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REPORT
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*The New York
Aquaculture Program
Present and Future*

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Cover: Interior view of an oyster hatchery building showing the development tanks for the tiny seedling oysters. Photo courtesy of Lilco.

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*The New York
Aquaculture Program -
Past, Present, and Future*

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The New York Aquaculture Program-- Past, Present, and Future

Aquaculture in the United States remains at an early stage of development, even though long-term prospects for the industry are good. The basic rationale for an aquaculture program is to speed up this development through research and technical assistance. Ideally, this might be accomplished using an experiment station and state college system comparable to (or even part of) the land-grant college system. Under such a system new culture techniques could be developed, tested at a pre-production level, and demonstrated to potential users. However, though Sea Grant was conceived as a marine analog to the land-grant system, it has not been funded on anything approximating that scale. The Sea Grant approach to aquaculture must therefore emphasize cooperation with existing agencies. New York's Sea Grant aquaculture program in turn will build upon the support now available to the aquaculture industry from other sources.

The New York situation differs from many: we already have a functioning aquaculture industry--the controlled

farming of clams and oysters. Bivalve culture has a long and moderately profitable history here, although there are some serious new problems. Consequently, a program to advance aquaculture in New York State should both support the present industry and create a research and education base for new ventures.

The aquaculture program must have two distinct facets. To encourage new ventures, it should conduct innovative research, education, and pilot-scale demonstrations of new culture procedures with local promise. These would benefit both new enterprises and established companies wanting to modernize or diversify their operations. The Sea Grant organization, with its nationwide research activities and associated communications network, is uniquely adapted to perform this role.

The second essential program function should be as quick-response information source, where industry can apply for help with current problems. Existing companies are small and cannot support extensive research and development undertakings of their own. New aquaculture enterprises are also likely to be small, at least in the near future. Yet both new and old are confronting a whole spectrum of unprecedented problems in such highly technical areas as disease control,

waste disposal, genetics, nutrition, engineering, economics, and law. Some of these problems can be anticipated far enough in advance to permit an organized attack through research. Others are general enough to have already been studied in other states. But still others will be novel, unique, unforeseen emergencies, to which only a firefighting type of response will be appropriate.

The quick-response function does not need to be physically separate from the longer-term research and education. Each supports the other and the same people can and should be involved in both. But the approaches are different and they must be planned and funded differently. An effective aquaculture program will have to assess New York's specific needs in the two areas and then provide and maintain a reasonable balance between them.

Just as New York had a pre-Sea Grant aquaculture industry, it also had some components of research and educational programs. Until recently, research support for marine (Long Island) aquaculture, mainly the oyster industry, was centered at the Bureau of Commercial Fisheries Laboratory at Milford, Connecticut on the Long Island Sound shore. Many of the details of current bivalve hatchery practice were originally

developed at Milford. Milford was in effect a regional aquaculture experiment station.

The bureau's successor organization, National Marine Fisheries Service (NMFS), redirected the work of the Milford laboratory, mainly toward pollution studies. This has been a serious loss to the aquaculture industry. Milford had nearly everything needed for useful aquaculture research and it has not as yet been possible to replace either facilities or staff.

Limited NMFS funding for aquaculture-related research has, however, been made available to the New York State Department of Environmental Conservation (EnCon) for work at its Flax Pond Laboratory on the Long Island side of the Sound. At present there is a promising movement, initiated by Sea Grant, to extend the laboratory's aquaculture research and to bring in outside research groups that will share the facilities.

Also on Long Island, the pioneering Marine Technology Program at Suffolk Community College, which emphasizes mariculture, has been an important source of technical information as well as trainees for industry, although it lacks funding and major facilities for active research. A new teaching laboratory at Cedar Beach, in Southold, New York, may help to remedy this situation.

A new research building and other support structures for mariculture have recently been added to The New York Ocean Science Laboratory in Montauk, and prospects are good for further expansion of mariculture research at this laboratory. Local government on Long Island has also become increasingly aware of the value of its fishery resources and of the potential for their expansion through mariculture.

Historically, mariculture and its freshwater analog have had little in common in New York, although both are now usually subsumed under the general term "aquaculture." The breeding, hatching, and stocking of freshwater fish species have in the past been conducted as a public service rather than as an industry. With the increasing popularity of such anadromous species as salmon and sea trout, however, freshwater aquaculture and mariculture have obviously begun to overlap.

Should commercial fish culture be instituted in New York, as seems likely in the near future, industry will have the benefit of EnCon's hatchery experience and will undoubtedly draw on the expertise of the US Fish and Wildlife Service's Tunison Fish Nutrition Laboratory in Cortland, New York. It is ironic that there is a better research facility in the state for

finfish culture, which is not yet commercial here, than for marine shellfish culture, a long-established industry.

