Appendix 6 to Annex 8

Proposed Plan for the Albacore Research Program

1. Why have an Albacore Research Program?

Paradoxically, our understanding of the current state of the albacore stocks in the Atlantic is becoming worse and worse, while in the past stock evaluations were available. In addition, new fishing methods are developing and their possible impact on the traditional fisheries cannot yet be evaluated. This unfortunate deficiency on the part of the SCRS has many causes which concern the statistics, biological parameters and the absence of reliable analyses for some years.

In view of the significant progress achieved during the International Skipjack Year Program (ISYP) and the Yellowfin Year Program (YYP), carrying out an Albacore Research Program (ARP) appears to be an excellent way to obtain precise answers to the questions posed at present on this species by the scientists as well as by those responsible for stock management.

The SCRS albacore species group examined the Report of the Albacore Workshop held in September, 1989, in Madrid (SCRS/89/16). This report recommended on the one hand holding another workshop in 1990 to examine the results of short-term research, and on the other, the development of a more complete research program coordinated and supported by ICCAT. The foreseen costs and priorities must be identified.

The albacore group recognized that some of the statistics and research objectives recommended for the 1990 Workshop are also included in the Albacore Research Program on a longer term. The possible means for resolving each problem, the priority and the probability of success are evaluated in Table 1, according to a scale of 1 to 3 (1 being the best, 3 the least likely).

The duration of the Albacore Research Program is estimated to be four years (according to the experience gained through the ISYP and the YYP). In this case, the 1990 Workshop could also coordinate the progress of the research. It would be followed by similar meetings in 1991 and 1992. A final conference on the results will take place in 1993. A coordinator for the progress of the work should be designated for the duration of the Albacore Research Program.

The research objectives were categorized according to the three stocks assumed to exist in the Atlantic, as the need for progress in knowledge and urgency of research are not the same for each stock. Some countries have been proposed for the research objectives, but this does not mean that the list is exclusive.

Finally, it should be recalled that bilateral research is being carried out by Spain and France, financed by the EEC. The results of this research, which mainly concerns interaction between the two national fleets, will be communicated to ICCAT.

2. Research Objectives and Budget

A calendar of research activities and their approximate annual costs are given in Table 2. Explanations of the research objectives identified in Table 2 are given below with a description of the research activities involved.

NORTH ATLANTIC

Coherent longline data base (Activity 1)

The most recent longline statistics are those of Taiwan and go from 1967 to 1988. However, the Japanese (and Korean to a lesser degree) longline fleets have exploited Atlantic albacore in the past before turning to fishing bigeye tuna by using deep longlines. It seems possible to generate a statistical set on the traditional longline for the 1955-1988 period, by recuperating data in the ICCAT base or in Japan, completely separating the surface longline data from the deep longline data and verifying all the data.

Coherent surface fisheries data base (Activity 1)

There still exist some statistical problems for the troll and baitboat fisheries. Some French historical data are missing and should be found and verified. Some other files could have been lost while changing the data processing system at ICCAT. Some effort data for Spanish baitboats should be verified. Also, a new historical statistical data series could be obtained for 1967-1988 (e.g., for the trollers).

Length-weight relationship (Activity 1 and 7)

The length-weight relationships of Atlantic albacore seem to differ significantly from albacore in other oceans. This must be verified and, taking into account the sexual dimorphism of adult albacore, should be done according to sex for sizes greater than 80 cm.

Catch-by-size tables (Activity 2)

It is necessary to prepare total catch tables by size and by quarter to cover as long a series as possible. Although the current tables represent great progress, they are still imperfect (in particular, 1980, 1987, and 1988 need to be corrected and data for 1989 should be submitted to the Secretariat as soon as possible).

Stochastic methods for estimating catch by age from size distributions (Activity 2)

The stochastic length-frequency analysis method for aging and generating catch-at-age data from a given catch-at-length composition was

developed by Akamine (1984). Provided that the environmental conditions have not changed significantly, the average biological size and the standard error for an age group are usually stable and can be viewed as one of the genetic characteristics of a population, also assuming that the size distribution of each age group is normal. Then a probability function can be constructed, and the maximum probability estimates can be used to obtain the suitable parameter estimates of the mean and the standard error for each age group. Size distribution tables were generated by the September Workshop. They are an excellent basis for application of this method.

