

# THE MEXICAN VIEW OF THE BASIC RESEARCH NEEDS FOR THE MANAGEMENT OF THE ANCHOVY FISHERY

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The northern anchovy is now considered to be the largest unexploited fishery resource of North America, largely because CalCOFI has brought attention to the vast resources of the California Current system. The work of CalCOFI, covering more than 20 years of data collection and analysis, provides a vast amount of information on the northern anchovy, *Engraulis mordax*.

## OBJECTIVES

Mexico urgently needs to avoid overexploitation of its few valuable species and must increase and diversify the total catch. The realization of this fact has caused us to focus a great part of our research efforts on the more abundant resources, especially those of the California Current system. Thus, the growing national protein needs, and more specifically the need to have accessible food items for the great majority of the Mexican population, have been the most powerful stimulus for Mexico to develop the anchovy fisheries off Baja California.

Research on the California anchovy was undertaken before the fishery began and has offered scientists the possibility of analyzing an unexploited resource, as opposed to most other exploited fisheries. Thus, we may try to forecast the possible effects of an expanded fishery on the resource.

Since the development of this fishery is among the most important social objectives for Mexico, we intend to exploit the resource rationally. To prevent ourselves from permanently disturbing the self-perpetuating capabilities of the resource, we expect to obtain the greatest amount of the resource, for the longest possible time, with the broadest possible security margin.

## RESEARCH PATTERNS

Because of the research efforts of CalCOFI over the past several years, there is a vast amount of information available, which obviates the need for considerable time and research efforts for Mexican scientists. Because of this, our first efforts have been focused on gathering as much information as possible on the abundance of the anchovy resource, the actual status of its populations, some technological aspects of catch and product processing, and economics.

Three main research areas to be studied now and in the future are: 1) acoustic surveys, 2) analysis of the fishery-resource interaction, and 3) egg-larva surveys. Four central areas of investigation must support these three research areas: 1) general biology of the anchovy and other related species, 2) the environmental conditions of the area under

study, 3) catch and product processing technologies, and 4) economics.

Because of the varied nature of the research areas involved in the program, it seems logical to expect results at different times. We are assuming that the results will follow this order:

1) Research on a very short time scale. Results will be derived from the acoustic surveys, which should give us fast information on abundance and distribution of anchovy schools;

2) Midterm results. These will come largely from the different analyses of the fishery-resource interaction; and

3) On a long term basis. Egg and larva surveys can yield relevant information on distribution, abundance, variations in time or space, self-perpetuating capabilities, and other characteristics of the populations.

Clupeoid fish populations have proven fragile under a heavy exploitation scheme. The world has seen more than one instance in which the collapse of the fishery has been fast and, up to this time, not entirely reversible. Furthermore, in some cases, the fishery has simply disappeared at the normal levels of exploitation. Most of the time, the causes of such declinations have not been fully elucidated, particularly because there has been a lack of necessary information collected before the collapse. Because of this, we are not only seeking to make the anchovy resources for exploitation available, but we also will gather information to prevent those causes of decline known to have been present in other similar fisheries.

We also will be compiling biological, oceanographic, and meteorological data to be correlated with general populations characteristics. The Peruvian experience seems to demonstrate that there are many factors in addition to those normally considered that may account for major variations in the abundance or availability of the resource. Furthermore, there is evidence that the northern anchovy may undergo considerable fluctuations regarding its catchability because of vertical and/or horizontal movements. On the other hand, traditional models have proven, until now, to be poor predictors, which results in poor forecasting abilities. That is why we are planning on high speed data collecting systems. In Mexico's favor is the fact that the fishery is barely beginning and has the potential to be a huge one. We must keep in mind other countries' experiences, and thus avoid the consequences of an insufficient information base.

In addition to a good information base, data have to be accessible and standardized for their

utilization. Because of this, we are developing computer files and retrieval systems to be generated at the same time the information is collected.

