

INTERNATIONAL OCEAN INSTITUTE

Mediterranean Study

A Multidisciplinary Project for Improvement of the Living Resources of the Mediterranean Sea.

Introduction

Intensive biological research was pioneered in the Mediterranean with the establishment, a century ago, of the marine laboratories at Naples and at Monaco. Since then there have sprung up numerous research stations of varying size, scope and quality all round its shores and in practically every coastal country. In addition, non-Mediterranean states have, singly and cooperatively, sponsored an important series of oceanographic expeditions. In recent years attention has been given to physical and geological investigations as much as to biology.

Multiple use of ocean space is not a new feature of the Mediterranean region; fisheries, tourism, maritime trade, disposal of waste all have long histories there. However, the greatly increased intensity of these activities in recent years, together with new ones, such as exploration for oil on the continental shelf, have added enormously to the interactions, and potential conflicts, between these uses.

Recognising this, the IOI began, two years ago, an interdisciplinary study of the development of the Mediterranean and its impact on the marine environment. This study was supported first by the Ford Foundation and then by the United Nations Development Programme; appendix I lists the papers prepared during it, and reports the work done up to the fourth Pacem in Maribus Convocation sponsored by the Institute, in Malta, June 1973.

The Mediterranean study is one among several regional projects sponsored by the IOI. The Mediterranean is, however, in many ways representative of the problems of the ocean as a whole with respect to consideration of a new ocean regime. Thus, while being almost an enclosed sea, it has - unlike, for example, the Baltic and the southern North Sea - continental shelf, slope, and deep water areas. Important rivers flow into it. It is bordered by both "developed" and "developing" countries. Practically all uses of ocean space are exhibited in it. Some of its resources are already being fully utilized, others are not.

Military use of Mediterranean ocean space impinges on peaceful economic uses of it. All coastal states of the region have an interest in those uses, but so also do other coastal states - and even some land-locked states. For such reasons, it is reasonable to view the Mediterranean sea as a model of the world ocean, and the region as a model of the world community. A model is "a small imitation of the real thing", but in some ways the Mediterranean is larger than life. In particular, international conflict there is sharper than in many other regions, and resolution of such conflict is desired far away from its shores. Perhaps nowhere could there be more to be gained from peaceful regional development, and particularly from the peaceful cooperative use of the common heritage of ocean space. These considerations lead us to conclude that the IOI Mediterranean Study warrants continuation and expansion, and that in the present difficult period^{for} of governmental relationships, international non-governmental action can be particularly helpful.

Three lines of activity seem now to be needed in continuation of the IOI Study:

- 1) To fill certain gaps left by the earlier study. This covered broadly fisheries, tourism, pollution problems and air communications but an analysis of surface transportation patterns, including ports, is still required, and more systematic work is needed on the methodology of forecasting the consequences of resources use interactions in the area.

- 2) Having in mind the number and diversity of initiatives for international cooperation in the area, some of which were reviewed at the fourth PIM Convocation, to continue to promote cooperation at all levels aimed at agreements among the coastal nations for comprehensive management of the use of this sea, and for development and protection of its resources. Current initiatives include consultations among city and provincial governments for the control of pollution in the coastal zone, and intergovernmental agreements under the sponsorship of IMCO and FAO for the general control of pollution from ships and from other sources and for the management of the bottom fisheries. At present these lack a broader general framework which the IOI should be able to help provide.
- 3) To encourage and support actions aimed not merely at the conservation and protection of the sea, but at positive improvement of its resources. Such actions will require for their eventual application an effective machinery for international management. Efforts to promote them may therefore be expected to catalyze the creation of an appropriate regional regime, within the broader agreements that it is hoped will result from the forthcoming U.N. Conference on the Law of the Sea. It seems more likely that lasting cooperation among Mediterranean peoples can be achieved if eyes are turned to a possible more abundant future than while efforts are concentrated on the protection of current limited sectoral and national interests.

The present proposal is directly mainly to this third line of activity and specifically to the improvement of the fishery resources of the region. Unlike, for example, shipping and tourism, the fishery resources are essentially of interest only to

the Mediterranean coastal nations, and to all of them, developing and developed alike. They are the ones who at present exploit the resources exclusively, who consume their products, and in whose hands their future lies. Many of the natural fish stocks extend beyond the limits of national jurisdiction, and move from one part of the region to another. These resources have a "natural" limit and the level of present use is near to that limit, but they could surely be increased, given the appropriate scientific and technical knowledge, the means and the will to invest in the application of that knowledge, and the necessary international arrangements to sustain and regulate a new biotechnical industry.

