Appendix 6 to Annex 9

THE REPORT OF THE WORKING GROUP ON INTENSIFIED ATLANTIC-WIDE SKIPJACK RESEARCH PROGRAM *

(COM-SCRS/77/21)

The meeting was held on August 9-11, 1977, at ICCAT Headquarters, Madrid, Spain. Mr. A. Fonteneau was selected convener and Drs. Gulland and Sakagawa served as rapporteurs.

Messrs. A. Fonteneau (France), J. Gulland (FAO), S. C. Kim (Korea), A. Laurec (France), O. Moura (Portugal), Al. Santos Guerra (Spain), G. Sakagawa (USA), O. Rodríguez-Martín (ICCAT) and P. M. Miyake (ICCAT) attended the meeting.

The agenda (Attach. 1) for the meeting was adopted by the participants, and papers (Attach. 2) prepared for the meeting by various authors were reviewed by the participants.

1. Background

Skipjack tuna is believed to be the most abundant of the commercial species of tuna in the Atlantic. It was not exploited on a large scale until recently, but since 1961 catches have increased rapidly, reaching a maximum of 110,000 tons in 1974.

With growing world demand for tuna, and the fact that little increase in catch can be expected from the larger species of tuna from any ocean, including the Atlantic, there is an obvious opportunity for expanding production from Atlantic skipjack tuna. However, apart from a general feeling among scientists that these stocks are not yet fully exploited, there is at present insufficient information to plan this expansion in a rational manner, avoiding on the one hand any failure to take advantage of opportunities where they exist, and on the other, damaging the stocks and the fisheries on them through overdevelopment and overexploitation.

Accordingly, the Standing Committee on Research and Statistics (SCRS) has been giving special attention to improved and increased research on Atlantic skipjack tuna in order to be able to provide the scientific advice necessary for the rational development and management of this resource. An outline plan was developed at the 1976 SCRS meeting for an Intensified Atlantic-wide Skipjack Research Program. This plan included the proposal that a more detailed outline of the Program should be prepared for consideration by SCRS and by the Commission at their 1977 sessions.

A draft program was prepared at a meeting of French scientists in Brest in

* Now renamed "International Skipjack Year Program".

June 1977, and other proposals and suggestions on particular types of activity were received from a number of scientists, including several concerned with skipjack tuna research outside the Atlantic as a result of a request from the Chairman of SCRS and the Executive Secretary. This present report is based largely on these documents, especially the French report.

Reviews of the population biology of Atlantic skipjack tuna have shown that despite the importance of the fishery for skipjack tuna and the volume of research that has already been done, many of the most important questions about skipjack cannot be answered. Even the wide-spread belief that current catches could be considerably increased is based on qualitative impressions, rather than on any quantitative assessment of how much skipjack tuna could be caught in the Atlantic. The present fishery is concentrated along the eastern border of the Atlantic, and catches fish up to about 60 cm (5 kg). There are some minor catches by the surface fisheries in the Caribbean, and catches of a few fish which are bigger (60-80 cm, 5 to 15 kg) by longliners in the central Atlantic. There is a reasonable hypothesis, therefore, that catches could be increased by extending fishing into other areas, and onto other sizes of fish, though the extent of such increase will depend critically on the relation between the fish in different areas, and whether any increase in catches in say, the western Atlantic [1] would be partially or wholly at the expense of the present catches in the eastern Atlantic.

At the same time, it is difficult to determine the current state of the stocks in the eastern Atlantic. Catches dropped abruptly from the peak of 110,000 tons in 1974 to about 60,000 tons in 1975 and 1976. Previously there have been year-to-year fluctuations and the recent drop may be no more than a pause in a general upward trend that could be continued for some time yet; on the other hand, it may indicate that the eastern Atlantic stock (or stocks) are already fully exploited within the present pattern of exploitation. Assessment is difficult because the growth and mortality rates are not well known, so that the more sophisticated analytical models of fish population dynamics cannot be used. Even the simpler models are difficult to use because of uncertainties in the measurement of abundance, and catch per unit of effort, due in particular to the fact that the fleets fish for both skipjack and yellowfin tuna.

The degree of uncertainty, and its practical importance, is shown by the fact that the total sustained catch from the Atlantic could be little more than the 1974 catch; or it could be as much as 400,000 tons. The difference in value is around $ 240,000,000 annually.

The problems on which the Commission requires solution can be summarized in four major questions:

A. Can catches be increased by fishing new areas (and presumably new stocks), especially in the western Atlantic?

B. Can catches be increased by fishing other elements of the currently exploited stocks, especially fish over 5 kg?

[1] Unless otherwise stated, western Atlantic in this report includes the Caribbean Sea, Gulf of Mexico as well as the western half of the Atlantic Ocean.

C. What could be the effects of the above two actions, if successful, on the existing fisheries?

D. How can better assessments be obtained of the existing fisheries? In particular, will increasing effort in these fisheries significantly increase the total catch?

