
Pterocaesio sp.
Cheilodipterus macrodon
Sp. of Menidae
Sp. of Squid
Fistularia sp.
Sardinella clupeoides
Sp. of Sphyraenidae

* Several revisions of specific names used in previous Skipjack Programme reports on Kiribati have been maintained. The most notable changes in nomenclature have been:

Herklotsichthys punctatus to Herklotsichthys quadrimaculatus
Pranesus pinguis to Atherinomorus lacunosa.

APPENDIX C. RELEASE AND RECOVERY DATA FOR ALL FISH TAGGED IN KIRIBATI. A list at the end of this appendix gives the meanings of the codes used. The inset lines present release data as follows: country abbreviation (see Appendix E); school number; year/month/day of release; time of release; latitude of release; longitude of release; numbers of tagged skipjack released; numbers of tagged yellowfin released; numbers of species other than skipjack and yellowfin that were tagged and released. Line(s) following that for release data present the following data for each tag recovery: species, S for skipjack, Y for yellowfin; recovery country abbreviation (see list); year/month/day of recovery; days at large; recovery latitude; recovery longitude; great circle distance in nautical miles between release and recovery location; fork length in millimetres at time of tagging and length credibility code (see list); fork length at recovery and credibility code (see list); tag number; nationality of recapture vessel (or country chartering vessel, that is the JICA and FAO/UNDP survey vessels are assigned country code "KIR"), and tag recovery gear (see list). Date or position of recovery was excluded if the range of possible values was more than half the span from the release date or release position to the midpoint of the range of possible recovery dates or positions. If the range was less than half of this span, the information was included and the date or position of recovery was taken to be the midpoint of the range.

```
        GIL 272 780705 1500 0217S 17541E   291    0    0

S GIL 780925 082 0346N 17238E 0406 500M 552J SK23941 JAPPOL
S GIL 781025 112 0158S 16853E 0408 480M 492W SK23918 JAPPOL
S                                  450M 576W SK23933 JAPPOL
S INT 790429 298 0053N 16234E 0809 492B 570C SK23282 JAPPOL
S INT 790920 442 0518N 16904W 1021 500M 575J SK23684 JAPPOL
S AMS 791214 527 1325S 17022W 1064 470M 550E SK23573 WESSUB
S INT 800309 613 0331N 17918E 0410 460M 530C SK23586 JAPPOL

        GIL 273 780705 1745 0206S 17524E   194    0    0
S MAS 790126 205 0428N 16904E 0547 470M 530C SK23873 JAPPOL
S HOW 790816 407 0218N 17635W 0549 470M 455C SK24001 JAPPOL
S INT 790826 417 0158N 17811E 0296 460M 552J SK23987 JAPPOL
S HOW 790915 438 0100N 17600W 0548 450M 541W SK24225 JAPPOL
S INT 810302 971 0206N 16859W 0970 480M    U SK23990 JAPPOL

        GIL 274 780710 0845 0116N 17257E   104    0    0
S GIL 780907 059 0027N 17342E 0067 480M 520W SK24284 KIRPOL
S HOW 791013 460 0135S 17651W 0635 480M 560C SK24269 JAPPOL
S HOW 791018 465 0317N 17441W 0751 530M 540C SK24272 JAPPOL
S INT 791122 500 0605N 16551W 1301 521B 650J SK24065 JAPPOL
S INT 800205 576  530N 17600E 0313 520M 675W SK24265 JAPPOL

        GIL 275 780713 0900 0256N 17246E     0   17    0

        GIL 276 780713 0930 0256N 17245E    83    0    0
S GIL 780819 037 0312N 17237E 0018 530M 530W SK24414 KIRPOL
S GIL 780827 045 0208N 17149E 0074 503B 560W SK24096 JAPPOL
S GIL 780920 069 0318N 17229E 0027 503B 514W SK24451 KIRPOL
S GIL 780924 073 0319N 17230E 0027 520M 540W SK24459 KIRPOL
S GIL 781008 087 0317N 17233E 0024 520M 530W SK24099 KIRPOL
S MAS 781208 148 0449N 16802E 0304 510M 523W SK24445 JAPPOL

        GIL 277 780713 1200 0255N 17240E   303    0    0
S GIL 780723 010 0303N 17241E 0008 486B 515B SK24386 KIRPOL
S GIL 780723 010 0305N 17240E 0010 486B 520B SK24569 KIRPOL
S GIL 780723 010 0305N 17240E 0010 486B 495B SK24346 KIRPOL
S GIL 780803 021 0151N 17238E 0064 486B 565B SK24548 KIRPOL
S GIL 780805 023 0307N 17234E 0013 486B 485B SK24861 KIRPOL
S GIL 780805 023 0310N 17239E 0015 486B 530W SK24594 KIRPOL
S GIL 780808 026 0306N 17242E 0011 486B 495B SK24512 KIRPOL
S GIL 780827 045 0314N 17233E 0020 486B 485W SK24843 KIRPOL
S GIL 780827 045 0315N 17236E 0020 486B 474W SK24387 KIRPOL
S GIL 780827 045 0314N 17233E 0020 486B 485W SK24876 KIRPOL
S GIL 780903 052 0242N 17516E 0156 486B 520J SK24599 JAPPOL
S GIL 780921 070 0310N 17201E 0042 486B 490W SK24596 KIRPOL
S GIL 780922 071 0315N 17229E 0023 486B 490W SK24368 KIRPOL
S GIL 780922 071 0315N 17229E 0023 486B 488W SK24370 KIRPOL
S GIL 780924 073 0319N 17230E 0026 486B 540W SK24572 KIRPOL
S GIL 781012 091 0309N 17236E 0015 486B 526W SK24833 KIRPOL
S GIL 781012 091 0309N 17236E 0015 486B 535W SK24856 KIRPOL
S GIL 781012 091 0309N 17236E 0015 486B 519W SK24558 KIRPOL
S GIL 781012 091 0320N 17225E 0029 486B 520W SK24589 KIRPOL
S PON 781018 097 0515N 15837E 0852 486B 505W SK24331 JAPPOL
S MAS 781130 140 0311N 17032E 0129 486B 550W SK24538 JAPPOL
S GIL 790202 204 0445N 17528E 0200 486B 526J SK24565 JAPPOL
S HOW 791010 454 0317N 17642W 0637 486B 661W SK24801 JAPPOL

        GIL 278 780713 1345 0255N 17248E    29    0    0
S GIL 780723 010 0305N 17238E 0014 490M 489A SK24483 SPCPOL
S GIL 780808 026 0309N 17237E 0018 490M 510B SK24122 KIRPOL
S GIL 780827 045 0315N 17236E 0023 490M 480W SK24124 KIRPOL
S GIL 781023 102 0306N 17241E 0013 465M 550W SK24488 KIRPOL
S GIL 781024 103 0307N 17242E 0013 480M 510W SK24490 KIRPOL

        GIL 279 780713 1430 0257N 17246E    34    0    0
S GIL 780723 010 0305N 17240E 0010 505M 505B SK24612 KIRPOL
S GIL 780723 010 0303N 17241E 0008 500M 510B SK24602 KIRPOL
S GIL 780818 036 0307N 17238E 0013 490M 510W SK24607 KIRPOL
S GIL 781020 099 0310N 17237E 0016 560M 524W SK24499 KIRPOL

        GIL 280 780713 1620 0300N 17238E    80    0    0
S GIL 780808 026 0309N 17237E 0009 480B 486W SK24630 KIRPOL
S GIL 780808 026 0306N 17242E 0007 500M 519W SK24145 KIRPOL
