Appendix 7

BIGEYE TUNA YEAR PROGRAM (BETYP): RECOMMENDED FRAMEWORK AND BUDGET*

1. Overview

A spectacular and uncontrolled increase in bigeye tuna catches has been observed during recent years, mainly by the purse seine and longline fisheries, which may significantly endanger the management and conservation of bigeye tuna. Scientific research efforts on bigeye have always been at a very low level in ICCAT, resulting in poor knowledge on the basic biology, stock structure, migration, and dynamics of this species. The analyses carried out in 1997 by the SCRS confirm that there are serious uncertainties about the state of the stock and a danger that the stock may face a risk of recruitment over-fishing.

Given the present high level of catches, an intensive research program, coordinated by ICCAT, is necessary to determine whether the present catches are sustainable or whether they will drive the stock towards a serious decline.

Considering the present status of the stock, the high level of catches, and the value of bigeye tuna, the proposed Bigeye Tuna Year Program (BETYP) is a necessary investment in the context of responsible fishing, and requires that a large scale research program be started as soon as possible.

The costs of such a Program are fully justified by:

- the very high value of the present bigeye catches, especially those of the longline fisheries, which take large amounts destined for the lucrative sashimi market;
- the unknown, but probably serious, risks of recruitment over-fishing which currently threatens the long-term viability of the bigeye stock because of the dramatic increase in catches by purse seiners (juveniles) and by longliners (spawners); and
- the almost complete lack of baseline research on bigeye tuna (growth, stock structure, spawning, dynamics etc.).

This research program should be:

- Urgently conducted, because of the potentially critical situation of the stock.
- Very large and ambitious, given the lack of basic knowledge on most of the parameters. The high budget can be considered as a minimum investment in view of the high value of the bigeye landings (US$ 600 million in 1994).
- Primarily conducted by all those involved in the bigeye fisheries: Japan, Uruguay, Chinese Taipei, and others that have longline fisheries, EU countries (Spain, France, Portugal) for purse seine and baitboat fisheries, Ghana for the equatorial baitboat fishery, etc. Active research must be conducted simultaneously on both the longline and surface fisheries, and must cover the entire area of distribution of the species.
- The ICCAT Secretariat should play an active role in every stage of this Program (as during the International Skipjack Year Program). An *ad hoc* BETYP Coordinator should be recruited for the duration of the Program. This expert will be in charge of the various coordination aspects necessary for such a large-scale Program (data collection, data analysis, working groups, tagging and recoveries, etc.). An ICCAT BETYP Budget, to be funded by the Commission or other sources, (such as a landing tax on every Atlantic bigeye landed), should be established.

* As revised by the SCRS in 1997.

- The ICCAT Secretariat should also organize, during this Program, various working groups, as follows:

  -- A Working Group should be established for the organization and planning of the BETYP, once the source of financing for the BETYP has been identified.
  -- Several technical Working Groups will be responsible for specific bigeye research, such as: genetics, tagging, ageing, modeling.
  -- A large scale, comprehensive Bigeye Symposium.
  -- ICCAT should be responsible for the publications from the BETYP research.

2. Necessary research operations and estimated budget

Tagging is one of the major activities of the BETYP. Carried out with conventional tags with archival tags, and pop-up tags, it is in effect a high priority item within the BETYP. This is the most expensive activity, but on the results are essential to the success of the Program. If this activity is not fully supported, the BETYP will not fully achieve its objectives.

The objectives of the tagging program should also include stock structure, growth, stock size and natural mortality at different ages.

2.1 ICCAT coordinating actions and budget

The Bigeye Year Program requires special ICCAT funds of about US$ 2.2 million, over a period of four years (year 1 to year 4):

		Total Budget (US $)
1	Recruitment of a BETYP Coordinator & secretariat services during 4 years	300,000
2	Normal operating expenses of the BETYP	100,000
3	Organization of various working groups and the Symposium	200,000
4	Coordination & research expenses for which the ICCAT central office will necessarily be in charge (tags, awards, mailing, manipulation of samples	100,000
5	Costs of necessary research for the Program, whose planning depends on ICCAT financing	110,000
6	Costs of conventional tags and archival tags	500,000
7	Costs of chartering a purse seiner for 6 months for tagging	800,000
8	Editing and publication of the BETYP results	50,000
9	Other expenses	50,000
10	**Total**	**2,210,000**

