SPC/Fisheries 18/Information Paper 2
15 July 1986

ORIGINAL : ENGLISH

SOUTH PACIFIC COMMISSION

EIGHTEENTH REGIONAL TECHNICAL MEETING ON FISHERIES
(Noumea, New Caledonia, 4-8 August 1986)

REPORT OF THE FIRST SOUTH PACIFIC ALBACORE RESEARCH WORKSHOP

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604/86

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Preface

The concept of a workshop to identify research needs and to coordinate existing and proposed research on South Pacific albacore arose from informal discussions between French, U.S.A. and New Zealand scientists in 1984-1985 and more formally during the 17th Regional Technical Meeting on Fisheries held in August 1985 by the South Pacific Commission. Interest in the potential for developing surface fisheries was expressed by delegates from the Cook Islands, Fiji, France, French Polynesia, Kingdom of Tonga, New Zealand, United States of America and Vanuatu. With the possibility of an increased yield from the South Pacific stock(s) and potential for interaction between surface and longline fisheries, delegates expressed the opinion that research coordination was essential for rational development. Subsequent to this meeting representatives from agencies conducting or planning research met in New Zealand to establish possible objectives, venue and timing for such a workshop. The resultant workshop sponsored by the South Pacific Commission and organised by the New Zealand Fisheries Research Division was held in early June 1986 in Auckland, New Zealand, less than a year after it was formally proposed in Noumea. Despite its rapid evolution it has served (1) to review existing fisheries, (2) to identify types of fisheries statistics currently collected and their availability, (3) to review research programmes and present preliminary findings, (4) to identify and assign priorities of future research, and (5) provide for the coordination of research on albacore in the South Pacific. The success of the workshop is a tribute to the participants and reflects the importance of the albacore resource in the region. Thirty-two documents were tabled as working or background papers in the meeting. These papers were intended to facilitate discussion and range from preliminary reports on work in progress to reprints of previously published studies. Reference to workshop documents is given as SPAR/WP1-WP18 or SPAR/BP1-BP14 and may be obtained by contacting individual authors.

REPORT OF THE FIRST SOUTH PACIFIC ALBACORE RESEARCH WORKSHOP

I. INTRODUCTION

There is a growing awareness that the South Pacific albacore resource is capable of supporting larger yields through the development of surface fisheries. Rational development of the resource requires knowledge of stock size, life history information, patterns of movement, locations and size of fishable concentrations, relative age composition and the potential for interaction between longline and surface fisheries. The primary objectives for the meeting were to:

1. Establish a consistent set of catch and effort statistics or mechanism(s) for gathering them.

2. Identify critical research needs, especially those of South Pacific nations capable of exploiting the resource.

3. Coordinate existing and planned research to maximise use of resources.

II. REVIEW OF NORTH PACIFIC FISHERIES

Albacore are exploited by four different gear types in the North Pacific. Japanese longline, gill net and pole-and-line vessels operate primarily in western regions, while U.S.A. and Canadian troll vessels operate along the coast of North America. U.S.A. vessels operate as far west as the date line. Total catches range from 36,000 to 91,000 tonnes per year with most catches by Japanese vessels. The U.S.A. catch ranges from 9,000 to 14,000 tonnes while Canadian catches amount to a few hundred tonnes.

The trend in North Pacific fisheries is towards decreasing numbers of pole-and-line vessels, gill netters and troll boats. Pole-and-line vessels are being phased out as a management decision in preference for commissioning skipjack purse-seiners. Gill net activity is expected to

decline due to low product quality, while recent declines in the troll fleet are in response to factory closures in the continental U.S.A. and rising insurance costs. Longline effort in the North Pacific has been relatively static for about the last 20 years. In the U.S.A. there is a trend towards producing high quality products using troll caught fish for west coast restaurants and for export to Japan and Thailand. These markets are expected to take about 5,000 tonnes per year.

The most crucial information which led to the expansion of the U.S.A. troll fleet from coastal waters to the Central North Pacific was provided by:

1. tagging studies to show patterns of fish movement and for establishing the timing of fishing activity and

2. oceanographic studies to identify potential fishing areas and to help restrict search areas.

III. REVIEW OF NORTH PACIFIC ALBACORE BIOLOGY

A collection of published papers on biological studies were presented as background documents (SPAR/BP4 to SPAR/BP14). Tagging studies and results, done cooperatively with the albacore industry, have provided much of the information for understanding these fisheries. Between 1971 and 1985 21,789 fish were tagged, mostly by fishermen. Recoveries have been made from all fisheries with an overall recovery rate of 5.7%. Most tagging has been of 2 to 4 year old fish east of 180°. Recoveries have been made up to 7 years later with 28% of recoveries made during the season of release and 46% recovered 1 year after release across the North Pacific. These data have been used to estimate age and growth rate as well as determine patterns of movement. Tag recoveries indicate two "subpopulations", differing in growth rate and migration patterns, are exploited. The southern "subpopulation" undergoes a less extensive migration than that of the northern group and has a faster growth rate. These "subpopulations" appear to differ in spawning times. The southern group appears to have two peaks of spawning activity while the northern group has a single peak. Spawning

areas probably differ between the two groups, but occurs between 10°N and 25°N latitude. Age at first spawning based on macroscopic examination of gonads occurs at about 6 years. Recent study, however, of South Pacific albacore gonad sections indicate that fish as young as 3 or 4 years old may contain mature sperm and ova.

Length at first birthday in the North Pacific has been confirmed to be about 35 cm in fork length, based on recoveries of tetracycline injected fish. Migration rate, route and timing are affected by frontal boundaries of transition zone waters. An analogous oceanographic feature in the South Pacific is the Subtropical Convergence Zone.

Vertical structure, particularly thermocline characteristics, also affects fishing success. Results of ultrasonic tracking indicate that the thermocline is not a barrier to vertical movement. The extent of vertical movement is greater during the day and may cover a 10°C range in 20 minutes or less. It appears that fish aggregate in the region of the thermocline and along frontal boundaries because of higher food availability. For successful fishing the thermocline must be shallower than 90 m, with an optimal depth of about 25 to 30 m.