S GIL 780819 037 0306N 17239E 0006 480M 497W SK24646 KIRPOL
S GIL 780820 038 0302N 17237E 0002 480M 490W SK24649 KIRPOL
S GIL 781024 103 0310N 17229E 0013 490M 510W SK24143 KIRPOL
S GIL 790825 408 0100N 17700E 0288 460M 520W SK24157 JAPPOL
S HOW 790826 409 0125N 17645W 0644 460M 550W SK24641 JAPPOL

        GIL 281 780713 1713 0304N 17235E   205    0    0
S GIL 780723 010 0253N 17249E 0018 520M 520B SK24744 KIRPOL
S GIL 780723 010 0253N 17249E 0018 530M 530B SK24796 KIRPOL
S GIL 780807 025 0308N 17241E 0007 540M 538W SK24191 KIRPOL
S GIL 780820 038 0313N 17235E 0009 520M 535W SK24788 KIRPOL
S GIL 780824 042 0307N 17230E 0006 510M 500W SK24163 KIRPOL
S GIL 780824 042 0307N 17240E 0006 470M 490W SK24727 KIRPOL
S GIL 780827 045 0315N 17236E 0011 500M 496W SK25019 KIRPOL
S GIL 780827 045 0315N 17236E 0011 500M 502W SK25006 KIRPOL
S GIL 780827 045 0315N 17236E 0011 491B 500W SK24800 KIRPOL
S GIL 780827 045 0315N 17236E 0011 470M 472W SK24689 KIRPOL
```

```
S GIL 780903 052 0242N 17516E 0162 480M 511W SK24752 JAPPOL
S GIL 780921 070 0310N 17241E 0008 500M 500W SK24737 KIRPOL
S GIL 780921 070 0310N 17201E 0034 590M 500W SK24164 KIRPOL
S GIL 780922 071 0315N 17229E 0013 510M 510W SK24777 KIRPOL
S GIL 780924 073 0319N 17230E 0016 500M 510W SK25015 KIRPOL
S GIL 781012 091 0320N 17225E 0019 520M 540W SK24774 KIRPOL
S GIL 781021 100 0319N 17228E 0017 530M 530W SK24187 KIRPOL
S GIL 781024 103 0310N 17229E 0008 510M 512W SK25105 KIRPOL
S MAS 781228 168 0406N 16941E 0184 491B 535W SK24740 JAPPOL
S MAS 790131 202 0516N 17152E 0139 490M 610W SK24753 JAPPOL
S HOW 791009 453 0305N 17430W 0774 470M 450C SK25029 JAPPOL
S INT 800205 573 0432N 17828E 0363 510M 670W SK24769 JAPPOL

    GIL 282 780713 1810 0302N 17232E     0    7    0

    GIL 283 780713 1825 0303N 17232E   135    7    0
S GIL 780723 010 0305N 17240E 0008 460M 480B SK25064 KIRPOL
S GIL 780806 024 0309N 17238E 0008 480M 535W SK25162 KIRPOL
S GIL 780808 026 0307N 17240E 0009 470M 474W SK25209 KIRPOL
S GIL 780826 044 0306N 17241E 0009 470M 465W SK25147 KIRPOL
S GIL 780827 045 0315N 17236E 0013 470M 472W SK25060 KIRPOL
S GIL 780909 058 0307N 17220E 0013 480M 480J SK25049 JAPPOL
S GIL 780920 069 0318N 17229E 0015 500M 530W SK25220 KIRPOL
S GIL 780920 069 0318N 17229E 0015 470M 480W SK25205 KIRPOL
S GIL 780921 070 0310N 17201E 0032 480M 495W SK25154 KIRPOL
S GIL 781020 099 0310N 17237E 0009 460M 525W SK25231 KIRPOL
S GIL 781023 102 0322N 17230E 0019 480M 505W SK25082 KIRPOL
S GIL 781024 103 0307N 17242E 0011 480M 570W SK25148 KIRPOL
S MAS 781125 135 0318N 16737E 0295 610M    U SK25151 JAPPOL
S HOW 790823 406 0222N 17622W 0667 480M 527W SK25138 JAPPOL

    GIL 284 780714 1135 0309N 17238E    76    0    0
S GIL 780903 051 0242N 17516E 0160 540M 552W SK25292 JAPPOL
S KOS 781209 148 0524N 16418E 0517 540M 571W SK25271 JAPPOL

    GIL 285 780714 1230 0308N 17238E   229    0    0
S GIL 780722 008 0300N 17248E 0013 470M 475A SK25580 SPCPOL
S GIL 780723 009 0305N 17240E 0004 460M 495B SK25299 KIRPOL
S GIL 780723 009 0305N 17240E 0004 490M 510B SK25350 KIRPOL
S GIL 780723 009 0305N 17240E 0004 520M 505B SK25540 KIRPOL
S GIL 780808 025 0309N 17237E 0001 510M 494W SK25531 KIRPOL
S GIL 780808 025 0308N 17239E 0001 495M 488W SK25547 KIRPOL
S GIL 780827 044 0315N 17236E 0007 520M 495W SK25582 KIRPOL
S GIL 780827 044 0315N 17236E 0007 510M 500W SK25297 KIRPOL
S GIL 780827 044 0315N 17236E 0007 510M 495W SK25587 KIRPOL
S GIL 780827 044 0315N 17236E 0007 460M 462W SK25309 KIRPOL
S GIL 780827 044 0315N 17236E 0007 470M 460W SK25306 KIRPOL
S GIL 780921 069 0310N 17201E 0037 470M 494W SK25561 KIRPOL
S GIL 780921 069 0310N 17241E 0004 480M 490W SK25512 KIRPOL
S GIL 781008 086 0317N 17233E 0010 600M 500B SK24916 KIRPOL
S GIL 781012 090 0309N 17236E 0002 470M 505W SK25328 KIRPOL
S GIL 781012 090 0320N 17225E 0018 480M 520W SK25331 KIRPOL
S GIL 781024 102 0310N 17229E 0009 470M 520W SK25376 KIRPOL
S GIL 781024 102 0310N 17229E 0009 495M 520W SK25596 KIRPOL
S INT 781119 128 0614N 17816E 0385 500M 584W SK25298 JAPPOL
S HOW 791012 455 0251N 17711W 0610 460M 514W SK25591 JAPPOL
S MAS 800206 572 0358N 16700E 0341 490M 600W SK25333 JAPPOL
S INT 800415 642 0435N 17720E 0294 520M    U SK25548 JAPPOL

    GIL 286 780715 1615 0308N 17236E    14   13    0

    GIL 287 780716 0803 0257N 17245E   573    0    0
S GIL 780722 006 0300N 17248E 0004 470M 485A SK25422 SPCPOL
S GIL 780722 006 0300N 17248E 0004 477B 465A SK25896 SPCPOL
S GIL 780722 006 0300N 17248E 0004 470M 480A SK25476 SPCPOL
S GIL 780722 006 0300N 17248E 0004 477B 495A SK25886 SPCPOL
S GIL 780723 007 0305N 17240E 0009 477B 475B SK25681 KIRPOL
S GIL 780723 007 0305N 17240E 0009 477B 505B SK26153 KIRPOL
S GIL 780723 007 0303N 17241E 0007 490M 490B SK25919 KIRPOL
S GIL 780723 007 0305N 17240E 0009 477B 500B SK26143 KIRPOL
S GIL 780723 007 0305N 17240E 0009 500M 535B SK25495 KIRPOL
S GIL 780723 007 0305N 17241E 0009 477B 510B SK26140 KIRPOL
S GIL 780723 007 0305N 17240E 0009 477B 470B SK26146 KIRPOL
S GIL 780723 007 0305N 17234E 0014 460M 508A SK24946 SPCPOL
S GIL 780723 007 0305N 17240E 0009 477B 490B SK26106 KIRPOL
S GIL 780723 007 0305N 17240E 0009 480M 505B SK25985 KIRPOL
S GIL 780723 007 0305N 17240E 0009 470M 500B SK25989 KIRPOL
S GIL 780807 022 0308N 17241E 0012 480M 498W SK24949 KIRPOL
S GIL 780808 023 0307N 17240E 0011 477B 470W SK25652 KIRPOL
S GIL 780808 023 0307N 17240E 0011 485M 480W SK25720 KIRPOL
S GIL 780808 023 0309N 17237E 0014 477B 494W SK26136 KIRPOL
S GIL 780808 023 0304N 17241E 0008 477B 482W SK26115 KIRPOL
S GIL 780808 023 0304N 17241E 0008 477B 482W SK25876 KIRPOL
S GIL 780808 023 0304N 17241E 0008 470M 467W SK25768 KIRPOL
S GIL 780808 023 0308N 17239E 0013 477B 468W SK25831 KIRPOL
S GIL 780808 023 0306N 17242E 0009 500M 510B SK24967 KIRPOL
S GIL 780808 023 0308N 17239E 0013 477B 478W SK25611 KIRPOL