Annual Budget (in US $)

	1st year	*2nd year*	*3rd year*	*4th year*	*Total*
Coordinator & Secretariat	75,000	75,000	75,000	75,000	300,000
BETYP Coordination	40,000	20,000	20,000	20,000	100,000
Working Groups	30,000	30,000		30,000	90,000
Symposium				110,000	110,000
Coordination & research by ICCAT Secretariat	25,000	25,000	25,000	25,000	100,000
Cost of research activities	90,000			20,000	110,000
Tags	500,000				500,000
Boats for tagging	600,000	200,000			800,000
Publications			20,000	30,000	50,000
Other	12,500	12,500	12,500	12,500	50,000

2.2 National research

Various research activities should be conducted at the national level; the corresponding costs (manpower and laboratory costs) to be covered by the countries participating in the Program.

For this research sources of financing should be sought at the national level.

1) Improved bigeye statistics:

Obtaining improved bigeye statistics for all the fleets (purse seine, baitboat and longline; particularly intensive size sampling covering a full year and all fisheries), with multiple trips at sea and observers on-board all fleets that catch significant amounts of bigeye, and an in-depth analysis of the data on this species (to obtain an index of bigeye abundance for juvenile bigeye). The planned activities are specifically:

-- To place five permanent observers on-board the longline fleets (12 months x 5 observers in order to conduct this intensive sampling).

-- To employ temporary technicians to increase the sampling of bigeye taken by the surface fleets at all the landing ports during an entire year, and observers being placed on a significant portion of the purse seine fleet. The increase in fishing power on small bigeye is clear but not well documented (the fishery on logs explains part but not all of the increase in catches). The observer program should then be developed on the purse seiners catching bigeye to carry out sampling in order to understand the basic technological or behavioral reasons explaining the increase in purse seine fishing power on this species. One of the parameters that should be measured is the current extent of the purse seine closure. The goal is to cover 40 observer trips on-board purse seiners. This action is partially being carried out on purse seiners of the European Union in 1997 and 1998.

-- To employ temporary technicians to sample landings at the major ports where longline landings or transshipment occur.

2) Tagging:

-- Intensive tagging of bigeye, targeting growth, stock structure and stock size, should be developed. All the sizes caught and all major fishing zones should be covered. This tagging program should use all the models of tags available: conventional, archival, and pop-up tags (for which the initial results, obtained in 1997, are very encouraging).

A significant amount of tagging should be carried out using tetracycline injections in order to validate simultaneous growth studies.

At this stage the following tagging activities should be planned:

-- Conventional tagging in the nursery area: chartering of a Tema baitboat during a four-month period (November to February) to carry out intensive tagging of small bigeye (and yellowfin). (Goal: 20,000 tagged bigeye, 5% with tetracycline).

-- Conventional tagging of medium and large sized bigeye taken by surface gear in the north temperate waters: chartering of a baitboat during a one-month period in the Canary Islands (Goal: 1,000 tagged bigeye), in Madeira and Azores (Goal: 1,000 tagged bigeye). (Estimated cost: US$ 300,000 for the charter of the northern baitboats (3-month period) and US$ 500,000 for the charter of a Tema baitboat).

-- Opportunistic tagging of large bigeye taken by longline, using conventional tags, conducted by trained scientific observers: a significant number of large bigeye should be tagged in all the major fishing zones (feeding areas and spawning areas of the north and south Atlantic). Goal: 500 bigeye in each of the seven longline strata (i.e., a total of 3,500 large bigeye tagged).

-- Archival and pop-up tags on medium and large bigeye; the goal is to tag 500 tunas, using the best tags available; those tags should be released in diverse well-selected areas (feeding and spawning strata), for a better understanding of bigeye migrations, (e.g., between nurseries and between spawning and feeding areas).

To guarantee the complete success of this fundamental activity, all the costs of chartering the baitboats, purchasing the tags, paying the recovery rewards, the organization and publicity for the recoveries should be allocated to ICCAT and included in the BETYP budget.

3) Genetics:

-- Full use of the various modern genetic analytical techniques should be developed and applied to bigeye in order to evaluate the heterogeneity of the potential bigeye sub-populations in the Atlantic. Significant sampling should be carried out in all the major fishing strata and on all the sizes caught by the various fisheries (see attached map of the major bigeye fishing areas).