The northern and southern "subpopulations" in the North Pacific arrive along the U.S. coast at different times, the southern group arriving in early July, while the northern group arrives in mid to late July. Tagging results indicate that there is no exchange between these groups during the season of release, but some exchange occurs in subsequent years. Tagging studies have changed views regarding migration paths and increased the understanding of stock structure in the North Pacific. Similar studies will provide considerable insight into the dynamics of the South Pacific resource.

IV. ALBACORE STOCK ASSESSMENT

In the mid 1970's the NMFS Southwest Fisheries Centre began studies on North Pacific albacore as a model for evaluating methods for investigating migrating fish populations. The reasons for choosing this fishery was the apparent simplicity of stock structure, an extensive

long term oceanographic data base and the cooperation between the nations fishing the resource. The accumulation of data through these programs is being used in population models of various tuna stocks. The estimated MSY for this stock is about 125,000 tonnes. Model projections doubling either longline or surface troll effort indicate few adverse effects on the fisheries or stock structure. Such simulations are useful in evaluating the consequences of changing the pattern of effort between fisheries.

The South Pacific albacore resource is currently harvested at about the MSY of 37,500 t. This estimate is based on longline catches by vessels based in Pago Pago. Experience with other tuna fisheries has indicated that an MSY calculated from longline statistics does not necessarily reflect the potential yield of all fisheries. It is likely that it is possible to increase the South Pacific albacore yield by further development of surface fisheries. Rational development of South Pacific stock(s) requires a greater understanding of stock dynamics. One approach is through the application of age structured models such as cohort analysis. Such models will require information on age and growth which is not presently available for this resource. It will also require a more consistent set of catch and effort statistics than is presently available.

V. SOUTH PACIFIC ALBACORE FISHERIES

New Zealand

Three commercial fisheries catch albacore in the New Zealand area. The most important is the domestic troll fishery which lands approximately 2,000 to 3,000 tonnes each year. The remaining two fisheries are foreign longline fisheries, one of which targets for albacore in northern N.Z. waters and the other taking a significant by-catch while targeting for southern bluefin tuna. The total longline catch per year is usually less than 1,000 tonnes.

Australia

Albacore is a by-catch of the yellowfin longline fishery and of the southern bluefin tuna pole-and-line and purse-seine fisheries. The highest catch recorded was 2,000 tonnes in the Great Australian Bight from a total catch of 14,000 t of southern bluefin in the pole-and-line fishery. Albacore weigh up to 30 kg, with an average of 6 to 10 kg and currently receive AUS $1,000 per tonne.

New Caledonia

Albacore is caught as a by-catch of Japanese and domestic longline fisheries targeting for the Japanese sashimi market. In 1985 15 Japanese vessels, with 20% of their catch being albacore, and 3 domestic vessels, with 31% of their catch being albacore, operated within the EEZ of New Caledonia. The average weight of fish caught in these fisheries is 15 to 20 kg. The total 1985 longline catch was 1,200 t of which 300 t were albacore.

Fiji

Albacore is caught as the target species of chartered longline vessels, together with catches of skipjack and yellowfin by purse-seine and pole-and-line vessels. Most of the catch is landed at a local cannery.

The longline fishery reached a peak in 1978 with 36 vessels and a catch of 5,528 tonnes, but has since declined to 11 vessels. The average fish weight is 14 to 19 kg and presently achieves US $1,705 per tonne for fish over 15 kg.

Cook Islands

At present, there is one longline fishery in this area, involving 80 licensed Korean and Taiwanese longliners. The Korean vessels unload in Pago Pago, receiving US $1,707 per tonne, albacore average from 18 to 24 kg.

The Cook Islands do not have a pole-and-line fishery for tuna because of the scarcity of suitable bait fish but are interested in the recent successes of U.S.A. troll vessels in the South Pacific.

Vanuatu

Vanuatu has a joint-venture with a Japanese company chartering Taiwanese longline vessels. Twelve Taiwanese vessels landed 3,000 tonnes of albacore in 1985, operating within and outside the EEZ of Vanuatu. Catch and effort data are supplied to the South Pacific Commission.

Kingdom of Tonga

Tonga has one domestic longline vessel that in 1985 caught 370 tonnes of tuna, of which 80% were albacore; 325 tonnes were exported of which albacore made up 90%. The 45 t sold locally consisted of other tunas as all albacore, except for damaged fish, are exported. The albacore had an average weight or 20 kg and the catch rate was 1.8 tonnes per day. The Tongan government hopes to increase this fleet in the near future.

French Polynesia

Japanese vessels target for tuna for the sashimi market. In 1985 these vessels caught 1,700 tonnes of tuna of which 5% was albacore with a CPUE of 0.02 tonnes albacore per day over 900 fishing days. Korean vessels caught 3,100 t of tuna, of which 39% was albacore with a CPUE of 0.4 tonnes albacore per day over 2,600 fishing days. These data are provided by the vessels through a weekly radio schedule.

Taiwan (R.O.C.)

Taiwan has divided their tuna-like (tuna and other scombrids) fisheries into two classes, the inshore fishery with vessels less than 50 tonnes and the far seas fishery with vessels over 50 tonnes. The inshore fishery employs longlines, gill nets and purse-seines. But, only tuna longliners target for tuna, with a predominant catch of yellowfin. This fishery has shown a trend towards larger vessels.

The far seas fishery involves large purse-seines, large mesh gill nets and tuna longlines. Only tuna longliners operating in the South Pacific have albacore as the predominant catch. Trends in this fishery include a decrease in vessel numbers and a shift to other fisheries

based at home for economic reasons (the rise in oil prices and the decline in tuna prices). A considerable number of albacore from this fishery have been measured (length estimates provided by vessel captains) which will be analysed to estimate the effect of fishing effort.

