

Fisheries Training Institute.
Central Institute of Fisheries Education
Bombay, India

Final report from the FAO Fisheries Biologist.

[for the two years contract period 1965-67]

United Nations Development Programme
Food and Agriculture Organisation of the United Nations
Project No 70, India

From

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To

The Project Manager
Fisheries Biologist UNDP/FAO Project No 70
Central Institute of the Fisheries Education
Bombay

SUBJECT: FINAL REPORT FOR THE TWO YEARS CONTRACT PERIOD 12 JULY 1965 TO
JUNE 11 JUNE 1967.

1. INTRODUCTION

1.1 Appointment of the Fisheries Biologist.

In September 1964 the former Project Manager Mr Hans Tambs-Lyche as representative of the subcontractor of the Project (NORAD)¹ approached the Director of the Norwegian Institute of Marine Research for a candidate to the post as Fisheries Biologist of the present Project.

Following his recommendation, conveyed by the Project Manager, the FAO as the executing agency of the Project offered the post to me in April 1965. On the end of 2nd of July a two year contract was signed between me and FAO on the normal terms of employment for field project personnel in grade P-4 step 1.

I left home station on 12th of July 1965 and after 6 days stopover at the FAO Headquarters in Rome for briefing and clearance I arrived at duty station on the 20th of July 1965 and presented myself to the Project Manager.

On the 29th of September I was joined by family, consisting of wife and three children.

1.2. Personal background.

When entering the contract with FAO at the age of 36, my personal background was the following:

¹ Norwegian Agency for International Development.

Education: Cand.Real (M.Sc.) in Marine Biology from the University of Bergen, Norway 1957, with by-subject courses in applied mathematics, chemistry, physical geography and zoology.

Assignments: Fixed term assignment (stipendiat) with the Norwegian Institute of Marine Research from 1st of August 1956 to 30th of March 1958. Permanently assigned to the said institute from 1st of April 1958 to date.

Field of Experience: Research on various aspects of population studies of tunas and related species. Planning and execution of exploratory fishing and research cruises in the tropic, subtropic and the temperate zones of the North-East Atlantic and adjacent seas.

Theoretical studies on the mechanics of webbing and testing of fishing gears.

Member of international fisheries research committees of I.C.E.S. and FAO.

1.3. Duties and responsibilities.

1.3.1. Letter of instruction.

According to my Letter of Instruction dated 19th July 1965 and signed by the Director of Fisheries Division of FAO, the duties and responsibilities of the Fisheries biologist should be to work as a member of FAO team carrying out the special task stated in the project's Plan of Operation.

Progress reports on the work and future work plans should be submitted to the Project Manager every third month.

Towards the end of his assignment the Fisheries Biologist should prepare a final report, a draft of which should be sent to the Project Supervisor two months before leaving the Project. The final report should be submitted to the Project Manager towards the end of his assignment.

1.3.2. Obligation according to Plan of Operation.

According to Plan of Operation the FAO personnel should assist the Indian Government in establishing the Central Institute of Fisheries Education (CIFE) equipped with laboratories, library, work shop, fishing training vessel, machinery and gear, and assist in establishing sub-centres for training in fresh and brackish water fisheries. The contract with the Indian Government moreover states that FAO personnel should act as advisers and consequently have no executive power.

The Fisheries Biologist acting as adviser to the Professor of Fisheries Biology and chief of the Biology Section of CIFE has been concerned with the facilities and equipment under the responsibility of the Biology Section. These comprise two laboratories

equipped for training and research work, one small aquarium named the "live animal room" and one room earmarked for keeping a collection of aquatic animals and plants, the "museum".

Although the chief of the Economic Section has been in charge of CIFE's library equipment, it has been practised that the incorporation of required book, journals and periodicals on the various subjects is the responsibility of the section concerned. Assistance and advice have been given by the Fisheries Biologist in preparing lists of the required literature in fisheries biology and oceanography.

The fresh and brackish water sub-centres have not yet been established. The bulk of work to be performed at these centres is, however, biological in nature, and it is fair to assume that the design of instructional localities and the equipment to be provided will, to a large extent, come under the responsibility of the Biology Section.

Referring to the curriculum of CIFE, the Plan of Operation stresses the importance of practical knowledge of the elements of such matters as studies of fisheries, their environment and ecology. In order to be able to perform practical training on such matters, the fishing training vessel has been equipped for oceanographic work under the guidance and advice of the Fisheries Biologist. Under the absence of the FAO Fishing Gear Technologist, guidance and advice matters related to gear design, deck arrangement and fishing operation has also been given as and when required.

The Plan of Operation does not include any obligation of the Project towards the execution of the training courses. The contract states that the courses shall be given by the regular staff, which may be supplemented from time to time by visiting lecturers.

1.3.3. Subcontractor's (NORAD) obligation towards the Project.

According to the subcontract between NORAD and FAO, through which NORAD has assumed responsibility for the day-to-day work of the Project, the obligations of the FAO personnel have been extended to also include an active participation in the instructional work. As outlined in Article 2a of the subcontract, the subcontractor agrees, in cooperation with the Indian Government, to draw up a curriculum of study, to deliver lectures and to arrange for such practical demonstrations as are required for the operation of the Institute.

Although my Letter of Instruction does not refer to the subcontract, I have considered the Article 2a of this as part of my obligation towards the Project, and have therefore actively participated in the instructional work. I have, however, avoided any

interference in the courses held by the national staff, and have only lectured on topics particularly asked for by the Chief of the Biology Section.

Finally, my advice has been sought to a fairly large extent on the planning and execution of field training courses, which in some cases have developed into combined training-research projects. Although the Chief of the Biology Section, hereafter named my national counterpart, has been in charge of these programmes, I have been given the benefit of executing power in the technical set up of these projects, and also in the execution of the work to be done.

2. SUMMARY OF ACTIVITIES AND RESULTS.

2.1. Instruction facilities.

2.1.1. The Syllabus

During the academic year 1965-66 the instructional work within the Biology Section followed in principal the curriculum prepared by the former Project Manager in consultation with the teaching staff. This proposal suggested 585 lecture hours for the whole year course, supplemented by 175 two-hours and some 8 months for field work and excursions. Although the allocation of time and topics were not grouped sectionwise in this proposal, the number of lecture hours allocated the Biology Section appeared to be about 180 one hour periods, according to the nature of the topic listed.

The curriculum did not indicate time to be allocated the various subjects to be covered through practicals, field work or excursions. It was felt that no well balanced plan for the field work and the practicals could be tried out before the Institute had got its own building with laboratories and fish processing plant, substations and vessels.

Following the appointment of the Syllabus committee, a more detailed plan of instruction was worked out, and approved by the Standing Committee in April 1966. According to this revised syllabus, the lecture course is extended to 715 lecture hours, 500 one hour laboratory practicals and 250 days of field work including visits to fisheries and fisheries research centres in India. In addition 250 hours are set aside for guest lectures, tutorials and seminars.

Except for 35 hours guest lectures, the revised syllabus prescribes the time to be allocated each main topic to be covered sectionwise. The Biology Section has been allocated 250 hours for theoretical instruction, distributed on main topics as listed below.