S GIL 780808 023 0306N 17242E 0009 450M 456W SK24939 KIRPOL
S GIL 780808 023 0309N 17237E 0014 480M 510W SK24937 KIRPOL
S GIL 780819 034 0312N 17237E 0017 477B 505W SK25863 KIRPOL
S GIL 780819 034 0306N 17239E 0011 477B 510B SK25830 KIRPOL
S GIL 780819 034 0306N 17239E 0011 477B 488W SK25892 KIRPOL
S GIL 780820 035 0302N 17237E 0009 510M 525W SK25737 KIRPOL
S GIL 780820 035 0302N 17237E 0009 490M 520W SK25420 KIRPOL
S GIL 780820 035 0302N 17237E 0009 477B 480W SK25817 KIRPOL
S GIL 780820 035 0302N 17237E 0009 477B 503W SK25671 KIRPOL
S GIL 780822 037 0112N 17300E 0106 477B 490W SK25875 KIRSUB
S GIL 780825 040 0309N 17231E 0018 477B 520B SK25804 KIRPOL
S GIL 780825 040 0305N 17233E 0014 480M 473W SK25981 KIRPOL
S GIL 780826 041 0301N 17240E 0006 480M 494W SK25435 KIRPOL
S GIL 780826 041 0306N 17241E 0010 477B 445W SK25857 KIRPOL
S GIL 780826 041 0308N 17240E 0012 450M 480W SK25982 KIRPOL
S GIL 780826 041 0308N 17240E 0012 460M 465W SK24995 KIRPOL
S GIL 780827 042 0315N 17236E 0020 470M 475W SK25452 KIRPOL
S GIL 780827 042 0315N 17236E 0020 470M 468W SK24981 KIRPOL
S GIL 780827 042 0315N 17236E 0020 470M 474W SK25990 KIRPOL
S GIL 780827 042 0315N 17236E 0020 477B 488W SK26122 KIRPOL
S GIL 780827 042 0314N 17233E 0021 470M 485W SK25970 KIRPOL
S GIL 780827 042 0315N 17236E 0020 477B 492W SK26142 KIRPOL
S GIL 780827 042 0315N 17236E 0020 470M 495W SK25904 KIRPOL
S GIL 780827 042 0315N 17236E 0020 480M 479W SK25934 KIRPOL
S GIL 780827 042 0315N 17236E 0020 477B 466W SK25658 KIRPOL
S GIL 780827 042 0315N 17236E 0020 480M 480W SK25757 KIRPOL
S GIL 780827 042 0315N 17236E 0020 477B 470W SK25654 KIRPOL
S GIL 780827 042 0315N 17236E 0020 460M 470W SK25707 KIRPOL
S GIL 780827 042 0315N 17236E 0020 477B 472W SK25614 KIRPOL
S GIL 780920 066 0307N 17241E 0011 477B 540W SK25618 KIRPOL
S GIL 780920 066 0307N 17241E 0011 477B 520W SK25895 KIRPOL
S GIL 780921 067 0308N 17238E 0013 477B 490W SK25890 KIRPOL
S GIL 780921 067 0310N 17241E 0014 470M 480W SK25911 KIRPOL
S GIL 780921 067 0310N 17201E 0046 440M 498W SK24933 KIRPOL
S GIL 780921 067 0310N 17201E 0046 470M 497W SK24934 KIRPOL
S GIL 780921 067 0310N 17241E 0014 477B 502W SK25829 KIRPOL
S GIL 780921 067 0310N 17241E 0014 470M 490W SK25960 KIRPOL
S GIL 780921 067 0310N 17201E 0046 460M 480W SK25473 KIRPOL
S GIL 780921 067 0310N 17201E 0046 477B 462W SK25868 KIRPOL
S GIL 780921 067 0310N 17201E 0046 470M 497W SK25962 KIRPOL
S GIL 780921 067 0310N 17201E 0046 490M 500W SK25770 KIRPOL
S GIL 780922 068 0315N 17229E 0024 480M 500W SK25969 KIRPOL
S GIL 780922 068 0316N 17229E 0025 480M 504W SK25922 KIRPOL
S GIL 780922 068 0315N 17229E 0024 477B 484W SK26109 KIRPOL
S GIL 780924 070 0319N 17230E 0027 477B 520W SK26132 KIRPOL
S GIL 780924 070 0319N 17230E 0027 477B 508W SK25880 KIRPOL
S GIL 780924 070 0319N 17230E 0027 500M 490W SK25741 KIRPOL
S GIL 781002 078 0335N 17218E 0047 477B 523C SK25828 JAPPOL
S GIL 781008 084 0317N 17233E 0023 477B 500W SK26112 KIRPOL
S GIL 781008 084 0317N 17233E 0023 477B 510W SK25638 KIRPOL
S GIL 781008 084 0317N 17233E 0023 480M 510W SK25939 KIRPOL
S GIL 781011 087 0308N 17231E 0018 480M 510W SK25703 KIRPOL
S GIL 781011 087 0308N 17231E 0018 477B 493W SK26117 KIRPOL
S GIL 781011 087 0308N 17231E 0018 477B 510W SK25832 KIRPOL
S GIL 781013 089 0253N 17230E 0016 480M 515J SK25992 JAPPOL
S GIL 781019 095 0316N 17230E 0024 480M 500W SK25466 KIRPOL
S GIL 781020 096 0310N 17237E 0015 470M 525W SK25940 KIRPOL
S GIL 781020 096 0310N 17237E 0015 480M 500W SK24941 KIRPOL
S GIL 781020 096 0310N 17237E 0015 480M 505W SK24974 KIRPOL
S GIL 781021 097 0311N 17238E 0016 470M 520W SK25986 KIRPOL
S GIL 781021 097 0311N 17238E 0016 500M 530W SK25758 KIRPOL
S GIL 781023 099 0305N 17238E 0011 470M 500W SK25994 KIRPOL
S GIL 781024 100 0310N 17229E 0021 477B 492W SK25644 KIRPOL
S GIL 781024 100 0307N 17242E 0010 475M 504W SK25736 KIRPOL
S GIL 781024 100 0310N 17229E 0021 480M 515W SK25925 KIRPOL
S GIL 781024 100 0310N 17229E 0021 477B 510W SK25841 KIRPOL
S GIL 781024 100 0310N 17229E 0021 470M 490W SK25931 KIRPOL
S GIL 781119 126 0331N 17251E 0035 477B 540W SK25698 JAPPOL
S GIL 781130 137 0249N 17456E 0131 460M 560W SK25704 JAPPOL
S MAS 781228 165 0406N 16941E 0196 520M 541W SK25711 JAPPOL
S GIL 790107 175 0302N 17055E 0110 477B 550C SK26155 JAPPOL
S GIL 790427 285 0153N 17240E 0064 477B 530W SK25653 KIRPOL
S HOW 790905 416 0040N 17600W 0688 480M 480C SK25983 JAPPOL
S HOW 790906 417 0020N 17700W 0634 477B 550W SK25622 JAPPOL
S GIL 790909 420 0046N 17736E 0319 477B 552J SK26121 JAPPOL
S HOW 791002 443 0215N 17440W 0755 460M 536W SK25418 JAPPOL
S HOW 791005 447 0200N 17400W 0796 477B 528W SK25700 JAPPOL
S HOW 791008 449 0300N 17500W 0734 477B 578W SK25888 JAPPOL
S INT 791101 473 0459N 17000W 1040 477B 650J SK25847 JAPPOL
S HOW 800410 634 0353N 17733W 0584 477B    U SK25893 JAPPOL
S PAM 800704 719 0556N 16221W 1500 480M 650W SK25997 JAPPOL
S HOW 800916 793 0356N 17621W 0655 477B 695W SK26141 JAPPOL
S INT 801007 814 0535N 17814E 0364 480M 650W SK25748 JAPPOL
S INT 801014 821 0334N 17726E 0283 480M 660W SK25966 JAPPOL

    GIL 288 780717 0729 0305N 17244E   251    0    0
S GIL 780722 005 0300N 17248E 0006 480M 480A SK26418 SPCPOL
S GIL 780723 006 0305N 17238E 0006 470M 470A SK26419 SPCPOL
S GIL 780723 006 0305N 17240E 0004 500M 515B SK26413 KIRPOL
S GIL 780723 006 0305N 17240E 0004 480M 510B SK26512 KIRPOL
S GIL 780723 006 0305N 17239E 0005 484B 470B SK26307 KIRPOL
S GIL 780723 006 0305N 17240E 0004 484B 490B SK25786 KIRPOL
S GIL 780723 006 0305N 17240E 0004 495M 495B SK26479 KIRPOL
S GIL 780825 039 0310N 17237E 0009 484B 490W SK25791 KIRPOL
S GIL 780825 039 0305N 17233E 0011 484B 494W SK26322 KIRPOL
S GIL 780826 040 0301N 17240E 0006 484B 468W SK25793 KIRPOL
S GIL 780827 041 0315N 17236E 0013 490M 500W SK26515 KIRPOL
S GIL 780921 066 0310N 17201E 0043 470M 484W SK26431 KIRPOL
S GIL 780921 066 0310N 17201E 0043 484B 500W SK26320 KIRPOL
```