United States of America

The U.S.A. South Pacific albacore fishery began in 1986 with two commercial troll vessels working in conjunction with the NOAA ship R.V. Townsend Cromwell along the Subtropical Convergence Zone between 38° and 41°S from 140° to 170°W. A total of 92 t were caught, with a further 4.5 t (610 fish) tagged and released. The maximum catch by one vessel was 1,421 fish in a day (10.4 t), with an average weight for the trip of 8.0 kg. These vessels caught an average of about 1.5 t per day. The catches were landed in Pago Pago and received US $1,635 per tonne.

At present 20 to 25 vessels have expressed interest in joining this fishery in 1987.

VI. PRESENT RESEARCH ACTIVITIES

France (ORSTOM)

A research programme on albacore has been carried out by ORSTOM in the western and central South Pacific since 1965. This programme covered two areas, surface albacore and deep-swimming albacore. The work on surface albacore is based on a cruise by the R.V. Coriolis in 1982 which determined that albacore were present in the Subtropical Convergence Zone in the central South Pacific. A similar survey is planned for 1987.

Information on deep-swimming albacore has come from commercial fisheries based in Vanuatu and a series of research surveys conducted between 1965 and 1974. The primary aim of these surveys was to understand the feeding habits of longline caught tuna in relation to their vertical distribution and that of their forage.

New Zealand Research on Albacore Biology

Feeding:

Albacore from the Subtropical Convergence Zone east of New Zealand fed primarily on mesopelagic and epipelagic fishes, in particular myctophids and saury over the Chatham Rise, and the jack mackerel, Trachurus murphyi, further to the east. The high concentrations of T. murphyi in the eastern area suggests that they may be a possible bait source for a possible pole and live bait fishery for albacore in the region but this requires further investigation.

Maturity:

A small sample of female albacore ranging in size from 48 to 89 cm were found to be immature. Two groups of egg sizes were identified, with the separation between groups occurring around 70 cm fork length.

Parasites:

This study is aimed at examining the movements of albacore based on the parasites found in albacore viscera and heads. Samples from 45 fish have been examined, these fish have a high percentage of tropical parasites. This suggests that albacore caught in N.Z. waters have a tropical origin.

Proximate composition of albacore muscle:

Samples of albacore from various areas have been analysed to determine the levels of oil, moisture, crude protein and ash in the fillet, head, viscera, frame and skin. Preliminary results indicate that:

- Highest oil levels in the flesh are found in the outermost 1 cm.
- A strong negative correlation exists between oil and moisture content.
- White muscle contains higher levels of crude protein than does red muscle.
- The total omega-3 poly-unsaturated fatty acid content is higher in the red muscle than in white muscle.
- Low sea surface temperature appears to be associated with high oil content.
- Oil content of small fish appears to be lower than that of larger fish.

Research Surveys

United States of America

As part of a multi-ship operation involving U.S. and N.Z. vessels, the NOAA ship Townsend Cromwell surveyed the oceanic area associated with the Subtropical Convergence Zone (STCZ) east of the Chatham Islands. The objectives were (1) to obtain information for use in developing our understanding of South Pacific albacore biology, ecology and population dynamics, (2) to describe the physical and biological characteristics of the surface layer of the central South Pacific, and (3) to evaluate relationships between the distribution and availability of albacore in surface waters of the Subtropical Convergence Zone in the South Pacific.

Data recorded included continuous sea surface temperature and salinity, CTD casts, usually to 1000 m, chlorophyll samples, XBT drops, two types of midwater trawl and neuston hauls. Most of the effective fishing was done by two U.S. commercial troll vessels, but the Townsend Cromwell, trolling 3-9 lines, caught albacore for tagging, various biological samples and to evaluate the relationship between albacore distribution and the southern boundary of the Subtropical Convergence Zone. Although conclusions from the one cruise are tentative, the following results are evident:

- Albacore catches in the South Pacific were associated with the Subtropical Convergence Zone.
- Fishing success was highest at the northern boundary of the STCZ.
- Best catches were made in warm water intrusions, within the STCZ.
- The southern edge of the STCZ appears to be the southern limit to albacore distribution.
- The width of the STCZ east of 170°W lies between about 38.5°S and 40.5°S; west of 170°W to N.Z. it is located between 39°S and 46°S.
- Most catches were made at temperature fronts with gradients of about 0.5° to 1°C per mile.
- Albacore were caught in waters where sea surface temperatures were between 16.5° and 19.0°C. The highest catches were made at temperatures of near 18.3° to 18.6°C.

- Fish weighed from 4.5 to over 18.0 kg, averaging about 8.0 kg.
- Juvenile jack mackerel were the most important food item. Other food items included small squid, krill and other small fishes.

New Zealand

The primary objective of recent cruises has been to describe the relationship between oceanic conditions and albacore fishing success. Two important oceanographic features in the New Zealand region, the Subtropical Convergence Zone (STCZ) and the Subtropical Divergence or Tasman Front were surveyed during February and March 1986. The first cruise (KO3/86) concentrated on surveying the STCZ over the Chatham Rise east of New Zealand.

The second cruise (KO5/86) was conducted across the Subtropical Divergence northwest of New Zealand. Data collected included CTD and hydro casts to 500 m, manual bathythermographs to 140 m, chlorophyll samples, continuous sea surface temperature, surface salinity and various biological samples from troll caught albacore.

Catches of albacore were highest over the Chatham Rise and at the northern and southern boundaries of the STCZ. Catch rates equivalent to commercial vessels were achieved along the 200 m isobath west of Chatham Island. During KO5/86, few fish were caught in the vicinity of the Subtropical Divergence but good catches of small fish were made on the shelf off Cape Egmont.

Both the STCZ and Subtropical Divergence are areas of locally high productivity which at times should concentrate albacore. Seasonal studies of these areas are believed to be important in understanding the movement of albacore in the New Zealand region.