Mediterranean countries are large consumers of fish, they import much from other regions, and several of the wealthier countries fish also outside the Mediterranean. Both prices and demand are high. Any technical means of increasing the local resources would therefore be welcomed, and would be beneficial, provided that their exploitation can be brought effectively under control and the benefits of improvement equitably distributed. Conversely, the existence of a technique for resource improvement would in itself stimulate efforts to create an effective regulatory machinery. Furthermore, large-scale improvement of the living resources implies, eventually, a systematic control and manipulation of the Mediterranean marine ecosystem and therefore the integrated management of all other interacting uses of the sea, whether they be polluting uses, mutually beneficial ones or simply competing for limited space.

Fishery Improvement Project

The total catch of fish from the Mediterranean has been for many years practically steady at about 1,000,000 tons per year. The value of this catch is, however, relatively very high. Practically all fish caught in the Mediterranean is used for direct human consumption. Although the basic biological productivity

is low compared with some other regions, the prices attained are such that the value of all Mediterranean fisheries exceeds, for example, that of the Peru current (at its former peak) and that of the Northwestern Atlantic, which are among the world's largest fisheries.

The resources are exploited at present most intensively by the European countries of the Mediterranean, especially by Italy. Productive areas of continental shelf lie also, however, on the southern side, and in some of the African countries, particularly Tunisia, the fisheries are rather important. Stocks of bottom-living fish are mostly ^{yielding} the limits of their natural production and some are very depleted. Some of the stocks of surface fishes are not yet fully exploited, (except for the tunas, swordfish and dorado) but they are less valuable species.

In addition to offshore fishing of wild stocks, fish and shellfish culture in ponds, coastal lagoons and sheltered bays and inlets is an ancient and widespread industry in the Mediterranean area. This culture has consisted basically of collecting or entrapping young animals and keeping them under protected conditions for growth. More recently research in, for example, Israel, has resulted in successful methods of artificially induced spawning in fish such as grey mullets. These forms of culture are critically dependent on continued availability of "undeveloped" coasts and unpolluted water. Although still a vigorous sector of industry, ^{such} mariculture is under continuous threat from the expansion of coastal industry and tourism. Yet tourism creates an ever greater demand for high quality fresh fish and shellfish (as well as for clean seas and beaches) so a successful extension of mariculture industries is highly desirable. How is this to be achieved, in the long run? There are several possibilities. One is to increase, locally, the basic biological production, which is generally limited by the availability of inorganic nutrients in the surface waters. It may be that means could be

invented, not necessarily requiring huge inputs of energy, to bring "lost" nutrients back from the deep water to the surface, and occasional suggestions have been made to this end. Alternatively, additional nutrients, originating perhaps in sewage, could be introduced deliberately and selectively. Another line of possibilities is, however, to divert a greater proportion of the present natural production into animals of direct interest to man as food. There are several approaches to this. One is to increase the natural living space of certain species, for example lobsters and rock fishes, by building artificial "reefs" and the like -- experiments of this kind have been done in many parts of the world, including the eastern Mediterranean, with some success. Another approach is to introduce new useful species, but such action may be ecologically hazardous. Russian scientists, in particular, have proposed species introductions elsewhere -- such as in the Antarctic -- and have made successful implantation of fish species, and of the organisms on which they feed, in the Caspian sea. It may be noted that the Mediterranean is already a natural "laboratory" for unwitting species introductions, as a result of migration of Indo-Pacific species into the Eastern basin via the Suez canal.

A third approach, and one which we believe is more likely to be fruitful, is the rearing of young fish beyond the age at which they have an exceptionally high mortality, and releasing them into the open sea, or into more or less closed areas. Research to that end has been carried on for years in North Sea countries and in Japan, but not at all in the Mediterranean. Success depends on many factors, ranging from knowledge of the breeding behaviour and of the pattern of larval mortality, to international agreement to ensure that the young are permitted to grow up in the sea and that the harvest is limited and equitably distributed among fishing nations and fleets. There are many problems and more possible solutions. By one proposal

young fish would be transported to better feeding grounds than they would normally reach in their wanderings from a natural breeding area. It would be necessary, in the experimental stage, to follow batches of released fish to see that they survived and grew at least as well as their wild cousins. A culture system of this kind opens, however, new perspectives to fishery development. There is, for example, the possibility of breeding improved varieties, and of using organic wastes from land to fertilize the initial operation of rearing the young. Better knowledge of behaviour patterns gained from attempts at rearing and at following the fate of released young, will help us to understand the natural changes in, and movements of, fish populations - which are still mysterious - and may lead to the invention of better ways of catching fish, based, as were ancient methods, more on subtle observation of behaviour than on the exertion of power. To this we may add the possibilities of controlling the movements of fish, that is of herding them as well as leading them to capture.

