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REPORT ON THE SOUTH PACIFIC COMMISSION'S TUNA AND BILLFISH ASSESSMENT PROGRAMME ACTIVITIES FOR 1990-91

(Paper prepared by the Secretariat)

TUNA AND BILLFISH ASSESSMENT PROGRAMME (TBAP)

1. The Tuna and Billfish Assessment Programme (TBAP) was established by the 1980 South Pacific Conference to continue the work initiated by its predecessor project, the Skipjack Survey and Assessment Programme (SSAP). The Programme is funded by extra-budgetary contributions from Australia, France, New Zealand, the United States of America, the European Economic Community (EEC) and the International Centre for Ocean Development (ICOD).

2. The Tuna and Billfish Assessment Programme has as its goal the provision of assistance to SPC countries to develop, rationally exploit and manage the renewable oceanic resources of the region, the tuna resource constituting the single largest fishery resource available to member countries. Two projects are defined within the TBAP, the Tuna and Billfish Research Project (TBRP) and the Fishery Statistics Project (FSP). These projects, while interacting to a large extent, reflect the two basic types of work undertaken by the TBAP: (1) the conduct of a programme of scientific research on tuna and billfish stocks in the SPC region; (2) the collection, processing and dissemination of fisheries statistics pertaining to those stocks. The activities of both projects remain focussed on the priority tasks defined in the TBAP mission statement approved by the 19th RTMF, but the division provides a clearer definition of staff responsibilities and activities within the scope of the TBAP, and recognizes the role of the Fisheries Statistics Project in supporting other SPC Fisheries Projects. In addition, the TBAP is involved with ORSTOM in a continuing cooperative study of the effects of environmental variation on tuna fishing.

1. TUNA AND BILLFISH RESEARCH PROJECT (TBRP)

3. The work of the TBRP can be conveniently subdivided, with the recent involvement in albacore issues, into that involving tropical tunas and albacore respectively.

1.1 Tropical Tuna Research

1.1.1 Regional Tuna Tagging Project

4. The Regional Tuna Tagging Project (RTTP) is a three-year project being undertaken by the TBAP, with 3.5 million ECU in funding from the European Community Sixth European Development Fund (Lomé III). The project is expressly designed to provide practical answers to questions raised by tuna fisheries interaction and tuna exploitation generally within the region. The project will provide information on the population characteristics of yellowfin, skipjack and, to a lesser extent, bigeye, so that these questions can be addressed using various modelling approaches. Tagging has been carried out predominantly from the chartered Tuvaluan pole-and-line vessel, *Te Tautai*, although various locally-based vessels have been used on an opportunistic basis for specific in-country components (which also contribute to the overall objectives of the project). The operations of the *Te Tautai* began in December 1989, following initial work in Solomon Islands during the second half of 1989 on Solomon Taiyo Ltd pole-and-line vessels. The following report provides a description of the work carried out to date and preliminary analyses of some of the results.

1.1.1.1 Tag Releases

5. Year 1 of the RTTP was completed in October 1990, with all nominal operational targets exceeded. Tagging took place in the waters of Solomon Islands, Papua New Guinea, Federated States of Micronesia, Palau, Philippines, Marshall Islands, Kiribati and Tuvalu, as well as in international waters within the primary operational area. Most tagging took place from the chartered project vessel, *Te Tautai*, with supplementary work being carried out on a Japanese group seine vessel (with cooperation of the FSM Government) and on Solomon Taiyo Ltd. pole-and-line vessels (as part of the Solomon Islands in-country tagging project). In all, 48,263 tuna were tagged to the end of October 1990, comprising 16,909 yellowfin, 30,841 skipjack, 865 bigeye and 8 longtail tunas.

6. The Project re-commenced in February 1991, and as at 31 May 1991, tagging had been carried out in Papua New Guinea, Federated States of Micronesia, Indonesia, Philippines and Palau. The fishing conditions so far in 1991 have been excellent and have resulted in the tagging of a further 7,190 yellowfin, 23,179 skipjack, 277 bigeye and 74 longtail tuna. Tag releases are summarised in Table 1.

Table 1. Tag releases by the RTTP (including associated in-country projects). (Note: This table will be updated at the 1991 SCTB meeting.)

Period	Yellowfin	Skipjack	Bigeye	Longtail	TOTAL
To 31 October 1990	16,909 (35%)	30,481 (63%)	865 (2%)	8 (0%)	**48,263**
1 February-31 May 1991	7,190 (23%)	23,179 (75%)	277 (1%)	74 (0%)	**30,720**
TOTAL	**24,099 (31%)**	**53,660 (68%)**	**1,142 (1%)**	**82 (0%)**	**78,983**

7. These tag releases have been spread throughout the range of the western tropical Pacific tuna fisheries, although larger numbers have tended to be released in, or in the vicinity of, archipelagic waters, eg. Solomon Islands, Papua New Guinea and Indonesia. The distribution of tag releases by five-degree square is shown in Figure 1. The remainder of the project will see priority given to tagging in areas where relatively few releases have so far been made, i.e. FSM, Marshall Islands, Kiribati, Tuvalu, etc.

8. The size distribution of releases is largely as would be expected for a pole-and-line vessel, but has varied significantly according to the type of aggregation fished. In particular, FAD- and log-associated yellowfin tend to be smaller than seamount-associated or unassociated fish (Figure 2). Therefore, it has been possible to extend the size range, of tagged yellowfin in particular, downward by tagging around FADs and logs. Skipjack and yellowfin 25-34 cm have been tagged in this fashion using smaller tags and applicators than those routinely used for tuna larger than 34 cm. More difficulty has been experienced in tagging large numbers of larger (>60 cm) yellowfin. This will have implications for how the data are later analysed, but will not compromise the objectives of the project. The Project continues to make efforts to develop techniques of catching and tagging larger yellowfin. Of particular note is a cooperative activity with the FSM Government in which a locally employed fisherman is tagging large yellowfin at Kapingamarangi Atoll.

1.1.1.2 Tag returns

9. The success of any tagging operation is largely dependent on the cooperation of fishermen and fish handlers in returning tags. Consequently, considerable effort is required to encourage the return of tags, through initial publicity, provision of incentives (rewards) to return tags, periodic reinforcement of this incentive (lottery, media publicity), feedback for tag returners and the establishment of standard reporting procedures.

10. For the RTTP, an international fleet comprising purse seiners of USA, Japan, ROC, ROK, Philippines, Indonesia, USSR, Australia and Solomon Islands, pole-and-line vessels of Japan, Solomon Islands, Indonesia and other smaller domestic fleets, longliners of Japan, ROK and ROC, and artisanal vessels of numerous countries, could potentially recapture tagged fish. In addition, western Pacific surface-caught tuna are predominantly utilised for canning, in Thailand, Philippines, American Samoa, Puerto Rico, Indonesia and other smaller domestic canneries. Those fish destined for canneries are typically transhipped at sea to carriers from fishing vessels. There are thus many potential points of recovery where awareness of the project needed to be raised.

11. Publicity posters in 10 languages have been distributed for display in appropriate locations, with smaller versions available for direct mailing to individual vessel operators and owners. The establishment of contact points in particular countries, usually within a cooperating Government fishery agency, has proved invaluable in this regard. Local media, (newspaper, radio, television) are also utilised for publicity, with the assistance of contact points.

12. Generally speaking, the response of the various sources of tag recovery has been good, and in most cases excellent. As at 12 June 1991, 5,530 tag returns (7.0% of releases) have been received, comprising 1,452 yellowfin (6.0% of yellowfin releases), 3,993 skipjack (7.4% of skipjack releases) and 85 bigeye (7.4% of bigeye releases). Details of tag recoveries by gear type and vessel nationality are shown in Table 2.

13. Most of the returns were detected by tag finders on board the vessel during catching or unloading, although fish detected in canneries or at transhipment facilities after unloading from the catcher vessel are also common (Table 3). In many cases, it has been possible, with the cooperation of the cannery/transhipment operators, to identify the catcher vessel and estimate an approximate location and date of recapture.

