

Centennial Lecture I: History and Contributions of the Woods Hole Fisheries Laboratory

ROBERT L. EDWARDS

The genesis and the early history of the Woods Hole Laboratory (WHL), to a lesser extent the Marine Biological Laboratory (MBL), and to some degree the Woods Hole Oceanographic Institution (WHOI), were elegantly covered by Paul S. Galtsoff (1962) in his BCF Circular "The Story of the Bureau of Commercial Fisheries Biological Laboratory, Woods Hole, Massachusetts." It covers the period from the beginning in 1871 to 1958. Galtsoff's more than 35-year career in the fishery service was spent almost entirely in Woods Hole. I will only briefly touch on that portion of the Laboratory's history covered by Galtsoff.

Woods Hole, as a center of marine science, was conceived and implemented largely by one man, Spencer Fullerton Baird, at that time Assistant Secretary of the Smithsonian and who was also instrumental in the establishment of the National Museum and Permanent Secretary of the newly established American Association for the Advancement of Science. He was appointed by President Ulysses S. Grant in 1871 as the first U.S. Commissioner of Fisheries. Fisheries research began here as early as 1871, but a permanent station did not exist until 1885.

In the first years, work was carried out by a number of eminent scientists brought to Woods Hole by Baird. Included in the list were such notables as Addison E. Verrill, Louis Agassiz, Theodore Gill, and George Brown Goode. The studies of these gentlemen took place often in an environment that prevails to this day in the Marine Bio-

logical Laboratory. It took place during the summer, the investigator using whatever facilities were available to carry out his research. The permanent buildings ultimately came about, in part, because three institutions, Johns Hopkins, Princeton, and Williams College, pledged funds to assist in the purchase of land. Many others, including local citizens, also contributed property and funds. Money was also provided by Alexander Agassiz.

Baird noted in 1885 that "The colleges in question and Mr. Agassiz made their contributions with the understanding that, as far as possible, they were each allowed to send one specialist to the station for the purpose of carrying on scientific research." You will recognize that this was, in fact, the origin of the protocol that led to the ultimate establishment of the Marine Biological Laboratory in 1888. For all practical purposes, this agreement stands to this day, although in recent years the National Marine Fisheries Service (NMFS) has assisted in the funding of the MBL library instead of providing space to investigators.

In the beginning, the Woods Hole Laboratory was an adjunct of the Smithsonian Institution. The Fish Commission itself became an independent agency in 1888, and it was transferred to the new Department of Commerce and Labor in 1903. Later, in 1939-40, the Bureau of Fisheries was joined with the Biological Survey and this new unit then made part of the U.S. Fish and Wildlife Service in the Department of Interior. In 1956, the Fish and Wildlife Service was reorganized and the Bureau of Commercial Fisheries was formed. In 1970, the Bureau of Commercial Fisheries

became the National Marine Fisheries Service as part of the newly formed National Oceanic and Atmospheric Agency, settling again in the Department of Commerce. This record suggests, of course, that there may be another change within a few years.

The Laboratory's first half-century was filled with the enchantment of discovery. The researchers involved were explorers in a new world, both from the biological and physical point of view. Nonetheless, Baird, in his assessment of the problems faced by the fishery of southern New England at the very beginning, would not be in a strange environment were he to address his colleagues today. Baird (1873) stated in the first report of the Commissioner of Fish and Fisheries for 1871 that the causes of the problems encountered might include: 1) Decrease or disappearance of the food of commercial fishes, 2) migration of fishes to other localities, 3) epidemic diseases and "peculiar atmospheric agencies such as heat, cold, etc.," 4) destruction by other fishes, 5) man's activities resulting in the pollution of water, in overfishing, and the use of improper apparatus. With a few changes in words and emphasis, that statement is probably as valid today as it was then.

The initial era of exploration and discovery was brought to its natural end in the 1920's by Henry Bigelow of Harvard University. He, with his colleagues and students, conducted extensive research on the fishes, physical oceanography, and plankton in the ocean off New England. Bigelow, of course, went on to become the first Director of the Woods Hole Oceanographic Institution.