Standardized index of abundance (Activity 2)

Up to the present, the abundance indices for surface fishing have only been partially standardized. This could be done using GLM or a similar method. The indices should be calculated by age class by using the same methods as used for generating the catch-at-age tables from the catch at size.

The abundance indices for longline fishing have been standardized in the past by the Honma method by using two sets of reference variables according to the fleets (Japanese and Taiwanese). Unification would be necessary, preferably using GLM.

Cohort analysis and yield per recruit (Activity 3)

On the basis of old verified statistics and the proposed improved statistics, good catch-at-age tables are expected to be available on a quarterly basis. Cohort analyses calibrated with abundance indices will then be possible, and should be made. As the research on the biological parameters would produce results which can be incorporated in the VPA and thus refine the estimates of exploitation rates.

Growth (Activity 2, 5, 7 and 8)

The growth of albacore beyond 100 cm is still rather hypothetical. Moreover, it is probably different for males and females. Two lines of research are possible. Much tagging is needed on large fish to improve the estimation of the growth curve. On the other hand, double-purpose sampling (size frequency plus sub-sampling of hard parts) of large albacore presently caught by the paired trawlers and the baitboats in the Bay of Biscay and the Canary Islands area would allow verification of the age composition of these catches. There are possibilities of reading ages on the hard parts (vertebrae, otoliths, spines) according to previous experience. It would probably be necessary to purchase some fish to sample the hard parts. This double-purpose sampling could also allow an estimate of the variance around the mean age attributed in this way to the fish.

The verification of the hypothesis of annual double marks on the hard parts, however, seems difficult as large albacore are difficult to obtain throughout the year for analyzing hard parts.

Study of sex ratio vs. length (Activity 4)

A study of the size distribution by sex for the large albacore in the Bay of Biscay and the Canary Islands, should be conducted for several years (at least three years) would permit generating the size frequency by sex tables. The separation of the size frequency by sex tables into age classes (above-mentioned stochastic methods) would then be of great interest.

Maturity (Activity 7 and 8)

The spawning hypothesis of albacore in the Atlantic was first presented in the 1950-1960's (Shiohama). According to this theory, the large albacore now caught in the Bay of Biscay would be immature or sexually inactive. This should be verified. Sampling of ovaries from other areas of the North Atlantic seems, unfortunately, difficult.

Natural mortality (Activity 5)

The natural mortality of albacore is not well known and rather poorly estimated. It is found that, in addition, there are hypotheses of an increasing natural mortality for the older age classes (Suda). Two lines of research are proposed:

--Estimation from the results of particularly successful tagging.

--Study of biochemical parameters which give an index of senescence for large individuals. Such indices are studied in medicine from animal models. Could they be extended to tunas? This should be investigated.

Interaction between fishing gears (Activity 3, 5, 6)

The instantaneous interaction (competition for space) is the principal objective of the EEC program. It is studied by observers on board vessels using surface gears. Improvement of the detailed statistics ($1^{o}x1^{o}$ by the finest time strata possible) is thus foreseen for these same vessels. Tagging at the beginning of migration can also give good results. Towards the end of 1989 Spain carried out very successful tagging from which much is expected.

The long-term interaction (competition for the resource) could be studied from the resolution of the VPA on the F vectors. This refers to adjusted cohort analyses.

Stock structure (Activity 5)

Tagging seems to be the most effective way to verify the stock structure, particularly the relationships between the north Atlantic and the Mediterranean.

Effects of environmental data on the abundance indices (Activity 9)

Abundance indices can be affected by changes in the environment (as was shown for yellowfin in 1984). Abnormal CPUEs of the surface gears for some years could have been caused by environmental factors.

Hopefully the past effects of such environmental variations can be identified by studying the northeast Atlantic surface temperature files in the physical oceanographic services. Other parameters which could be considered include some abundance files of preys found in the stomachs of surface albacore exist in France.

Behavior of albacore as a function of fishing gears (Activity 6, 7)

In addition to the means of direct observation proposed and in progress within the EEC program, another approach proposed is the study of stomach contents of albacore taken by different gears, including the new French gears. The possibility of characterizing the different bathymetric levels of albacore development according to the preys still remains hypothetical.