Table 2. **Tag recoveries as at 12 June 1991. Note: This table will be updated at the 1991 RTMF meeting. (PS: purse seine; PL: pole-and-line; LL: longline; T: troll; HL: handline; U: unknown/other)**

A. SKIPJACK

VESSEL NATIONALITY	Gear type						
	PS	PL	LL	T	HL	U	TOTAL
Solomon Islands	572	352		3		37	964
U S A	200					1	201
Japan	595	56					651
Philippines	803			86		74	963
Korea	188						188
Taiwan	96						96
Palau		52		1			53
Indonesia	16	578		1		16	611
U S S R	1						1
Other/Unknown	129	120		15		1	265
TOTAL	2600	1158		106		129	3993

B. YELLOWFIN

Solomon Islands	132	18		2		6	158
U S A	99						99
Japan	158	1				3	162
Philippines	314			7		15	336
Korea	89						89
Taiwan	82					4	86
Palau		8				1	9
Indonesia	13	355				23	391
U S S R	1						1
Other/Unknown	82	30		4		5	121
TOTAL	970	412		13		57	1452

C. BIGEYE

Solomon Islands	6						6
U S A	20						20
Japan	25					1	26
Philippines	13						13
Korea	3						3
Taiwan	3						3
Palau							
Indonesia	1	6				1	8
U S S R							
Other/Unknown	6						6
TOTAL	77	6				2	85

**Table 3: Sources of tag recoveries, as at 12 June 1991.
(Note: This table will be updated at the 1991 RTMF meeting.)**

Cannery/transhipment facility	Yellowfin returns	Skipjack returns	Bigeye returns	Total returns
Philippines	173	454	5	632
Indonesia	5	14		19
Puerto Rico	15	44	2	61
Thailand	216	295	11	522
American Samoa	78	192	7	277
Northern Marianas	17	36		53
Vessel returns	946	2957	60	3963
Source unknown	2	1		3
TOTAL	1452	3993	85	5530

14. Special port sampling projects have been initiated at several key transshipment ports in the region (Pohnpei, Chuuk, Palau). These projects will maximise tag recovery from small longline vessels as well as collect valuable biological data on various species unloaded.

1.1.1.3 Preliminary analyses

15. Detailed analyses of tagging results and biological data have not yet been carried out, and will commence after the completion of field work. However, some preliminary, descriptive analyses can be presented at this stage to indicate the nature of the data and types of quantitative analyses to which they might be suited.

(i) Returns by time at liberty

16. Returns by time at liberty (on a log scale) for yellowfin and skipjack are shown in Figure 3. Both plots show a near-perfect log-linear attrition with time, even without correction for variations in catch or effort. This suggests that the standard tag-attrition models will be applicable to these data for spatially-aggregated analyses.

17. Under a series of simplifying assumptions, the slopes of the regression lines fitted to the points in Figure 3[1] are estimates of the total attrition rates (which include natural and fishing mortality, emigration, declining vulnerability with time, long-term tag shedding and long-term tagging-induced mortality). These preliminary estimates are 0.19 mo^{-1} for yellowfin and 0.37 mo^{-1} for skipjack. The only other estimates available for comparison are from the Skipjack Survey and Assessment Programme (SSAP), where the total attrition rate for skipjack from a similar area ("Trust Territory and Guam") to the present operational area of the RTTP was estimated to be 0.23 mo^{-1} (Kearney *et al.* 1987). The increase in skipjack attrition rate from the early 1980s (SSAP) to the present time (RTTP) is consistent with the large increase in catch that has taken place over the same period, i.e. if all other factors have remained constant, the increased attrition

[1] Yellowfin returns in the first 30-day period after release appear to be over-represented, possibly because of high fishing effort in the vicinity of releases. Also, returns in the last 30-day period, and possibly in other periods near the end of the time series, appear to be under-represented, probably because returns from these periods could only have come from releases early in the Project. Accordingly, the first and last yellowfin data points and the last skipjack data point were omitted for the purpose of deriving the preliminary regression estimates of total attrition rate.

may be due to increased fishing mortality. Increased fishing mortality is also reflected in the raw recovery rate (currently 7.4% for skipjack, compared to 3.8% for the SSAP).

18. The much lower total attrition estimate for yellowfin is consistent with expectations that the average natural mortality rate of yellowfin is substantially less than that of skipjack. More analyses are required to precisely estimate the various components of tag attrition for both skipjack and yellowfin. These analyses will be carried out at the completion of field work and when representative tag return data sets have been established.

(ii) Movement

19. Movement of tagged fish can be displayed in various ways. The simplest is to construct frequency histograms of displacement for different time-at-liberty categories. Such histograms for yellowfin and skipjack (Figure 4) show the classical dispersion effects of tagged tunas for increasing time periods at liberty. For both skipjack and yellowfin, 70-80% of returns during the first 90 days after release were displaced less than 100 nmi. The frequency of large displacements increases for fish at liberty 91-180 days (but more so for skipjack); for fish at liberty longer than 180 days, recapture within 100 nmi of release is relatively rare (1-3% of returns), with skipjack displacements of 300-500 nmi. and yellowfin displacements of 100-400 nmi. most common. For all time-at-liberty categories, skipjack have substantially higher (30-60%) mean displacements than yellowfin, indicating more rapid and more frequent long-distance movements.

20. Alternatively, movements of tagged tuna can simply be represented by arrows on maps. Such movements for yellowfin and skipjack are depicted in Figures 5 and 6, respectively. For both species, large-scale movements in equatorial areas are essentially meridional, with maximum displacements of 1,974 nmi. for yellowfin and 2,455 nmi. for skipjack. Most long-distance displacements for both species have been from the PNG-Solomon Islands area (where most releases have occurred) to the east (Kiribati, Samoa) and to the west to the Philippines.

21. A computer animation package, which can incorporate both time and space dimensions in its display, is available and will be demonstrated separately.

22. These simple presentations of tag-movement data are useful, but far from complete. Detailed analyses of the data, incorporating catch and effort data from the fisheries, for the purpose of parameterising a generalised movement model will be a priority in the analytical phase of the project.

(iii) Growth

23. The incorporation of growth sub-models will be important for at least some analyses of skipjack and (particularly) yellowfin tag data. Tag returns with reliable length measurements at release and recapture provide explicit measurements of the growth of individual fish. Plots of yellowfin and skipjack length increments against time at liberty for different release-length categories are shown in Figures 7 and 8, respectively. In theory, such plots, ideally for an identical length at release, should display a characteristic asymptotic behaviour if the von Bertananffy growth model is appropriate. Although these data are essentially raw (i.e. little reliability screening has taken place, apart from eliminating several negative-increment returns) and show substantial variation in length increments for given time at liberty, asymptotic behaviour is suggested in at least some of the plots for both species. Therefore, adherance to von Bertalanffy growth may be a reasonable working hypothesis. Substantial effort on data screening and editing will be required before reliable estimates are obtained.

(iv) Nuisance parameters

24. The so-called nuisance parameters associated with tagging experiments are the rates of tag shedding and non-reporting of recovered tags. Tag-shedding rates will be estimated from double-tagging experiments that have been carried out regularly throughout the course of the project.

25. As at 31 May 1991, 1,234 yellowfin, 1,494 skipjack and 69 bigeye had been double tagged. Returns of these fish are detailed in Table 4.

Table 4: Returns of double-tagged yellowfin, skipjack and bigeye from releases up to 31 May 1991.

	Yellowfin	Skipjack	Bigeye	TOTAL
No. released	1234	1494	69	2798
No. returned with two tags	20	42	5	67
No. returned with one tag	6	6	1	13
Total returned	26	48	6	80
Point estimate of proportion of tags retained	0.870	0.933	0.909	0.912
Standard deviation of estimate	0.053	0.027	0.091	0.024

26. The point estimates of the number of tags retained pertains to the mid-point of the average period of liberty of double-tag recoveries, and are therefore necessarily approximate. Also, tag-shedding and non-reporting rates are confounded in these estimates. The estimates indicate that some tag shedding is taking place, but the precision of the estimates, as indicated by the standard deviations, is such that these estimates should not be considered reliable at this stage. More refined estimates of shedding rates, employing specific tag-shedding models, will be derived in due course.

27. Non-reporting rates will be more difficult to estimate. A limited number of tag-seeding experiments have been carried out on U.S. purse seiners and on Solomon Islands purse seiners and pole-and-liners. The return rate of the small number of tags seeded in the Solomon Islands has been 100%, which, combined with other observations, suggests that the overall rate of reporting in Solomons is high. However, of 71 tags seeded aboard US purse seiners by both US Multilateral Treaty and FSM Government observers, only 21 have so far been returned. This result appears to be at variance with overall impressions of return procedures from the US purse seine fleet, and requires further study.

28. Unfortunately, it has not been possible to carry out such experiments in the fleets of most concern (Taiwanese and Korean purse seiners). Our current thinking is that non-reporting rates for these fleets will need to be estimated by comparison to key benchmark fleets where reporting can be assumed to be good (eg. Philippines and Japanese purse seiners). Magnitude and geographical distribution of catch in relation to location of tag releases would be important variables to consider in these anal

1.1.1.4 In-Country Tagging Activities

29. Under the general umbrella of the RTTP, several collaborative in-country tagging projects, to address local tuna fishery assessment and interaction issues, are planned. The field phase of the first of these projects, in the Solomon Islands, has been completed. The results of four tagging cruises using Solomon Taiyo Ltd. pole-and-line vessels and two *Te Tautai* cruises are given in Table 5.

Table 5: Results of Solomon Islands tagging cruises, as at 12 June 1991. Return rates (returns/releases x 100) are given in parentheses.