I. Marine Fisheries	hrs.	II. Inland Fisheries	hrs.
Introduction to Marine Fisheries Biology	5	Introduction to Inland Fisheries Biology	5
Oceanography	20	Limnology	15
Meteorology	10		
General biology	20	General Biology	20
Fishes and fisheries	50	Fishes and Fisheries	35
Fish population studies	20	Fish culture	50
Total lecture hours	125	Total lecture hours	125

The theoretical classes are equally distributed on two examination papers, one in marine and one in inland fisheries. The five hours introduction to each paper is earmarked for a brief outline of the major fisheries of the world and their biological background. Apart from methodological aspects, the other topics listed above refer to Indian fisheries mainly.

The lecture programme of fisheries shall, according to the revised syllabus, be supplemented by 220 one hour periods of laboratory practicals, 110 periods on each paper. The practicals shall cover the following topics:

- (i) Identification of commercial important fishes and crustacea, their eggs, larvae and juveniles by external characters.
- (ii) Studies of feeding and breeding behaviour of fishes by dissection and display of organs concerned. Identification of major planktonic groups as food for commercial fish species.
- (iii) Age and growth studies of fish based on bones, scales and otoliths. Studies of fish tags and training in fish tagging technique.
- (iv) Analysis of water samples and soil as to physical and chemical composition. Preparation of hydrographic charts. In addition to the theoretical courses 200 days are set aside for field work and excursions.

2.1.2. Staff of Biology Section.

The teaching staff attached to the Biology Section consists of four persons. A brief statement on their education and previous experience is given below:

- (i) Dr. P.C. George, Professor of Fisheries Biology and chief of the Section. B.Sc. degree in zoology and chemistry, PhD degree in zoology. Previous experience as lecturer of zoology and marine fisheries biology research.

Joined the Institute in November 1964, recruited from the Central Marine Fisheries Research Sub-station Ernakulam, Kerala State, as head of the Prawn Research Division.

- (ii) Mr. A. Datta, Asstt. Professor of Inland Fisheries. M.Sc. Degree in zoology. Previous experience as District Fisheries Officer and lecturer in inland fisheries biology. Joined the Institute in December 1962, recruited from Central Inland Fisheries Training Institute, Barrackpore, West Bengal, as Fisheries Training Superintendent.
- (iii) Mr. M.R. Patil, Asstt. Professor of Oceanography. M.Sc. in chemistry. Previous experience as lecturer in chemistry and oceanographic research. Joined the Institute in June 1964, recruited from the Central Marine Fisheries Research Sub-station Ernakulam, Kerala State, as Asstt. Research Officer.
- (iv) Mr. T.J. Varghese, Demonstrator of Fisheries Biology. M.Sc. degree of zoology. Previous experience in estuarine fisheries research. Joined the Institute in July 1964, recruited from Central Inland Fisheries Research Institute, Barrackpore, as Asstt. Research Officer.

In addition to the academic staff, there are three laboratory attendants and four laboratory boys assigned to the Biology Section. The technical staff has no technical education.

2.1.3. Premises and instructional equipment.

2.1.3.1. Laboratory and Lecture rooms. The localities in Raj Chamber did not provide adequate space for the laboratory practicals and for the installation of the laboratory equipment delivered through Special Funds during the course of the reporting period. Most of this equipment has therefore not so far been used for training purposes. However, when the laboratories in the new premises at Versova are completed, and the oceanographic equipment supplied and under order has been installed, it is felt that the Institute is adequately equipped for both training and research on the subjects outlined in the revised syllabus. The class work in Raj chamber was moreover very much disturbed by the noise from outside (from the railway lines and the docks), since all the windows had to be kept open in the crowded class rooms. A lecture hour in the Raj Chamber was therefore a real strain on the lecturer and also on the trainees, particularly during the hot season. This situation was, however, considerably improved when moving to Versova in April this

year, although the class work in the new uncompleted building also has been disturbed by noise due to constructional work going on in corridors and other uncompleted rooms. This is, of course, a temporary problem, and it is felt that when the constructional work is completed, the new Institute building may provide excellent conditions for class work, for laboratory practicals and for research work, disregarding the hot and humid climate. With respect to the latter, airconditioned rooms would have improved the situation. However, the Bombay climate may not create the same trouble for the local staff as it does for the temporary foreign personnel.

2.1.3.2. The Library. The Institute's library at Raj Chamber was insufficient for the required stock of books, journals and periodicals. The orders of literature through Special Funds have therefore been limited to the most urgently required reference books. In anticipation of new localities coming up at Versova, the Biology Section has worked out a list of literature on the subjects under the Section's responsibility, to be incorporated in the new Institute library. It is advisable to place the order on this literature in the course of the year, so that it can be delivered within the project period. It is, however, very important that before this consignment arrives, a proper cataloguing and control system of the library stock of books, journals and periodicals has been introduced and adopted by the librarian and the staff.

2.1.3.3. The training vessels. Only the 50 ft. Training vessel has so far been taken into use for the Institute's training programme. According to Plan of Operation this vessel was meant to be a fishing training vessel exclusively, and it was built and delivered to the Project as such. No fixed arrangement on board was made for oceanographic work, although oceanographic equipment was ordered and delivered together with the boat.

In consultation with my national counterpart and the Asstt. Professor of Oceanography, the training vessel has been fitted and equipped with the minimum requirement for conducting oceanographic work. The storeroom on the rear of the pilot house has been made into a small hydrographic laboratory providing space for the Nansen reversible water bottles. The upper drum of the main winch has been reserved for the hydrographic wire and the purse-seine davit is used as hanging arrangement for the meter counting wheel.

For the purpose of training in fish tagging technique, the boat has been equipped with a splashless water tank with a built in tagging cradle with running seawater, and net bags to be tied up alongside the boat for keeping live fish. A hoisting arrangement to

transfer fish from the net bags into the splashless tank, without removing the fish from water, has also been provided.

In spite of the somewhat improvised fixtures, the boat has served the purpose of training in fishery biology and oceanographic work very satisfactorily.

2.1.3.4. The Sub-centres. The Institute's sub-centres to be established according to Plan of Operations have not been materialised. The inland fisheries training programme outlined in the syllabus has therefore had to be conducted at available inland state fisheries establishments, under somewhat improvised conditions with regard to laboratory facilities and accommodation. The non-availability of inland fishery centre under the Institute's own administration has also made it difficult to follow up the work initiated by the trainees during their summer courses.

2.1.4. Experience and educational background of the trainees.

In the course of my two years stay at the Institute, three classes of trainees have been encountered; the Institute's 4th, 5th and 6th batch, the fifth batch being followed throughout the course.

The bulk of students has as educational background a B.Sc. in zoology. Some candidates possessed a M.Sc. degree in that subject. Most of the students are State Fisheries Officers with several years of experience in the fishery administration of various states.

In the field of taxonomy and general fisheries biology the standard of knowledge, when entering the course, has been fairly good. In the field of quantitative studies of fish populations and the properties of their environment, however, the students had practically no experience. The teaching of these subjects has moreover, become problematic as the student's theoretical background of basic mathematics, physics and statistical aspects is poor compared to graduate students of biology or any other physical subject in my country.

2.2. Description of work conducted.

2.2.1. Instructional work.

The training programme of the Institute consists of a theoretical training course at the Institute (lectures and laboratory practicals) and a practical course of field work. The bulk of the field work has so far been performed outside the Institute's premises due to lack of necessary facilities. During their first year (junior batch), the students have

received theoretical training mainly, whereas the bulk of field training programme has been executed in the course of their second year of studies (senior batch).