Investigate biases in the evaluation of cohorts if sexual dimorphism of adult albacore is proven (Activity 2)

It seems that the growth of female albacore is slower than the males after the first sexual maturity. This could significantly affect the size composition tables taken from the size distribution tables. Extension of the bias caused by the different growth rates thus introduced in the VPA, could be estimated by simulations.

SOUTH ATLANTIC

Coherent longline data base (Activity 1)

The problem is identical to that of the North Atlantic.

Size composition of surface fishery catches (Activity 1)

The statistical data provided more or less regularly to the Secretariat by South Africa should be analyzed after verifying the homogeneity of the set of data.

Stochastic estimates of age classes from size distributions (Activity 2)

The problem is identical to that of the North Atlantic. It seems that the compiled Taiwanese longline data would be of particular help.

Stock structure (Activity 5)

Regular interchanges of albacore between the south Atlantic and the Indian Ocean seems very probable. Tagging experiments from South African baitboats would be of great interest in this respect. It seems possible to study the oceanographic conditions in the southeast Atlantic that influence these interchanges.

Growth parameters (Activity 2 and 5)

The problem is more urgent than in the North Atlantic, because no growth estimates have yet been proposed for the south Atlantic.

Standardized CPUE for longline (Activity 2)

This problem is identical to that of the North Atlantic as regards longline. (The problem of the two reference sets from the Honma's method for longline.) Moreover, an abundance index for the South African surface fisheries should be calculated.

Analytic model applied to the south stock (Activity 3)

A VPA has never been run for the south stock. This is of high priority, particularly in order to verify the conclusions of the production models already applied.

Maturity (Activity 7 and 8)

South American longliners (Venezuela, Brazil or Uruguay) take large albacore from the south stock. Examination of gonads, if possible, would be a good verification of the Shihohama model. Examination of fish caught by the Taiwanese longline seems very difficult.

MEDITERRANEAN

Albacore in the central and eastern Mediterranean seem to have typical biological characteristics. The study of the characteristics, in particular using Italian literature, may resolve the stock structure of these particular albacore.

The collection or submission and exploitation of Italian statistical data would perhaps allow estimation of the exploitation level of Mediterranean albacore. A stock evaluation committee of the GFCM will meet in 1990. It will be useful to examine the conclusions the GFCM will obtain on Mediterranean albacore.

Table 1. Research objectives proposed for the Albacore Research Program

Objective	Activity	Priority	Probability	Comments	Short Term	Medium Term
NORTH ATLANTIC						
Coherent longline data base	Reexamination of 1957-89 data	1	1	Can be done by Taiwan and Secretariat	+	
Coherent surface fisheries data base	Reexamination of 1957-89 data	1	1	Can be done by France, Spain and Secretariat	+	
Length-weight analysis	Reexamination of old data, new measurement by sex	1	1	By sex for FL >80 cm can be done by France, Spain and Azores	+	
Catch-by-size tables by quarter	Computation on available statistics	1	1	France, Spain, Secretariat	+	
Use of stochastic methods for estimating catch by age	Computation on available statistics	1	1	France, Spain for surface catches, Taiwan for longline	+	
Standardized index of abundance	Computation on available statistics	1	1	Should be done by France, Spain, Taiwan, and Japan	+	
Cohort (VPA) and yield-per-recruit analyses	Computation on catch-at-age table and abundance indices	1	1	Should be done each year	+	
Growth	Tagging already done in 1989	1	1	Spain		+
	Hard part analysis of piece collected on large fish	1	2	Double sampling by France and Spain on BB and trawlers (means buying the large fish); other countries who want to		

Table 1. (Cont.)