In practice we imagine that open-sea mariculture would eventually involve a combination of many types and degrees of human "intervention" in the natural marine ecosystems, and that these would result in a complex mosaic of interrelated activities. All these derive from a combination of actions to enhance the natural biological production, and actions to divert more of that production to ends desired by man, while maintaining ecological stability and diversity. As with agriculture, such diversion may involve special habitat creation, and perhaps means of restraining and directing the movements of animals, but certainly it depends on our ability to control, to some degree, the reproduction and early growth of the kinds of animals in which we are most interested. While a favorable combination of many other conditions - environmental, technical, economic, social, legal and political - are all necessary for

husbandry of marine resources, the key to success must lie in the rearing of the young animals.

Recent events in the Mediterranean and elsewhere have shown the importance of resolving conflicts between different "users" of the coastal waters. In the present context, a significant source of conflict is the establishment of marine parks and reserves which may lead to pressures to exclude local fishermen from certain areas in which they have traditionally fished. But in Japan a government- and industry-financed research and development programme for fish culture has helped fishermen to accept governmental and inter-governmental fishery management measures which, when put into effect at a time that the resources have already been seriously depleted, can be hard on the fishermen in the short term, even if they will bring great benefits to them in the long-term. Furthermore, marine parks in which fishing is not allowed, or is strictly controlled, can be most important as locations for the study of the subsequent behaviour, movement, and survival of released young fish and shellfish.

In the light of the above considerations, we propose the creation of an International Laboratory for the Improvement of the Living Resources of the Mediterranean. The work of the Laboratory would concentrate on the rearing, experimental release, and monitoring of young fish and shellfish, but studies directed to improvement by other means would not be excluded. The work of the Laboratory would be primarily scientific, but its scope would include inter-disciplinary studies, both initially, and at later phases of application, as well as the promotion of international machinery required eventually for successful industrial operation. The Laboratory would be a project of the IOI, and subject to scientific direction under the guidance of the IOI Planning Council or of some special group to be set up by the Planning Council. The International Laboratory would have its own research programme, but it would work closely with other

research laboratories in the Mediterranean area, with the several regional international organizations concerned with the living resources of the area and with programmes that may be started to monitor and control marine pollution. It may be wondered why the IOI rather than other existing international organizations such as the General Fisheries Council for the Mediterranean (GFCM) should engage in a research and development effort of the scale and scope envisaged here. The GFCM is a well-established intergovernmental body under FAO, and in the twenty years of its existence, it has given considerable attention to problems of mariculture in working groups and symposia. Although in theory it could become an operational body, it has not done so. Its activities are naturally and properly focused on inter-governmental actions which are feasible now, and the GFCM is at present more than fully occupied in seeking agreements for the management of existing fisheries - especially on already over-exploited stocks, and for the protection of the resources from pollution. A project, including an international research facility, developed under the auspices of IOI would not only be relatively free of the political constraints of inter-governmental decision, but could also maintain a longer term perspective, while having nevertheless a clear, practical objective. The proposed expanded IOI project would thus be complementary to the activities of GFCM and other such bodies, rather than in any way competitive with them. This is especially true in that we would anticipate funding from private or public sources, and only limited financial support from governments in the later stages.

Project Plan (Total duration 7 years)

Implementation of the project would be divided in three overlapping phases:

Phase 1 - Systemic analysis and planning (Two years)

Phase 2 - Establishment of Laboratory and conduct of a five year research programme, in the laboratory

and at sea, beginning in the second year of Phase 2.

Phase 3 - Study and development of international arrangements for application of the research results. (Two years, the first of which is concurrent with Phase 2.)

Phase 1

From what has been described above it will be seen that a very wide range and combination of technical possibilities will need to be examined before a concrete programme of scientific research and inventory of required research facilities can be laid down. For each of these possibilities the non-technical requirements need also to be anticipated as far as possible. Experience shows that economic assessment of new technologies at their very early stage is hazardous at best, and can be misleading, but legal and institutional criteria can usefully be analysed, as well as the possible impingement of other ocean space uses on various forms of marine husbandry. It would also be desirable to try to evaluate the likely requirements of energy input for maricultural systems in relation to the energy expended in catching, and to the energy inputs for other systems of producing protein for human consumption.

The first phase of systemic analysis and planning would involve inter alia:

- a) Review of the status and results of work - scientific and technical - carried out elsewhere in this field, principally in Japan, Hawaii, UK and also in Canada, United States (mainland) and some other European countries. Some general reviews have been made and published elsewhere; they may need updating, but the situation needs to be examined closely, specifically from the point of view of Mediterranean conditions, and having in mind the aim of mariculture in international waters and a wide range of possible types of activity.