2.2.1.1. The theoretical training programme of the Biology Section.

According to the revised syllabus, the theoretical training course in fisheries biology consists of 250 one hour lectures, supplemented by 220 one hour practicals. The lectures are distributed on topics as shown on page 5.

The allocation of subjects to members of the teaching staff (para 2.1.2.) is as follows:

- (i) The Professor of Fisheries Biology is allocated the topics of Fishes and Fisheries (50 hrs.), and partly the 20 lecture hours on General Biology, with reference to the paper of Marine Fisheries.
- (ii) The Asstt. Professor of Oceanography shall cover the topics of Oceanography (20 hrs.), Limnology (15 hrs.) and Meteorology (10 hrs.).
- (iii) The Asstt. Professor of Inland Fisheries is allocated that paper's subjects of Fishes and Fisheries (35 hrs.), Fish culture (50 hrs.) and partly the topic of General Biology (20 hrs.).
- (iv) The Demonstrator of Fisheries Biology has delivered some lectures on General Biology with regard to both inland and marine fisheries.
- (v) The lectures on Fish population studies (20 hrs.) have temporarily been assigned to the FAO Fisheries Biologist.

The numbers of lecture hours delivered to the junior batch of trainees during the academic year 1966-67 are as follows:

Professor of Fisheries Biology	45	lecture	hours
Asstt. Professor of Oceanography	70	"	"
Asstt. Professor of Inland Fisheries	80	"	"
Demonstrator of Fisheries Biology	13	"	"
FAO Fisheries Biologist	32	"	"
Total	240	lecture	hours

Comparing the figure of total lecture hours delivered to that described in the syllabus, it appears that the theoretical course in fisheries biology should be nearly completed. Comparing the figures topicwise, however, it occurs that the Asstt. Professor of Oceanography and the FAO Fisheries Biologist have exceeded the time allocated the

topics covered by them, whereas some 35 lecture hours are still to be given on the other topics, particularly those covered by my national counterpart. The simple reason to this is that the many projects and other duties under his responsibility this year have forced him to hand over some of his lecture hours to other members of the teaching staff.

It has, however, been practised to let the trainees undergo theoretical training the two last months of their second year of study as preparation for the final examination. Following a time table of 6 or 7 lecture hours a week, being the usual lecture allocation to the Biology Section, this should provide ample time to complete the topics lagging behind according to the syllabus.

The five instructional lectures allocated each paper are available for lectures on principles of world fisheries. My national counterpart has so far given two lectures on the subject with reference to mackerel and clupeids, whereas I myself have delivered one two-hour period on discussion of the world tuna fisheries.

The previous batches of trainees have been taught according to the plan of study proposed by the committee of Fisheries Education, which formed the basis for the proposal of syllabus prepared by the former Project Manager. Although the exact number of lecture hours delivered at the Biology Section has not been available to me, it is understood that the lecture course actually performed exceeded considerably that presented in the plan of study.

The 240 lecture hours delivered to the 6th batch of trainees 1966-67 have been supplemented by 78 two-hour periods of laboratory practicals, (156 hrs.). The practicals have been guided by the Demonstrator of Fisheries Biology under the supervision of the teacher of the subject concerned. The practicals have been arranged for half the batch at a time interchanging the two working groups between sections. Four hours practicals a week have usually been allocated the Biology Section.

2.2.1.2. The FAO expert's contribution to the lecture programme. As mentioned previously (para 1.3.2.) the Plan of Operation does not include any obligation of the Project personnel towards the execution of the Institutes training programme. When joining the project, this was also the attitude of the Institute's administration, which never has accepted the sub-contract between NORAD and FAO of having any bearing on the Institute's work programme. The Indian view on the FAO personnel's contribution to the instructional work was in line with their general attitude towards the Project. The execution of the training courses should be carried out by the Indian staff,

the FAO advisers should take part in the planning and preparation of the courses as and when required.

The syllabus proposed by the former Project Manager comprised two items on Fisheries Biology, which he felt were not adequately covered by the Indian staff.

- (i) Marine biological working methods and practises (20 lecture hrs.).
- (ii) Age, growth, population dynamics (20 lecture hrs.).

He suggested therefore that these topics should be under the responsibility of the FAO Fisheries Biologist, also with regard to the execution of the training programme, but in co-operation with his national counterpart with the view to his taking over after termination of the Project.

After some consideration his suggestion was accepted and the FAO Fish Biologist became incorporated in the regular lecture programme. He was allocated two lecture hours a week to cover the said topic. When changing over to revised syllabus, the latter item (ii.) was assigned to me under the title of "Fish population studies".

In the table below I have listed the lectures delivered by me to the 5th and 6th batch of trainees being juniors during the reporting period.

Main topics	5 th batch 1965-66	6 th batch 1966-67
Introduction	2 lectures	1 lecture
Basic mathematics	6 "	8 "
Principles of the dynamic of exploited fish populations	4 "	2 "
Assessment of stocks based on catch and effort statistics	10 "	8 "
Age and growth	6 "	4 "
Mortality estimates	4 "	2 "
Fish tagging techniques	3 "	2 "
Recruitment selection	2 "	1 "
Yield estimates based on the vital statistics	4 "	2 "
Principles of fisheries regulations	4 "	2 "
Total	45 lectures	32 lectures

The course 1965-66 was held according to the curriculum prepared by the Project Manager, that of 1966-67 after revised syllabus. In both cases I have extended the time set aside for the subjects, particularly with regard to the latter course.

When joining the Project no similar course had been held at the Institute, and being a new matter of training, my first lectures were arranged as discussion periods in order to sound the background knowledge of the students. It was soon born out that Indian graduate candidates I biology are not familiar with the basic mathematic concepts,

indispensable for the understanding of the subject, being mostly quantitative in nature. Their previous education appeared to be descriptive and their knowledge based on memory mainly. The analytic approach of a problem, which I had to introduce, was a new form of thinking which required time to adopt besides being introduced to a new field of study.

The present situation created some major problems in the set up lecture course. The textbooks available on population dynamics were of little use for reference, because they are written in a technical language the students were not able to understand. To bring their knowledge of basic mathematics up to level was, moreover, not possible with time available. However, any problem in fish population studies may be solved without using higher mathematics, but at the cost of considerable labour, and under the prevailing circumstances I felt I had no other choice than the most time-consuming approach to the illustration of the principles of the subject. Simple model populations have been used for the purpose, avoiding the integrated formulas for the assessment of stocks, and only the use of logarithms and exponential calculation has been thought as basic mathematic preparation for the lecture course.

As the above table shows, relatively many lecture hours are devoted to catch and effort statistics. Being in the tropics, where reliable estimates of the growth and mortality parameters may be very difficult to obtain, and selective fishing impractical to introduce because of the larger variety of species, I am of the opinion that collection of catch and effort statistics is the most practical way of assessing the marine fish resources in Indian waters, particularly with regard to the demersal fish stocks. The exploitation of the demersal fish resources may more-over increase considerably in the years to come, following the building up of a modern trawling fleet. Under this expected dynamic phase, highest attention should be paid to the collection of catch effort statistics, and I have therefore endeavoured to make the students understand how useful such data can be in fisheries administration and management.

In Indian inland fisheries, however, the main exploitation problem seems to be related to selective fishing. The fisheries in rivers and lakes are gill-net fisheries mainly, and the mesh size to be used in order to obtain optimum return, is a question which should be given high priority in the future development of these fisheries. Similar population dynamic problems do also exist in the field of fish culture, and my lecture course on yield estimated based on the vital statistics, I have paid most attention to exploitation and fish harvesting problems which may be encountered in inland fisheries.