Cruise	Vessel	Period	Releases YF	Releases SJ	Releases BE	Releases Total	Returns YF	Returns SJ	Returns BE	Returns Total
SB 1	*Soltai 8*	Jul-Aug 1989	176	4034	0	4210	21 (11.9)	609 (15.1)		630 (15.0)
SB 2	*Soltai 8*	Oct-Nov 1989	3	111	0	114	0 (0.0)	2 (1.8)		2 (1.8)
RT 1-3	*Te Tautai*	Dec 89-Jan 1990	400	493	29	922	32 (8.0)	37 (7.5)	6 (20.7)	75 (8.1)
RT 8-13	*Te Tautai*	Mar 1990	1349	594	11	1954	67 (4.9)	25 (4.1)	0 (0.0)	92 (4.7)
SB 3	*Soltai 6*	Mar 1990	232	1241	1	1474	35 (15.1)	214 (17.2)	0 (0.0)	249 (16.9)
SB 4	*Soltai 12*	Jun 1990	163	2343	0	2506	6 (3.7)	126 (5.4)		132 (5.3)
TOTAL			2323	8816	41	11180	161 (6.9)	1013 (11.5)	6 (14.6)	1180 (10.5)

30. A preliminary analysis of these results was presented to SCTB 3. Final analyses, which will be conducted jointly with Solomon Islands MNR staff (and include training in data quality control and analytical techniques for the MNR counter-parts), should be completed and presented to the Solomon Islands Government during the first quarter of 1992.

1.1.1.5 RTTP and In-Country Tagging 1991/92

31. The RTTP cruise schedule for the remainder of 1991 is as follows:

April 1991	Philippines, Palau
May 1991	Palau, Federated States of Micronesia, Papua New Guinea
June 1991	Federated States of Micronesia, Papua New Guinea
July 1991	Federated States of Micronesia
August 1991	Marshall Islands
September 1991	Kiribati, Tuvalu, Solomon Islands
October 1991	Solomon Islands, Australia (Coral Sea)
November 1991	Australia, New Caledonia, Solomon Islands, Fiji

32. Approval will be sought to continue the *Te Tautai* charter for an additional three months in 1992, and also utilise two months of unused charter time from year 2 (due to the one month delay in start-up and one month of Coral Sea tagging funded primarily from other sources). The rationale for this extension is to enable coverage of the eastern extremes of the fishing area that have been recently subject to increased exploitation. Consequently, proposed activities in 1992 will concentrate in waters of Nauru, Tuvalu, Kiribati

(Gilberts, Phoenix and possibly Line groups), Wallis, U.S. (Howland, Baker and possibly Jarvis Islands), and adjacent international waters.

33. Also, the possibility of tagging from a Te Mautari pole-and-line vessel in Kiribati waters in June/July 1991 is currently being investigated. This activity will assist in the extension of overall geographical coverage of tagging, as well as examine some specific questions regarding the exploitation of tunas in the Kiribati EEZ. Training of a Kiribati counter-part will begin in May 1991 on board the *Te Tautai.*

1.1.2 Assessing and monitoring levels of exploitation of commercially important tuna and billfish species

1.1.2.1 Stock assessment and monitoring

34. Assessment of the status of tropical tuna stocks continues to be an important activity of the Tuna and Billfish Research Project, and overlaps considerably with the work of the Fishery Statistics Project in maintaining the Regional Oceanic Fisheries Database. Trends in total catch and catch per unit effort are monitored by species and fishery, and periodic status reports are prepared. Skipjack and yellowfin stock status was reviewed at SCTB 3 and the fisheries for these and other species are reviewed in SCTB 4/WP.3.

35. Recent catch and CPUE trends for skipjack, yellowfin and bigeye are presented in Table 6.

Table 6: **Recent catch and CPUE trends for major western Pacific tuna fisheries. (PL: pole-and-line; PS: purse seine; LL: longline; PL CPUE in mt per day fished or searched; PS CPUE in mt per day fished or searched; LL CPUE in number per 100 hooks. Total catch estimates are taken from SCTB 4, WP.3; CPUE estimates are from the SPC Regional Tuna Fisheries Database. CPUE estimates for 1990 are incomplete and should be regarded as preliminary.**

Year	Skipjack				Yellowfin				Bigeye	
	PL		PS		PS		LL		LL	
	Catch	CPUE	Catch	CPUE	Catch	CPUE	Catch	CPUE	Catch	CPUE
1987	146,915	4.0	295,085	11.3	148,101	4.8	40,414	0.80	32,467	0.46
1988	163,415	7.1	424,543	12.8	93,968	2.7	36,066	0.75	36,940	0.27
1989	148,385	6.1	427,803	11.0	156,494	4.7	36,480	0.71	28,833	0.38
1990	99,287	3.7	519,761	11.3	176,703	3.9	38,057	0.83	32,207	0.55

36. Skipjack CPUE by pole-and-line vessels has varied substantially, and the low value in 1990 is due primarily to the low coverage of Japanese vessels (which generally have much higher CPUEs than smaller, regionally-based vessels) on the SPC Regional Tuna Fisheries Database when this report was prepared. On the other hand, skipjack CPUE by purse seiners has been very stable. Yellowfin CPUE by purse seiners has been variable, with preliminary data for 1990 suggesting lower-than-normal CPUE (but not as low as in 1988). Yellowfin CPUE by longline has been steady since 1987. Bigeye CPUE by longliners has fluctuated over the past few years, but the 1990 preliminary figure is the highest for the series tabulated.

37. Recent trends in skipjack CPUE give no indication that the resource is approaching full exploitation. A full assessment of skipjack potential on the basis of RTTP tagging data should be available in 1992.

Similarly, yellowfin does not show signs of over-exploitation on the basis of these CPUE trends, and therefore the conclusions of SCTB 3/WP.11 remain unchanged at this stage. There is currently insufficient information on which to base an assessment of bigeye stock status.

1.1.2.2 U.S. Multilateral Treaty Observer Programme and other Observer Activities

38. The TBAP has continued to provide support to FFA regarding the observer programme on U.S. purse seiners, and port sampling of the catch. Observer reports provided by FFA are processed and analysed at SPC and a report sent back to FFA. Detailed analyses of both observer and port sampling data collected under Treaty provisions were prepared, at the request of FFA, for Treaty review meetings in 1990 and 1991.

1.1.2.3 In-country assessments

39. In-country assessments, intended to provide individual countries with rigorous scientific assessment of the status of their tuna resources, are in strong demand. Assessments for Papua New Guinea and Marshall Islands were completed in 1988 and 1989. A much more comprehensive format for the assessments has now been implemented, and the first of these (FSM) was completed in early 1991. At least two more are scheduled for preparation in 1991, with the assistance of an Australian scientist on secondment to the TBAP (funded by the Australian International Development Assistance Bureau) for a three month period beginning 1 May.

1.2 South Pacific Albacore

40. The TBAP has continued to upgrade its research effort on South Pacific albacore during the past twelve months. Efforts have concentrated on:

(i) staging the Third South Pacific Albacore Research (SPAR) Workshop, immediately preceding the Third Consultation on Arrangements for South Pacific Albacore Management;

(ii) co-ordinating an observer programme during the 1990/91 surface fishery;

(iii) continuing sampling of albacore landings in the South Pacific, including port sampling in Noumea and onboard biological sampling on a Tongan longliner;

(iv) planning and implementing a medium-scale albacore tagging project.

41. Funding became available during 1990 from ICOD for the recruitment of an albacore scientist, Dr Marc Labelle, for a three year period. This will enable albacore reasearch, and in particular, data collection to be better co-ordinated, ultimately leading to a much-needed assessment of South Pacific albacore stocks. Dr Labelle commenced work in late December 1990.

1.2.1 SPAR Workshop

42. The Third SPAR Workshop was held in Noumea on 9-12 December 1990. The major outcomes of the meeting were:

(i) best estimates of the historical catch record by gear type, nationality and year were again constructed;

(ii) the reduction of the 1989/90 catch to level less than half those of 1988/89, primarily through reduction of driftnet catches, was confirmed;

(iii) biological observations onboard both driftnet (Japanese research vessel) and troll vessels were reported in detail;

(iv) it was concluded that, at the current reduced catch levels, there appears to be no immediate need for management action to further reduce fishing effort, although great uncertainty remains regarding yield potentials and fishery interactions;

(v) research needs for the future, much to be undertaken by SPC, include tagging studies, reproductive and age and growth studies, continuation of observer work, and monitoring various aspects of the fisheries.

43. SPAR now additionally functions as a scientific advisory group to the Consultation, and is likely to be incorporated as such into any future management regime.

1.2.2 Albacore port sampling

44. In order to obtain information on the size distribution of albacore caught in various fisheries, fork-length measurements have been collected regularly at various landing ports. Troll and longline catches landed in French Polynesia have been sampled by EVAAM personnel in Papeete. During March, SPC's albacore scientist inspected the sampling activities in Papeete, and the existing sampling regime was modified in order to collect more data on longline catches. Troll and longline catches landed in American Samoa have been routinely and effectively sampled by NMFS personnel in Pago Pago. Troll and Japanese longline catches landed in New Zealand have also been sampled regularly by MAF staff.