S GIL 780921 066 0310N 17241E 0006 470M 492W SK26020 KIRPOL
S GIL 781008 083 0317N 17233E 0016 480M 500W SK26027 KIRPOL
S GIL 781009 084 0319N 17233E 0018 490M 510W SK26513 KIRPOL
S GIL 781009 084 0319N 17233E 0018 530M 520W SK26496 KIRPOL
S GIL 781011 086 0308N 17231E 0013 490M 510W SK26416 KIRPOL
S GIL 781018 093 0321N 17225E 0025 460M 520W SK26469 KIRPOL
S GIL 781021 096 0319N 17228E 0021 480M 525W SK26404 KIRPOL
S GIL 781024 099 0310N 17229E 0016 470M 500B SK26015 KIRPOL
S MAS 790127 194 0350N 16855E 0233 480M 560W SK26029 JAPPOL
S HOW 790816 395 0230N 17623W 0653 484B 470C SK26312 JAPPOL

GIL 289 780718 1150 0226N 17250E 40 0 0
S INT 780815 028 0418N 17957E 0441 620M 630W SK26057 JAPPOL

GIL 290 780722 1020 0304N 17242E 11 0 0
S GIL 780807 016 0307N 17241E 0003 470M 465W SK26540 KIRPOL

GIL 291 780722 1150 0300N 17248E 842 0 0
S GIL 780722 000 0300N 17248E 0000 460M 462A SK27131 SPCPOL
S GIL 780806 015 0309N 17238E 0013 450M 480W SK26986 KIRPOL
S GIL 780806 015 0309N 17238E 0013 480M 500B SK26579 KIRPOL
S GIL 780808 017 0309N 17237E 0014 490M 510W SK26684 KIRPOL
S GIL 780808 017 0310N 17238E 0014 490M 488W SK26794 KIRPOL
S GIL 780808 017 0310N 17238E 0014 480M 480W SK26694 KIRPOL
S GIL 780808 017 0304N 17241E 0008 470M 479W SK26840 KIRPOL
S GIL 780808 017 0306N 17242E 0008 480M 495B SK26663 KIRPOL
S GIL 780808 017 0304N 17241E 0008 460M 477W SK26820 KIRPOL
S GIL 780808 017 0309N 17237E 0014 480M 472W SK26593 KIRPOL
S GIL 780808 017 0310N 17238E 0014 490M 472W SK26727 KIRPOL
S GIL 780808 017 0309N 17237E 0014 480M 510B SK26583 KIRPOL
S GIL 780820 029 0313N 17235E 0018 490M 495W SK27171 KIRPOL
S GIL 780820 029 0302N 17237E 0011 450M 480W SK26882 KIRPOL
S GIL 780824 033 0305N 17231E 0018 490M 480W SK26959 KIRPOL
S GIL 780824 033 0307N 17230E 0019 480M 492W SK27188 KIRPOL
S GIL 780824 033 0307N 17230E 0019 480M 482W SK27151 KIRPOL
S GIL 780824 033 0309N 17231E 0019 460M 500W SK26875 KIRPOL
S GIL 780825 034 0310N 17237E 0015 470M 468W SK27209 KIRPOL
S GIL 780825 034 0305N 17233E 0016 460M 494W SK26828 KIRPOL
S GIL 780826 035 0301N 17240E 0008 490M 486W SK26739 KIRPOL
S GIL 780826 035 0308N 17240E 0011 470M 480W SK26810 KIRPOL
S GIL 780827 036 0315N 17236E 0019 460M 466W SK26771 KIRPOL
S GIL 780827 036 0315N 17236E 0019 480M 472W SK26791 KIRPOL
S GIL 780827 036 0314N 17233E 0021 460M 470W SK26878 KIRPOL
S GIL 780827 036 0315N 17236E 0019 480M 478W SK27055 KIRPOL
S GIL 780827 036 0314N 17233E 0021 480M 480W SK27046 KIRPOL
S GIL 780827 036 0315N 17236E 0019 470M 470W SK26996 KIRPOL
S GIL 780827 036 0315N 17236E 0019 470M 478W SK27148 KIRPOL
S GIL 780827 036 0315N 17236E 0019 470M 470W SK27175 KIRPOL
S GIL 780827 036 0315N 17236E 0019 480M 478W SK27167 KIRPOL
S GIL 780827 036 0315N 17236E 0019 470M 468W SK27162 KIRPOL
S GIL 780827 036 0315N 17236E 0019 460M 475W SK27301 KIRPOL
S GIL 780827 036 0315N 17236E 0019 470M 480W SK26888 KIRPOL
S GIL 780827 036 0315N 17236E 0019 470M 480W SK26887 KIRPOL
S GIL 780827 036 0315N 17236E 0019 460M 470W SK26892 KIRPOL
S GIL 780827 036 0315N 17236E 0019 490M 480W SK26988 KIRPOL
S GIL 780827 036 0315N 17236E 0019 460M 470W SK26906 KIRPOL
S GIL 780827 036 0315N 17236E 0019 470M 484W SK26893 KIRPOL
S GIL 780827 036 0315N 17236E 0019 460M 460W SK26597 KIRPOL
S GIL 780827 036 0315N 17236E 0019 495M 480W SK26613 KIRPOL
S GIL 780827 036 0315N 17236E 0019 460M 475W SK26217 KIRPOL
S GIL 780827 036 0315N 17236E 0019 480M 490W SK26268 KIRPOL
S GIL 780827 036 0307N 17238E 0012 480M 480W SK26377 KIRPOL
S GIL 780827 036 0315N 17236E 0019 500M 500W SK26686 KIRPOL
S GIL 780827 036 0315N 17236E 0019 470M 488W SK26702 KIRPOL
S 780905 046 490M 485W SK27050 JAPPOL
S GIL 780909 049 0307N 17220E 0029 470M 480J SK26679 JAPPOL