In addition to the two lecture courses for the benefit of the 5th and 6th junior batches of trainees, I have delivered 12 lectures to the 4th senior batch (April-June 1966) and 8 lectures to the 5th senior batch (April-May 1967).

The 4th senior batch had not received instruction on the subject of fish population analysis as juniors, with the exception of some few lectures on age and growth studies. When returning to the Institute in April 1966, after completion of their field training programme, it was assigned to me to teach them in these topics of population dynamics not covered the previous year.

The 8 lectures delivered to this year's senior batch have been concerned with methods of processing of data the batch collected during their field training courses, and with discussion of the results obtained. This is in my opinion a very important part of their training, in which the trainees have been very actively engaged. These lectures constitute the link between their theoretical training and their practical field work, and are the natural completion of the whole course.

Technical reports concerning most of my lectures have been left behind for the benefit of my national counterpart when taking over the teaching on the subjects (para 2.2.6.).

2.2.1.3 Guest lectures. When visiting fisheries research institutes in various states, local administrative and research workers have been invited to give lectures for the trainees on subjects within their field of studies. This is an effective way of keeping abreast with the latest achievements within fisheries development in the country. The senior batches of trainees have received such training through guest lectures, arranged at the Central Inland Fisheries Research Institute at Barrackpore and Guttack, and at the Central Marine Fisheries Institute in Mandapam and Ernakulam.

Some few guest lectures have also been arranged at the Institute by visiting research workers.

2.2.2. Practical training.

The practical training programme of fisheries biology comprises:

- (i) Courses in inland fisheries working methods and practises.
- (ii) Courses in marine fisheries working methods and practises.
- (iii) Visits to fisheries research institutes and excursions to fishing centres.

2.2.2.1 Inland fisheries field training course. In anticipation of the inland fisheries sub-centre, the inland fisheries training courses have been held at Nowgong and in Sehore-Bhopal area, Madhya Pradesh. The courses are held in July-August when breeding of the freshwater fish species take place (during the monsoon).

The programme of work include practises on carp breeding by injection of hormones, and "dry-bund" breeding techniques, rearing of spawn and fry in rearing and nursery ponds, maintain of ponds and productivity studies. The programme further contains studies on the state of maturity of carps, observations of natural breeding of carps and spawn collection practises in rivers and lakes. The crops of fry raised by the trainees have been handed over to the State Fisheries Department for stocking of the various water areas under the Departments administration.

The planning and execution of the said programme have been under the supervision of the Institute's Director. The subjects concerned are his particular field of research, in which his work has gained favour as well outside as inside India.

When joining the Project in July 1965, the 4th batch of trainees was staying at Nowgong, where they received training according to the above programme. In order to use this opportunity for an immediate introduction to the problems encountered in the inland fisheries enterprises, and with a view to incorporate in the inland fisheries course the subject of population analysis, it was planned that the FAO Fisheries Biologist together with his national counterpart should join the batch at the end of the course, and follow the trainees on their excursion tour to inland fisheries research centres, arranged as a continuation of the course. Due to the outbreak of the Indo-Pakistani conflict, however, this tour had to be cancelled, which actually involved a one year delay in my contribution to the inland fisheries training programme.

Prior to the inland fisheries course for the 5th batch, held in Sehore-Bhopal area in 1966, a visit was made to the selected area for drawing up a training programme in fish population studies. This programme comprised size and composition studies of fish stocks in water tanks by size frequency studies plus marking of fish, and gear selectivity study of gillnets and seines.

As a training programme the work was carried out to our full satisfaction. Two methods of marking fish were demonstrated. In order to obtain a direct estimate of the size of a fish stock in a limited water area, fish were marked by making a cut in their anal fin, and released into the water. Leaving the fish for some few days in order to get mixed with the unmarked population, a certain quantity of fish was again netted out and

examined as to recoveries. On the basis of the proportion of marked fish to unmarked ones, the population size could be estimated.

The other method of marking fish was a regular tagging experiment, using different types of tag made at the Institute by the students and the technical staff.

These experiments received great interest, not only among the trainees, but also among the local fisheries authorities and research workers. The programme has been followed by an agreement between the Director of Fisheries, Madhya Pradesh and the Director of CIFE, to undertake on a co-operative basis a population survey of the Gandhi Sagar Dam as a combined research – training programme for future batches of the CIFE's trainees. This programme was initiated in September 1966. For further details see para 2.2.3.1.

2.2.2.2. Marine fisheries field training courses. The CIFE's marine fisheries field training programme as outlined in the Syllabus presupposes availability of training vessels. The Institute's 50 ft. Training vessel was made available for training in December 1966; the larger one to be provided according to Plan of Operation has not been materialised.

In anticipation of the training vessels, the Institute arranged in November 1965 a composite fishery survey of two fishing villages, Bassein and Arnala, located some 50 and 60 miles north of Bombay. The Survey was arranged as a field training course in marine fisheries for the benefit of the 4th batch trainees (seniors). This is an important "doll-net" fishing area, the fishery which produces a major part of the best table fishes available in Bombay, and the bulk of the "Bombay-duck" (*Harpodon* sp.) catch. The doll-net is an anchored net of similar design as a trawl, the tide current providing the sufficient flow of water through the net to catch fish.

The programme comprised a study of the biological, technological and economic aspects of the fishery on the basis of statistical information collected and compiled by the trainees under the supervision of the teaching staff.

With regard to the biological contribution, the students worked in the area for four weeks, collecting data on catch pr. boat pr. day, composition of the catches with regard to species and size, and made observation on feeding behaviour and maturity stages. A fairly large material was collected, and some preliminary grouping of the data was made by the students themselves. It is, however, regrettable that this material has not been properly processed and analysed, due to non-availability of time and a technical staff who could assist in the grouping of the data and the computation work.

The marine fisheries field training course held for this year's senior batch (5th batch) was the first one accomplished by the means of the Institute's own training vessel, Harpodon. The course was arranged as a five weeks programme, making five daily cruises a week to the fishing grounds of Bombay. The batch of trainees was divided in 5 working groups, each group going to sea once a week. The groups were alternated so that one group going to sea the first day of the 1st week would go on cruise the 2nd day of the 2nd week, 3rd day of the 3rd week etc. This alternation made it possible to reserve particular weekdays for particular work, and secure at least one day training for each group on all the subjects concerned.

The course was carried out in January-February 1966, and the composite programme of work comprised training in operation of fishing gears, data collection on size and composition of catch pr. unit of effort, handling of oceanographic equipment, collection and preservation of biological and oceanographic samples, and handling of fish for processing and marketing purposes.

A corresponding daily work plan was further set up for the four groups not going to sea. One group was engaged by the fish processing laboratory (the day after being on cruise), one by the Biological Section (the second day), one by the Economic Section (3rd day), and one by the Craft and Gear Laboratory (prior to the day of the sea trip).

When working at the Biological Section, the trainees were engaged in working up the biological and oceanographic material they had collected during their sea trip two days earlier.

The timetable described above worked excellently and may serve as model for similar courses to be arranged for future batches. When the other boat also is made available for training, two groups may go to sea each day, and the other three groups may be engaged one by each section.

As for training purposes the cruises were conducted satisfactorily. The data collection may, however, be improved in future courses, when some experience has been gained in coordinating the daily work on board the boat.