Some of the excitement of those days

is contained within the following paragraph from "The Plankton of the Offshore Waters of the Gulf of Maine" by Bigelow (1926) concerning a cruise made in the summer of 1912:

"If one approaches the Gulf of Maine *de novo*, one might naturally expect the plankton of its central portion to be so largely recruited from the coastal zone that neritic elements would loom large there also, judging from the form, length and complexity of the shore line with the abundant and varied bottom fauna which it supports; from the confinement of the gulf by the extensive and shallow offshore banks on the ocean side; from the fact that the tides are strong enough in places to stir the water thoroughly. Our first summer's cruise (in 1912) was enough to show that this is not the case, but that the pelagic communities of the gulf a few miles out to sea are predominantly oceanic, except over the offshore banks."

The second era was one of consolidation based largely on detailed studies of individual species of commercial significance. Some of the scientists involved include O. E. Sette, mackerel; R. A. Nesbit and W. C. Neville, weakfish, scup, and summer flounder; and W. Royce, yellowtail flounder. Never to be forgotten of course, Paul S. Galtsoff, well-known oyster expert, worked here from the early 1920's until his retirement from full-time service in 1957.

There was a growing awareness after World War II that the world was getting smaller. Pressure on fisheries was no longer local, but increasingly international in scope. The Canadians, more than anyone else, were well aware of this; some of their fishing banks had been the object of exploitation by many countries, perhaps even before Columbus discovered America and certainly immediately thereafter (de Loture, 1957). Out of this concern, ICNAF, the International Commission for the Northwest Atlantic Fisheries, was born. The convention was ratified in 1950, and for about 10 years, ICNAF had significance to us only in connection with our fishery interactions with Canada. For a long time, the Commission was infor-

mally referred to as the "haddock" commission because the management of haddock was of prime interest to the United States. More about ICNAF later.

In 1951, Herbert W. Graham was appointed Director of the Woods Hole Laboratory (Galtsoff, 1962). It fell on his shoulders to develop new programs for the Laboratory in light of the new and growing international responsibilities, and the increased interest our country had in marine fisheries as expressed in the Saltonstall-Kennedy (S-K) bill. A new phase had begun which, for lack of a better term, may be called the "ecological" era. Lionel Walford, at the time the Director of Fisheries Research in Washington, D.C., fully supported the approach.

It should be noted that this era had been clearly signaled by a gentleman who had connections both with the Fisheries Service and Harvard University, and as well, WHOI, George L. Clarke. His paper on "The Dynamics of a Marine Community" (Clarke, 1946), provided our initial master plan.

As a consequence of S-K funding, a new vessel, the *Albatross IV*, was acquired, the original buildings that had been badly damaged by several hurricanes were replaced, and the programs began to change from those with a single-species orientation to one of programs with a broader ecological orientation.

One particular development at this time deserves mention. As the single-species programs were consolidated, regular spring and fall groundfish surveys were implemented. The survey continues to this day providing without doubt one of the finest long-term biological data bases in existence.

The last 25 years have seen radical changes in a great many aspects of life, more changes, in most cases, than had occurred in the preceding 75 years.

In the area of technological change:

1) We still go to sea in ships, but now, under the sea as well.

2) We may now examine the bottom and the intervening water column with comparative ease—using man himself, undersea habitats, submarines, television, and other exotic instruments.

3) We handle vast amounts of data quickly and easily.

4) We can navigate our vessels with pinpoint precision.

5) Satellites can now map sea surface temperatures over wide areas almost instantaneously and detect even relatively minor undulations in the sea floor thousands of feet beneath the surface.

In the area of institutional change:

1) The NMFS predecessor, the BCF, moved from its home in the Department of Interior to NOAA, thus returning to the Department of Commerce.