S GIL 780909 049 0307N 17220E 0029 480M 480J SK27201 JAPPOL
S GIL 780920 060 0318N 17229E 0026 470M 486W SK27027 KIRPOL
S GIL 780920 060 0314N 17237E 0018 500M 504W SK26342 KIRPOL
S GIL 780921 061 0310N 17201E 0048 490M 500W SK26911 KIRPOL
S GIL 780921 061 0310N 17241E 0012 480M 486W SK26381 KIRPOL
S GIL 780921 061 0310N 17241E 0012 490M 501W SK26921 KIRPOL
S GIL 780921 061 0310N 17201E 0048 450M 472W SK26070 KIRPOL
S GIL 780921 061 0310N 17241E 0012 460M 492W SK26223 KIRPOL
S GIL 780921 061 0310N 17241E 0012 470M 482W SK26356 KIRPOL
S GIL 780921 061 0310N 17201E 0048 470M 574B SK27179 KIRPOL
S GIL 780921 061 0310N 17241E 0012 490M 500W SK26968 KIRPOL
S GIL 780921 061 0301N 17201E 0047 490M 490W SK26762 KIRPOL
S GIL 780921 061 0310N 17201E 0048 460M 476W SK26093 KIRPOL
S GIL 780921 061 0310N 17241E 0012 470M 488W SK27132 KIRPOL
S GIL 780921 061 0310N 17241E 0012 460M 488W SK27123 KIRPOL
S GIL 780921 061 0310N 17241E 0012 480M 490W SK27225 KIRPOL
S GIL 780921 061 0310N 17201E 0048 476B 482W SK27228 KIRPOL
S GIL 780921 061 0310N 17241E 0012 480M 494W SK26553 KIRPOL
S GIL 780921 061 0308N 17238E 0013 470M 500W SK26254 KIRPOL
S GIL 780921 061 0310N 17201E 0048 480M 492W SK26903 KIRPOL
S GIL 780922 062 0316N 17229E 0025 470M 490W SK26090 KIRPOL
S GIL 780922 062 0315N 17229E 0024 480M 518W SK26891 KIRPOL
S GIL 780922 062 0316N 17229E 0025 470M 482W SK27066 KIRPOL
S GIL 780922 062 0315N 17229E 0024 480M 500W SK27207 KIRPOL
S GIL 780922 062 0316N 17229E 0025 470M 500W SK27205 KIRPOL
S GIL 780924 064 0347N 17253E 0047 480M U SK26676 JAPPOL
S GIL 780924 064 0319N 17230E 0026 480M 496W SK26087 KIRPOL
S GIL 780924 064 0319N 17230E 0026 420M 520W SK26998 KIRPOL
S GIL 781008 078 0317N 17233E 0023 480M 490W SK27067 KIRPOL
S GIL 781008 078 0317N 17233E 0023 480M 520W SK26222 KIRPOL
S GIL 781011 081 0308N 17231E 0019 490M 500W SK27101 KIRPOL
S GIL 781011 081 0308N 17231E 0019 490M 504W SK26580 KIRPOL
S GIL 781012 082 0309N 17236E 0015 490M 518W SK26945 KIRPOL
S GIL 781012 082 0309N 17236E 0015 472B 495W SK26919 KIRPOL
S GIL 781018 088 0321N 17225E 0031 500M 535W SK26215 KIRPOL
S GIL 781018 088 0321N 17225E 0031 485M 500W SK26589 KIRPOL
S GIL 781018 088 0321N 17225E 0031 490M 550W SK26827 KIRPOL
S GIL 781018 088 0321N 17225E 0031 470M 510W SK27030 KIRPOL
S GIL 781018 088 0321N 17225E 0031 490M 510W SK27015 KIRPOL
S GIL 781020 090 0310N 17237E 0015 490M 533W SK27021 KIRPOL
S GIL 781020 090 0310N 17237E 0015 460M 514W SK26288 KIRPOL
S GIL 781021 091 0316N 17230E 0024 460M 500W SK26967 KIRPOL
S GIL 781021 091 0319N 17228E 0028 460M 510W SK26572 KIRPOL
S GIL 781023 093 0305N 17238E 0011 480M 504W SK26925 KIRPOL
S GIL 781023 093 0322N 17230E 0028 470M 524W SK27177 KIRPOL
S GIL 781024 094 0310N 17229E 0021 450M 478W SK27304 KIRPOL
S GIL 781024 094 0310N 17229E 0021 490M 510W SK27048 KIRPOL
S GIL 781024 094 0310N 17229E 0021 480M 510W SK27018 KIRPOL
S MAS 781201 132 0330N 17015E 0156 500M 520J SK26570 JAPPOL
S GIL 781202 133 0331N 17153E 0063 480M 530W SK26587 JAPPOL
S GIL 781206 137 0331N 17216E 0045 470M 510W SK26724 JAPPOL
S GIL 790106 168 0253N 17106E 0102 480M 596J SK27187 JAPPOL
S INT 790826 401 470M 565W SK27174 JAPPOL
S HOW 790830 405 005N 17630W 0665 470M 532W SK26855 JAPPOL
S INT 790926 431 0200N 17210W 0903 475M 540W SK26622 JAPPOL
S INT 790926 431 0147N 17153W 0921 470M 555W SK27307 JAPPOL
S MAS 800207 565 0406N 16752E 0303 470M 600W SK26680 JAPPOL
S INT 800317 604 0420N 17919E 0398 480M U SK27170 JAPPOL
S HOW 800320 607 0252N 17830W 0521 460M 500C SK26703 JAPPOL
S HOW 800702 711 0258N 17452W 0739 480M 567W SK27227 JAPPOL
S HOW 800821 761 0155N 17450W 0744 470M 600W SK26978 JAPPOL
S HOW 800824 764 0222N 17624W 0648 460M 618J SK26272 JAPPOL