During the above course, the batch was given the opportunity to follow a comparative fishing experiment, arranged by the CIFE in cooperation with the Indo-Norwegian Project, Ernakulam and the Deep Sea Fishery Station, Bombay. The purpose of this programme, besides training, was to test the fishing efficiency of 5 trawlers equipped with different types of nets. The experiment in which also Harpodon participated was carried out on the fishing grounds off Bombay in January 1967.

Finally a fish tagging programme on mackerel and sardine was executed by the CIFE off Goa in December 1966. This was the first project in which Harpodon was used. Although the 6th batch of trainees (junior batch) participated at the end of the course, this project carries more weight as research project, and will be further described under para 2.2.3.

2.2.2.3. Tours and excursions. After completing the inland fisheries training course in September, the senior batches have been sent on a 3-4 weeks tour to visit the Central Inland Fisheries Research Institute in Barackpore, West Bengal State, and its sub-station at Cuttack, Orissa State. On these tours, excursions have further been arranged to inland fisheries establishments around Culcutta and Cuttack area. On their way back to Bombay, the batches have paid visits to inland fisheries centres in Andhra Pradesh and Mysore.

A similar tour programme in marine fisheries has been arranged during the winter season (December-January). On these tours, the students have visited marine fisheries establishments in Mysore, Goa, Kerala and Madras States. With regard to fisheries biology, the most important part of the programme has been arranged at the Central Marine Fisheries Institute Sub-station and the Indo-Norwegian Project in Ernakulam, where the trainees have stayed for 2-3 weeks.

In December 1965 the institute arranged, moreover, a tour for the 5th batch junior to Veraval, Gujarat State, which is one of the most important fisheries areas in India.

The training received on tours consists of lectures delivered by local workers and field studies.

2.2.3. Research projects.

When conducting practical training on academic level, one can hardly avoid to be engaged in research work. A practical field training course of academic standard is in principle identical to the experimental part of a research project. The value of a field training course as research, will this depend on the scale in which the experimental work is done, and the existing knowledge on the subject concerned.

In India, very little work has been done on fish population studies. The relative small scale experiments carried out by the CIFE's trainees have therefore become very important, because they constitute the initiation of research projects in a new field of studies, both with regard to the inland and the marine fisheries.

2.2.3.1. Inland fisheries research projects. The fish marking experiments carried out in the Sehore-Bhopal area, by the 5th batch of trainees in July 1966, constitute the initiation of the CIFE's fisheries research programme (para 2.2.2.1.). The experiments have been followed up by an agreement between the Director of Fisheries, Madhya Pradesh and the Director of CIFE, in which the CIFE has been actively engaged in a research project.

The project has as ultimate aim to assess the fish stock of the Gandhi Sagar Dam in relation to the present exploitation. The Dam has a surface water area of about 250 square miles, and has been regularly stocked by the Fisheries Department since 1961. A gill net fishery of carps was started in 1964, under the control of the department.

For the execution of the project, the CIFE shall, according to the agreement, provide equipment and know-how for the experimental work to be carried out; by direct assistance and by arranging field training courses on the topics concerned, for the benefit of the project and the Institute's trainees. The Department shall provide the required samples of fish to be tagged and released in the Dam, and for other studies relevant to the project. The local staff shall collect and compile, on a monthly basis, catch and effort statistics of the fishery and take care of fish tag recoveries. The Department shall moreover, make provision for accommodation and transportation facilities as and when required.

The project was initiated in September 1966. The target of the first years work was to tag 500 adult carps and 2000 fingerlings. The target has been reached with regard to tagging of fingerlings, whereas some 400 adult carps have so far been tagged. The tags used have been made by the Institute's technical staff, under my supervision.

In connection with the obligation towards the above project, the Institute has arranged test experiments of different types of self made fish tags. The purpose of these is to obtain a direct check on the various problems in fish tagging technique, such as growth and mortality rate of tagged and untagged fish under the same living conditions, healing of the wound caused by the tag, and the rate of tag shedding. These experiments are still going on in fishponds of Bhopal fish farm.

It may also here be mentioned that Maharashtra State fisheries authorities have recently asked for the CIFE's assistance in making an assessment of the fish stock of Powai Lake, located in the suburb of Bombay. The biology section has framed a preliminary programme for this project to be carried out before the monsoon starts this year.

2.2.3.2. Marine fisheries research projects. Although the data of the Bassein-Arnala fishery survey (para 2.2.2.2.) may contain information of scientific value, the fish tagging experiment executed off Goa in December 1966 is regarded as the initiation of the CIFE's marine fisheries research programme. This project received particular interest also because it was the first training programme carried out on board the Institute's training vessel Harpodon.

The main purpose of the experiment was to study the behaviour of mackerel and sardine in captivity, with a view to tag these species, which previously were supposed to be extremely delicate fishes. The boat was specially equipped for the purpose of tagging without touching the fish by hand, and without removing the fish from water (2.1.3.3.).

The project was made possible through the cooperation and assistance rendered by the Fisheries Department of the Goa Territory. Two purse seiners belonging to the Department supplied the project with the live fish required for the experiment.

The project turned out to be a great success, and has evoked a keen interest among fisheries circles in India. It was discussed at the 13th meeting of the fisheries Research Committee held at Madras on 13th October – 1st November 1966. A follow-up programme, suggested by CIFE, received great support from the Director of Fisheries of Maharashtra, Mysore and Kerala, the States of for which mackerel and sardine constitute a major part of the fish resources. In order to throw more light upon the life history of these species, of which so little is known, the states concerned have now under consideration to launch a large scale tagging experiment as a joint project, in which CIFE, if materialised, may play a central role.

A report on the project has been published in the Institute's Bulletin no. 3 (2.2.6.5.).

The marine fisheries course, carried out off Bombay in January 1967, is also regarded as a combined training-research project. Since this course may be the most regular marine fisheries field training programme for the future batches of trainees, these courses provide an excellent opportunity of establishing a routine research project, keeping under continuous observation the commercial fish resources off Bombay, and their environment. The Institute's location and facilities for sponsoring a research programme like this is excellent, and will be even better when also the large training vessel is made available.

2.2.4. Tour programmes of the Fisheries Biologist.

For the performance of the work outlined in this report, the Fisheries Biologist has undertaken tours outside duty station as listed below:

Date of departure	nos of days out	Places visited
18.8 1965	5	Panjim, Union Territory of Goa
Nov. 1965	7	Bassein and Arnala, Maharashtra
7.12 1965	5	Veraval, Gujarat State
4.1 1966	21	Ernakulam, Kerala; Mandapam, Madras
22.5 1966	8	Bhopal-Sehore-Gandhi Sagar, Madhya Pradesh
1.7 1966	12	Bhopal-Sehore, M.P.
31.8 1966	13	Gandhi Sagar; Ahmedabad, Gujarat, Union Territory of of Daman
25.9 1966	10	Calcutta-Barrackpore, West Bengali; Cuttack, Orissa; Hyderabad, Andhra Pradesh
28.11 1966	8	Gandhi Sagar-Bhopal, M.P.
10.12 1966	13	Union Territory of Goa
10.1 1967	3	Ernakulam, Kerala
6.2 1967	5	Bhopal, M.P.
<hr/> Total 110 days		

In addition to the above listed tours, I have worked on sea off Bombay for twelve days during December-January 1966-67. On tours I have usually been accompanied by my national counterpart, and also often by the Director of CIFE, who has taken a very active interest in the experimental work previously described.