2) The centuries-old concept of freedom of the high seas passed from the scene to be replaced by a 200-mile economic zone (EEZ), and the partitioning of the Gulf of Maine on this the U.S. northeast coast. Still coming are further extensions of the territorial seas. The process of further subdivision along parochial lines is continuing even today, but it is slowing down.

3) International fishery commissions grew in size and responsibility at a great rate and in some instances have disappeared from the scene equally rapidly.

4) Interstate commissions, which once had a great influence on our priorities, no longer play a significant role in our lives. Many of their activities have since been taken over by the Regional Fishery Management Councils set up under the Magnuson Fishery Conservation and Management Act (MFCMA).

During the 1960's, concern for understanding the oceans was high on our national agenda. Compared with that time of intense and continuous interest, our present national concern may be described as being one of random moments of high interest as the consequence of a crisis, for example oil spills or sewage sludge washing up on the beaches of Long Island, between which events nobody really seems to be paying much attention.

The change in venue of the Woods Hole Laboratory in the 1970's was significant and it tended to blur its image as a particular institution at a particular place. It is now the headquarters for all

of the NMFS research for the northeastern sector of the country, carried out by satellite laboratories in many different states.

The changes that have taken place in the scientific arena, of greatest interest to most of us, are the least easy to describe. They are perhaps best illustrated by differences in the schooling of those here in the earlier period and those hired since. Electrons, for one example, no longer circle the nucleus of an atom like moons around the earth—they may or may not exist in this place or that, earlier, now, or in the future. The simply conceived gene of my generation has been replaced by a coded filament conceptually similar to the instructions on a piece of computer tape promoting a series of actions and transformations undreamed of just a few decades ago. The earlier professional staff was dominated by individuals with bachelor and master degrees, and often in the area of wildlife management. Now the majority have their doctorates in a wide variety of fields including economics, statistical theory, genetics, parasitology, ecology, and so on.

Galtsoff's 1962 history of the Laboratory, brings us to the point where substantial scientific reorganization of the program structure began to take place. At that time, virtually every major fishery was represented by its own research project. Each project often had an office and personnel in a particular port dominated by that fishery. The sea scallop project had an office in New Bedford, redfish had an office in Gloucester, and so on. Each office took care of the needs of other projects as well, of course, in the time available. The change took place under the direction of Herbert W. Graham in the early 1960's and, in fact, occurred very quickly despite the fact that such a structural change was a radical departure from past tradition. It was a form of programmatic restructuring that did not take place quickly, if at all, in some of the other laboratories around the country. It set the stage for additional integration and coordination between programs in the other laboratories in the Northeast when the Northeast Fisheries Center was created.

The Research Center concept, which included a new role for the Woods Hole Laboratory, was implemented in two stages. Initially, in 1970-71, it was decided to remove the research laboratories from the purview of the Regional Directors, who had a great many other things to do, and to place them under a Research Center Director reporting directly to the NMFS Washington, D.C., office. Subsequently, in 1975, the marine sportfish laboratories were also placed within the Center structure. It is a credit to those who made that decision that they recognized that one cannot divide a fish species along bureaucratic lines. Further, while it was already apparent 30 years ago that angling was a growing and important recreational activity in the Northeast, it is now clearly recognized as a dominant activity, and at least, from the sociological point of view, as important as commercial fishing.

The Center concept, incidentally, grew out of a period of severe financial difficulty, in 1969-70, for what was then the Bureau of Commercial Fisheries. An opportunity presented itself at that time to take advantage of the growing appreciation of the need for having a "critical mass" and interdisciplinary teamwork to deal with marine ecological problems relevant to fishery management. In addition, there was finally a willingness to accept the fact that there were real regional differences in the biological arena, despite the fact that everyone thought that regions were only administrative. It should be noted in passing that the term "ecology" was still considered an arcane word in Washington, D.C., in the 1960's, although those in charge did appreciate the significance of ecological research in the marine environment insofar as fisheries problems were concerned.