45. Sampling of longline catches landed at the PAFCO cannery in Fiji has not been successful due to difficulties in sampling efficiently without disrupting processing operations at the cannery. A different sampling regime for troll catches is currently being formulated for next season (starting late 1991), and an interim sampling regime will be implemented for longline catches, pending the establishment of a more permanent arrangement.

46. Weekly sampling of longline catches has been conducted in New Caledonia by TBAP staff. Gonad samples and hard-parts (otoliths, fin rays and vertebrae) have also been collected there for determining spawning periodicity, sex ratios and length-at-age.

46.7 Finally, length-frequency and gonad sampling has been conducted on board the Tongan longliner M.V. *Lofa*. This sampling operation has proved to be a very effective and efficient means of collecting valuable data and samples.

1.2.3 Albacore Tagging Project

48. An EEC-funded albacore tagging project was carried out from 11 December 1990 to 26 March 1991. The major objective of the project was to tag albacore in the Tasman Sea, in coastal waters of New Zealand and in the Subtropical Convergence Zone (STCZ) of the central Pacific Ocean, using both troll and pole-and-line fishing techniques, to provide a basis for estimating population parameters required for albacore stock assessment and interaction models. The project was carried out as a collaborative venture between SPC and the New Zealand Ministry of Agriculture and Fisheries (MAF).

49. The tagging vessel *Solander III* was chartered by the SPC as the primary tagging platform, and tagged 2,119 albacore during the course of the charter period in trying (and sometimes desperate!) conditions. Few responsive surface schools of albacore were located, however approximately 200 albacore were tagged using pole-and-line gear. Additional releases were also made from the *Daniel Solander* (approximately 620), and the MAF research vessel R.V. *Kaharoa* (approximately 400), resulting in a total

of 3,139 albacore tagged and released by the Project. This was a most pleasing result under the less than optimal conditions experienced.

50. As at 22 April 1991, SPC had received no reports of tagged albacore being recaptured. This is a source of some concern, particularly as the majority of releases were made in the general vicinity of troll fishing activity, initially in New Zealand waters and later in the STCZ. The absence of tag returns could result because of poor survival of troll-caught albacore after tagging and release, non-cooperation by the fishing fleet in returning recovered tags, or unanticipated population or behavioural characteristics of albacore that greatly reduce the probability of tagged fish being recaptured. The limited number of albacore tagged by pole-and-line (the "control" group) may preclude a conclusive analysis of the effects of capture technique on the survival of tagged albacore. Further experimental work may be required to examine this problem. There have been some reliable reports of non-cooperation by some portions of the fishing fleet and this matter is currently under investigation by SPAR. The possibility of unusual population or behavioural characteristics cannot be ruled out at this stage, and simulation trials are currently being carried out to test a number of hypotheses.

1.2.4 Observer programme

51. Two observers embarked during December 1991 on a New Zealand troll vessel for the STCZ, where they met with the rest of the fishing fleet. Since then, the observers have been visiting various US and NZ troll vessels, spending approximately 2 weeks on each vessel collecting data on catch rates, size composition, loss rates and by-catch. So far, over 10,000 fish have been measured. Observations on the incidence of driftnet damage have indicated a relatively low incidence so far (<2%), presumably due to the low number of driftnet vessels present (up to 10 identified). Observers have also reported the presence of the JAMARC research vessel, which is conducting feasibility studies on trolling potential for Japanese interests.
One observer will remain on the fishing grounds until late April on a US troll vessel conducting exploratory fishing in the eastern region of the STCZ (140°-100°W). The information obtained this year will complement that obtained last season in which five observers spent a total of 263 days on six troll vessels between November 1989 and April 1990 in the Tasman Sea, New Zealand EEZ and along the STCZ. Over 55,000 albacore were measured in the 1989/90 season and a variety of other valuable biological and fisheries data obtained. These observations were presented during SPAR 3 (Working Paper No. 2).

1.3 Study on Tuna and their Environment

52. ORSTOM and SPC have been co-operating for some years in studying the effect of environmental variations on tuna fishing, under an agreement between these two bodies. The value of this co-operation lies in the opportunity it provides to pool and compare the data available for the region at ORSTOM (oceanography) and at the SPC (tuna statistics). This agreement, renewable yearly, continued during 1990-91.

53. The long-term goal of the programme is the study of the impact of seasonal and inter-annual environmental variations, (in particular those linked to the El Niño phenomenon) on the space-time distribution of tuna as well as on their availability to and catchability by various fishing methods. The results of the study will be reported separately by the ORSTOM representative.

2. FISHERY STATISTICS PROJECT (FSP)

2.1 Regional Tuna Fisheries Databases

2.1.1 SPC Regional Tuna Fisheries Database

54. Since its inception in 1981, the Tuna and Billfish Assessment Programme has maintained a database on industrial tuna fisheries in the region. The main sources of data have been daily catch and effort logsheets provided to SPC by member countries; the logsheets have been obtained either from distant-water fishing nations (DWFNs) under access agreements or from vessels of domestic fleets.

55. The database is used extensively for research and monitoring purposes. The Tuna and Billfish Research Project uses the database to assess the state of exploitation of the stocks and to study interactions between the different fleets operating in the region. Monitoring of the fisheries is accomplished by the Fisheries Statistics Project (FSP) through quarterly publication of statistics compiled from the database in the SPC Regional Tuna Bulletin and through detailed analyses of trends in catch and effort.

56. In6addition to research and monitoring conducted at SPC, the FSP also provides direct output through data summaries to the SPC member countries which provide the data. Reports summarizing the data are sent back to member countries on a quarterly basis. For several member countries, the processed data are returned on diskettes for incorporation into databases which are maintained on computers within each country.

57. Daily catch and effort data for tuna vessels fishing in the region have been received from 16 countries, including Australia, the Cook Islands, the Federated States of Micronesia, Fiji, French Polynesia, Kiribati, the Marshall Islands, New Caledonia, New Zealand, Palau, Papua New Guinea, Solomon Islands, Tonga, Tuvalu, the United States and Vanuatu.

58. During the current reporting period, a major development was the provision to SPC of a large portion of historical catch and effort data covering the activities of American purse seiners in the SPC area, aggregated by 5° square and month. These data, for the period 1981—1984, were released by the American Tunaboat Association on an entirely voluntary basis, after initial data processing by the Inter-American Tropical Tuna Commission. Efforts to both increase the coverage for the 1981—1984 period and to obtain data for the period from 1985 until full coverage of the American fleet was achieved with the implementation of the Multilateral Treaty, in June 1988, are continuing.

59. During the current reporting period, from May 1990 to April 1991, maintenance of the Regional Tuna Fisheries Database continued as usual. Data were received from all 16 countries listed above, that have contributed data in the past. Delays in receiving data from two countries, Solomon Islands and Tonga, were experienced, due in both cases to staff departures in-country; in both cases the problem was rectified and the delays are not expected to recur. Recent data from New Zealand, covering domestic trollers and purse seiners and foreign longliners, remain outstanding, due to staff reorganization within the Ministry of Agriculture and Fisheries; however, this delay is temporary and should be resolved in the near future.

60. During the current reporting period, editing of longline data that had been entered into the Regional Tuna Fisheries Database prior to 1987 was carried out with the help of a part-time data entry secretary. Prior to 1987, limitations in storage capacity on the available computing equipment required that certain fields

61. recorded on the logsheets be omitted from the database. The longline data have now been restored to include all data recorded on the logsheets.

62. For those countries with in-country tuna database systems, processed data were sent on a quarterly basis from SPC on diskette, while for the remaining countries, trip reports summarizing the data provided to SPC were forwarded.

63. Prior to the current reporting period, some countries had received only recent data for their in-country tuna databases, rather than their complete set of historical data, due to storage limitations with in-country computing equipment and other factors. During the reporting period, several countries received their outstanding historical data, including the Cook Islands, the Federated States of Micronesia, Fiji, the Marshall Islands, Tonga and Palau.

64. Data in the Regional Tuna Fisheries Database that are received from South Pacific Forum member countries are shared with the Forum Fisheries Agency (FFA). The quarterly data transfers from SPC to FFA proceeded as usual, except for the third quarter 1990 transfer, which was delayed due to the editing of historical longline data, mentioned above.

65. Queries regarding tuna statistics were received from several member countries during the current reporting period, including the Australia, Federated States of Micronesia, Kiribati, the Marshall Islands, New Caledonia, Palau, Papua New Guinea, Solomon Islands, Tonga and the United States.

2.1.2 Standing Committee Database

66. At the meeting of the Standing Committee on Tuna and Billfish held in Suva from 19 to 21 June 1989, the Committee considered the problem of inadequate statistical coverage of the fishing activities of distant-water fishing nations in the region, including Indonesia, Korea, Japan, Philippines, Taiwan and the USSR. The Standing Committee is an advisory sub-committee of the Regional Technical Meeting on Fisheries and includes scientists from most DWFNs which fish for tuna in the South Pacific, as well as scientists from SPC member countries. At the meeting there were representatives of Indonesia, Japan, Philippines and Taiwan, as well as several SPC member countries in attendance. It was concluded that

(a) "SPC had succeeded in gathering most of the daily catch and effort logsheet data available through SPC member countries" for the Regional Tuna Fisheries Database, but

(b) "these data from local fleets, or collected under access agreements, still did not adequately cover the activities by DWFNs in the region".