Japan

Over the last 3 to 4 years two JAMARC gill net vessels have fished for slender tuna and albacore to the north and east of New Zealand. At present there appear to be difficulties in developing markets for slender tuna due to its high oil content and colour when canned. Research survey information is not widely distributed, but catches of

albacore are reported to average about 1 to 1.5 t per set when it is the target species.

VII. PROPOSED RESEARCH ACTIVITIES

United States of America

Present plans are for the Townsend Cromwell to repeat and extend the survey of South Pacific albacore resources associated with the Subtropical Convergence Zone begun in 1986. The primary survey area is expected to be between 160°W and 140°W longitude. The area and timing will coincide with that of up to 25 U.S.A. commercial troll vessels. The cruise track of the Cromwell will bracket the area fished by U.S.A. commercial vessels and be designed to improve our ability to characterize the STCZ. The 1987 cruise objectives will be similar to those of 1986 and will be coordinated with surveys proposed by New Zealand and France. Research plans beyond 1987 will depend on the U.S.A. albacore fishing industry's interest in developing a Central South Pacific surface fishery.

U.S.A. commercial vessels in 1987 will conduct, as they did in 1986, XBT drops, exploratory fishing operations and tagging in conjunction with the Townsend Cromwell.

France

In late 1986 ORSTOM will begin a tuna-environment study in collaboration with SPC. The aim of the programme is to relate tuna catches to oceanographic features. Under a joint agreement between ORSTOM and SPC, ORSTOM will supply environmental data and SPC will supply fisheries statistics.

ORSTOM-Noumea also expects to deploy the R.V. Coriolis in the summer of 1987. Present plans are to survey the STCZ region at about 40°S from 150°W to the longitude of Easter Island. The proposed survey track will require 27 days steaming time and leave 20 days for sampling. The coordination of proposed cruises by the Coriolis with those proposed for the Cromwell and Kaharoa is essential to maximise spatial coverage of

size composition data and tagging efforts. Coordination will also minimise time spent locating the STCZ through real time processing of CTD data.

New Zealand

In November and December 1986 the Kaharoa will survey surface waters over the southern part of the Norfolk Trough to estimate the geostrophic flow in the North Taranaki Bight. A second objective is to determine whether the southward flow of surface water observed over the Norfolk Trough north of the Subtropical Divergence during KO5/86 is present to the south of it. An equally important objective will be to tag albacore prior to the start of the domestic season in an area north of the fishing grounds. Tagging will also be conducted in January 1987 from commercial vessels along the west coast of the South Island. These tagging studies are directed at testing an hypothesis that albacore move with rather than against the direction of surface flow. We expect to be able to test this hypothesis using tag returns during the season of release together with estimates of surface flow.

In February 1987 the Kaharoa will repeat and extend its survey of the STCZ concentrating in the area around and to the east of the Chatham Islands. The survey area is expected to extend out to 170°W with fishing effort concentrated along the northern and southern boundaries of the STCZ. The survey area includes the region east of the Chatham Islands where the Townsend Cromwell had poor catches in 1986. A comparison of catch rates in this region with adjacent shelf edge areas may make it possible to determine if high catch rates are related to shelf edge shear zones.

South Pacific Commission

The SPC will continue efforts to compile data from tuna fisheries in the South Pacific and will give special emphasis to the acquisition of albacore data. These data will be made available to collaborating researchers. Existing work on interactions between surface and longline fisheries for yellowfin tuna will be extended to albacore fisheries. Planned work on general two-dimensional tuna migration models will also be extended to albacore.

VIII. REVIEW OF RESEARCH DATA AVAILABLE IN THE SOUTH PACIFIC

A map of French, U.S.A. and New Zealand research cruise tracks (Figure 1) indicates that there is little survey data available for the South Pacific outside of the New Zealand EEZ. There may be historical cruise data available for oceanographic studies, but these are expected to be few and with stations widely spaced. Satellite remote sensing should provide a useful source of synoptic sea surface temperature data but may be limited by cloud cover in the vicinity of the STCZ.

IX. REVIEW OF SOUTH PACIFIC ALBACORE CATCH DATA

At present Taiwan, Japan and Korea catch about 23,000 tonnes of albacore per year in the South Pacific. New Zealand lands a further 3,000 tonnes per year while several Pacific Island nations land minor quantities of albacore (see Table 1).

There are at present three estimates of total albacore landings from the South Pacific. They do not differ greatly and indicate that the total catch is somewhere between 25,000 and 40,000 tonnes per year. From these data, the South Pacific Commission was able to show that its logsheet data collection system is currently able to obtain only 10% of the known catch. The major reason for this is that a large proportion of longlining is conducted in high seas areas and there is no provision in the present licensing system to collect this data.

The SPC has an official policy, with an international legal basis, of maintaining confidentiality of data. These data are restricted and may only be used with written permission from the source country or organisation. Thus the SPC is in a position to act as an impartial custodian of regional fisheries data for southern albacore. The meeting expressed support for the efforts of SPC to obtain a complete set of catch and effort statistics for albacore in the South Pacific. Access to these data could be improved if they were used in an aggregated form. It was considered that more detailed data could be studied by arranging cooperative pooling of data from contributing countries at ad hoc scientific meetings.

X. RESEARCH PRIORITIES FOR RATIONAL DEVELOPMENT OF ALBACORE FISHERIES

Tagging:

Both New Zealand and U.S.A. fishermen consider tagging to be important in understanding tuna fisheries. American experience shows that less than 15% of troll caught albacore are suitable for tagging, and since research vessels usually have relatively low catch rates it is more effective to tag from commercial boats. An additional advantage in tagging from commercial vessels is the higher return rate associated with enthusiasm amongst fishermen for research programmes in which they are involved. Pole-and-line caught albacore are in better condition than troll caught fish for tagging, with 95 to 98% of the fish being taggable. Unfortunately such vessels are usually expensive to charter.