### ACOUSTIC SURVEYS

In the early stages of our program, we are focusing our attention at providing the industry with relevant information to widen the fishery operations and increase the catch. All our efforts in acoustic surveys are geared towards giving and receiving information as fast as possible. Thus, cruise reports will be generated when the ship arrives in port, and relayed to the industry to let them know the actual distribution and abundance of anchovy schools. These reports should prove useful in determining trends of distribution and abundance of the resource, a necessary base for assessing the building of processing plants at sites other than Ensenada. It is more than probable, however, that this will change in the future. Up to the present time, anchovy schools have been sufficiently abundant in the accessible areas near Ensenada and the major factor limiting the boats from getting a good catch is the boat's storage capacity. However, a major change will soon occur because 30 new anchovy boats are being built. This will mean more than a two-fold increase in the actual fishing potential (Presently, there are 29 medium-aged, low cost and tonnage boats).

Such an increase will probably necessitate an expansion of fishing areas. The growing need to furnish information to the fishing fleet forces us to consider, within our research, the use of automatic recordings of acoustic surveys, as well as automatic processing and fast information capability.

Several members of our staff are devoting a good part of their time to developing and adapting such recording systems. In addition, we have the valuable support of experts and consultants from FAO.

### FISHERY STATISTICS ANALYSIS

The activities related to fishery statistics analysis are devoted, at the present time, almost entirely to the development of information systems which may yield, at the beginning of the fishery, an understanding of the increasing fishery-population relation, as well as the problems implied in its control. Essentially, this information system implies the use of fishing log cards, per boat landing records, and sampling of the commercial catch, as well as a complete inventory of boats. Up until now, our sampling procedures, including the forms used, closely follow those developed by the California Department of Fish and Game. However, to be able to adequately meet industry requirements, relying on fast collection and accessibility of data, we are developing new options. Regarding the fishing log, we are working on a form that can be easily used by the skippers who will need no special training; additionally, such a form will be compatible with our

automatic data processing system, to avoid unnecessary transcription. Thus, we are working on mark-sense cards which will be read, in the future, by an optical card reader located at our Ensenada Station and transmitted daily, if necessary, to the central files in Mexico City. If this system proves feasible, we would have, by the end of each month, a complete record of all the operations of the fleet that could be reported within 2 weeks to the industry.

Concerning landing data, we have devoted some effort to describing the information flow of the industry, based on records of landing for each particular boat. It is possible to obtain copies of such records; however, this will necessitate the revision of all the forms and transcription to codification sheets. We are thus looking for a design to develop this information system based on mark-sense cards, to be completed by the industry. In the future, our staff will use similar systems in sampling the commercial catch.

This system development, we hope, will have the following two important results: 1) the compiling, from the beginning of the fishery, of readily accessible, up-to-date, and standardized data; 2) by means of monthly or bi-weekly bulletins, we will be able to inform the industry what is actually happening. We are convinced that, in the future, the control of the fishery will depend mostly on the mutual understanding between the fishing industry and the research and control agencies. We want to have them on our side and have them understand, as much as possible, our recommendations.

Of course, all the other activities involved in the program, such as general biology, oceanography, technology, and economics will have, as much as possible, similar information systems.

### ICHTHYOPLANKTON SURVEYS

Our activities in the field of ichthyoplankton surveys follow closely the methods and techniques developed by CalCOFI. This type of work yields very important results but, unfortunately, with a considerable lag in time. Ordinarily the delay in total sample analysis ranges from 1 to 2 years. Furthermore, the inherent difficulties of the work, together with the fact that on a long term basis this activity becomes routine and to many people boring, caused many trained personnel to leave this work, with the subsequent need to train new people. On the other hand, automatic sorting or processing of the samples seems, at the present time, far from yielding satisfactory results. No efforts have been made by us up to the present time to modify this type of work in any way.

Nevertheless, we consider this work to yield very important results, especially if we look at the new evidences pointing to the possibility that the strength of a particular year class may not depend so much on the abundance of the breeding stock as on

the general environmental conditions under which the larvae develop.

Even if the predictive value of these activities is limited by the considerable time lag between collecting and analyzing the samples, their analytical value is very great. However, we should determine whether we are really collecting all of the necessary information with the intensity and coverage that could yield best results.