GIL 292 780723 0945 0302N 17243E 59 0 0
S GIL 780825 033 0305N 17233E 0010 480M 462W SK27240 KIRPOL
S GIL 780827 035 0315N 17236E 0015 510M 480W SK27237 KIRPOL
S GIL 780921 060 0310N 17241E 0008 460M 465W SK27323 KIRPOL
S GIL 780921 060 0310N 17201E 0043 495M 502W SK27256 KIRPOL
S GIL 780922 061 0315N 17229E 0019 480M 500W SK27333 KIRPOL
S GIL 780922 061 0315N 17229E 0019 480M 488W SK27089 KIRPOL

GIL 293 780723 1030 0302N 17243E 81 0 0
S GIL 780921 060 0310N 17241E 0008 500M 500W SK27346 KIRPOL
S GIL 780921 060 0310N 17241E 0008 410M 470W SK27264 KIRPOL
S HOW 790810 383 0145N 17930W 0473 500M U SK27277 JAPPOL
S INT 791201 496 0404N 17926W 0474 470M 684W SK27340 JAPPOL

GIL 294 780723 1135 0305N 17238E 103 0 0
S GIL 780808 016 0304N 17241E 0003 495M 502W SK27604 KIRPOL
S GIL 780819 027 0312N 17237E 0007 450M 490W SK27370 KIRPOL
S GIL 780921 060 0310N 17241E 0006 490M 492W SK27617 KIRPOL
S GIL 781018 087 0321N 17225E 0021 480M 520W SK27300 KIRPOL
S GIL 781020 089 0302N 17237E 0003 490M 510W SK27610 KIRPOL
S GIL 781021 090 0316N 17230E 0014 500M 540W SK27434 KIRPOL
S GIL 781021 090 0319N 17228E 0017 500M 520W SK27629 KIRPOL
S GIL 781021 090 0319N 17230E 0016 500M 540W SK27427 KIRPOL
S MAS 790109 170 0312N 17013E 0145 510M 570C SK27439 JAPPOL
S GIL 790328 248 0114N 17301E 0113 470M 500E SK27428 KIRSUB
S MAS 790411 262 0342N 16547E 0412 500M 550W SK27615 JAPPOL
S HOW 791004 438 0305N 17456W 0745 480M 605C SK27605 JAPPOL
S INT 800805 745 0308N 17221W 0900 495M 598W SK27298 JAPPOL

GIL 295 780723 1155 0305N 17238E 349 0 0
S GIL 780805 013 0310N 17239E 0005 530M 520W SK27451 KIRPOL
S GIL 780807 015 0308N 17241E 0004 495M 496W SK27649 KIRPOL
S GIL 780808 016 0309N 17237E 0004 520M 500W SK27460 KIRPOL
S GIL 780808 016 0304N 17241E 0003 480M 483W SK27579 KIRPOL
S GIL 780808 016 0309N 17237E 0004 500M 510W SK27668 KIRPOL
S GIL 780819 027 0312N 17237E 0007 470M 490W SK27822 KIRPOL
S GIL 780820 028 0313N 17235E 0009 480M 485W SK27699 KIRPOL
S GIL 780824 032 0307N 17230E 0008 475M 468W SK27479 KIRPOL
S GIL 780825 033 0310N 17237E 0005 480M 492W SK27397 KIRPOL
S GIL 780826 034 0306N 17241E 0003 500M 500W SK27654 KIRPOL
S GIL 780827 035 0315N 17236E 0010 490M 490W SK27644 KIRPOL
S GIL 780827 035 0315N 17236E 0010 490M 495W SK27689 KIRPOL
S GIL 780827 035 0315N 17236E 0010 500M 495W SK27880 KIRPOL
S GIL 780827 035 0315N 17236E 0010 460M 464W SK27657 KIRPOL
S GIL 780827 035 0315N 17236E 0010 460M 465W SK27666 KIRPOL
S GIL 780827 035 0315N 17236E 0010 490M 500W SK27520 KIRPOL
S GIL 780909 048 0307N 17220E 0018 470M 480J SK27550 JAPPOL
S NAU 780909 048 0058S 16706E 0411 490M 510W SK27396 JAPPOL
S GIL 780909 048 0307N 17220E 0018 500M 480J SK27724 JAPPOL
S GIL 780921 060 0310N 17241E 0006 520M 540W SK27675 KIRPOL
S GIL 780921 060 0310N 17201E 0037 490M 494W SK27839 KIRPOL
S GIL 780921 060 0310N 17201E 0037 450M 486W SK27573 KIRPOL
S GIL 780921 060 0310N 17201E 0037 470M 500W SK27586 KIRPOL
S GIL 780922 061 0315N 17229E 0013 530M 520W SK27886 KIRPOL
S GIL 781008 077 0317N 17233E 0013 490M 500W SK27492 KIRPOL
S GIL 781023 092 0305N 17238E 0000 490M 530W SK27594 JAPPOL
S GIL 781023 092 0306N 17241E 0003 480M 520W SK27879 KIRPOL