A coordinated albacore tagging programme was proposed as a high priority for research. The objectives of the tagging programme would be primarily to (1) determine patterns of albacore movement and migration, and (2) provide age and growth rate estimates. Tagging should also help in defining mortality and exploitation rates and in investigating interactions between surface and longline fisheries.

Release areas for tagging studies are likely to include:

Australia : along the east coast incidental to a yellowfin tagging programme currently underway.

New Zealand : west coasts of the North and South Islands and the east coast of the South Island (the STCZ)

Central South Pacific : the STCZ.

Some double tagging to estimate tag shedding rate is desirable. Since double tagging is more complicated than single tagging it is not expected to be done by commercial fishermen. Double tagging together with tetracycline injections was considered impractical. Studies validating daily growth rings by tetracycline marking of North Pacific albacore should be extended to the South Pacific population. Tagging in the first year will concentrate on tetracycline marking.

Protocol for Cooperative Tagging Programmes

The large head, spaghetti streamer dart tag produced by Hallprint Ltd., Australia, was recommended. The New Zealand pelagic group agreed to investigate the availability of small diameter applicator needles for the Hall tag. The recommended tag colour for fish injected with tetracycline is red, and for fish not injected is yellow. The red and yellow tags will have separate number series to ensure that tag reports clearly indicate whether a fish is marked with tetracycline or not.

A central collection area for tags was proposed to improve tag recovery. The port of Pago Pago, American Samoa was suggested as the most suitable place for tag and fish returns since it has the highest landings of albacore in the South Pacific. A U.S.A. NMFS staff member will be available to collect fish and tags in Pago Pago.

The text on the tag will include:

> Identification number, return to SPAR, P.O. Box ...., Pago Pago, American Samoa. REWARD (in English and Chinese).

Fishermen catching tagged albacore near New Zealand are likely to leave the tag and fish in the care of the fishing company, who if notified will return them to the Fisheries Research Centre in Wellington. A similar pattern is expected to occur with fish caught within the EEZ of other countries. All data will be forwarded to the SPC Tuna and Billfish Programme for archiving. The South Pacific Commission has agreed to accumulate data from all countries and arrange for data distribution. It was agreed that the data would be accessed and used in consultation with the tagging agencies involved. The possibility that tag numbers be included in the ICCAT worldwide tag data base was discussed.

The SPC and the NMFS Southwest Fisheries Centre have well developed techniques for tagging. The Southwest Fisheries Centre will supply more information on their tagging programme for North Pacific albacore. A standard method will be adopted for the cooperative South Pacific albacore tagging programme. Length measurements will be to the nearest lower cm, on a solid, flat surface. The tagging board should be kept wet while tagging to prevent damage to the fish.

Tagging publicity details will be developed outside the workshop by a tagging working group. General features of publicity will include distribution of posters (in Chinese, Korean, Japanese and English) and announcements in newsletters, newspapers and magazines.

The tag reward system will be patterned after the North Pacific albacore tagging programme. People returning tags will receive a baseball cap with programme logo, data on release and recovery, and be entered in a lottery for a cash prize. People returning fish with red tags, in addition to the above, will be awarded the price of the fish and a cash reward of $50.00 (U.S.A.). Commercial fishermen who carry out or cooperate in tagging will be reimbursed for their trouble with a cash incentive of twice the landed value of the tagged fish based on recorded fork length converted to weight.

Length Frequency Distributions

The collection of length frequency information has a wide range of applications and is relatively easy to gather. There is, however, uncertainty as to effects of sex composition on length frequency distributions, sample size required to characterize catch composition, and the extent of variability in size composition within the region. Sex is difficult to determine from macroscopic examination of gonads in surface caught fish and data on sex composition is sparse. It is difficult to obtain adequate length and sex data from market sampling since fish are landed as whole frozen fish. Sampling length composition alone is often unreliable due to unknown biases in "random" sampling strategies. An alternative sampling strategy which is possible on longliners and research vessels is systematic sampling.

The value of length frequency data to various modelling approaches makes the consistent and routine collection of such data a high priority research area. As a minimum condition for fisheries monitoring some protocol for collecting length frequency data should be developed.

Biological Studies

EARLY LIFE HISTORY INFORMATION

Information on the distribution of early life history stages is relatively well known latitudinally, but the unequal distribution of sampling longitudinally has created gaps in our knowledge of spawning areas. One area where there has been little sampling is the area north of the central and southwestern South Pacific where surface fisheries are likely to develop. ORSTOM collected and may still hold approximately 2,000 zooplankton samples from this area which can be provided for analysis of tuna larvae. The possibility that NMFS may be able to arrange for their analysis will be investigated in Honolulu. It may also be possible to learn more about the distribution of larvae and juveniles from their occurrence in stomach contents. Other high priority research areas include studies on gonad maturation. It was suggested that the approach used by John Hunter (NMFS) applied to preserved gonads from longline caught fish in tropical regions could resolve whether albacore are single or multiple spawners. New Zealand is prepared to receive preserved gonads and provide stained sections as part of any cooperative programmes.

FOOD AND ENERGETICS

The study of food and feeding would contribute to studies of albacore distribution and behaviour. Studies on the vertical distribution of food, size selectivity of prey, energy values of prey, and variability in diet are potential areas for research. Given the limited understanding of South Pacific albacore biology and ecology, trophodynamic studies were considered inappropriate and of low priority. Opportunistic sampling and limited studies of albacore forage will be conducted as part of research surveys. Any stomachs collected can be forwarded to New Zealand for analysis.

AGE AND GROWTH

Studies of growth rings in sagittae and other hard parts will be carried out. Returns of tetracycline injected fish will be sampled for otoliths, dorsal spines, scales, and caudal vertebrae. Otoliths are

to be sent to NMFS La Jolla and other hard parts to New Zealand. Otoliths will be used to verify that the daily banding sequence found in North Pacific albacore also occurs in South Pacific albacore. Other hard parts will be studied and banding sequences compared with otolith banding to determine whether alternative aging methodologies can be developed.