#### FUTURE PERSPECTIVES

Until a very short time ago, the anchovy was considered a potential resource of relatively low economic yield, mainly because most of the fishing effort was directed toward catching a few valuable species. However, a major breakthrough has occurred in recent years, probably due to 1) the demonstration that the stocks of highly valuable species are already overexploited; 2) that the anchovy potential represents the most abundant North American underexploited resource (information mostly resulting from CalCOFI research); and 3) the collapse of the Peruvian anchovy fishery, that opens a market for fish meal. As a result, the fishing industry (including the Government owned *Productos Pesqueros Mexicanos*) has turned to this potential and is beginning a major incursion into this fishery. As a result, we should expect a developing industry very soon.

Once the development of the industry begins, it can be foreseen that in a few years there will be enough fishing potential to catch the resource's annual yield, as well as plant capacity to process the products by the various technological alternatives available.

Our short term objective is for the industry to develop such capacity in the most orderly, controlled, and efficient manner possible.

In addition to the normal working lines mentioned above, we are working on technologies for catching and product processing. Such activities use all the available methods to locate and evaluate anchovy schools. To increase the efficiency of the fishery, product processing is a major objective at the present time. For both lines of work we are being adequately supported by experts and consultants from the FAO Fisheries Development Project. Other experts will soon come to support economics work and other lines of inquiry.

We are confident that this work will help in the development of an adequate capacity of exploitation. Nevertheless, we must always bear in mind that a great majority of the world fisheries, if not all, follow inevitably the path of overexploitation, impelled by the inertia of development. Especially in the case of clupeoid fishes such overexploitation may easily lead to an irreversible decline of the stocks. Our actual knowledge seems insufficient to explain adequately what are the actual causes of this decline; however,

one could easily point at excessive fishing effort as a facilitating factor.

Taking this for granted, we should search for an adequate fishing regime that will allow us to exploit the resources to the fullest during the high abundance years, without jeopardizing the self-perpetuating capabilities of the stocks during poor recruitment years. This may imply an exploitation level lower than that normally considered as maximum sustained catch. Furthermore, it may require optimal distribution of effort in a very large area and through successive years.

Indeed, such effort distribution will require adequate control of fishing operations at all future landing ports, including not only catch and effort records, but catch composition as well as general biological, hydrographic, and meteorological data.

This means a considerable amount of work to train the people to collect such records, sample the catch, locally process the samples, and compile the resulting information in general archives as soon as possible.

Furthermore, the Californian, as the Peruvian, experience points to the possibility of a close correlation between environmental conditions and population abundance and availability. To be able to cope with this need for data, it will prove necessary to continue regular oceanographic and ichthyoplankton cruises. It also is obvious that in some way we will have to contribute to the development of a meteorological outfit that should be sufficient for fishing and research purposes.

I hope that, in the context of the preceding discussion, it has been clearly established that one of the main objectives of this program is to build, based on other countries' experiences, a good, fast and reliable information system. However, this is only part of the story. We are gathering data that we assume relevant to the fishery, although there is no way of knowing if we are actually collecting all the necessary information. To improve this state of knowledge, we have to jump from the mere adaptation of methodologies into the fields of basic research.

Not long ago, the collaborative program between INP and CalCOFI was based on CalCOFI teaching the established procedures to our Mexican staff. Most of these procedures dealt with acoustic surveys, egg-larval work, oceanography, age determination, and so forth. However, we have started work on other new areas, and specifically on the integration of the results from these studies. The integration of these activities has proven to be the most difficult of the vast majority of research programs. Thus, the INP/CalCOFI Steering Committee decided to join efforts by establishing several standing committees on egg and larvae surveys, acoustic surveys, catch and effort, age determination and, above all, the stock assessment working group.

To be effective, one of the first requirements of these groups is that information should be readily available to all research people participating. On a short term basis, we believe that the following areas of research are among the most urgent:

a) adequate evaluation of quantity and distribution in time/space of the anchovy schools, including the methods to estimate such characteristics;

b) determination of the breeding mechanisms, as well as the recruiting process, including the parent/progeny relation;

c) age and growth, including the age distribution of the commercial catches; and

d) standardization of the fishing power, and determination of the effect of the fishing effort on the natural populations.

It should be made clear that many other research areas will have to be looked at in the near future, including the possible population-environment relations, product processing technologies, etc. Furthermore, research on the above mentioned areas involves investigation of many partial works.