These are questions that are not easy to answer directely. What can be done is to identify certain research topics (e.g., study of stock structure) which should help answer one or more of these questions. Those topics in turn can be studied by engaging in some specific research activities (e.g., tagging). The following sections of this report describe first, in general terms, the major topics and research activities and their relation to each other, and to the main practical questions (Table 1); and second, for each activity in more detail, how it will be carried out, and what support will be needed from national sources and from the Commission.

2. Research topics

2.1 DISTRIBUTION OF SKIPJACK TUNA

Better knowledge is required of where skipjack tuna occurs in the Atlantic outside the known fishing grounds (Figure 1). A distinction needs to be made between the occurrence of skipjack, even in considerable numbers and the presence of skipjack in suitable concentrations, or behaving in suitable ways, to provide opportunities for catching on an economic scale with available gears. Both aspects (presence or absence and availability to fishing) will be examined; the latter aspect will include, where appropriate, examination of the availability of bait fishes. This topic will help solve questions A and B.

2.2 THE RELATION OF SKIPJACK TO THE ENVIRONMENT

Skipjack are active fish, capable of moving rapidly, vertically and horizontally, out of unfavorable locations to more preferred locations. Research already carried out and currently in progress, has shown that skipjack tuna preferences, in terms of temperature and oxygen concentration, can be well predicted from their physiological and metabolic requirements. Better knowledge of this topic can, on an ocean-wide basis, help predict the general areas in which skipjack tuna are likely to be found; in a smaller area, it can promote the understanding of the local behavior of skipjack tuna, e.g., formation of schools, or either aggregation at particular places, and hence assist the development of improved fishing techniques and the interpretation of catch and effort statistics. The ocean-wide studies will assist in question A (and partly B); the other studies will assist in question D. This is a large topic, and may be divided into two parts:

1) Studies on physical environment.
2) Studies on the physiology and behavior of skipjack tuna.

2.3 STUDIES ON THE ABUNDANCE OF SKIPJACK TUNA AND THE RELATION BETWEEN ABUNDANCE, CATCH PER UNIT EFFORT, FISHING EFFORT, AND FISHING MORTALITY

No good method is presently available to adequately monitor the abundance of skipjack tuna and its changes from year to year. Methods used in other fisheries (acoustic surveys, or surveys by research vessels with normal types of fishing gear) present unsolved technical or practical obstacles. The nominal catch per unit effort (CPUE) obtained from the presently available statistics seems to be a poor index of abundance, partly because a variable part of the effort is directed towards yellowfin tuna. Research under this topic will concentrate on obtaining a better understanding of the relation of CPUE to abundance and also of the fishing mortality exerted by a nominal unit of effort. This should lead to devising improved units of effort, and CPUE, more nearly related to fishing mortality and abundance, and possibly also to an increased efficiency of the fishing fleet itself. The first of these would represent a major advance in relation to question D. The second would help question B.

2.4 STOCK STRUCTURES

The Atlantic skipjack tuna is a highly migratory species, but certainly not a uniform population with rapid and complete ocean-wide mixing. Little is known of the structures of different stocks and other groups in the Atlantic, and the rate of mixture between them, though it is suspected that some degree of separation exists on all scales; at one extreme between adjacent schools on the same fishing ground; at the other, between fish in the eastern and western Atlantic. This topic is highly relevant to question C and could also help with question D.

2.5 POPULATION PARAMETERS

A full analysis of the population dynamics of skipjack and hence a full understanding of the reaction of the stock to different patterns of exploitation, require a knowledge of the parameters of growth, mortality (including its separation into fishing and natural mortality) and reproduction. None of these are at present more than poorly known. This topic is very important in relation to question D.

In addition to these specific research topics in which it is expected that there will be significant advances as a result of the proposed program, it is also expected that the increased volume of interest and research on skipjack tuna will produce a more general improvement in the knowledge of skipjack biology and behavior and could lead to improvement in fishing techniques.

3. The program

The Intensified Atlantic-wide Skipjack Research Program is basically organized around a set of activities that concentrate on collection of new data and information through intensive sampling and experimentation in 1980. Certain activities, however, are scheduled to commence as early as 1979 and all activities are scheduled to be in some phase of organization and planning by January 1978.

The program is not an ICCAT funded and controlled program but one in which ICCAT would *coordinate* the collective inputs of interested parties. Funds, material and labor that are required in preparation and execution of the activities would be borne, for the most part, and controlled by the individual participating countries. Participating countries, however, would share in the outputs of the activities.

All activities of the Program are grouped into three major Program elements: (1) Intense Study of the Eastern Atlantic, (2) Study of New Fishing Areas, and (3) Supporting Activities. A brief description of the individual activities is contained in Addenda 1-12.

3.1 INTENSE STUDY OF THE EASTERN ATLANTIC

The eastern Atlantic, off Africa, is currently the major fishing area for Atlantic skipjack tuna. Catches from the area fluctuated upward to a peak of 110,000 tons in 1974 before abruptly falling to about 60,000 tons in 1975 and 1976. Whether this decline is a signal that the stocks are already fully exploited or just a pause in a general upward trend is not known. Assessment is difficult because basic information on the population dynamics parameters is unavailable. ICCAT's skipjack tuna program proposes to obtain information to assess the condition of the stocks through a detailed study of the eastern Atlantic fishery.