MORTALITY RATES

The development of methods to estimate mortality rates was identified as a high priority for research. Present techniques generally require data which are not presently available for South Pacific albacore. In addition, the lack of an adequate understanding of population structure limits our ability to plan tagging studies to estimate mortality rate. No plans to estimate mortality were proposed other than those based on the use of catch and effort data.

TIME AND SPACE DISTRIBUTIONS

Much of the research activity discussed earlier in the meeting is designed to develop a better understanding of the distribution of albacore in time and space. This includes research cruises and the tagging proposals. Discussion of the 'stock' concept centred around the separation of North and South Pacific albacore. The likelihood of significant exchange between North and South Pacific albacore was considered to be low, based largely on the absence of tag movements between hemispheres. It was suggested that exchange between South Pacific and Indian Ocean albacore might be possible around southern Australia.

Consideration of possible 'stocks' of South Pacific albacore was postponed due to inadequate biological data on which to base hypotheses and from concern about the value of the currently available techniques other than tagging (morphometric and electrophoretic studies).

XI. ALBACORE FISHERY DEVELOPMENT OPPORTUNITIES FOR SOUTH PACIFIC ISLAND NATIONS

Cook Islands:

The Cook Islands are very interested in the recent U.S.A. effort in the South Pacific and feel that they could actively participate in this fishery if it develops. Since trolling is not as capital intensive as other tuna fishing methods it appears to be a relatively promising method for the Cook Islands to adopt. The Cook Islands look strongly to the U.S.A. for technical assistance in light of the increasing American interest in the Pacific region.

Kingdom of Tonga

The management committee of Tonga's only longline vessel is interested in U.S.A. involvement in the South Pacific. At present Tonga is setting up a Fishing Industry Board primarily for fisheries development. The possible participation by Tonga in a surface troll fishing for albacore is a development opportunity for them to evaluate.

French Polynesia

French Polynesia would probably be interested in the possible albacore fishery to the south, but at present this is uncertain. Currently, most effort is aimed at poling skipjack from relatively fast and light vessels. These boats have little storage space and no refrigeration, and because of their small size are considered unsuitable for high seas fishing over 1,000 miles south of Tahiti.

Fiji

Fiji expressed an interest in increasing the landings of albacore at their cannery and suggested that the unloading time for U.S.A. troll vessels might be faster at Levuka than at Pago Pago.

Island participation in the U.S.A. commercial troll venture was suggested, but it is considered impractical at present because of insurance problems. If such problems can be solved in the future U.S.A. fishermen would include islanders on their trips.

XII. FUTURE WORKSHOP ON SOUTHERN PACIFIC ALBACORE

The value of regular scientific workshops on North Pacific albacore was noted and given the success of the current meeting it was agreed to hold a second workshop on South Pacific Albacore Research in August 1988 with a possible venue of Noumea, New Caledonia.

Communication between research groups (e.g. cruise planning and tagging) would continue through informal communications.

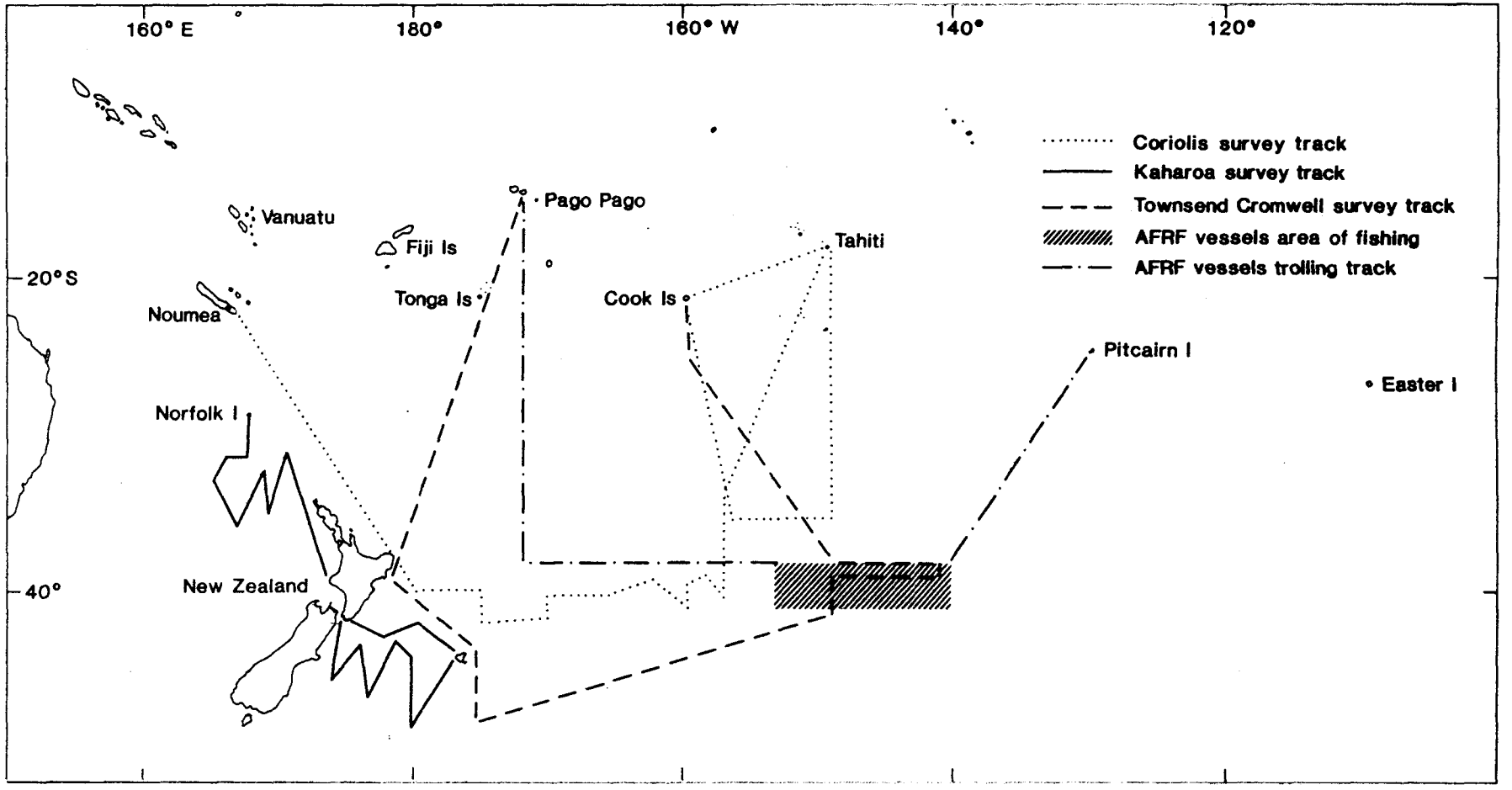
Participants will be kept informed of progress and developments in South Pacific albacore research by a newsletter.