Traditional intra-industry contacts, especially among the long-established shellfish companies, ought not to be overlooked, but the time is ripe for a more organized approach to information services. Sea Grant is making substantial progress in developing a capacity to respond to the problems of existing industry, filling in the major gaps in the work of other agencies. Sea Grant Advisory Service (AS) is the first line of contact with industry and, in many ways, the most important. Through Sea Grant and various other contacts nationwide, AS can find and supply the best current information on most aquaculture problems. Like the land-grant system's extension service, no other organization is in a position to perform this function as well, long-term, because no other organization has as good an information system to draw on.

To continue a useful comparison, land grant's extension service has one more important capability: it can call directly on the agricultural experiment stations for special assistance in emergencies. At least some of agriculture's problems, like aquaculture's, are regional or local, and a general solution from some

other state may not be adequate. In such a situation, extension can simply contact the agricultural experiment station in the area and obtain local expertise. If required, the station may quickly initiate research directed to the immediate need. Experts in related fields can pool their information on the subject. The experiment station thus constitutes a flexible and effective technical backup to extension in its day-to-day operations. Its personnel often deal directly with the information user, once the contact has been made.

New York's Advisory Service still has little quick-response support in the field of aquaculture, although a significant beginning has been made. This year's proposal includes the funding of such research, on a necessarily limited scale, directly through Advisory Service offices, without detailed administrative review. A quick-response service to Long Island hatcheries has also been set up at the College of Veterinary Medicine, Cornell, for consultation on disease problems and for fieldwork with industry. Initial results are promising.

Recently, work on the nutrition of marine invertebrates has been initiated at the College of Agriculture and Life Sciences, also in Ithaca. As further

needs are clearly identified, additional specialized information resources will be brought into the program. Ultimately, with further growth of the aquaculture industry, it will be necessary to provide one or more central foci where adequate physical research space and equipment can be maintained and where effective interaction among investigators is possible. Cooperation with existing agencies seems to offer the main hope for an aquaculture experiment station, since Sea Grant cannot, by legislation, build or rent structures. Sea Grant is working toward arrangements of this type, and prospects are reasonably promising.

Long-term aquaculture research is in some ways more compatible with the realities of Sea Grant support than is the quick-response approach, since there are as yet no facilities to handle emergency situations. Individual project evaluation is easier, and funding is much more flexible. One of the principal strengths of the Sea Grant system is its capacity for enlisting the efforts of an almost unlimited range of research specialists from many institutions. This is especially true in New York State, with its several statutory colleges, the largest state university system in the country, and many prestigious private colleges and universities. Program development can proceed in

various directions: those suggested by the program itself--on the basis of observed needs--or completely new and unanticipated paths reflecting a scientist's special area of competence. Both approaches have important advantages and should be continued.

One of the major obstacles to conducting practical research in aquaculture is the shortage of necessary research facilities. While many useful experiments can be performed with minimal equipment and space, others cannot. Marine laboratory space, especially, is limited and in high demand, but aquaculture needs something more than lab space. For aquaculture to be cost-effective--the greatest need at present--it must be conducted on a sizable scale. Significantly different results often appear when a laboratory culture is scaled up substantially. While it may not be feasible to conduct research on a commercial-size operation, there can be an intermediate level, perhaps best designated as a pilot scale, where some of the same problems are encountered. This is the kind of thing routinely done at an agricultural experiment station. Pilot-scale experiments require specialized equipment and considerable space. When it becomes possible to conduct aquaculture experiments on such a scale, pilot cultures will also serve to demonstrate

the state of the art to potential users--often a significant step in hastening production.

Many scientists agree that the most critically needed aquaculture research is in the area of breeding domesticated strains of aquatic plants and animals. One can easily visualize the difficulties agriculture would encounter if it had to use only "wild" plant and animal species. Every aspect of an aquaculture enterprise can be influenced by the breeding stock used. All technical problems and most legal and marketing problems are importantly affected by genetics. Yet to date, almost no progress has been made in domesticating aquatic species in this country. (There are limited exceptions, notably, Donaldson's salmonids.)

Little has been accomplished anywhere else in the world with species of current commercial interest. The reasons are evident: plant or animal breeding is a long-term enterprise, even with the use of modern shortcuts. The sorts of improvement implied by the term "domesticated" are in large part multi-gene characteristics, changed only a little at a time through the trial and error process. Only by patient culturing of many successive generations can one expect to learn what improvements are possible in a

given species, for example, disease resistance or tolerance for close confinement. This is not a field in which one can ever safely predict a specific result in a fixed time period. Though results would be practical, the actual research must largely be "pure" rather than applied. And this means funding problems.