67. The Standing Committee therefore discussed the establishment of a common database consisting of aggregated data provided by all fishing nations (including DWFNs), which would be separate from the data currently assembled by SPC in the Regional Tuna Fisheries Database (which are contributed only by SPC member countries). The tuna fishing nations which have operated in the region include: Australia, Fiji, Indonesia, Japan, Kiribati, Korea, Mexico, New Caledonia, New Zealand, Philippines, Solomon Islands, Soviet Union, Taiwan, Tonga, Tuvalu, and the United States.

68. After much discussion, the following points represented the consensus:

(a) "The establishment of a common database would be extremely useful and would solve current problems of inadequate coverage of the tuna fisheries in the region;

(b) "Data should be provided at a level of aggregation consistent with levels of aggregation used by other tuna research organizations, i.e. by five-degree square and month for longliners and gillnetters and by one-degree square and month for other gear types;

(c) "Data held in the common database should be made available to all countries that provide data to the common database, subject to the minimum level of aggregation (i.e., five-degree square and month for longliners and gillnetters and one-degree square and month for other gear types)".

69. The Standing Committee recommended that "SPC work towards the implementation of a common regional tuna database, holding data aggregated to an acceptable level, which would be available to all contributing partners via a defined distribution network." Representatives at the Twenty-First Regional Technical Meeting on Fisheries, held in Noumea from 7 to 11 August 1989, recognized that "the proposed common regional scientific tuna database will considerably improve scientific studies and assessments of regional tuna fisheries" and strongly recommended that it be implemented as soon as possible.

70. The Standing Committee Database was implemented prior to the third meeting of the Standing Committee, held from 6 to 8 June 1990 in Noumea. At present, data have been provided for the Standing Committee Database by Australia, Fiji, Kiribati, New Caledonia, New Zealand, Papua New Guinea, Solomon Islands, the United States of America and Taiwan. Statistical bulletins previously published by Japan, Korea and Taiwan covering longline and pole-and-line activity have also been included in the Standing Committee Database.

71. Fishing nations for which data are outstanding include Indonesia (various artisanal gears; industrial purse seiners), Japan (recent data for longliners and pole-and-line vessels; drift gillnet vessels; purse seiners); Korea (recent data for longliners; purse seiners); New Zealand (recent data for purse seiners; trollers); Philippines (various artisanal gears; industrial purse seiners); Taiwan (purse seiners); and the Soviet Union (longliners; purse seiners).

2.1.3 SPAR Database

72. At the Second South Pacific Albacore Research (SPAR) Workshop, held in Suva from 14 to 17 June 1989, the participants agreed to the offer made by SPC to act as a clearinghouse for the receival and distribution of albacore data. Further, at the Second Consultation on Arrangements for South Pacific Albacore Fisheries Management, held from 2 to 7 March 1990 in Honiara, Solomon Islands, the meeting agreed that, as an interim arrangement prior to the establishment of the South Pacific Albacore Scientific Advisory Group, data will be provided to SPC by all fishing parties, and that SPC will compile all data and make it available for distribution.

73. Requests for data for the SPAR Database were first sent to all countries concerned in October 1989. At present, catch and effort data have been provided by Australia, Japan, Korea, New Caledonia, New Zealand, Taiwan and the United States. Size frequency data have been provided by the Australia, Fiji, French Polynesia and the United States.

74. During the current reporting period, FSP staff were involved in importing several data sets into the SPAR Database prior to the Third SPAR Workshop, held from 9 to 12 October 1990 in Noumea. During the workshop, FSP staff worked long hours responding to numerous SPAR database queries. Immediately following the workshop, FSP staff distributed the SPAR database on diskette to SPAR participants.

2.1.4 Transhipment Data

75. In 1988, the FSP began to compile statistics on tuna landings in the region. Data on transhipment have been received from French Polynesia, Guam, New Caledonia, the Northern Marianas and Palau, and data on landings at Levuka have been obtained from Fiji.

76. During the current reporting period, provision of transhipment data to SPC has declined somewhat. While data were received from Guam, data requested from the Federated States of Micronesia, French

Polynesia and the Northern Marianas remain oustanding. When transhipment data are provided to SPC, summaries are published in the SPC Regional Tuna Bulletin.

2.2 SPC Regional Tuna Bulletin

77. In August 1988, the Fisheries Statistics Project first prepared the *SPC Regional Tuna Bulletin.* The *Tuna Bulletin* has since been distributed on a quarterly basis to fisheries officers within the region and to research institutions and industry within the region and beyond.

78. During the current reporting period, the Tuna Bulletin was published on a regular basis. Delays with printing of the Tuna Bulletin that were experienced in the previous reporting period were resolved by contracting a local company to do the printing, rather than printing the Tuna Bulletin at the SPC printery.

2.3 National Fishery Statistics Systems

79. In the past, several member countries have been assisted with the collection and analysis of local fisheries data. In February 1985, a data collection programme was implemented in Tuvalu to monitor subsistence and artisanal fisheries. In June 1986, SPC undertook a consultancy to review the fisheries statistics system in Tonga. In January 1987, a review of inshore fisheries data colection in Solomon Islands was conducted. In November 1987, the fisheries data collection programme in Palau was evaluated.

80. During the current reporting period, in March 1991, further work to establish a fisheries statistics programme in the Kingdom of Tonga was conducted by the Fisheries Statistician, over a three week period in Tonga and Noumea. Guidelines were developed for a fisheries statistics programme, to include monitoring of catch and effort in inshore, offshore and oceanic fisheries, fish market sales, and imports and exports of marine products.

81. Commencing in 1988, tuna fishery databases have been developed and installed in eleven countries, namely the Cook Islands, the Federated States of Micronesia, Fiji, Guam, Kiribati, the Marshall Islands, the Northern Mariana Islands, Palau, Papua New Guinea, Solomon Islands and Tonga. Each database has been customized to the needs of the individual country. Thus, in the Federated States of Micronesia and the Marshall Islands, the database systems enable monitoring of foreign fishing activities and licensing; in Guam and the Northern Mariana Islands, tuna transhipment by foreign vessels is monitored; in Fiji, foreign fishing activities, in addition to the local pole-and-line tuna and bait fisheries, are monitored; in Kiribati, Palau and Solomon Islands, foreign and domestic fisheries are monitored; while in the Cook Islands, Papua New Guinea and Tonga, the database contains logsheets from foreign fishing vessels.

82. During the current reporting period, ten SPC member countries were visited by FSP staff to provide programming support for in-country fisheries databases, including the Cook Islands, the Federated States of Micronesia, Guam, Kiribati, the Marshall Islands, Papua New Guinea, the Northern Mariana Islands, Palau, Solomon Islands and Tonga.

83. It should be noted that while six attempts have now been made by FSP staff over the past two reporting periods to visit Tuvalu to install an in-country tuna database system. Each attempt has been thwarted due to cancellations of flights out of Noumea or into Tuvalu. Nevertheless, it is anticipated that further attempt(s) will be made by FSP staff to install an in-country tuna database in Tuvalu during the next reporting period. An in-country tuna database system will also be installed in Vanuatu during the next reporting period.

2.4 Statistical Support for Other SPC Fisheries Projects

84. Statistical support is provided to other SPC fisheries projects by the Fisheries Statistics Project, in particular the Tuna and Billfish Research Project, the Deep Sea Fisheries Development Project, the Inshore Fisheries Research Project and the Regional Fisheries Training Programme. During the current reporting period, this support has continued as usual, as described below.

85. The research activities of the Tuna and Billfish Research Project are supported by the Regional Tuna Fisheries Database maintained by the FSP. In addition, databases for Solomon Islands length frequency data and US Multilateral Treaty port sampling and observer data have been developed, as well as for observer data from the South Pacific albacore fishery and port sampling data from transhipment by Japanese gillnet vessels in New Caledonia.

86. A database has also been developed for the tagging projects conducted by the Tuna and Billfish Research Project since 1989. The tagging database system allows tagging data to be entered on laptop computers onboard the tagging vessels; the tagging data can then be transferred to SPC headquarters on diskette.

87. In March 1989, the FSP implemented a database for detailed catch statistics collected during fishing trials in member countries by the Deep Seas Fisheries Development Project since 1981. The database has been used by the Inshore Fisheries Research Project for analysis. In August 1990, a database system was developed for bottom-fishing trials to be conducted in Kiribati in 1991 by the Deep Seas Fisheries Development Project.

88. Since 1988, a database covering the technical background of participants in regional fisheries training courses has been supported by the FSP for use by the Regional Fisheries Training Programme. The FSP has also assisted the Regional Fisheries Training Programme with organization of the SPC Fisheries Statistics Workshop held at the University of the South Pacific in February 1989 and shared in tutoring of the participants at the workshop.