Table 1. South Pacific albacore fisheries showing flag vessels, bases, estimated annual landings and data collected.

Country	Bases	Methods	Estimated annual landings in recent years (tonnes)	Data collected
Taiwan	Taiwan American Samoa Vanuatu Fiji	Longline Longline Longline Longline	15,000	- Daily catch (Number estimated weight), No. of hooks, position (5° square) estimated size frequency. - Pago Pago catch, effort noon position and some size frequency.
Japan	Japan	Longline Gillnet	2,000	- Daily catch (No. and weight), No. of hooks, position.
Korea	Korea? Japan America Samoa	Longline Longline Longline	6,000	- ? - Pago Pago catch, effort, noon position, and some size frequency.
New Zealand	New Zealand	Troll	3,000	- Daily catch (No. and weight), No. of hooks, position (special areas).
Tonga	Tonga	Longline	150	- SPC Log
Fiji	Fiji			
New Caledonia	New Caledonia	Longline	150	- SPC Log
Australia	Australia	Purse seine Pole & line Longline	1,000	- Daily catch, effort and position.
Indonesia	Bali	?		
Chile		?		
U.S.A.	Pago Pago	Troll		- Catch, effort, position.

Others - small catches from various Pacific Islands

Figure 1. French, USA and New Zealand research cruise tracks in the South Pacific.



APPENDIX I:

LIST OF WORKSHOP DOCUMENTS

Working Papers

SPAR/WP 1 : Kwoh, Chung-Hai and Chien-Hsiung Wang. Taiwan's Tuna longline fisheries operating in South Pacific Ocean, 26 pp.

SPAR/WP 2 : Farman, R. and J. Sibert. A review of southern albacore catch data from the South Pacific Commission region, 9 pp.

SPAR/WP 3 : Sharma, S.P. and A.D. Lewis. Notes on the Fiji albacore fishery, 7 pp.

SPAR/WP 4 : Murray, T. and A. Ross. A review of New Zealand albacore fisheries, 10 pp.

SPAR/WP 5 : Cade, R.M. and M. Anderson. Summary of the albacore seasons from 1976-77 to 1985-86, 14 pp.

SPAR/WP 6 : Chabanne, J. La peche au germon dans la ZEE de polynesie francaise, 13 pp.

SPAR/WP 7 : Wetherall, J.A. and M.Y.Y. Yong. South Pacific albacore stock assessment and related issues, 28 pp.

SPAR/WP 8 : Grandperrin, R. and J.C. Le Guen. Outlines of research on albacore conducted by ORSTOM in the Western and Central South Pacific Ocean from 1965 to 1985, 19 pp.

SPAR/WP 9 : FRD Pelagic Research Group. Proposed studies on the seasonal distribution, movement and variation in fishing success for albacore in the New Zealand region, 25 pp.

SPAR/WP 10 : Hallier, J.P. and J.Y. Le Gall. Surface albacore survey in the Central and Western South Pacific Ocean. 10 pp.

SPAR/WP 11 : Murray, T. and K. Bailey. Preliminary report of RV Kaharoa cruises K03/86 and K05/86 - oceanography and albacore catch rates, 22 pp.

SPAR/WP 12 : Laurs, R.M., K.A. Bliss and J.A. Wetherall. Preliminary results from R/V Townsend Cromwell South Pacific albacore research survey, 80 pp.

SPAR/WP 13 : Laurs, R.M. U.S. Albacore Trolling exploration conducted in the South Pacific during February-March 1986, 30 pp.

SPAR/WP 14 : Wang, Chien-Hsiung. Reconsideration of the ACC-Method (Approach of Catch Curve Method) for estimating natural mortality and catchability, 12 pp.

SPAR/WP 15 : Jones, B. Parasite Studies, 6 pp.

SPAR/WP 16 : Vlieg, P. Proximate composition of New Zealand albacore tuna, 13 pp.

SPAR/WP 17 : Bailey, K. A preliminary analysis of the stomach contents of albacore, Thunnus alalunga, from the Subtropical Convergence Zone east of New Zealand, 14 pp.

SPAR/WP 18 : Ross, A. A preliminary study of albacore (Thunnus alalunga) maturity in New Zealand waters, 8 pp.

Background Papers

SPAR/BP 1 : Bailey, K. A preliminary bibliography on albacore, Thunnus alalunga (Bonnaterre, 1788), in the South Pacific Ocean, 23 pp.

SPAR/BP 2 : Munro, C. The organisation of tuna statistics in New Zealand. FAO Fish. Circ., 21 pp.

SPAR/BP 3 : Murray, T. South Pacific surface circulation during the austral summer.

SPAR/BP 4 : Laurs, R.M. 1983. The North Pacific albacore - An important visitor to California Current water. CALCOFI Rept. 24: 99-106.