Activities such as super-sampling (comprehensive collection of data on fishing operations), tagging, collection of oceanographic data, aerial survey, sonic tagging, and behavior/physiology, are included in the proposed program. The activities will be executed during a 3-month period in the Annobon area in 1979, and again during 3-month periods in each of three areas in 1980.

The purpose will be to obtain a detailed synoptic picture of the hydrographic conditions, the distribution of fish (including the sizes of fish in different schools), and of the fishing fleet, as well as the short-term movements of individual fish. This should provide a picture of the behavior of fish in relation to oceanographic conditions, the formation and dispersion of aggregations and movement into and out of the fishing area.

Super-sampling. Super-sampling will be designed to collect detailed information on the fishing operations of the fleets for use in refining the measures of skipjack fishing effort in a fishery which is basically a muti-species, skipjack-yellowfin tuna fishery. This activity will require collection of data aboard fishing vessels of as many fleets as possible by trained technicians.

Tagging. Tagging will be used to obtain information on general movement, behavior-physiology, mortality and short-term growth. Dart tags will be used on a large number of releases, whereas sonic tags will be used on a selected few to obtain information on short-term behavior and physiology.

Sonic tagging. Sonic tagging will require the use of at least two research vessels for simultaneous tracking of the fish and collection of oceanographic data along the fish's track.

Oceanographic data. Oceanographic data will be routinely collected for analysis with data from super-sampling on the relationship of fishing success and oceanographic factors and with data from aerial surveys on the relationship of occurrence of surface schools and oceanographic factors.

Aerial surveys. Aerial surveys will be conducted to obtain information on occurrence of surface schools of tuna in areas where the fishing fleet is not fishing or searching. The information is important in evaluating catch-per-unit-effort data from the fishing fleet. Airplanes will also collect data on sea surface temperature, which can be related to some oceanographic conditions that affect skipjack tuna behavior.

3.2 STUDY OF NEW FISHING AREAS

The present geographic location of skipjack tuna fisheries in the Atlantic is primarily limited to the coastal areas off Africa, parts of the Caribbean Sea and parts of the Gulf of Mexico. Compared to the total distributional range of the species (Figure 1), the current fisheries are located in a small area, and it seems that the fisheries can expand and possibly produce a higher total catch. ICCAT's skipjack program proposes to study this possibility of expansion into new fishing areas. Indirect and direct methods will be used in the study.

Indirect methods will include the collection and analysis of *oceanographic data* to locate areas favorable for skipjack tuna and to appraise the fishability of the areas; *larval survey* data will be used to locate areas where spawning skipjack tuna occur; and *stomach contents* data from predators will be used to locate areas where young skipjack tuna occur.

The direct methods will be with *exploratory fishing* and *aerial survey.* Both techniques will be used to determine the occurrence and apparent abundance of skipjack tuna and bait fishes in areas where are no major skipjack fisheries, such as in the western Atlantic. Exploratory fishing for skipjack tuna will be conducted with baitboats and purse seiners. The baitboats will also be used to assess the availability of bait, an important factor for development of new fishing areas in the western Atlantic. Aerial surveys will be conducted in 1980.

3.3 SUPPORTING RESEARCH ACTIVITIES

Grouped in the following section are a variety of activities which can be carried out independently of the two major groups of activities outlined above. They will, however, be of supporting value to some of these activities, as well as improving in a more general way our understanding of the skipjack resource.

Tagging. The most conclusive evidence of interchange between any two fishing grounds is the movement of tagged fish from one to the other. The returns (or lack of returns) from the main fishing areas in the eastern Atlantic of fish tagged elsewhere would be the most valuable piece of information in studying the possible stock structure, and in assessing the likely effect on the existing fisheries of increased catches from the other areas. Emphasis will be given to tagging a large number of fish as well dispersed in space and time as possible over the western Atlantic. This will require chartered baitboats; these boats could to some extent also work on the survey of new fishing areas.

Genetics. The existence of a genetic and, therefore, very clear-out distinction between groups of fish can sometimes be established by the detailed examination of the biochemical characteristics of the blood and tissues, morphometrics, or a combination of these. Preliminary analyses of small samples from the Gulf of Guinea and the Caribbean showed no distinguishable difference (Fujino, 1969), but larger and carefully selected samples might give clearer results with different genetic systems. The work would have to be carried out by laboratories experienced in the techniques. Initially only a few well-chosen samples will be examined, if possible in 1978; inclusion of large scale sampling in the main program for 1980 will depend on the results of the preliminary analysis.