Objective	Means	Priority	Probability	Comments	Short Term	Medium Term
NORTH ATLANTIC (cont.)						
Study of sex ratio vs. length	Measurement of sex ratio by length	1	1	On Bay of Biscay large fish >80 cm, 3 years sampling		+
Maturity	Study of ovaries	2	3	Check on Bay of Biscay large fish		+
Natural mortality	Tagging	1	3			+
	Biochemical analysis	3	2	Studies on samples taken from big fish (means buying the fish) France		
Interaction between gears (immediate)	Tagging already done in 1989. Observers on board. 1989, 1990	1	1	Analysis by France and Spain under EEC authority.		+
Interaction between gears (long-term)	VPA solved and F's vector by gear	1	1	After resolving the collection and processing of the catch-at-size tables then catch-at-age		
Stock structure	Tagging	1	2	France and Spain for Atlantic/Mediterranean; Italy ??		+
Effects of environmental data on the abundance indices	Recuperation of environmental data in available or purchased files	2	2	France, Spain, Portugal		+
Behavior as function of gears	Stomach analysis	2	3	Spain		+
Investigate biases in assessment if sexual dimorphism of albacore is real	Modeling	1	2	??		+

Table 1. (Cont.)

Objective	Means	Priority	Probability	Comments	Short Term	Medium Term
SOUTH ATLANTIC						
Coherent longline data base		3	1	Since 1970's, Japanese longline fishery has changed its target species, also Korean longline fishery did not target on albacore in both the south and north Atlantic. These statistics of catch and effort should be separated from regular longline fishery. Taiwan	+	
Provision of size composition of surface fishery		1	2	The catch and effort of surface fishery in the south Atlantic increases significantly. The countries using surface gears regularly submit the size data or catch-at-length data in use. (South Africa)	+	
Stock structure	Tagging	1	2	South Africa		+
	Analysis of oceanographic data	2	2	South Africa		
Growth parameters	Tagging	1	3	The growth parameters is still not available for the south stock. South Africa, Taiwan		+
Aging and catch-at-age data construction	Computation on available data	1	1	Aging and constructing catch-at-age data from catch-at-length data. Taiwan, South Africa	+	

Table 1. (Cont.)

Objective	Means	Priority	Probability	Comments	Short Term	Medium Term
SOUTH ATLANTIC (cont.)						
Standardized CPUE for longline	Analysis of available data	1	1	Traditionally, the Honma's algorithm was used in standardizing longline effort. A GLM should be tried in standardizing CPUE of the south Atlantic. albacore stock. (Taiwan)	+	
Analytic yield-per-recruit analysis	Computation on catch-by-age table and abundance indices	1	1	The evaluation of the south Atlantic albacore stock has always been done by production model. Some yield-per recruit analyses are necessary.	+	
Maturity	Study of ovaries	2	3	Brazil on coastal longliners; Uruguay, Venezuela		+
MEDITERRANEAN						
Research on biological parameters	Bibliography Tagging	1 1	1 2	France, Spain, Italy France, Italy	+	+
Statistics	Mediterranean catch & effort	2	2	Italy, Yugoslavia		

Table 2. Summary of research activities and costs of the Albacore Research Program (ARP)

Activity	1990	1991	1992	1993	Source of Funding
1. Re-examination of historical data	XXXX				ICCAT Regular Budget and national budgets
2. Computation on available data	X	XXXX	XXXX		
3. VPA on catch-at-age tables and abundance indices	X	XXXX	XXXX		
4. Size-specific and sex ratio measurements	XX $2,000	XXXX $2,000	XXXX $2,000		ARP
5. Tagging: Bay of Biscay	XX $200,000				ARP
Other*	XXXX ?	XXXX ?	XXXX ?		Other countries?
6. Observers on board vessels using surface gears	XXXX $45,000				ARP/Other?
7. Collection of sampling data	XX $38,000	XXXX $18,000	XXXX $18,000		ARP
8. Analysis of sampling data	XXXX $5,000	XXXX $5,000	XXXX $5,000		ARP
9. Purchase and analysis of environmental data		XXXX $3,000	XXXX $3,000		ARP
10. Working group meetings and final conference	X	X	X	X $5,000	ARP
11. Final publication				$5,000	
12. Travel for coordination and Secretariat	$2,000	$2,000	$2,000		
13. Mailing by courrier	$1,000	$1,000	$1,000		
14. Miscellaneous	$2,000	$2,000	$2,000		
TOTAL	$295,000	$33,000	$33,000	$10,000	Grand Total $371,000

*Possible tagging encouraged in other areas.
Each X = one quarter
Estimated annual cost in U.S. dollars.