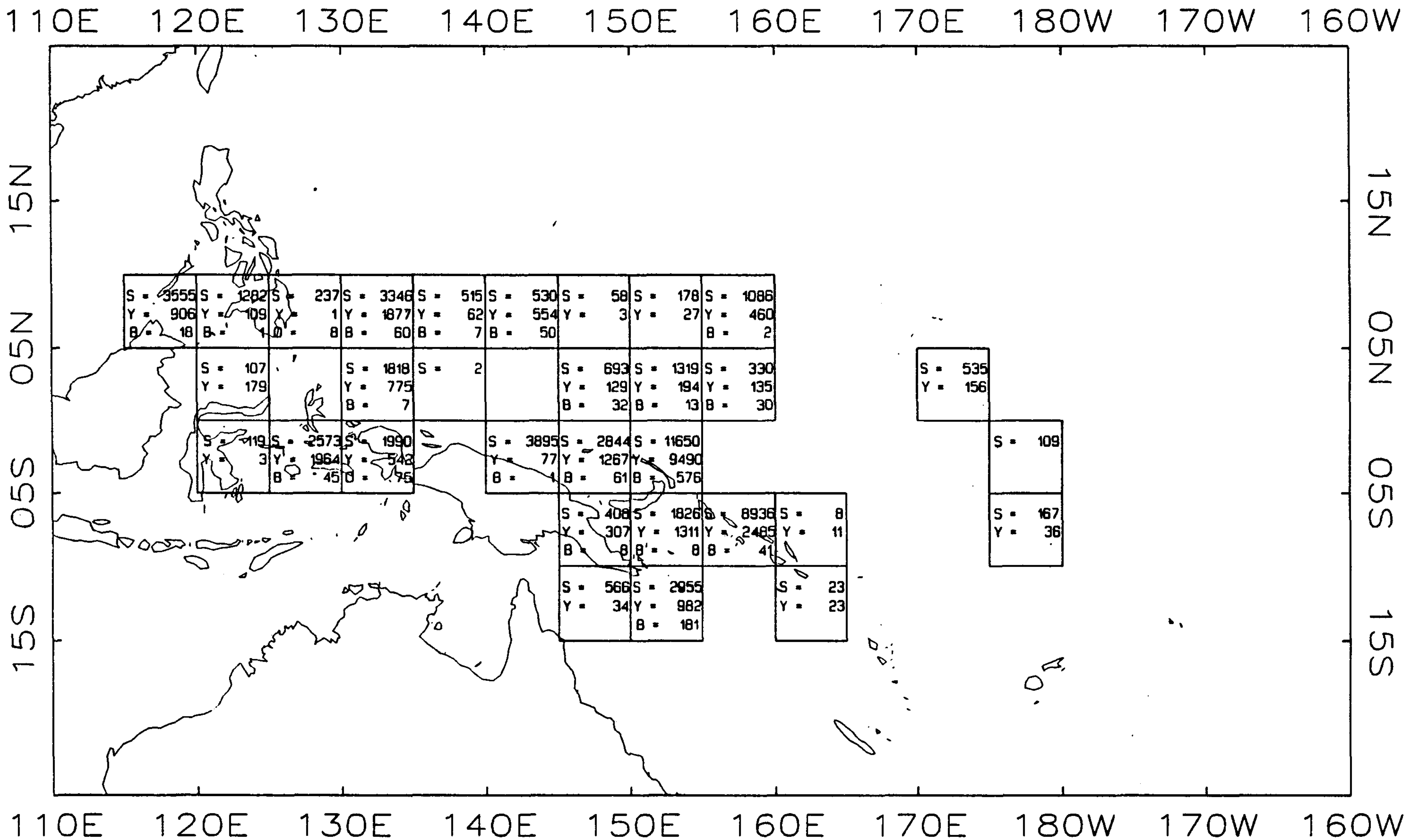


Figure 1: Tqg releases by five-degree square as at 31 May 1991. (S: SKIPJACK; Y: YELLOWFIN; B: BIGEYE)

Figure 2: Length-frequency histograms of tagged skipjack and yellowfin, by association.

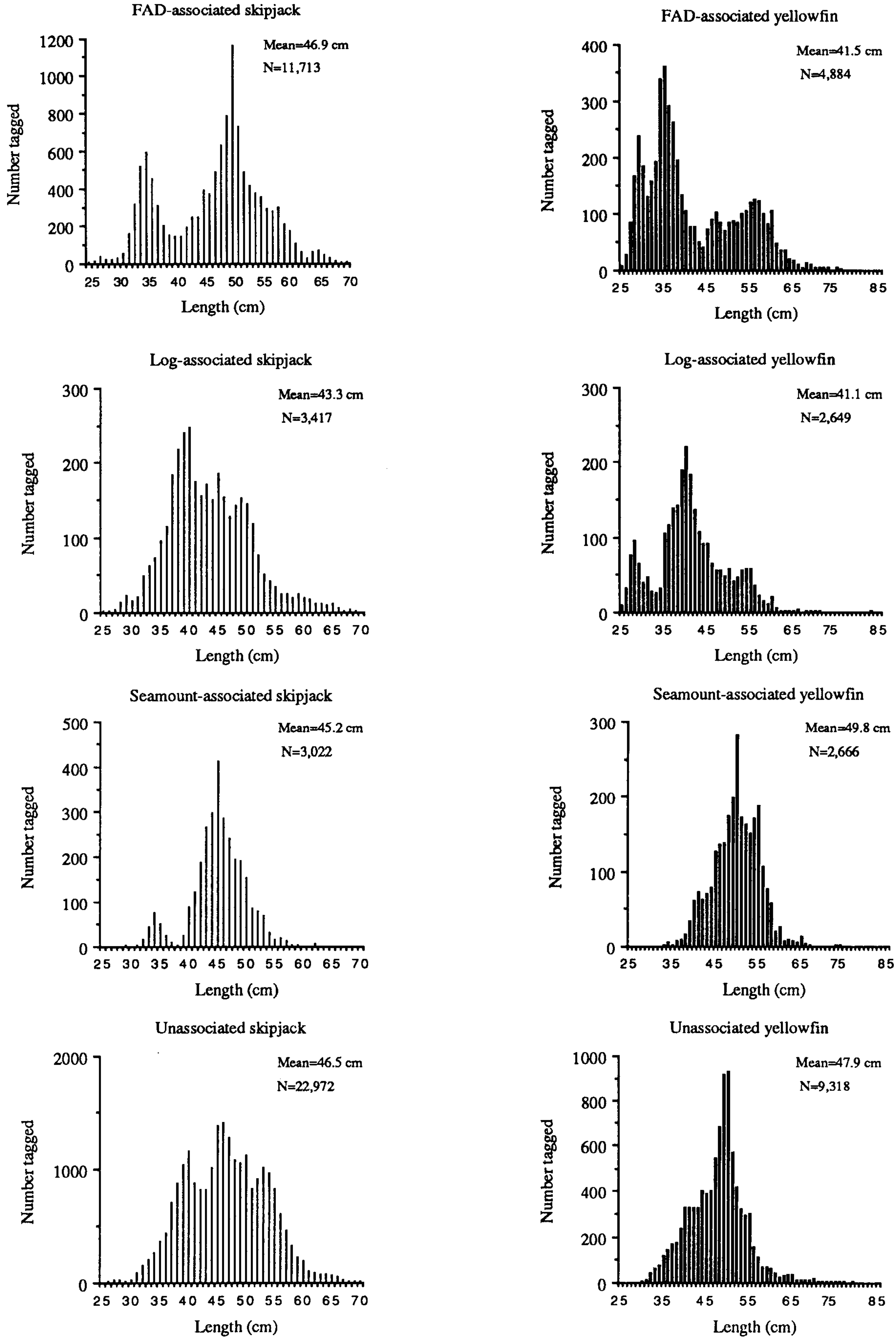
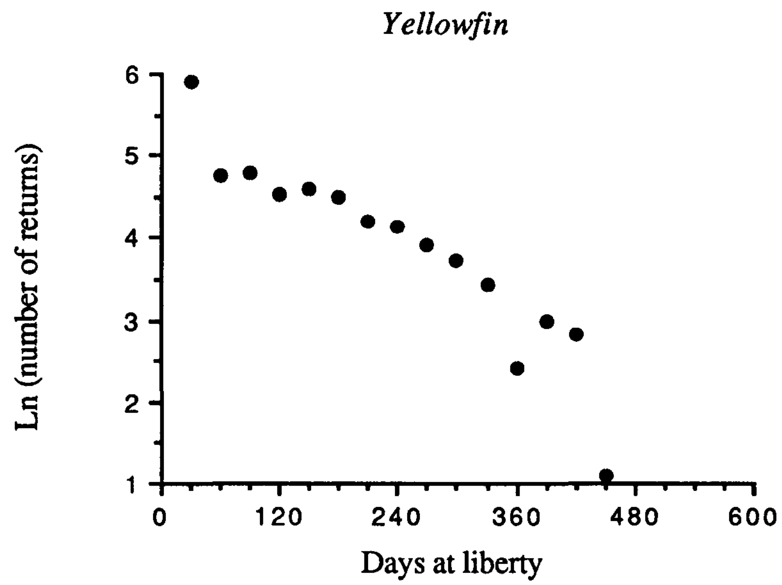


Figure 3: Plots of the natural logarithm of yellowfin and skipjack tag returns, by 30-day periods at liberty. X-axis labels refer to the upper limit of each category.