Otoliths. In temperate waters the age of individual fish and hence the growth and mortality rates in the population can be determined by counting annual rings on otoliths, scales or other hard parts. Skipjack tuna otoliths and scales do not show clear annual rings. Recently the existence of daily rings on the otoliths of anchovies and other small tropical fish has been demonstrated. If the same technique of counting daily rings could be validated for skipjack tuna, this would be a major breakthrough in studying skipjack population dynamics. This will be true even if the technique is so time-consuming that it can only be applied to a few fish, since this will establish a growth curve for the sampled stock with a good degree of confidence. The immediate emphasis will be given to stimulating further research into the technique. Examination of the otoliths of tagged fish (i.e., fish, a part of whose history is known) would be especially valuable if the fish were injected with tetracycline which leaves a mark on the otolith at the time of tagging.

Improved statistics. The need to improve statistics has been a constant call of SCRS since the establishment of the Commission. Nevertheless, the present statistics are still below the standards that would be desirable if the scientists are to have adequate information available to them in preparing advice to the Commission. At the same time, it is clear that maintaining the current standard of statistics, let alone improving them, is becoming a significant burden on the fisheries administration of some members of the Commission — which is not to say that this burden should not be accepted. It is, therefore, proposed that special effort be applied in 1980 to raise the standard of statistical reporting to the highest possible level. The resulting data will be analyzed to show the improvement in scientific understanding and hence in scientific advice that can be achieved, as well as the costs of maintaining such a high level of statistical reporting as a matter of routine. This will enable the Commission and member countries to determine more accurately and realistically the optimum level of statistical work, bearing in mind costs and potential benefits.

4. Organization and schedule of actions

ICCAT's Intensified Atlantic-wide Skipjack Research Program is designed to provide information so that the SCRS can develop scientific advice necessary for rational development and management of the Atlantic skipjack tuna resource. National contributions of technicians, scientists and funding to plan, execute and analyze the data will be required to perform the Program activities.

Because diverse activities will be executed and various scientists of different nations will participate, the program will require a special organization to ensure that the activities are properly designed, scheduled and executed. The organization should consist of a Program Coordinator, who would be a member of the Secretariat's staff, with supporting administrative staff to coordinate the Program activities; an SCRS advisory committee of scientists to provide the necessary link between the SCRS and Program Coordinator; and various "activity groups" to prepare detailed plans for each activity.

The Program Coordinator would be an additional member of the Secretariat's current staff, hired to assist in the planning of activities, coordinating the execution of the activities, and monitoring progress of the activities and final reports. The individual hired should have a broad scientific background with wide experience in managing research activities. Estimated period of service is January, 1978, through at least June, 1981. An estimated budget for this coordinating task is:

Activities	*Budget in thousands of dollars*			
	1978	*1979*	*1980*	*1981*
Tagging with dart tags	0	30	45	10
Improved fishery stat.	0	0	35	10
Super-sampling	0	15	20	10
Maturity and fecundity	0	0	0	0
Larval survey	0	0	*	0
Physical oceanography	0	0	0	0
Aircraft survey	0	0	*	0
Genetics	0	5	5	0
Otolith Ageing	0	0	0	0
Tagging with sonic tags	0	0	0	0
Stomach contents	0	0	0	0
Exploratory fishing	0	*	*	0
Administration				
ICCAT Coordination services	110	135	175	80
TOTAL	110	185	280	110

* Funding arrangements for these activities are not yet clear. The Secretariat may require funds to administer the arrangement that is adopted.

The development of the Program Plan has so far been performed by working groups of the SCRS with loose membership and no elected conveners. While such working groups have been sufficient for the early phases of the Program development, they would not be appropriate for more advanced phases of the Program nor to serve as the link between the SCRS and the Program Coordinator. A Committee with more structure and authority to communicate and advise the Program Coordinator on Program matters on a timely basis and on behalf of the SCRS will be required. It is therefore recommended that the SCRS at the November, 1977, meeting establish a Sub-Committee with elected convener and selected representatives to oversee further developments of the Program and serve as the link with the Program Coordinator. The Sub-Committee will also evaluate and advise the Program Coordinator on new activities or technology that may become available or brought to its attention for possible inclusion in the Program Plan.

It is also recommended that the Chairman of SCRS organize teams, "Activity Teams", of experts to prepare detailed plans for each activity. The activity plans will be consolidated and integrated according to objectives by the Sub-Committee into the overall Program Plan.

The proposed organizational chart and schedule of actions (Table 2) are shown below. It should be noted that the Program Plan and schedule of actions are developed on the assumptions that: (1) the Plan will be approved by the Commission at the 1977 meeting, a week after the SCRS meeting; and (2) at least 12 month of lead time is required between final plans and execution of any field activities in July-September 1979 and January-December 1980.