Apart from the Institute's work programme, I visited Tokyo, Japan for 18 days in August 1966. The purpose of this visit was to attend the FAO Expert Panel for the Facilitation of tuna Research, and to attend as the Project's observer at the 11th Pacific Science Congress.

2.2.5. The CIFE's new headquarter at Versova.

Beside the activities performed in the field of instruction and research, the FAO Biologist has actively participated in making lay-outs of laboratories, and designs for

furniture and fittings to be installed in the new Institute premises coming up at Versova. Two laboratories, for training in biology and oceanography, have been fitted according to lay-outs and detailed drawings worked out by the Fisheries Biologist in cooperation with, and consultation with the FAO Fisheries Technologist and the staff of the Biology Section.

On the ground floor of the main building the room reserved for keeping live fish has not yet been completed. The lay-out of the room and detailed drawings, giving all the particulars of the five aquarium water tanks to be installed, were made available in September last year. The glasses for the tanks, ordered through Special funds, have been delivered.

The work on the tanks has started, but the progress is very slow and it is doubtful that the room will be finished before I leave the Project. It is, however, hoped that the Fisheries Technologist, who has taken active part in the design of the tanks, will keep an eye on the completion of the room, particularly when the glasses are to be fitted.

Lay-outs and original drawings of furniture and fittings of the three said rooms will be handed over to the Project Manager on my leaving the Project.

2.2.6. Technical reports.

In addition to the progress reports submitted to the Project Manager every third month in accordance with my letter of instruction, technical reports on selected topics have been left behind for the benefit of my national counterpart and the trainees. In the present paragraph I may give a brief summary of these reports.

2.2.6.1 Lecture notes. A curriculum of the course in fish population studies has been worked out and left behind for the benefit of my national counterpart, from the view of taking over the teaching. Lecture notes of about half the course have been cyclostyled and distributed to the 5th and 6th batch of trainees, together with table works used for the computation exercises.

2.2.6.2 Report on marking experiment in Motia tank, Bhopal (July 1966).

The report deals with processing and analysis of the data obtained from marking experiments on carps carried out by the 5th batch of trainees (para 2.2.2.1). The aim of the experiment was to demonstrate for the trainees a simple method of estimating the stock size of a 3.5 hectares water tank, located inside Bhopal City, by marking fish.

The tank was believed to be overpopulated. Although the material obtained was not adequate for an accurate estimate of the stock size, the processed data strongly indicate that the density of fish in the tank was very low. This was most probably due to heavy poaching.

2.2.6.3. Fish marking experiment in Killa Channel, Cuttack (Sept. 1966).

This report comprise the working up of data from a fish marking experiment carried out by the 5th batch of trainees in a 4 hectares water area belonging to the Central Inland Fisheries Research Institute, Cuttack. The experiment is similar to that carried out in Motia tank, Bhopal. The method was repeated because the Motia tank data were inadequate for the purpose, due to scarcity of fish.

The experiment turned out to be very successful, due to high availability of fish, and the population size could be estimated to a high degree of accuracy. Moreover, the net used for catching the samples appeared to be very selective, favouring the catch of one species. The experiment became therefore also an excellent class example on the use of fish tagging experiments for the purpose of gear selectivity studies.

This experiment may be published under the authorship of the Fisheries Station of CIFRI.

2.2.6.4 Selectivity test of gillnets, carried out in Motia tank, Bhopal, (July 1966). The report deals with methods of processing and treatment of data, from a gillnet fishing experiment, carried out by the 5th batch of trainees. The aim of the project was to demonstrate the selectivity of gillnets of various mesh sizes (3", 4"). The nets were used in the Motia tank, Bhopal, where the size composition of the stock was known from the seine catches made under the fish marking experiment. The size composition of the catch taken by nets of the same mesh size is compared to the size composition of the stock. From these data the selectivity curves of the nets has been computed.

2.2.6.5. Preliminary report on tagging of the Indian mackerel, *Rastrelliger kanagurta* (Cuvier) and the lesser sardine, *Sardinella gibbosa* (Val.) off Marmagao harbour, Union Territory of Goa. This report is a detailed description of the tagging experiment carried out on board Harpodon in December 1966, and in which the 6th batch of trainees participated (para 2.2.3.2).

2526 mackerels and 308 sardines were tagged and released during the experiment. Four types of tags were applied, one dart tag and one anchor tag, both made in U.S.A., a loop tag and a semi internal tag, made at the Institute.

The report is published in the Institute's Bulletin No. 3, under the authorship of J. Hamre, K.H. Alikuhni, P.C. George and T.J. Varghese.

3. PROBLEMS ENCOUNTERED AND RESULTS OBTAINED.

Apart from some advisory activities on equipment to be ordered through Special Fund, and on lay-outs of the new laboratories at Versova my day to day work during the first year of my stay at the Institute was mostly concerned with theoretical instruction. Compared to the academic year 1966-67, the first year was rather ineffective due to several reasons. First of all, it took time to be familiar with this completely new environment, the hot and humid climate, and to adopt the rather rich bacterial flora. The contrast, moreover, between the Norwegian Institute of Marine Research and Raj Chamber was extreme, and did not either create much enthusiasm for constructive work.

However, the main difficulty hampering my work during the first year was lack of firsthand knowledge of Indian fisheries and the problems encountered by Indian fisheries workers. With respect to marine fisheries, the situation improved gradually, first by the marine field training course held at Bassein and Arnala, and by the later visits to Veraval, Ernakulam and Mandapam. The visits of the Central Marine Fisheries Research Institute in Ernakulam and Mandapam were particularly useful. This trip gave me for instance the first opportunity to see a trawl catch taken in Indian waters. The CIFE had at that time no facilities for work at sea.

With regard to inland fisheries, I had practically no knowledge of the nature of these before the 5th batch of trainees entered their second year of study in July 1966. As mentioned previously, I had planned to visit inland fisheries centres in September 1965, but due to the Indo-Pakistan conflict, this tour had to be cancelled. This unfortunate event was a major set-back for my contribution to the inland fisheries training programme, in which the subject of population studies may have the most significant application with a view to fisheries development in India.

The knowledge and experience gained during the inland fisheries course in 1966, made it possible to adjust the theoretical instruction on existing problems in Indian inland fisheries, and to discuss with the trainees problems they had encountered themselves in inland fisheries administration and research work. This improved the interest for the subject, and made the students more active in the class work.

With regard to practical training, the courses in population studies of fresh water fish stocks have been carried out with greatest interest and enthusiasm, both with regard to the trainees and the teaching staff, and I strongly feel that this new subject has come to stay. However, the keen interest these courses have been met with by the fisheries administration and the research workers is even more encouraging. It reveals that the necessity for more knowledge on fish population and exploitation problems is strongly felt within the inland fisheries administration. This may stimulate to increased effort in this field by CIFE, and may develop into joint projects which will strengthen the link between CIFE and the fisheries institutions where the trainees are going to serve when this course is completed. It should be unnecessary to stress that no effort should be spared to stimulate a development in this direction.

With regard to practical training in marine fisheries biology, not much can be done without facilities to work at sea. This was the situation at CIFE up to December 1966 when the training vessel Harpodon was made available. Taking into account the short period the boat has been to our disposal, it is felt that also in this field the results of the training programmes are quite satisfactory, and that the experience gained may be of great value for the planning and execution of future courses.