- b) Provisional selection of suitable species for study in Mediterranean and of localities where experimental release and/or habitat improvement might best be carried out.
- c) Drafting a provisional research programme for the proposed Laboratory.
- d) Preparing a detailed proposal for the structure, physical facilities, management, staffing and financing of the Laboratory.
- e) A programme of prior ecological survey and continuous monitoring of selected experimental areas. This has begun in connection with some of the marine reserves in the Mediterranean area but needs to be developed having in mind the particular value some of these reserves and other areas may have for ecological experiments under strict international supervision.

This analysis would be carried out by an international interdisciplinary team of consultants under the guidance of a full-time project leader, assisted by the Directorate of the IOI.

Phase 2

The proposed International Laboratory would have physical research facilities to be developed in Malta, in association with the new marine biological station of the Royal University. The University already has a very small and as yet inexperienced research group working on some basic biological problems involved in fish culture; this group could assist, and be assisted by, the International Laboratory. Some of the research could best be contracted to other existing institutes in the Mediterranean area. The sites chosen for experimental work, and hence for prior ecological survey, would include marine reserves proposed in Malta and elsewhere, particularly in southern Italy.

The International Laboratory would have a small, permanent scientific staff with technical and maintenance assistants, and

should have provision for a number of resident senior and junior fellowships each of two or three years duration (renewable), and also for short term consultants. The permanent staff might be drawn from anywhere in the world; the fellowships would be awarded by preference, but not exclusively, to citizens of Mediterranean countries, and a proportion of these earmarked for scientists from developing countries. Some of the junior fellowships would be earmarked for young Maltese scientists. Research training fellowships should also be available for Mediterranean scientists for studying abroad (both within and outside the Mediterranean), for up to one year, the methods and results of fish-culture research at important centres.

In addition to facilities on land, a research and survey vessel would be needed, especially in the later years. This would not need to be large, but adequate to carry water tanks, to sample fish and fish food organisms, and to make simple oceanographic observations. It would be leased or chartered.

Phase 3

By the time that Phase 2 is in progress, one might expect some success to have been achieved in current attempts, through the General Fisheries Council for the Mediterranean, to regulate demersal fishing, at least in the Western basin. We might also expect that some international measures for pollution control will be in effect. The form these take, their scope and inter-relationships will depend to some extent on the outcome of the UN Conference on the Law of the Sea (1974-?). The time should be ripe then for preparing the next step toward comprehensive management of ocean space in the Mediterranean area by the coastal nations there, and special measures could be needed to attract investment in large-scale mariculture, to protect off-shore operations and experiments, and to secure and distribute their benefits.

While these needs will be explored during Phase 2, in Phase 3 they would be analysed more fully, in the light of scientific results attained, and a concrete plan for investment and positive management elaborated, based on calculations of anticipated costs and benefits.

The closing action would be a Mediterranean Conference, to bring together the various organizations, governmental and non-governmental, to agree on the needed international machinery. Participants would include FAO and the GFCM and, inter alia, the Interparliamentary Union, the inter-communal organization established to implement the "Beirut Charter", the IOC and CIESMM (concerned with continuing marine research in the region), the major marine laboratories in the region, the regional association of marine parks which might by then exist, the IAEA/Unesco International Laboratory in Monaco (which conducts research on marine radioactive, pesticide and heavy metal contamination), any pollution research and monitoring unit by then set up with assistance from the UN Environment Programme, and the Regional Biological Center in Tunisia.

Budget

It is not at this time practicable to put forward a realistic budget for Phases 2 and 3, although their combined total costs would, over the six year period, surely run into several million dollars, that is of the order of the larger FAO/UNDP "Fishery Development Projects" operative in many sea areas.

Phase 1 might be costed as follows, based roughly on current UN-rates.

Project Director (12 man-months)	\$30,000	60
Project assistant(12 man-months)	8,000	16
Consultants (24 man-months)	60,000	120
Travel in Medit. area, and of consultants to Malta	8,000	16
Report, secretarial assistance	4,000	8
Overheads (15%) - to IOI	<u>21,000</u>	42
	\$131,000	

In addition, a number of junior training fellowships should be awarded, running into Phase 2, say 10 at \$3000 each

\$ 30,000 60

Grand total

\$161,000

Sources of funds

Support for Phase 1 could best be sought from public foundations. The operational and capital costs of Phase 2 should be sought mainly from industrial sectors that might benefit, directly or indirectly, from successful culture. The possibilities of operational and capital costs being obtained from UNDP and the World Bank should also be explored. The fellowships for Phase 2 (some to be awarded already during Phase 1) might be financed by national International Development associations (e.g. those of Canada, Sweden, Federal Republic of Germany).

Phase 3 could perhaps best be financed by the Mediterranean governments concerned, especially the European countries.

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