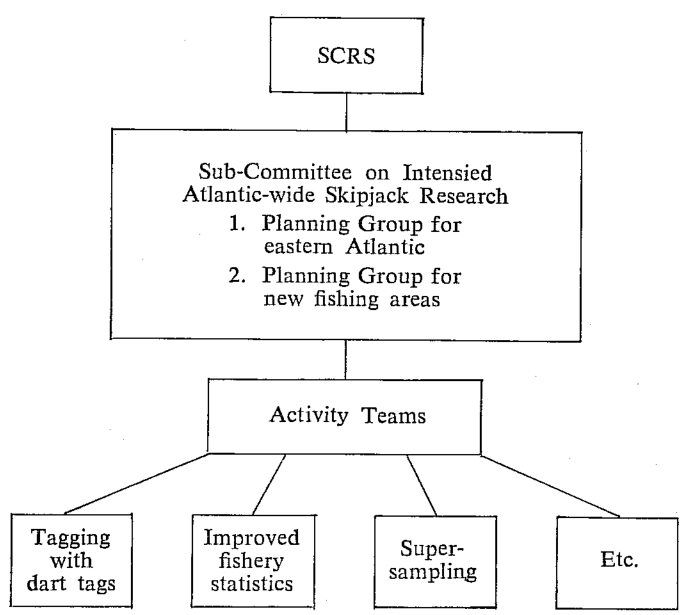


Table 1. Interrelation between research topics, activities and the basic questions for which the Commission requires answers [1]

Basic questions

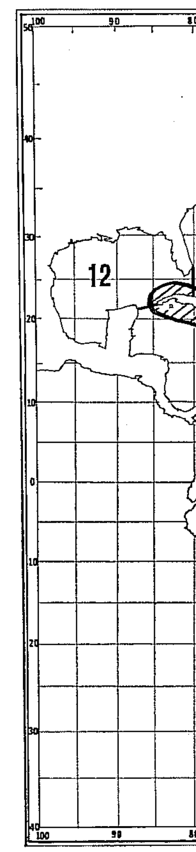
A — New grounds
B — Increased fishing on existing stocks
C — Interaction between fisheries
D — Stock assessment

	Research Topic						
					Population Parameters		
Activity	*Distribution*	*Fish & Environment*	*Abundance*	*Stock Structure*	*Growth*	*Mortality*	*Reproduction*
Intense study							
Super-sampling . . .		b, d	D		D	d	
Tagging			D	c	D	D	
Oceanography	a, b, c	c, d					
Sonic tags		c, d					
Aerial survey	b	c, d	d				
New areas							
Oceanography	a	b		c			
Larval survey	a		d				d
Stomach contents . . .	a						
Exploratory fishing . .	A						
Aircraft survey	A		d	c			
Supporting activities							
Tagging	a, b, c			c	d		
Genetics				c			
Otolith ageing					D	D	c
Maturity/Fecundity . .				c			d
Improved statistics . .			D		d	d	

[1] Capital letter denotes a major contribution to a question; lower case letters denote a smaller contribution.

Table 2. Schedule of actions for the Intensified Atlantic-wide Skipjack Research Program. Detailed schedule developed through July 1978

1977	
Aug.-Sept.	Report of August meeting circulated to SCRS and Commission.
Aug.-Nov.	Chairman of SCRS, in correspondence with others, identifies potential members of "Activity Teams".
November	(1) SCRS establishes Skipjack Sub-Committee and appoints convener.
	(2) Sub-Committee reviews outline program, proposes modifications if needed, and refers to SCRS.
	(3) SCRS approves scientific program and provides ICCAT with estimates of direct cost.
	(4) ICCAT approves outline programs and authorizes 1978 budget.
	(5) ICCAT initiates action to recruit Program Coordinator.
	(6) SRCS nominates conveners of "Activity Teams".
1977-78	
Dec.-March	Activity teams prepare detailed plans for each activity, including estimates of costs, vessel requirements, etc. Some of this can be done by correspondence, but meetings will be unavoidable for some groups.
1 April	Plan of Activity Teams circulated to members of Sub-Committee.
May-June	Meeting of Sub-Committee and planning groups to draw detailed Program Plan.
July	Program Plan distributed to participants for development and implementation in national plans, particularly for field studies.
1979	
July-Sept.	Execution of selected field studies.
1980	
Jan.-Dec.	Execution of "International Skipjack Year".