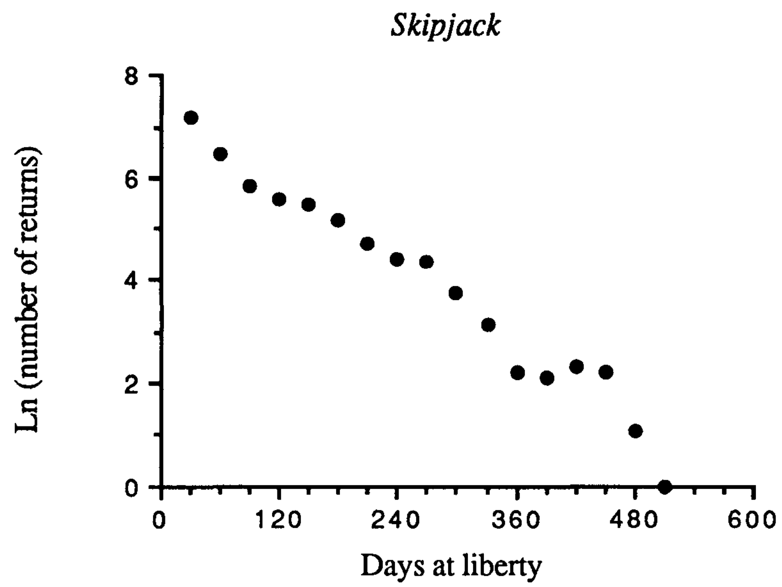
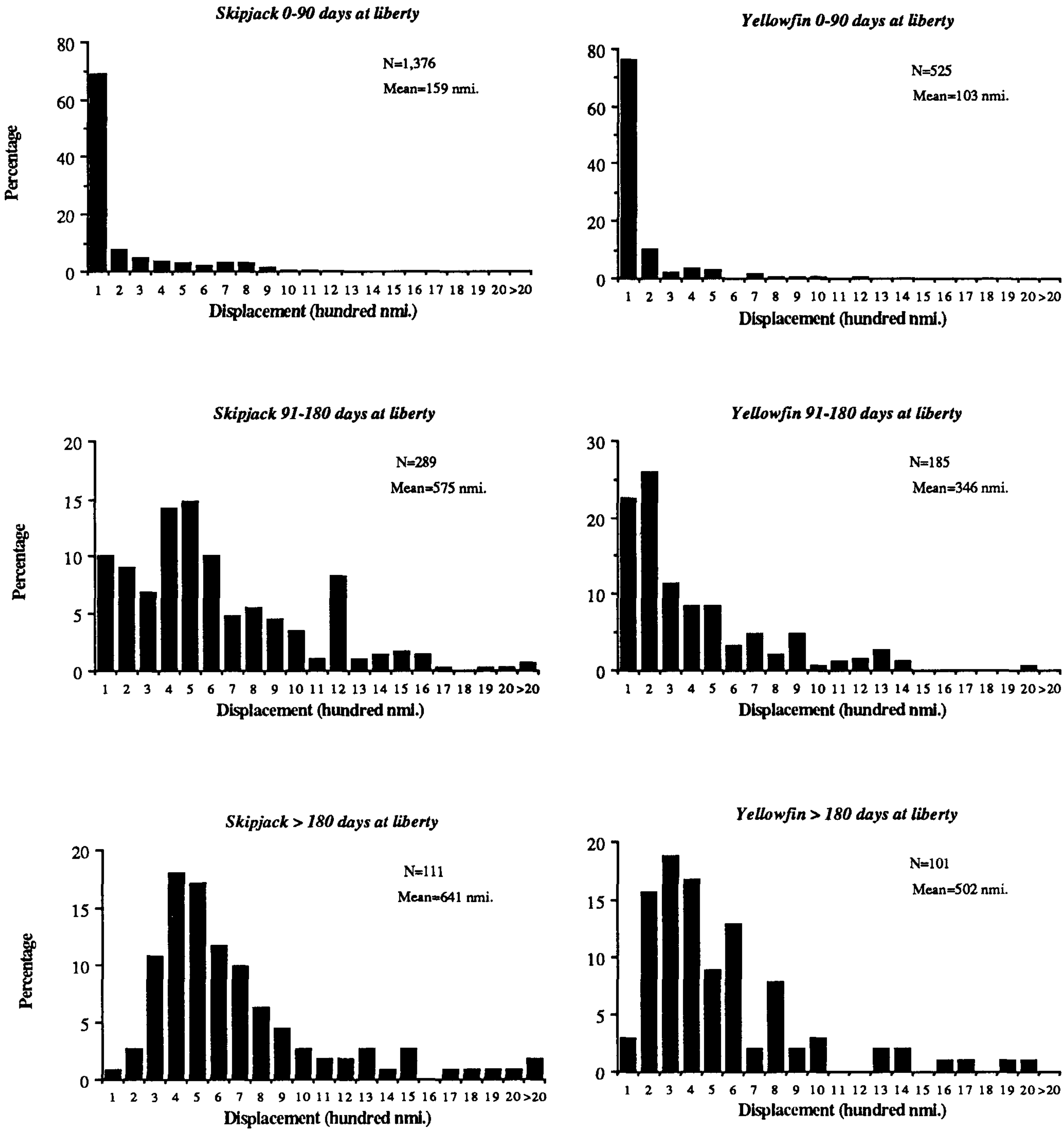


Figure 4: Skipjack and yellowfin displacement histograms for 0-90 day, 91-180 day and >180 day time-at-liberty categories. X-axis labels refer to the upper limit of each category.



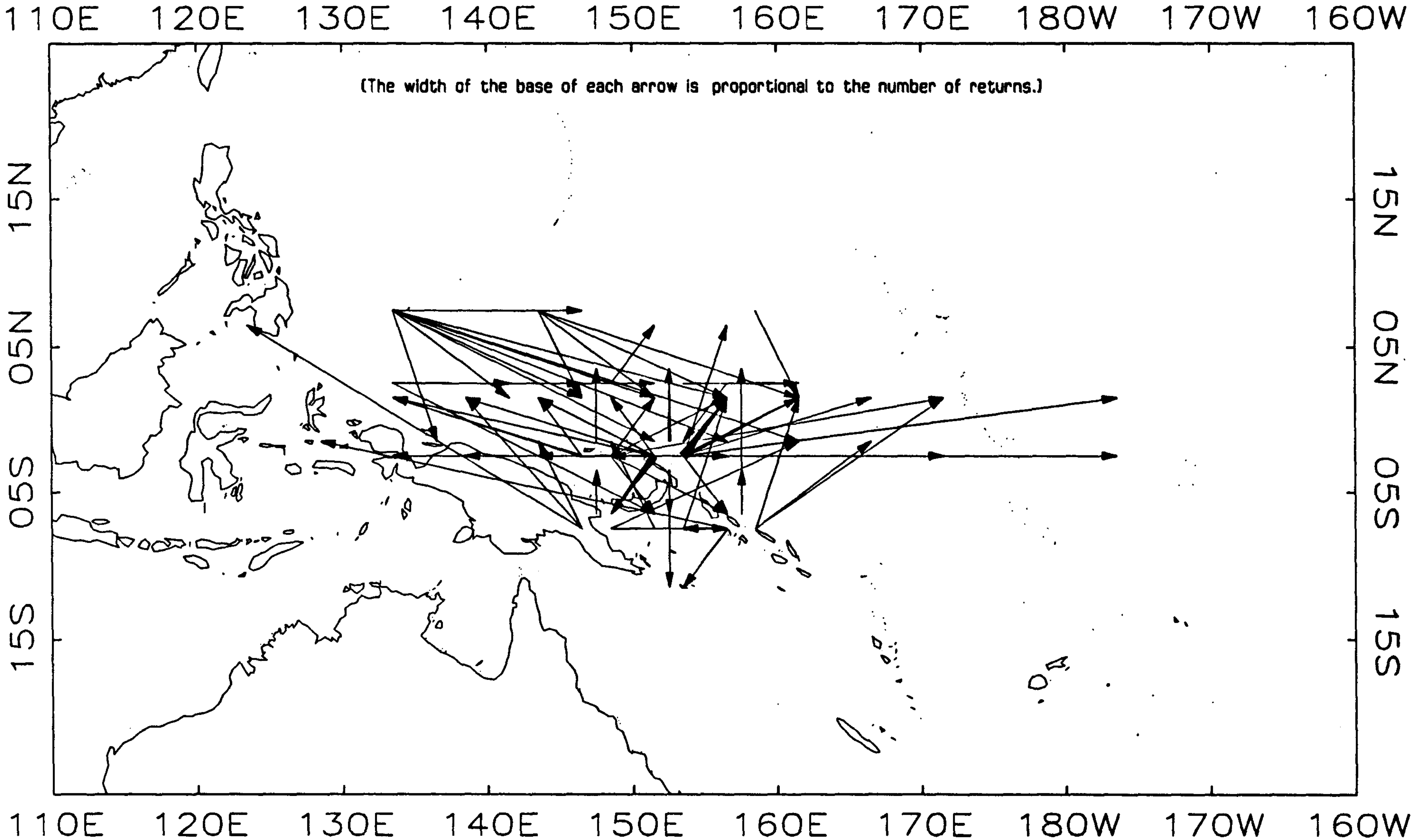


Figure 5: Movements of tagged yellowfin between five-degree squares.