SPAR/BP 5 : Laurs, R.M., R. Nishimoto and J.A. Wetherall, 1985. Frequency of increment formation on sagittae of North Pacific albacore (Thunnus alalunga). Can. J. Fish. Aqua. Sci. 42: 1552-1555.

SPAR/BP 6 : Laurs, R.M. and J.A. Wetherall, 1980. Growth rates of North Pacific albacore, Thunnus alalunga, based on tag returns. Fish. Bull 79: 293-302.

SPAR/BP 7 : Laurs, R.M. and R.J. Lynn, 1977. Seasonal migration of North Pacific albacore, Thunnus alalunga, into North American coastal waters: distribution, relative abundance, and association with transition zone waters. Fish. Bull. 75: 795-822.

SPAR/BP 8 : Laurs, R.M., H.S.H. Yuen and J.H. Johnson, 1977. Small-scale movements of albacore, Thunnus alalunga, in relation to ocean features as indicated by ultrasonic tracking and oceanographic sampling. Fish. Bull. 75: 347-355.

SPAR/BP 9 : Graham, J.B. and R.M. Laurs, 1982. Metabolic rate of the albacore tuna, Thunnus alalunga. Mar. Biol. 72: 1-6.

SPAR/BP 10 : Barrett, I. and E.C. Fullerton, 1986. Report of joint NMFS/Industry review of plans and operations for research, development and management of the Pacific albacore fishery, December 11 and 12th, 1985. NMFS/SWFC Admin Rept. LJ-86-05, 9 pp.

SPAR/BP 11 : Parrish, R. and D. Mackett, 1984. The strategic plan for the National Marine Fisheries Service's North Pacific albacore fishery program. NMFS/SWFC Admin Rept. LJ-84-09, 29 pp.

SPAR/BP 12 : Laurs, R.M., W.H. Lenarz and R.N. Nishimoto, 1976. Estimates of rates of tag shedding by North Pacific albacore, Thunnus alalunga. Fish. Bull. 74: 675-678.

SPAR/BP 13 : Laurs, R.M., P.C. Fielder and D.R. Montgomery, 1984. Albacore tuna catch distributions relative to environmental features observed from satellites. Deep Sea Res. 31: 1085-1099.

SPAR/BP 14 : Laurs, R.M., H.B. Clemens and L.H. Hreha. Nominal catch-per-unit effort of albacore, Thunnus alalunga (Bonnaterre), caught by U.S. jig vessels during 1961-70. MFR Paper 1186, 32 pp.

APPENDIX II:

AGENDA

WORKSHOP ON SOUTH PACIFIC ALBACORE RESEARCH

MONDAY 9TH JUNE 1986: Dr John McKoy (Chairman)

1. Opening Session

   A. Welcome and Introduction (Dr Robin Allen)
   B. Establishment of Objectives and Workshop Timetable
   C. Election of Chairman and Rapporteurs

2. Review of Albacore Fisheries and Biology

   A. North Pacific Albacore Fisheries
   B. North Pacific Albacore Biology
   C. Albacore Stock Assessment

3. Review of South Pacific Albacore Fisheries

   A. New Zealand
   B. Australia
   C. New Caledonia
   D. Fiji
   E. Cook Islands
   F. Vanuatu
   G. Kingdom of Tonga
   H. French Polynesia
   I. Taiwan, R.O.C.
   J. United States of America

4. Present Research on South Pacific Albacore

   A. Review of ORSTOM Research
   B. New Zealand research on Albacore Biology:
      1) Feeding studies
      2) Maturity
      3) Parasites
      4) Proximate biochemistry

TUESDAY 10TH JUNE 1986: Mr Richard Shomura (Chairman)

4. Present Research on South Pacific Albacore (continued)

   C. Research Surveys:
      1) United States of America
      2) New Zealand
      3) Japan

5. Proposed Research Surveys

   A. United States of America
   B. France
   C. New Zealand

6. Availability of Fisheries Statistics in the South Pacific

   A. Review of fishing nations involved, location of fisheries and estimates of recent catches
   B. Review of catch data from the SPC region

7. Research Priorities for Development of Surface Fisheries

   A. Tagging
      1) Objectives
      2) Proposed Release Areas
      3) Protocol for Co-operative Programmes

WEDNESDAY 11TH JUNE 1986: Mr Julian Dashwood (Chairman)

7. A. Tagging (continued)
   B. Size frequency distribution
   C. Biological studies:
      1) Early life history
      2) Maturation
      3) Food studies
      4) Age and growth
      5) Mortality
      6) Time and space distributions

8. Albacore Fishery Development Opportunities for South Pacific Island Nations

   A. Cook Islands
   B. Kingdom of Tonga
   C. French Polynesia
   D. Fiji

THURSDAY 12TH JUNE 1986: Dr John Sibert (Chairman)

9. Discussion of Draft Report and Adoption

10. Closing Remarks (Dr John McKoy)

APPENDIX III:

WORKSHOP PARTICIPANTS

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APPENDIX IV:

RAPPORTEURS

Monday 9th June 1986:	Morning session	- Dr Brian Jones
	Afternoon session	- Mr David Shirer
Tuesday 10th June 1986:	Morning session	- Mr Kevin Bailey
	Afternoon session	- Ms Carolyn Wood
Wednesday 11th June 1986:	Morning session	- Ms Carolyn Wood

AD HOC WORKING GROUPS CONVENED DURING THE WORKSHOP

1. Fisheries data and availability:	- Dr John Sibert - Dr John McKoy - Mr Richard Shomura - Mr Joe Stanley
2. Co-ordination of tagging programme:	- Dr Michael Laurs - Dr Talbot Murray - Dr John Sibert
3. Protocol for at-sea biological samples:	- Dr Brian Jones - Dr Michael Laurs - M. Max Palladin

Typists:

- Miss Janet Preston
  Lampen Agency,
  Auckland.
- Miss Margaret Sang
  FRD, Wellington.
- Mrs Sandra Stacey
  FRD, Wellington.