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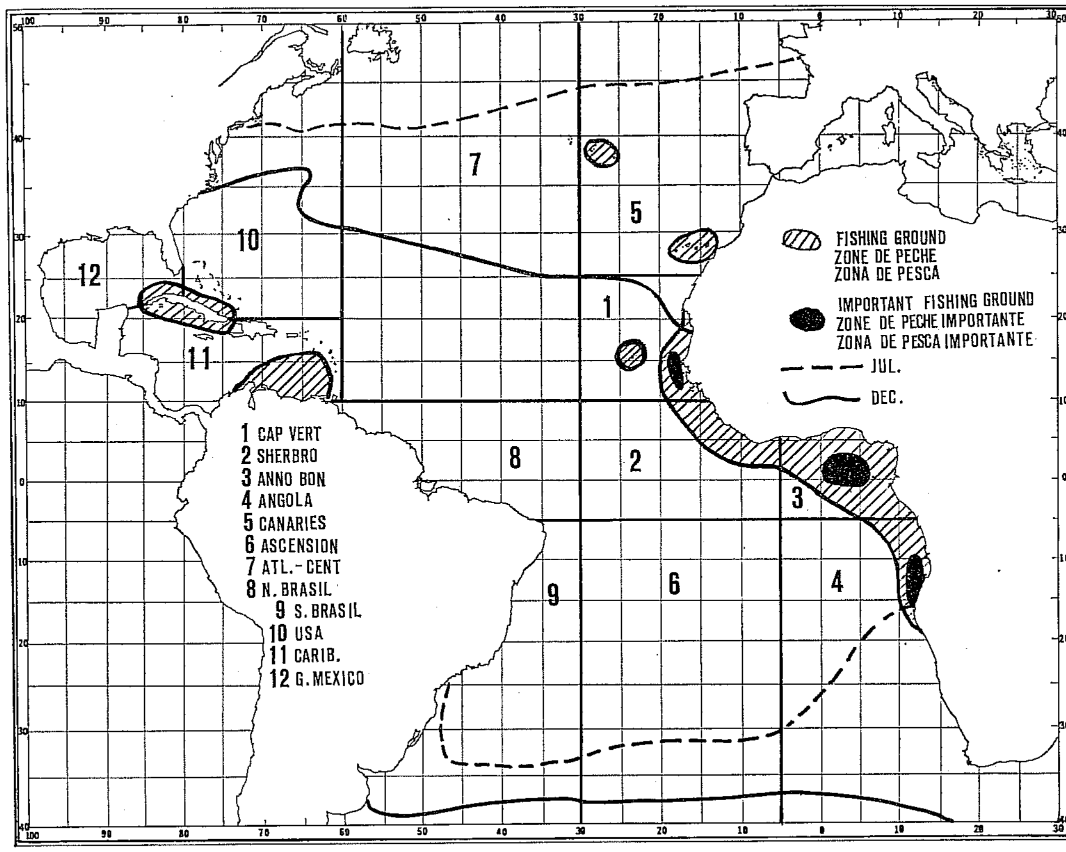

Fig. 1. Distributional range and location of fisheries for Atlantic skipjack tuna. Range is determined from data on larvae distribution, catches and skipjack preferred temperature of 18°C.

Addendum 1 to Appendix 6 to Annex 9

Tagging with Dart Tags

1. PLAN OF ACTIVITY

1979-1980 Eastern Atlantic. — Intense tagging in the Eastern tropical Atlantic for short-term recoveries (< 1 year). Activity is for 3 months in the Annobon area in 1979 and in all areas in 1980. This activity must be coordinated with super-sampling.

1979-1980 Western Atlantic. — Concentrated tagging in the western tropical Atlantic for short- and long-term recoveries (> 3 months). Activity is for approximately 6 months each year.

2. NATIONAL CONTRIBUTION

1979 Charter of one baitboat for 3 months in the eastern Atlantic and one baitboat for 6 months in the western Atlantic.

1980 Charter of 3 baitboats for 3 months each in the eastern Atlantic and 2 baitboats for 6 months each in the western Atlantic.

Scientists and technicians to participate in the planning in 1978 and 1979, execution of the plan in 1979 and 1980 and analysis of the data in 1980 and 1981 will be provided by individual countries.

3. AUGMENTATION OF ICCAT SECRETARIAT'S RESOURCES

The Coordinator would be responsible for various aspects, including the purchase and distribution of tags and tagging equipment, paying of rewards, data editing and filing, etc. The cost will amount to:

	Cost in thousands of dollars (man-months)				
Year	*Tags & Tagging equipment*	*Reward*	*Data Processing*	*Personnel*	*Total*
1979	15	5	5	5 (2)	30 (2)
1980	15	20	5	5 (2)	45 (2)
1981	0	5	5	5 (2)	15 (2)

Addendum 2 to Appendix 6 to Annex 9

Improved fishery statistics

1. PLAN OF ACTIVITY

1980 Collection of fishery statistics (catch, catch-effort, length-frequency) with more complete and improved sampling schemes. Skipjack fisheries in all parts of the Atlantic would be sampled.

2. NATIONAL CONTRIBUTION

1980 Intense sampling for fishery statistics (catch, catch-effort, length-frequency) of each skipjack tuna fleet will be required. Data collected from the fleets will be processed by the individual countries and submitted to the Secretariat.

3. AUGMENTATION OF ICCAT SECRETARIAT RESOURCES

The Coordinator would be responsible for summarizing the data and providing technicians for collecting data from some fleets. The estimated cost is:

	Cost in thousands of dollars (man-months)		
Year	*Data Processing*	*Personnel*	*Total*
1980	5	30 (72)	35 (72)
1981	10	0	10

Addendum 3 to Appendix 6 to Annex 9

Super-sampling

1. PLAN OF ACTIVITY

1979 Collection of detailed data on fishing operations from fishing vessels in the Annobon area with technicians. Technicians will be aboard vessels for 3 months to collect data.

1980 1979 level of activity will be expanded to include the entire eastern Atlantic fishing area. Activity will be for 3 months in each of three areas.

2. NATIONAL CONTRIBUTION

1979-1980 Individual countries would be responsible for placing technicians on their vessels and for collecting and pre-processing the detailed data.