In the late 1960's, at the time when the New England area was in a state of shock from the onslaught of the foreign fisheries, the Laboratory began an initiative that resulted in the establishment of the Polish Zooplankton Sorting Center in Szczecin, Poland. We were overwhelmed by the number and complexity of the samples required and the work involved in sorting and cataloging them.

The establishment of this institution solved our problems nicely and, of course, enabled the Polish Government to carry its load of fisheries research responsibility in the area. As a result, the Laboratory now has one of the better long-term data bases for zooplankton and ichthyoplankton. The Sorting Center still exists; it is at present planning an expansion since it now also serves the other three fisheries Centers.

The "ecosystem" approach to fisheries management was born in the Woods Hole Laboratory in the late 1960's and was implemented in the early 1970's when the fish biomass of the region reached historically low levels. Biomass management was an earthshaking proposition both to the international community, and to American administrators. Implemented in 1973, the biomass management concept was succeeding at the time that the United States extended its jurisdiction over marine fisheries. It was successful for a number of reasons, including: 1) The amount and quality of the joint research carried out with foreign countries, 2) the credibility of the groundfish survey data base, 3) the well turned out and voluminous analyses of the population assessment experts of the Laboratory, and 4) the general appreciation of basics of ecological science that was finally beginning to permeate international resource management decision makers.

Those were particularly interesting days, for just one reason, simply because success in ICNAF delayed the extension of jurisdiction by the United States. A biomass management system has not been invoked since, although the New England Fisheries Management Council is developing a groundfish management plan covering several of the more important groundfish species.

Over the years, the Laboratory has tried very hard to put man into the ecosystem as an integral, dynamic factor. Biomass management was the beginning of this effort, but there is still a very long way to go.

The ICNAF days, in particular the period from 1963 when foreign exploitation began to appear formidable, until 1977, were extremely busy times. You will recall that our national policy, then,

was still that of "freedom of the high seas." It was necessary to do many other things in addition to what one would normally regard as research. The United States, and particularly the Woods Hole Laboratory, had the responsibility, not only for the bulk of the research on the stocks off our shores, but also for maintaining a high degree of credibility in its studies and reports, and the manner in which we carried out our work. It was our country's position that other nations carry their share of the research, and that, as much as possible, this research be done jointly.

During this period, Laboratory and Center personnel took part in more than 200 ocean-going joint research projects (each project had an average duration of 2 weeks), on some 40 different vessels from eight different nations. At one time, in 1976, we had two Soviet, one Polish, one West German and a French research vessel in port at the same time. At that time, there were also two NMFS, NOAA vessels stationed in Woods Hole, the *Albatross IV* and *Delaware II*. We filled the WHOI docks as well as our own. Some of the other countries with whom the WHL has been involved include East Germany, Japan, Spain, and Canada. All told, some 60 worker-years of WHL personnel time were spent at sea on these vessels.

Another joint project initiated by the Laboratory in 1975, was the Helgoland undersea habitat project carried out in the Gulf of Maine to study the spawning behavior of sea herring. The habitat belonged to West Germany. The transportation logistics were handled by the Polish Government. Scientists from these countries, the United States, Canada, and the Soviet Union also took part in the study. A great deal was learned from this experiment about the usefulness and vulnerability of undersea habitats, as well as about sea herring behavior and spawning.

The ICNAF days were characterized by never-ending intensive study and hard work. There is no way one can describe this time and this effort beyond the fact that the volume of papers and reports prepared, mostly gray literature of course, fill many shelves. The challenge was so great, and so stimulating,

that we never had a serious case of burn-out. The nights were long, sometimes very long, the frustrations great, but the successes sweet.

Following the extension of jurisdiction and the establishment of the Regional Fishery Management Councils, in 1976, it was relatively easy, given the baptismal fire of the ICNAF days, to deal with the needs and attitudes of the new managers. These were very different days, however. It is one thing to be dealing with separate cultures, with actions and words filtered through the mesh of diplomatic delicacy, quite another to be dealing brother to brother with sibling rivalry dominating the scene. It would appear on the surface that much of what was learned in ICNAF by decision makers seems to have been forgotten, and that in some ways we are back to ground zero.