One of the major problems that the developing fisheries may find is the availability of anchovy schools in areas within reach of the fleet. Obviously, the greater the fishing power, the more we should expect that the capabilities of ports to process catches will be inadequate. An alternative to building faster and larger boats with many days-at-sea capability is developing other ports of landing. Although the industry itself would tend to distribute fishing power throughout the total potential area, this process might be inefficient and easily lead to overinvestment. Assessments should be made so that this process may occur with the maximum possible efficiency.

On the other hand, horizontal movements of the schools that take them far from the coast, as well as the vertical movements that keep them in deeper layers, may permit the fleet to fish only part of the year, while the rest of the year they are either tied to the pier or catching something else. Efficient research will have to be done in order to know if more powerful boats could continue their operation throughout the year.

One question that worries all of us is what will be the regulatory procedures in the future? Were it not for the fact that any regulatory scheme will need information collected from the beginning, it seems too early to elaborate on this. However, the normal regulatory procedures of closed seasons or areas, quotas and so on seem to be inefficient to varying degrees, especially in the sense that they promote the underutilization of fishing power. In one way or another, they are all restrictive in the sense that not all the fishing potential of the fleet can be used.

Thus, it seems logical to consider other regulatory schemes that could be used. Unreal as they may appear at first, their application would heavily

depend on the willingness of the industry and early planning. One such scheme could be based on the following factors:

1) The control of the fishing fleet to prevent it from going beyond the optimum fishing capacity. As we mentioned earlier, this may imply that the actual potential should be under that which is normally considered necessary to obtain the maximum sustained yield, especially to prevent overfishing during poor recruitment years. Besides, the number and individual fishing power of boats is not the only means of increasing total fishing potential. Technological advances on fishing gear and methods may considerably increase the fishing power. Because the fishery will be catching a product of relatively low commercial value, overinvestment prevention is a must.

2) Optimal distribution of effort in time and space. Heavily dependent upon fishing fleet mobility, it would require a high predictive capability. Although the technical difficulties seem unsurpassable at this time, we believe it's worth trying.

3) Adequate selection of the catch in terms of age or sizes. Clearly, this regulation may prove far more difficult to use than in a trawl fishery, since the selectivity function of the net may be totally nullified by the fact that anchovy schools are massive and contain mostly single-age groups. This will probably necessitate the selection of schools before the catch. Perhaps a good knowledge of differential distribution might help, or perhaps acoustic methods now developing will reach this advanced state of recognition. At any rate, the cost and willingness to use any of these improvements will be critical.

We are fully aware of the fact that the relationship between industry-research and regulation groups is always difficult and that most of the time fishermen are not only reluctant, but totally opposed to regulatory procedures. However, if that is the case, we could select the normal regulatory options, and the information obtained would benefit those as well.

The previously mentioned considerations take us to one very clear point: it is indispensable to increase, on a short term basis, our research capabilities. Until now, most of the work has been undertaken by individuals directing small groups of people. If the different problems mentioned are to be worked out, we'll need a greater number of researchers.

Training has been supplied, up to the present time, on a very limited basis. Furthermore, our collaborative program with CalCOFI, as I said before, has been concentrated towards learning specific techniques. This program, however, will prove insufficient in the near future. We feel that formal training in fields related to fisheries biology needs urgent consideration.

Anchovy schools are distributed along a very large area. It is highly unlikely that an isolated research institution will have all the necessary means to cover

the whole area. One of the most successful areas of collaboration to date has been that of combined and complementary cruises. We hope that this line of work will not only continue, but be increased in the future.

I would like to end with a final remark. We have an unequalled opportunity to work with a fishery that, for all practical purposes, is only beginning. Although this a clear advantage, there is also an enormous responsibility involved. Failure to assess properly the development of this industry might lead to the same serious consequences that have been suffered by others.

There are many aspects in which the industry and regulating agencies will have to be assessed from the

start. I believe that one of the most powerful aids in integration and assessment is model making. Models, even crude and rudimentary, have the great advantage of making us know what pieces of information are most needed and, in a way, give us a greater insight into the problem.

I hope that our new strengthened collaborative program will pay considerable attention to this problem and that our interaction will result in the elaboration of a powerful theoretical framework. We know the capability of the people we are dealing with. We only hope that we will contribute with some good ideas, as our sets of data are still small, to this joint venture of establishing the scientific basis for northern anchovy fishery management.