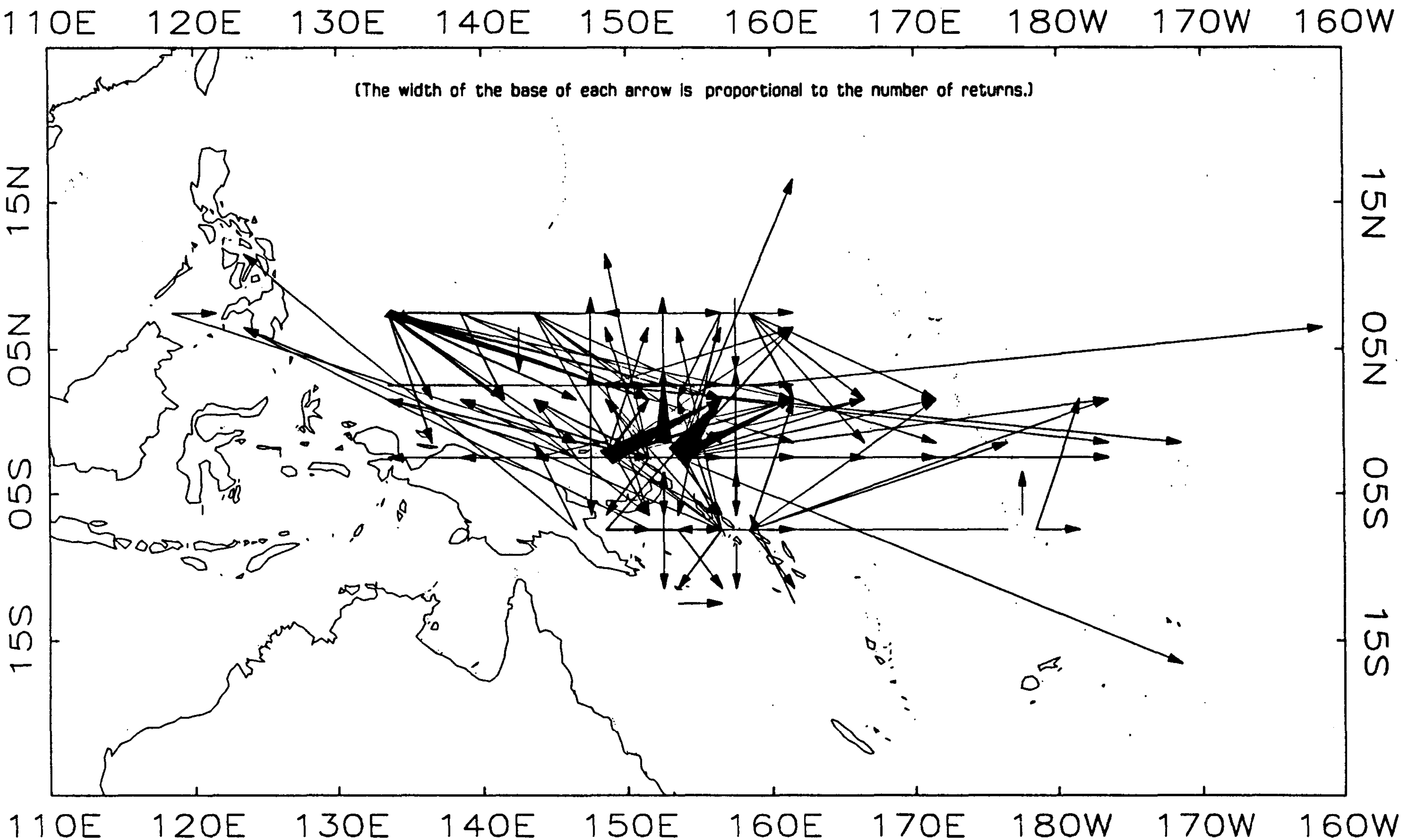


Figure 6: Movements of tagged skipjack between five-degree squares.

Figure 7: Length increment-time at liberty plots for yellowfin tag returns in different release-length categories. Negative length increments have been omitted.

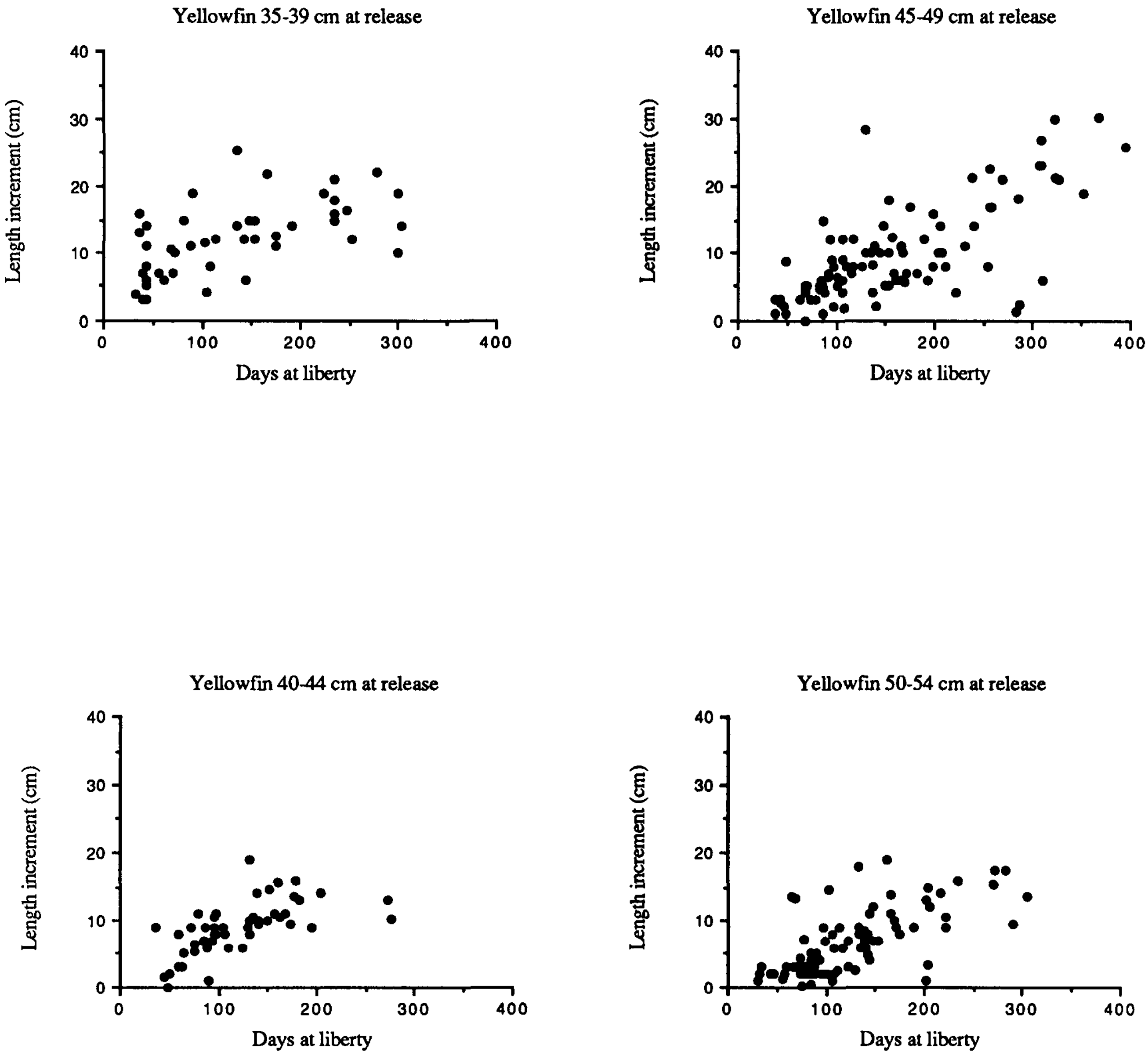


Figure 8: Length increment-time at liberty plots for skipjack tag returns in different release-length categories. Negative length increments have been omitted.