The U.S.-Canada boundary argument, an issue brought to the fore by extended jurisdiction, occupied a great deal of the Laboratory/Center attention in the last 4 years. An earlier negotiated agreement between the United States and Canada failed to get U.S. Senate approval, and was submitted to the World Court in The Hague for settlement. The principal burden for the preparation of the material on the environment and the provision of vast amounts of fishery and economic data was placed on the Woods Hole Laboratory. These were particularly trying times since the outcome was pretty well known even before we took the case to the World Court, and it was hard to put so much effort into what appeared to be a no-win situation. In addition, it was apparent that much of this work also would never get beyond the gray literature stage.

Our research today is properly characterized as ecological in tone, but the discipline "ecology" is merely the tool. Living resource ecosystems will inevitably be modified to man's ends in many different ways, and natural ecosystems, per se, will not be the entities conserved or managed in the long run. In point of fact, it is doubtful that we have been dealing with natural ecosystems for many years now. We are entering a period of redefinition of terms; for example, ecology is not synonymous with

conservation, and conservation may soon be found to be synonymous with management.

Conservation and management both stem from value judgements made by society, not science. Much of the present attempt to deal with such terms, and the approaches traditionally associated with them, has to do with the realization that man's activities, and needs, and population, have finally resulted in a situation where preservation of what once was, is no longer possible or feasible. Population pressure aside, new value judgements and new definitions of a desirable quality of life are mandatory.

While, on the surface, the basic fishery research priorities haven't changed all that much, the approach certainly has. It is now highly interactive and ecological rather than dominated by the fire-fighting, specific project approach characteristic of the NMFS or BCF and the Woods Hole Laboratory, in the earlier days. It is finally well understood that no species lives in a vacuum, and that its existence is dependent upon a biotic and abiotic amalgam that will continue to be difficult to deal with for some time to come. The biological system does not lend itself readily to the relatively simple, if elegant, modeling approaches characteristic of the physical sciences. In this regard, there has been considerable maturation within the ecological community. Model we must, regardless of the length, variability, and convolutions in time and space of the biological causal linkage chain. To this end, the Laboratory, and the consortium of laboratories of which it is headquarters, will continue to give a high priority to the maintenance of long-term data bases so necessary for the modeling approaches that are just now beginning to bear fruit.

Whatever happens, man will be desirous of maximizing returns, given the energy inputs, and this, of course, is one of the main themes of ecological research.

Just as the basic research priorities have not changed, the sociopolitical environment hasn't changed very much either, if at all. It should be noted that this is not a characteristic of the immediate fisheries constituency, but char-

acteristic of human beings anywhere, in whatever country. Management of resources, perhaps more so the renewable resources, is a contentious process at best. There never is enough data, that is, enough data to make a decision inescapable. As resources diminish, the demand for more data and information will continue to grow, both because there isn't enough fish to go around, and each decision, one way or another, threatens to change somebody's life style. Dealing with the need for more data and information will continue as a Laboratory priority as far into the future as I can see, or until the living marine resources are of no further value to our society.

With respect to the comment about diminishing resources, it has only been very recently that people have really begun to put aside the long-held, long-cherished notion that the ocean is filled with fish. Of course it isn't, at least in the sense of those species desired by and found useful to man, and, economically available in the technological sense.

As yet, there is no clean delineation between the economic and ecological disciplines, in fisheries at least. In ecosystem terms, man is not a prudent predator. His intervention is disjunct, and the feedback controls that he responds to are in good part independent of the natural resource ecosystem. It has been said often enough that the real problem is not fisheries management or fisheries research, but the management of man. Putting man into the ecosystem will certainly require further work in the near future and has, in fact, become a principal programmatic theme within the Laboratory.