The marine projects have also received a keen interest with regard to future line of Indian marine fisheries research, and if the planned follow-up work is going to be materialised, this means a significant step forward for CIFE in the direction of a recognised research institution. And since the aim of these projects is to gain knowledge of the Indian fish resources, this development is very encouraging also with a view to the Institute's educational activities in the years to come.

However, the practical instruction and the research work so far performed are still in an early stage of its development. The larger training vessel and the sub-centres, which together constitute a major part of the Institute's facilities for practical work, are not yet materialised. The field training programme executed up to now can therefore only be regarded as selected courses, which later may be incorporated in a composite and integrated plan of study for the whole Institute. And the necessary background material for framing such a plan may not be obtained before the Institute has worked for some time as a fully established unit.

The theoretical training course of the Biology Section is more or less in the same state as the practical one. With regard to a final plan of study, the localities at Raj Chamber did not provide the necessary space and facilities to try out a programme of instruction to be transferred to the new premises at Versova. I have, however, suggested

for my national counterpart that he should request all the teachers of the Section to work out a detailed curriculum on the theoretical aspects of the subjects they are teaching. This has not been done, and since such material is indispensable as background knowledge for the drawing up of a coordinated and well balanced plan for the theoretical course, I regret to state that this important matter remains unsolved.

Another important matter which has not been solved to my satisfaction is the working-up of the bio-statistical data collected during the field training courses. As mentioned previously, the Bassein-Arnala material is only semi processed. The catch statistics collected during the sea cruises with Harpodon, and those under the comparative fishing experiment arranged in January this year are remaining unprocessed at the craft and gear laboratory, which has assumed responsibility for the working-up of these data. This is very regrettable, because these data when processed should form the basis for the final discussion of the courses, to be undertaken in the class.

The main reason to the delay in the working-up of collected material is a non-availability of a sufficiently qualified technical staff to assist in work like this. This lack of such assistance has hampered my day to day work also in many other matters, because I have had to attend to technical work myself, which could as well have been done by technical staff. This has particular reference to my technical reports, which contain a large number of examples in quantitative terms.

It is also felt that the delay in the appointment of the FAO Fishing Gear Technologist has been a considerable drawback for the teamwork of the FAO personnel. This has particularly reference to the fisheries biology work, because many of the problems attacked in the marine fisheries courses, are as much gear technology problems as problems of interest in fish population studies. As effort on cooperative basis is the most efficient way of investigating problems like these, I strongly feel that an earlier appointment of the FAO Fisheries Technologist may have contributed to a better outcome of the sea cruises with Harpodon with respect to data collection, and a better coordination of the work on board the boat.

4. CONCLUSION AND RECOMMENDATIONS.

4.1. In General.

Being an institution to train techno-administrators with an eye to development of the Indian fisheries, the Central Institute of Fisheries Education should endeavour to adjust its training programme according to the current requirements of the fishing industry. This task require first of all a thorough knowledge of the various fisheries

enterprises by the teaching staff. In this respect the field training courses arranged outside the Institute, and the tours and excursions undertaken in connection to these, have been of benefit not only to the trainees, but also to the staff members who have supervised and guided these courses. The contacts with fisheries workers outside the Institute thus obtained, have moreover, proved to be an inspiration to joint effort in the approach to existing problems encountered by local fisheries officers. Combined training-research projects undertaken by the Institute in cooperation with state fisheries departments are in this respect very valuable, and it is strongly recommended that the Institute pursues this line in its general set-up of future work plans for the purpose of keeping the training programme on line with the current development in the fisheries, for initiating research on existing problems, and for keeping the Institute abreast of the current needs and requirements for trained personnel in the fisheries industries and administrations.

The Institute's training programme may be technically improved when the Institute is fully established, and has become independent with regard to training facilities. In India, as well as in other countries, governmental institutions have a tendency to become self contained enterprises. With respect to the CIFE, the danger of such a development will occur when a routine training programme, entirely based on the Institute's own facilities, have been established, if care is not taken to secure the proper connection outward to receive the necessary impulses for renewals of the programme. Consideration of convenience among the teaching staff may further contribute to an isolation of the Institute, if allowed to remain with routine work only. It is therefore very important for the further development of the Institute that the training programme is made sufficiently flexible to incorporate any new subject of study which may arise from fisheries development, as well outside as inside the country.

4.2. The Syllabus.

Training is simply spoken a transformation of knowledge, and the task of the teacher is to select from his source the knowledge he feels is relevant and required for the future work of his students. A techno-administrator will be concerned with the handling of practical problems mainly. Application of theories and methods in solving practical fisheries problems should therefore be given the highest priority in the Syllabus of CIFE.

The revised syllabus is exclusively based on the CIFE's teachers' individual views of what is relevant and required training to be conducted within their own field of knowledge. The necessary background material for an objective assessment of an

integrated plan of study has not been made available to the Syllabus Committee. Before such material is provided, there is no proper basis for suggestions of improvements of the existing Syllabus, both with regard to changes in subjects and adjustment in allocated time.

In order to provide the necessary material for an overall review of the CIFE's training programme, with a view to establish a well balanced and integrated plan of study, I may therefore recommend that all the teachers of the Institute should be requested to prepare a curriculum, giving detailed accounts on all the subjects handled in their lectures and practicals. On the basis of this background knowledge, the Syllabus Committee may reconsider the plan of study, and make suggestions for eventual improvements.

4.3. In the scope of instruction.

4.3.1. Theoretical training.

Due to the non-availability of a detailed curriculum, there has been little coordination of the teaching, as well within as between sections. The recommendation made above, if followed, may also form a base for a more rational lecture programme within sections, securing a natural sequence of related topics, and avoiding overlapping in the class work performed by the various teachers. An extract of the written lectures should, moreover, be cyclostyled and distributed to the trainees prior to the discussion of the topics in the class. Such lecture notes may enable the students to take more active part in the instructional work, and may be their main reference literature in their future work.

The present time table of 5 – 55 minutes lecture hours and two hours practicals each day, is very laborious for the trainees, particularly because no time is set aside for brake between lectures, except for one hour's lunch break. The next teacher moves into the classroom when the former moves out, leaving no time for the students to prepare themselves for a new subject. In order to avoid this unnecessary strain on the trainees, it should be considered to cut the lectures to 45 minutes, for the benefit of a ten minute break in between the lecture periods.

4.3.2 Practical training.

When the fresh and brackish water sub-centres are established, the inland fisheries field training courses may be stationary, and may develop into routine programmes. This will certainly improve the technical set-up of the courses. It will,

moreover, provide an opportunity to follow up the work on breeding, hatching and nursing of larvae to also include the nursing of juveniles up to adult fish. This latter part of the programme should be concerned with problems encountered in intensive fish culture. This is no doubt a very important and fascinating field of study, which I feel is lagging behind in Indian fish culture research. The practical training in this field should comprise routine sampling methods to assess the standing crop of planktonic organisms in fish ponds, and methods of sampling fish population with respect to growth and mortality estimates. The data obtained should be processed by the trainees themselves, in accordance with the theory of yield estimates the students have been taught in the theoretical course.

With regard to marine courses, it is felt that the composite course, arranged this year by the use of Harpodon, should continue as a routine course, also after the larger training vessel is provided. Two working groups of 6 trainees each may then be given training at sea simultaneously, and the subjects and the areas under study divided on the boats according to facilities and convenience. With two boats, it is also possible to extend the routine programme to include comparative fishing experiments, which may fetch considerable interest to the trainees.