S	GIL	781119	119	0331N	17551E	0194	480M	540W	SK27844	JAPPOL
S	INT	781123	123	0616N	17830E	0399	520M	570W	SK27595	JAPPOL
S	GIL	781216	146	0250N	17240E	0015	500M	516W	SK27803	JAPPOL
S	INT	790928	432	0221N	17141W	0941	470M	540W	SK27806	JAPPOL
S	INT	791010	444	0517N	16752W	1174	510M	660W	SK27878	JAPPOL
S	INT	791020	454	0400N	17350W	0812	480M	550C	SK27904	JAPPOL
S	INT	791202	497	0449N	17120W	0965	460M	647W	SK27903	JAPPOL
S	INT	791205	500	0540N	17905W	0519	520M	673W	SK27691	JAPPOL
S	INT	800220	577	0536S	16734E	0603	470M	520C	SK27477	JAPPOL
S	INT	800404	621	0252N	17939W	0463	470M	575J	SK27723	JAPPOL
S	INT	800707	715	0406N	17658E	0267	500M	U	SK27490	JAPPOL
	GIL	296	780723	1445	0305N	17234E	67	0	0	
S	GIL	780820	028	0302N	17237E	0004	530M	525W	SF01820	KIRPOL
S	GIL	780922	061	0315N	17229E	0011	490M	518W	SK27925	KIRPOL
S	GIL	780925	064	0159N	17239E	0066	470M	470W	SK27935	JAPPOL
	GIL	297	780724	0800	0308N	17247E	36	0	0	
S	GIL	780820	027	0302N	17237E	0012	520M	535W	SK27750	KIRPOL
S	GIL	780825	032	0305N	17233E	0014	460M	482W	SF01840	KIRPOL
S	GIL	780827	034	0315N	17236E	0013	490M	490W	SK27746	KIRPOL
S	GIL	781008	076	0317N	17233E	0017	590M	620W	SK27936	KIRPOL
S	PHO	791002	435	0123S	17313W	0882	510M	585C	SK27751	JAPPOL
	GIL	298	780724	1215	0300N	17249E	107	0	0	
S	GIL	780820	027	0302N	17237E	0012	490M	520W	SK27955	KIRPOL
S	GIL	780826	033	0308N	17240E	0012	480M	500W	SK27968	KIRPOL
S	GIL	780827	034	0315N	17236E	0020	480M	482W	SK27986	KIRPOL
S	GIL	780921	059	0310N	17201E	0049	470M	497W	SK27998	KIRPOL
S	GIL	780921	059	0310N	17241E	0013	530M	528W	SF01849	KIRPOL
S	GIL	780922	060	0315N	17229E	0025	480M	500W	SK27997	KIRPOL
S	GIL	780922	060	0316N	17229E	0026	540M	524W	SK27753	KIRPOL
S	INT	780929	067	0400S	17752W	0699	520M	522W	SK27775	JAPPOL
S	GIL	781020	088	0310N	17237E	0016	500M	535W	SF01874	KIRPOL
S	GIL	781023	091	0305N	17238E	0012	480M	504W	SK27982	KIRPOL
S	MAS	781127	126	0241N	16626E	0383	490M	533W	SK27779	JAPPOL
S	INT	791005	439	0302N	17217W	0893	480M	U	SK27758	JAPPOL
	GIL	299	780724	1310	0301N	17251E	12	0	0	
S	GIL	780825	032	0310N	17237E	0017	480M	495W	SF01877	KIRPOL
	GIL	300	780724	1350	0301N	17247E	1	0	0	
	GIL	301	780724	1415	0259N	17246E	94	0	0	
S	GIL	780806	013	0309N	17238E	0013	530M	535W	SF01911	KIRPOL
S	GIL	780819	026	0312N	17237E	0016	470M	490W	SF01913	KIRPOL
S	GIL	780820	027	0302N	17237E	0009	470M	520W	SF02031	KIRPOL
S	GIL	780826	033	0308N	17240E	0011	510M	510W	SF02102	KIRPOL
S	GIL	780827	034	0315N	17236E	0019	470M	490W	SF02011	KIRPOL
S	GIL	780827	034	0315N	17236E	0019	480M	490W	SF02020	KIRPOL
S	GIL	780827	034	0315N	17236E	0019	470M	472W	SF01896	KIRPOL
S	GIL	780827	034	0315N	17236E	0019	485M	470W	SF01899	KIRPOL
S	GIL	780827	034	0315N	17236E	0019	490M	490W	SF01887	KIRPOL
S	GIL	780921	059	0310N	17241E	0012	480M	490W	SF02037	KIRPOL
S	GIL	780921	059	0310N	17201E	0046	490M	505W	SF01879	KIRPOL
S	GIL	781012	080	0309N	17236E	0014	450M	482W	SF02038	KIRPOL
S	GIL	781019	087	0316N	17230E	0023	470M	500W	SF02044	KIRPOL
S	GIL	781020	088	0310N	17237E	0014	490M	523W	SF01912	KIRPOL
S	LIN	790903	406	0100N	15500W	1936	470M	540W	SF02005	JAPPOL
	GIL	327	781116	0720	0253N	17545E	16	0	0	
	GIL	639	791127	1230	0313N	17240E	9	0	0	
	GIL	640	791127	1320	0311N	17241E	3	0	0	
	GIL	641	791127	1400	0308N	17241E	27	8	0	
S	INT	800411	136	0417N	17753W	0569	605M	U	1E10067	JAPPOL
	GIL	642	791128	1355	0312N	17235E	25	0	0	
S	PAM	800704	219	0612N	16223W	1507	610M	710C	1E10072	JAPPOL
	GIL	643	791128	1435	0311N	17231E	4	0	0	
	GIL	644	791128	1600	0311N	17231E	29	0	0	
	GIL	645	791128	1645	0311N	17228E	53	0	0	
	PHO	646	791202	1715	0335S	17415W	184	4	0	
S	GIL	800730	241	0117N	17236E	0841	400M	505D	1B13768	KIRPOL
	PHO	647	791203	1055	0249S	17148W	127	0	0	
	PHO	648	791203	1225	0250S	17144W	9	0	0	
	PHO	649	791203	1245	0249S	17143W	0	12	0	
	PHO	650	791203	1500	0244S	17147W	2	0	0	
	PHO	651	791203	1540	0244S	17146W	44	0	0	
	PHO	652	791204	1640	0309S	17102W	1	0	0	

CODES FOR LENGTH MEASUREMENTS, RECAPTURE GEARS AND COUNTRY ABBREVIATIONS

Release Length Credibility

M	Measured
B	Estimated from Biological Data
T	Estimated from Tagging Data
G	Guessed
U	Unknown
Q	Length Questionable

Recapture Length Credibility

A	Measured by <u>Hatsutori Maru No.1</u> (SPC staff)
B	Measured by joint local ventures
C	Measured by Japanese long-range boats, or long-liners of other nationalities
D	Measured by other supposedly reliable sources
E	Measured by unreliable sources
W	Measured length verified by weight
J	Estimated from weight
K	Estimated from other sources (string, etc.)
U	Unknown

Nationality of Recapture Vessel (Country Abbreviations)

AMS	American Samoa
CAL	New Caledonia
FIJ	Fiji
IND	Indonesia
INT	International waters
JAP	Japan
KIR	Kiribati
KOR	Korea
NOR	Norfolk Island
NSW	New South Wales (Australia)
PAL	Palau
PHL	Philippines
PNG	Papua New Guinea
POL	French Polynesia
PON	Ponape (Federated States of Micronesia)
QLD	Queensland (Australia)
SOC	Society Islands (French Polynesia)
SOL	Solomon Islands
TAW	Taiwan
TOK	Tokelau
TON	Tonga
TUV	Tuvalu
USA	United States
VAN	Vanuatu
WAL	Wallis and Futuna
WES	Western Samoa
ZEA	New Zealand

Type of Recapture Vessel

SEN	Purse-seine
POL	Pole-and-line
LON	Long-line
SHE	Pearl-shell trolling
ART	Artisanal
GIL	Gill net
REC	*Recreational (sport fishing)*
SUB	Subsistance (village)
UUU	Unknown