-- The genetic samples should be analyzed in a simultaneous, independent but coordinated manner, by various laboratories using various analytical methods. The costs of analyzing the genetic samples will be covered by the countries participating in the Program (ICCAT will finance the sampling and the dissemination of the samples with an *ad hoc* limited budget of US$ 10,000).

4) Growth:

-- Bigeye growth will be studied from tagging and tag recovery results, and from hard part readings. Samples of the hard parts (otoliths and vertebrae) should be collected from the various areas and on diverse sizes of bigeye. Goal: to collect 500 samples and to analyze them independently by two different laboratories. The costs of reading the samples for age determination should be assumed by the countries that participate in the program (ICCAT will finance the sampling and the dissemination of the samples with an *ad hoc* limited budget of US$ 10,000).

5) Natural mortalities and population size of juvenile:

-- The natural mortality of bigeye tuna is a parameter which is essentially unknown, but is of key importance for the assessment of sustainable fishing mortality and the state of the stock, and determining the relative impact of high catches of juveniles. The potential negative consequences of increases in purse seine catches of juveniles will be relatively minor if the natural mortality of juveniles is very high. On the other hand, if juvenile mortality is low, the current over-exploitation of bigeye could have very serious consequences.

This research on the natural mortality of juveniles should simultaneously cover various fields:

-- Eco-physiology of juvenile bigeye aimed at determining the fragility of juvenile physiology (according to their habitat)

-- Study of predators of juvenile and adult bigeye;

-- Direct (use of modern sonar techniques) and indirect study (comparative analysis of the population sizes estimated from sequential population analysis of various species and from the numbers of juvenile tunas caught at sea in the nursery) in order to better measure the population size of juveniles.

-- Analysis of tagging and recovery of tags in the nursery area.

-- The development of models allowing better evaluation of juvenile natural mortality (e.g., using methods similar to those used by the South Pacific Commission for the analysis of tag/recapture data).

6) Reproductive biology:

Intensive sampling should be conducted to obtain a large number of bigeye gonads from all major bigeye areas, with more intensive sampling of gonads in the spawning areas. Those samples should be analyzed in order to determine the spawning potential of bigeye as a function of its sizes and age.

-- A limited sampling of 1,000 gonads should be carried out in each of the four northern and southern bigeye areas (i.e., 4,000 gonads) in order to calculate the monthly gonad index by area every year for three years.

-- Intensive sampling of gonads should be conducted, every year for three years, by observers in each of the three inter-tropical areas of the central eastern Atlantic (see map): 5,000 gonads in each of the three areas (for a total of 15,000 gonads) in order to calculate the gonad index, to count and measures the eggs of the pre-spawning females, and to study the physiology of maturity and the genetics of the contents of the gonads (using standard procedures).

7) Ethology and technology

Ethological research aimed at a better understanding of the behavior of bigeye in multi-species schools associated with floating objects should be developed. Combined with technological research on purse seiners, this could eventually lead to a reduction in fishing mortality of juvenile bigeye.

8) Modeling of bigeye stock assessments: building a comprehensive bigeye model

-- The management of bigeye tuna should preferably be conducted using an comprehensive model, which takes into account the biological peculiarities of the species (complexity of its stock structure and its migrations) and the major economic factors of the various fisheries (sashimi vs canning fisheries). This model should take the multi-species nature of the fishery into account. Such a complex model should be developed by a specialist in such methods contracted by ICCAT, and assisted by an expert in the development of this type of model. A working group should be established to finalize the model. A cost of US$ 20,000 should be included in the budgetary provisions for this highly technical activity.

2.3 Overall organization of the BETYP

A scientist specialized in bigeye should be designated to coordinate the BETYP. This scientist should work in close collaboration with the ICCAT Secretariat and the fishery biologist recruited to manage the Program at the ICCAT level.

A selected scientist should be designated to coordinate and promote the research activities of each activity (statistics, tagging, genetics, growth, natural mortality, reproductive biology, and modeling).