Beside the routine course, time should be set aside for arranging courses on selected topics, as and when required. But I want to stress, however, that whatever work is planned and performed, it is essential that the students are clearly explained the ultimate aim of the course. That the data collected are processed and analysed, and that the results obtained in relation to the purpose of the course, are discussed in the class as the final conclusion of the training programme.

4.4 In the scope of research.

The standard of education at CIFE will no doubt very much depend upon the future development of the Indian fisheries and fisheries research. The Institute has already taken the consequence of this, by its active interest and participation in research work. Although fisheries education is the Institute's main task, the CIFE can, and should play a central part in the future development of fisheries research in India in order to make full use of its equipment and facilities, and the central position it may obtain in the development of the Indian fisheries. Research on selected topics within the Institute's area of operation may to advantage be incorporated in the training programme, either as joint projects undertaken in cooperation with other research institutes, or as projects entirely based on the Institute's own facilities.

Fish tagging techniques have been given high priority in the combined training-research projects so far arranged by CIFE. Being in the tropics, where conventional methods of aging fish are not very reliable, introduction of fish marking methods is regarded as essential for obtaining knowledge of the primo factors governing the question of how to exploit the available fish resources in the most rational way. When completed, the Institute will possess the required facilities to carry out the necessary experiments on problems connected to fish tagging technique, to be applied to marine and inland fisheries research projects. Through the training programme and through direct assistance in research projects, the technical know-how obtained can be effectively distributed, and may contribute to increased effort in this field of fisheries research.

Another important matter, on which the Institute can and should do research work, is the subject of intensive fish culture. In my lecture course on population studies, the theoretical aspects of intensive fish culture technique are analysed, and some new lines of research suggested. And I may suggest that when the inland fisheries sub-centre is established, a combined training-research project is undertaken in accordance with the theory outlined in the theoretical course on fish population studies. I strongly feel that such systematically planned experiments may constitute a significant step forward in the approach of the problems of fish production in limited water bodies.

In marine fisheries research, it is hoped that the Institute will take the necessary follow-up action in the research projects already initiated. The success of the tagging programme on mackerel and sardine depends on an active participation of the fisheries administrations and research institutions in the southern states of India, and may at a later stage be taken over by them as a routine programme. The Institute may, however, take up similar programmes for other commercially important species, particularly when the larger training vessel has been provided. In this connection the tuna resources in the coastal areas and the high sea of the Bay of Bengal should be given high priority.

As mentioned previously, the marine fisheries training course undertaken by the Institute's training vessels off Bombay, should become a regular course in the Institute's training programme. These cruises will, however, constitute an excellent opportunity to establish a routine research project, keeping under continuous observation the fish resources in the area off Bombay, and their response to seasonal changes in the environmental conditions, and to increased exploitation expected in the years to come.

During the training course, the students should collect the required data for this project, whereas for the rest of the year, time should be set aside for the boats to collect the required data on catch pr. Trawl hour of a standard net, together with standardized

observations on the environmental conditions. These observations should be taken regularly, say every second week, at fixed stations covering the main fishing grounds off Bombay. A project like this will certainly be very valuable as an indication on the productivity of the fish resources in the area, and also as a practical example to be incorporated in the theoretical training course for the future batches of trainees.

4.5. In the scope of facilities required to carry out the work programme

When established according to the Plan of Operation, the CIFE will technically be very well equipped to carry out all the training and research projects dealt with in this report. The new laboratories at Versova should provide very good working conditions, as well for training purposes as for research work. The live animal room may give excellent opportunity to demonstrate fish behaviour under various circumstances, and provide facilities for experimental work on induced breeding, feeding behaviour and fish response to technical operations such as tagging.

The two training vessels will, moreover, enable the Institute to take up any training and research programme which require facilities for work at sea, and may supply the Institute with the marine material required for the current training and research programmes. And finally, the sub-centres when they are established may enable the Institute to perform more efficiently the existing training programme in inland fisheries, and provide opportunity to incorporate new subjects for study.

However, the execution of such an extensive work programme requires a correspondingly large and well qualified academic and technical staff. And this is a question to which the highest attention should be paid. The lack of qualified manpower at the Institute is even now a major problem, and unprocessed data, collected under the field training course has already started to accumulate. The teaching staff is fully occupied with the day to day training work, and have little time to spare for the working up of collected material. And the time they may be able to devote to such work is not properly utilised due to lack of qualified technical assistance. This problem will naturally increase with the current increasing activity of the Institute, and may become acute when the two sub-centres are to be taken into use, and when the larger training vessel is ready for operation. To be clear and straight on the matter, the CIFE has not a sufficient staff to make full use of the equipment and technical facilities which are to be provided according to the Plan of Operation. It is of little use to spend millions rupees on equipment and technical facilities, without securing the sufficient manpower to make use of these, as well for training purposes as for research work. CIFE will without comparison be the most

modern and best equipped fisheries institute in India, and perhaps the most multifarious equipped fisheries training institute in the world. From such an institution people expect production, within a broad range of fisheries science. The technical foundation for this is now under completion, but the building up of a sufficient staff to carry out the work is lagging very much behind. This is the fact which now has to be given the highest attention; otherwise I am afraid the Institute will fall short of expectation.

With regard to the Biology Section, the minimum requirements of additional staff are as follows:

Academic staff.

(i) One senior officer with experience in planning and execution of marine fisheries research projects, with particular reference to fish stock analysis.

His main duties and responsibilities should be to plan and coordinate the marine fisheries training courses and the marine fisheries research projects, in which the Institute is directly involved, and take active part in the execution of these projects. He should further have the responsibility for an immediate processing of all the bio-statistical material collected, and bring the data into a form suitable for instruction purposes and for the final discussion of the course, to be undertaken in the class. He should actively participate in such class work in collaboration with the Professor of Fisheries biology.

Finally, this officer should be in charge of the Section's bio-statistical record system, and keep this a jour with an eye to extract practical examples, complementary for the theoretical course and suitable for publication.

(ii) One senior officer with broad experience in inland fisheries research.

This officer should be stationed at the inland fisheries sub-centre, and have more or less the same duties and responsibilities for the inland fisheries work as the former officer for the marine courses. He should in addition be in technical charge of the sub-centre, and assume responsibility for the current work at the station in between the training courses.

A similar post may also be required for the brackish water sub-centre. However, if the two centres are to be established in the same area, the inland fisheries research officer may also be in charge of the brackish water sub-centre.

Technical staff

The lack of qualified technical assistance at the Biology Section is in the field of data processing work mainly. Two new posts for technical assistants are required, one to be attached to the Biology Section at the headquarters, and one to the sub-centres.

The candidates assigned to these posts, should have educational background and experience in statistical work, such as grouping and tabulating statistical observations, computation of statistical parameters, and should also have experience in drawing of charts, curves and other means of data illustrations.

The solving of the staff problems at CIFE is an urgent matter which should be taken up with the Indian Government at an early date.

Finally I want to state that the collaboration with my national counterpart Dr. P.C. George has been very good, and the relation between us excellent from the very beginning of my assignment. And I sincerely hope he will receive the necessary support and assistance to reach the goal of the Biology Section's work programme.

Bombay 23.5.1967

Johannes Hamre.