APPENDIX D. RELEASE AND RECOVERY DATA FOR ALL FISH RECOVERED BUT NOT RELEASED IN KIRIBATI. The format is described in the heading for Appendix C.

```
        CAL  96 780108 1545 2146S 16642E   261    3    0
S GIL 790817 586 0200N 17530E 1517 480M 638W SA07402 JAPPOL

        FIJ 171 780406 1052 1656S 17924W  1642    0    0
S PHO 780916 163 0400S 17320W 0854 520M 540C SD03944 JAPPOL

        FIJ 812 800411 1245 1835S 17749E   505   15    0
S PHO 810224 319 0508S 17254W 0973 540M 610W 1C19301 JAPPOL

        FIJ 843 800420 0815 1552S 17958W  1434  400    0
S PHO 800920 153 0600S 17500W 0660 500M 590W 2C27709 JAPPOL
S GIL 810412 357 0135S 17715E 0873 480M 680W 2C28400 JAPPOL
Y PHO 820715 816 0411S 16758W 0996 560M 200J 2C26968 KORLON

        FIJ 848 800422 1050 1555S 17903E   342   37    1
S PHO 800906 137 0430S 17416W 0790 540M 608J 2C28834 JAPPOL

        JAP 310 781005 1145 2403N 14152E   108    0    0
S GIL 800309 521 0225N 17620E 2382 438B    U SF02159 JAPPOL

        MAQ 675 791225 1620 0910S 14004W   510    0    0
S GIL 801019 299 0156N 17418E 2808 470M 590W SK50202 JAPPOL

        MAQ 710 800106 1550 0853S 14019W     8    0    0
S PHO 800916 254 0529S 17334W 1989 510M 600W 1C13628 JAPPOL

        MAS 638 791121 1415 0540N 16839E    41   86    0
Y GIL 800526 187 0047N 16938E 0299 750M 950C 1B10023 KORLON

        PAL 931 800811 0715 0257N 13140E   151  123    0
S GIL 801130 112  400N 17530E 2626 422T 484W 1B14154 JAPPOL

        PAL 942 800819 1045 0748N 13418E  1363  184    0
S GIL 810402 226 0200N 17300E 2338 390M 550C 2E28417 JAPSEN

        PAL 943 800820 1035 0735N 13459E   208    0    0
S GIL 801125 098  400N 17530E 2427 610M 628J 2E28351 JAPPOL

        PNG 560 790530 1600 0418S 15234E   117  117    0
S GIL 800812 440 0258N 17600E 1471 530M 600W SK39540 JAPPOL

        PON 918 800721 1050 0643N 15818E    49    0    0
S GIL 801018 089 0142N 17429E 1014 490M 517W 2E21099 JAPPOL

        SOL  46 771203 1510 1105S 16536E   213    0    0
S GIL 780203 062 0125S 16826E 0604 550M 590J AY04409 JAPPOL

        TON 188 780430 1600 2053S 17515W   284   12    0
S PHO 781008 161 0346S 17317W 1033 517B    U SE01182 JAPPOL

        TUV 256 780627 1703 0840S 17913E   420   19    0
S GIL 781006 102  212S 17643E 0416 519B 511W SK22501 JAPPOL

        TUV 266 780701 1710 0842S 17910E   470    0    0
S PHO 781028 119 0224S 17302W 0600 500M 518W SK22992 JAPPOL

        TUV 271 780704 1040 0557S 17715E    88    0    0
S GIL 790202 213 0350N 17440E 0607 619B 665J SK23277 JAPPOL

        WAL 190 780506 0930 1326S 17602W   602  105    0
S PHO 781002 149 0438S 17531W 0529 530M 551C SK10222 JAPPOL
S PHO 781003 150 0432S 17649W 0536 490M 551J SK10283 JAPPOL

        WAL 205 780515 0800 1324S 17612W    59    0    0
S PHO 780930 138 0410S 17609W 0554 530M 548W SK12543 JAPPOL

        WAL 207 780515 1035 1309S 17622W   410    0    0
S GIL 790202 263 0350N 17440E 1151 594B 665J SK12915 JAPPOL

        WAL 208 780515 1300 1308S 17622W   194    0    0
S PHO 781012 150 0233S 17425W 0645 600M 658W SK13603 JAPPOL

        WAL 212 780516 1350 1330S 17605W   768    0    0
S PHO 781126 194 0307S 17610W 0623 510M 556J SK13944 JAPPOL

        WAL 214 780517 1150 1329S 17607W  1034    0    0
S PHO 781002 138 0457S 17618W 0512 500M 530W SK15324 JAPPOL
S PHO 781002 138 0442S 17702W 0530 530M 485J SK14873 JAPPOL
S GIL 800117 610 0321N 17332E 1183 520M 555W SK15430 JAPPOL
S PHO 800922 859 0331S 17214W 0641 540M 670W SK15545 JAPPOL

        WAL 215 780518 0850 1331S 17605W   742    0    0
S PHO 781001 136  407S 17660W 0567 530M 508W SE02003 JAPPOL
S PHO 781016 151 0348S 17529W 0584 520M 530W SE02294 JAPPOL

        WAL 216 780518 1105 1334S 17612W   293    0    0
S PHO 780930 135 0410S 17609W 0564 540M 519W SE02471 JAPPOL

        WAL 218 780519 0915 1328S 17607W   194    0    0
S PHO 781009 143 0211S 17432W 0683 504B 520W SE03334 JAPPOL

        WAL 219 780519 1030 1330S 17605W  1028    0    0
S PHO 780926 130 0320S 17630W 0611 490M 485J SE03796 JAPPOL
S GIL 780928 132 0312N 17400E 1163 520M    U SE03553 JAPPOL
S PHO 781002 136 0554S 17424W 0467 530M 496J SE03284 JAPPOL
S PHO 781013 147 0230S 17353W 0673 520M 515W SE04056 JAPPOL
S PHO 781016 150 0331S 17344W 0615 480M 620J SE03648 JAPPOL

        WAL 221 780519 1320 1329S 17614W    60    0    0
S PHO 780816 089 0300S 17200W 0677 482T 525J SE04759 JAPPOL

        WAL 222 780520 0850 1317S 17623W   350    0    0
S PHO 781005 138 0521S 17425W 0490 510M 545B SK15805 JAPPOL

        WAL 223 780520 1030 1315S 17620W  1565    0    0
S PHO 780916 119 0426S 17336W 0553 505B 400K SK17079 JAPPOL
S GIL 780928 131 0312N 17400E 1143 505B    U SK15611 JAPPOL
S PHO 781008 141 0346S 17317W 0597 505B 505W SK16659 JAPPOL
S GIL 781013 146 0057N 17356E 1030 500M 450C SK15869 JAPPOL

        WAL 225 780521 0815 1332S 17610W   417    0    0
S PHO 781003 135 0447S 17605W 0525 520M 485J SK18628 JAPPOL

        WAL 237 780531 1500 1313S 17458W   337    0    0
S PHO 781010 132 0300S 17330W 0619 520M 501W SK19502 JAPPOL

        WAL 864 800515 0930 1304S 17621W  1604  206    2
S PHO 810312 301 0159S 17524W 0667 490M 598J 1E16219 JAPPOL

        WAL 873 800522 1545 1420S 17816W   477   42    0
S PHO 800918 119 0501S 17225W 0657 440M 491W 1E10524 JAPPOL

        YAP 316 781022 1640 0708N 13848E   726    2    0
S GIL 790805 287 0236N 17230E 2032 520M 598W SH00282 JAPLON
S GIL 800327 522 0318N 17559E 2233 530M 580W SK30282 JAPPOL
```

APPENDIX E. ABBREVIATIONS FOR COUNTRIES, TERRITORIES AND SUBDIVISIONS THEREOF

AMS - American Samoa
CAL - New Caledonia
COK - Cook Islands
FIJ - Fiji
GAM - Gambier Islands (French Polynesia)
GIL - Gilbert Islands (Kiribati)
GUM - Guam
HAW - Hawaii
HOW - Howland and Baker Islands (U.S. Possession)
IND - Indonesia
INT - International waters
JAP - Japan
JAR - Jarvis (U.S. Possession)
KOS - Kosrae (Federated States of Micronesia)
LIN - Line Islands (Kiribati)
MAQ - Marquesas Islands (French Polynesia)
MAR - Northern Mariana Islands
MAS - Marshall Islands
MTS - Minami-tori shima (Japan)
NAU - Nauru
NCK - Northern Cook Islands
NIU - Niue
NOR - Norfolk Island
NSW - New South Wales (Australia)
PAL - Palau
PAM - Palmyra (U.S. Possession)
PHL - Philippines
PHO - Phoenix Islands (Kiribati)
PIT - Pitcairn Islands
PNG - Papua New Guinea
POL - French Polynesia
PON - Ponape (Federated States of Micronesia)
QLD - Queensland (Australia)
SCK - Southern Cook Islands
SOC - Society Islands (French Polynesia)
SOL - Solomon Islands
TOK - Tokelau
TON - Tonga
TRK - Truk (Federated States of Micronesia)
TUA - Tuamotu Islands (French Polynesia)
TUV - Tuvalu
VAN - Vanuatu
WAK - Wake Island (U.S. Possession)
WAL - Wallis and Futuna
WES - Western Samoa
YAP - Yap (Federated States of Micronesia)
ZEA - New Zealand