By analogy to agriculture, commercial sources of breeding stock should appear as the market develops. This has already begun to happen with bivalve culture. However, one shouldn't expect great advances, like hybrid corn or "miracle" grains, to be made by private enterprise. The cost/return ratio is too high. These will come, if at all, out of some form of public funding over a sustained period, on a significant scale. Ideally, Congress should establish federal breeding stations in the various climatic areas. Aquaculture's potential is important enough to justify such an approach. But Congress hasn't shown much interest. Therefore, this could more realistically be a major responsibility of state or regional aquaculture experiment stations--and perhaps the most urgent reason for establishing them. Sea Grant's role here is mainly to point out the need for breeding programs.

Because of its very long response time, the breeding enterprise could be considered a third major element of a comprehensive aquaculture program, but constant interaction with industry is so essential that breeding is better treated as a major part of the response role of the program.

Within the realities of the current Sea Grant organization, what can the New York Sea Grant Institute try to accomplish for aquaculture in the state? The following measures are needed *and* possible:

- 1) Maintain and expand AS coverage in aquaculture. This would make available to present and prospective users a rapidly expanding nationwide and worldwide technology. Quick-response funding is a useful adjunct of AS activity and should be accented.

- 2) Concurrently with item 1, continue to build up a research-level response capacity for the aquaculture industry, enlisting existing institutional resources wherever possible. The long-term objective is a true aquaculture experiment station, with at least some of the stability and resources of its agricultural counterpart. Immediate needs are for response capabilities in such areas as engineering, law, genetics, and economics.

3) Support promising individual research projects in all aspects of mariculture and, where within Sea Grant guidelines, freshwater aquaculture. An important consideration in choosing these projects should be their contribution to the building of a response capability. Apparent duplication of research effort elsewhere in the country, although a negative factor, should never be an overriding one, simply because conditions and research methods vary so widely.

It is probably not desirable to concentrate this research on one or a few chosen crop organisms, despite certain advantages in terms of interaction and coordination of investigators. Some emphasis on current major crops such as bivalves appears inevitable. Otherwise, the normal mechanisms of project selection and review will tend to narrow the field sufficiently. Only the industry itself can accurately predict its future crop choices, and it usually does so only at the time of investing funds for production of those crops.

Sea Grant should investigate promising alternatives and, where possible, establish demonstration-scale cultures of those new crops which appear to have commercial potential. Concentration on one or a few chosen crops runs the risk of misleading industry.

which makes its ultimate choice, ideally at least, on the basis of information from many sources.

4) Support the provision of opportunities for education in aquaculture, both as a technical field and as a potentially significant factor in coastal management. Marine technician training is now provided by Suffolk Community College, and university-level courses are offered by Cornell's aquaculture program. Research and graduate education in aquaculture is now possible on a limited scale at SUNY at Stony Brook. The Sea Grant aquaculture program will benefit from coordinating these educational features with each other and with AS and aquaculture research.

5) Promote the expansion of marine research facilities for aquaculture, looking toward the eventual establishment of an aquaculture experiment station in New York State. Facilities cannot be provided by Sea Grant directly, but Sea Grant initiative can and should be a major factor in their establishment.

6) Work with industry to develop opportunities for aquaculture to use thermal and sewage plant effluents. Such use of currently wasted resources has great promise for urban states like New York, both to increase food production and to reduce pollution.

7) Help develop imaginative offshore and deepwater concepts in mariculture and lake aquaculture, through small planning grants and the solicitation of funds from non-Sea Grant sources. Developing such concepts would require an integral blending of engineering and biology. No quick return from such an investment is likely, but the long-term potential is too great to ignore.

The above priority list clearly does not make up a specific research program. Rather, it gives the criteria for choosing projects for each successive annual aquaculture program for New York's Sea Grant. The success of this program will depend to a large extent on parallel rather than successive development of priorities 1 through 5. Item 1 and, to a lesser degree, items 2 and 3 are immediately possible in that order. Providing a quick-response capacity will be important in the choice of research projects under item 3. As the program expands, it is anticipated that specific research requests under item 3 will be increasingly generated by AS and industry, thus strengthening the essential interchange between research and its users. The choice of long-term research projects will also be dependent on the progress of items 4 and 5.

Items 6 and 7 can be assigned a lower initial priority, although success in either would benefit the first five directly. All seven measures should at least be considered for funding in each New York proposal, even though budgetary considerations may force successive postponements of their inclusion.