3. AUGMENTATION OF ICCAT SECRETARIAT'S RESOURCES

The Coordinator would be responsible for coordinating the operations and summarizing the data. The estimated cost is:

	Cost in thousands of dollars (man-months)			
Year	*Travel*	*Data Processing*	*Personnel*	*Total*
1979	5	5	5 (5)	15 (5)
1980	10	5	5 (3)	20 (3)
1981	0	5	5 (4)	10 (4)

Addendum 4 to Appendix 6 to Annex 9

Maturity and Fecundity

1. PLAN OF ACTIVITY

1980 Collection of data on maturity and fecundity. Skipjack tuna will be sampled to obtain information on season and size at maturity and fecundity.

2. NATIONAL CONTRIBUTION

1980 Member countries will be asked to collect samples.

Selected scientists would be involved in processing the samples and in analysis of the data.

3. AUGMENTATION OF ICCAT SECRETARIAT'S RESOURCES

The Coordinator would coordinate the sampling effort and monitor progress of analyses. No augmentation will be necessary.

Addendum 5 to Appendix 6 to Annex 9

Larval Survey

1. PLAN OF ACTIVITY

1978-1979 Survey of all available data and plankton collections and as best possible an analysis of existing data on tuna larvae occurrence in the Atlantic Ocean. Feasibility study with existing information on the possible use of larval surveys to estimate spawning biomass.

1980 Collection of plankton samples in selected areas to determine the occurrence of skipjack tuna.

2. NATIONAL CONTRIBUTION

1978-1979 Selected scientists would conduct analysis of existing data and perform feasibility study.

1980 Plankton samples from selected areas will be collected aboard charter vessels and research vessels. Samples will be analyzed by selected scientists.

3. AUGMENTATION OF ICCAT SECRETARIAT'S RESOURCES

The Coordinator would coordinate the sampling effort and monitor progress of analysis. No augmentation will be necessary.

Addendum 6 to Appendix 6 to Annex 9

Physical Oceanography

1. PLAN OF ACTIVITY

1978-1979 Review and analyze existing data on oceanographic parameters that limit skipjack tuna distribution or that concentrate them.

1979-1980 Collection of oceanographic data for studying the distribution and concentration of skipjack tuna. In 1979 this activity will be performed in the Annobon area in tandem with super-sampling. In 1980 the level of effort will increase along with an increase in effort of tagging and super-sampling.

2. NATIONAL CONTRIBUTION

1978-1979 Selected scientists would conduct analysis of existing data.

1979 At least 2 research vessels for 3 months each would be required to perform this activity in the Annobon area.

1980 Several research vessels for 3 months each would be required to perform this activity in the eastern and western Atlantic.

Participating nations would process the data.

3. AUGMENTATION OF ICCAT SECRETARIAT'S RESOURCES

No augmentation would be necessary.

Addendum 7 to Appendix 6 to Annex 9

Aircraft Survey

1. PLAN OF ACTIVITY

1980 Eastern operation. — Intense survey in the eastern Atlantic to obtain information on school density and location and oceanographic conditions in relation to the location of the fishing fleets. Activity is for 6 months' duration.

1980 Ocean-wide operation. — Survey to locate new fishing areas, particularly west of the African fishing area.

2. NATIONAL CONTRIBUTION

1980 At least 2 airplanes for 3 to 6 months will be required to execute the ocean-wide operation. One airplane would be adequate for the eastern operation.

3. AUGMENTATION OF ICCAT SECRETARIAT'S RESOURCES

This activity would require coordination by the Program Coordinator but at no increase in cost to the Secretariat.

There is uncertainty on how best to handle the funding and participation in this activity. Special funding arrangements may be necessary to insure that contributors have priority in analyzing the data, especially from new fishing areas.

Addendum 8 to Appendix 6 to Annex 9

Genetics

1. PLAN OF ACTIVITY

1979 A feasibility study will be conducted to identify useable genetic systems for stock identification. The study will rely on few samples collected from especially the eastern and western Atlantic.

1980 Depending on results of the feasibility study, activity will be expanded or abandoned.

2. NATIONAL CONTRIBUTION

Scientists and technicians to participate in the planning and execution of this activity and analyzing the samples collected by this activity would be provided by various member countries. (Sampling and analysis can be done by different nationalities.)

3. AUGMENTATION OF ICCAT SECRETARIAT'S RESOURCES

The Secretariat's responsibility would be limited to the Coordinator's time, and about $ 4,000 at least for 1979 for contingency of shipping samples, trip expenses for experts, etc. Also technicians hired by ICCAT at ports might have to devote part of their time to sampling.

	Cost in thousands of dollars			
Year	*Materials*	*Shipping samples*	*Travel*	*Total*
1979	2	1	2	5
1980	2	1	2	5

Addendum 9 to Appendix 6 to Annex 9

Otolith Ageing

1. PLAN OF ACTIVITY

1978-1979 Validation and improvements of ageing techniques, especially in terms of discovering a faster reading technique.

1980 Collection of otolith samples from the entire size range of skipjack tuna caught in the eastern and western Atlantic. Execute experiments to validate daily rings with injection of tetracycline compound into tagged fish in the eastern Atlantic. Experiments would be conducted during the super-sampling period and will require coordination with the tagging with dart tag activity.