The heavy logistic requirements for maintaining certain data bases is going to decrease perhaps more quickly than many people think. As the academically oriented institutions come to grips with the fundamentals of continental shelf processes, especially in physical oceanographic disciplines, remote sensors, be they automated buoys or satellites or aircraft, will increasingly replace vessels. It will be a long time,

however, before the need for vessels to carry out biological sampling and process oriented studies will cease to be necessary. This particular instant in time is especially critical. It seems that we are still all too ready at the moment to discount the future for immediate gain, and vessels are expensive to operate.

There is no reason to believe that Baird, in selecting Woods Hole, appreciated (in the first instance) that he was giving birth to other institutions as well. The manner in which he stimulated research, almost immediately, set the stage for an academic counterpart, the Marine Biological Laboratory. The Woods Hole Oceanographic Institution came along very much later, in 1931. It grew out of a growing national appreciation for the ocean and its promise, a recognition that came about to a considerable extent because of the results of the work of H. B. Bigelow, which had been carried out, in part, on behalf of the Bureau of Fisheries.

The MBL and the Bureau of Fisheries were closely linked in interests and in the use of facilities for a very long period of time. The relationship might very well be described as incestuous. (Incidentally, a good friend of both institutions and a most distinguished biologist and colleague who has lived through almost the entire period we are talking about, Horace Stunkard, is with us tonight. He will be celebrating his 96th birthday next Friday, when we celebrate our hundredth birthday.)

We have grown apart in recent years as the MBL has moved more in the direction of squid axons and intracellular processes. The role that the Woods Hole Oceanographic Institution established for itself early on, that of an organization more interested in blue water and distant seas than the dynamics of the local continental shelf, also led to a separation of ways. Thus, it is that the three institutions now have unique roles and interests, although this is very hard for many people to understand. I will never forget the stunned look on the face of a former MBL Director, many years ago, when a certain concerned

congressman asked him what his institution was doing about the haddock problem; or that our first NOAA Administrator, Bob White, insisted on calling me through the WHOI switchboard.

One wonders if these roles will continue to remain so different, so unique. I suspect so. They are valid, and responsive to the needs of today. However, as time goes on and as we push the limits of exploitation ever more severely, we will all be working very hard, together, but within these different roles, to put humans into the ecosystem in an acceptable manner. That will require the good services of everyone, and at least thematically, Spencer Baird may, very well, once again have a single institution in Woods Hole. What a legacy that is!

Just as society is at a crossroads, so is the Laboratory.

More than ever before it is imperative that future options be preserved.

More than ever before the nation needs healthy, mission-oriented marine research arms and healthy, process-oriented marine research arms.

To the extent that this need is shared by the nation at large, the Fisheries Laboratory in Woods Hole has at least another hundred years of work before it, as does the entire scientific community in Woods Hole.

Epilogue: It should be noted, although it must be very obvious, that we are really celebrating two things today—first the 100th birthday of the Woods Hole Laboratory and second, that critical man at a critical time, Spencer F. Baird.

Literature Cited

- Baird, S. F. 1873. Report of the Commissioner for 1871-1872. U.S. Comm. Fish Fish. Part I. U.S. Gov. Print. Off., Wash., D.C.
- Bigelow, H. B. 1926. Plankton of the offshore waters of the Gulf of Maine. Bull. U.S. Bur. Fish. 40(2), 509 p.
- Clark, G. L. 1946. Dynamics of production in a marine area. Ecol. Mon. 16(4):321-335.
- Galtsoff, P. S. 1962. The story of the Bureau of Commercial Fisheries Biological Laboratory Woods Hole, Massachusetts. U.S. Dep. Inter., Fish Wildl. Serv., Bur. Commer. Fish., Circ. 145, 121 p.
- de Loture, R. 1959. History of the great fishery of Newfoundland. U.S. Dep. Inter., Fish Wildl. Serv., Spec. Sci. Rep.—Fish. 213, 147 p. [Transl. from 1949 French ed. by C. C. Taylor, USFWS.]