3. Conclusions

In the context of responsible fishing, it is now an obligation for ICCAT countries to develop, immediately, intensive research on the Atlantic bigeye, due to the lack of research done in the past on this highly valuable stock and because of the very serious risk of recruitment over-fishing presently faced by this stock. The high costs requested for this four-year research program are, in fact, quite reasonable, compared to the extremely high economic value of this fishery (more than US$ 500 million yearly; the US$ 2.3 million requested for four years only represents 0.5% of the annual landing value of the catches) and the critical lack of research on this stock in the past. This expensive research program is in fact an economic investment which is presently necessary for the rational management and conservation of the bigeye stock. In the absence of this intensive research program, a drastic reduction in fishing effort and catches should be implemented immediately on all fleets fishing this species. The decision to carry out this Program cannot be delayed due to the present state of the bigeye stock. ICCAT research should be coordinated with other research programs which are planned world-wide on bigeye tuna because of the increasing risk of over-exploitation now faced by this species in most oceans.

Considering the critical situation of the bigeye stock and the urgent need for a full research program, any limited research program will not be able to provide the information necessary for the management and conservation of the Atlantic bigeye tuna stock.

4. Planned activities of the Bigeye Year Program

- November, 1997: approval of the BETYP by the Commission.

Year 1: study the financing and operational organization of the BETYP.
-- Technical working group to establish the details of the content and the structure of the Program;
-- Recruitment of a scientist at the ICCAT Secretariat to coordinate the activities of the BETYP;
-- Designation of the scientists responsible for the research activities.

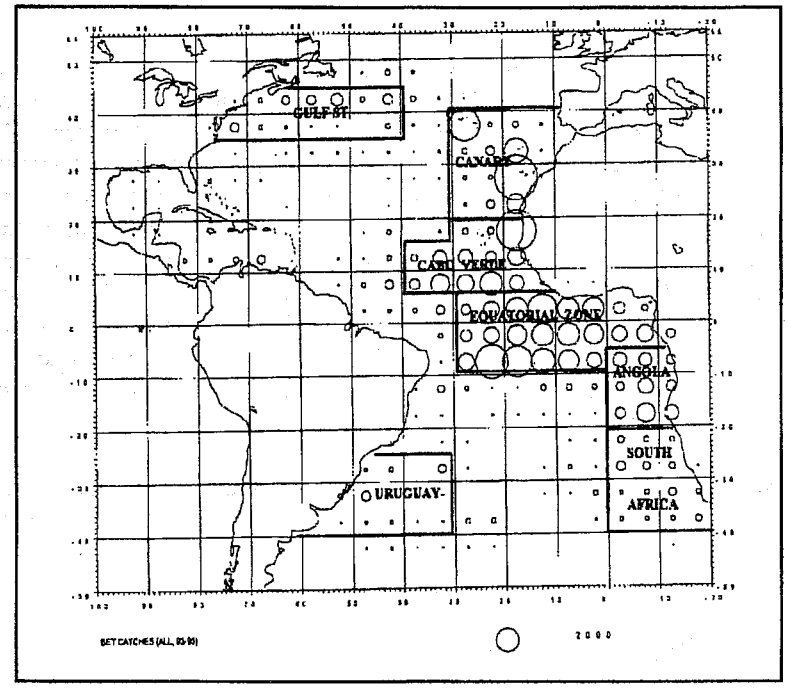
- Year 2: Carrying out research activities
- Year 3-4: Analysis of the data and samples; various working groups by research activity.
- End of Year 4: Celebration of the BETYP Symposium
- Year 6: Publication of the results of the BETYP.

5. Budgetary requirements for 1998 and 1999

The Committee requested "seed money" for initial funding of the BETYP (i.e., US$ 50,000 in 1998 and US$ 50,000 in 1999). Such minimal funding would clearly demonstrate the Commission's interest in and stress the importance of this Program. At the same time, such seed money might encourage contributions from other sources.

These ICCAT funds are needed to initiate the BETYP program, and will be allocated to the following chapters:

1998	US$ 10,000	Activities undertaken by the Executive Secretary to seek funds for the BETYP
	US$ 15,000	Opportunistic tagging (Tema, Dakar, Canaries, Madeira, Azores)
	US$ 10,000	Essential biological studies
	US$ 10,000	Working Group on detailed planning of BETYP
	US$ 5,000	BETYP/ICCAT coordination expenses
1999	US$ 5,000	Coordination expenses
	US$ 10,000	Essential biological studies
	US$ 5,000	BETYP missions undertaken by the Secretariat
	US$ 3,000	Opportunistic tagging



Map of bigeye fisheries (all catches, for the period 1993-1995), and fishing zones used to plan the Bigeye Year Program research plan.