2. NATIONAL CONTRIBUTION

1978-1980 Scientists and technicians to execute this activity would be provided by various member countries.

3. AUGMENTATION OF ICCAT SECRETARIAT'S RESOURCES

This activity would require some coordination by the Program Coordinator but would not incur extra cost to the Secretariat.

Addendum 10 to Appendix 6 to Annex 9

Tagging with Sonic Tags

1. PLAN OF ACTIVITY

1979-1980 Fish will be released and tracked in the eastern Atlantic. Activity will be performed in tandem with super-sampling.

2. NATIONAL CONTRIBUTION

1979-1980 One research or chartered vessel will be required to catch and tag fish. Another vessel suitably equipped with sonic equipment to follow the tagged fish will be required. Both vessels should be available for one month each year.

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3. AUGMENTATION OF ICCAT SECRETARIAT'S RESOURCES

The Secretariat will be responsible for coordinating some minor aspects of this activity to insure that they are executed simultaneously with super-sampling and other activities. No augmentation will be required.

Addendum 11 to Appendix 6 to Annex 9

Stomach Contents

1. PLAN OF ACTIVITY

1980 Stomachs from large predators, particularly billfishes, will be collected and examined for juvenile skipjack tuna.

2. NATIONAL CONTRIBUTION

1980 Countries will be asked to collect samples. Selected scientists will be involved in processing the samples and in analysis of the data.

3. AUGMENTATION OF ICCAT SECRETARIAT'S RESOURCES

The Coordinator will coordinate the sampling effort, distribute the samples and monitor progress of analysis. No augmentation will be necessary.

Addendum 12 to Appendix 6 to Annex 9

Exploratory Fishing

1. PLAN OF ACTIVITY

1979 Collection of data from longliners on incidental catches of skipjack tuna with troll gear. Exploration of offshore areas in the eastern Atlantic. Fishing survey for skipjack tuna and bait fish in the western Atlantic. Activity will be coordinated with tagging.

1980 More intensive survey effort in the western Atlantic. Activity will be coordinated with tagging.

2. NATIONAL CONTRIBUTION

1979 Charter of one baitboat or purse seiner for 3 months of exploration in the eastern Atlantic. Charter of one baitboat for 3 months of survey in the western Atlantic. At least one research vessel will be required for 3 months.

1980 Charter of one baitboat for 6 months of survey in the western Atlantic. At least one research vessel will be required for 3 months.

Scientists and technicians to participate in the execution of this activity and in analysis of the data would be provided by various member countries.

3. AUGMENTATION OF ICCAT SECRETARIAT'S RESOURCES

This activity will require coordination from the Secretariat but not result in extra cost. It is not very clear how results from this activity will be handled to assure that contributors have priority in analyzing the data. The Secretariat would be responsible for investigating funding schemes and appropriate procedures for handling data from this activity.

Attachment I to Appendix 6 to Annex 9

Agenda for the Working Group on the Skipjack Program

Madrid, August 9-11, 1977

1. Opening of the meeting
2. Selection of Convener and rapporteurs, and meeting procedures
3. Adoption of the Agenda
4. Review the papers presented
5. Review objectives and the techniques
6. Review of the Plan (when, where, quantity, intensity, scale of cruises)
7. Review of cost (Commission and national)
8. Review of priority
9. Organization of the program
10. Data and sample collecting system
11. Dissemination of data
12. Analyses and publication
13. Steps to be taken
14. Assignments and recommendations
15. Other matters
16. Adoption of report
17. Adjournment

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Attachment II to Appendix 6 to Annex 9

List of working documents

BAYLIFF, W. H.

Note on skipjack tagging. July 7, 1977.

FUJINO, K.

A plan for stock identification research by means of biochemical genetics. July 15, 1977

KUME, S.

Exploratory survey of skipjack in the Atlantic. July 14, 1977.
Predator-prey approach to biology and ecology of young skipjack. July 14, 1977.

MILLER, F. R.

Notes on applications of spacecraft instruments to marine fisheries problems and aerial survey. July 18, 1977.

MIYAKE, P. M.

Review and proposals on the organization of the Atlantic-wide skipjack program. July, 1977.

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Project de recherches intensives sur le listao de l'Atlantique (*Katsuwonus pelamis*). June, 1977. (English translation by ICCAT also available.)

SAKAGAWA, G. T., N. BARTOO, A. COAN and E. WEBER

Program development plan for stock assessment of skipjack tuna in the Atlantic Ocean for 1978-1983. August, 1977.

SHARP, G. D.

Notes on application of genetic studies to Atlantic skipjack research. July 22, 1977.

SHOMURA, R. S.

Notes on stasis respiration studies and ultrasonic telemetry. July 18, 1977.

STEVENSON, M.

Comments on spacecraft and aerial survey techniques for consideration by ICCAT. July 5, 1977.

YUEN, H. S. H.

Comments on applications of acoustic methods and acoustic transmitters for skipjack. July 1, 1977.