Spencer Baird and the Scientific Investigation of the Northwest Atlantic, 1871-1887

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Between 1871 and 1887, Spencer Fullerton Baird organized and led a pioneering biological and physical investigation of the Northwest Atlantic oceanic region. Born in Pennsylvania in 1823, Baird was largely self-educated as a scientist in the era preceding the rise of major U.S. universities.[1] Nevertheless, he became a major authority on the birds, mammals, reptiles, amphibians and fishes of North America. After 1850, as the Assistant Secretary of the Smithsonian Institution in Washington, DC (in 1878 he became head of that organization), Baird used the numerous exploratory expeditions that the US government sent to the far reaches of the North American continent to gather enormous collections of scientific specimens and data. Those collections were a major impetus for the National Museum that Baird was developing within the Smithsonian, and were also the basis for a number of scientific publications on the biology of North America.

By the early 1870s, in addition to his long-standing concern with terrestrial biology, Baird became increasingly interested in the oceanic environment. This new emphasis apparently grew out of the summers that Baird and his family spent at various locations along the Atlantic seaboard. In addition to offering a refuge from the oppressive heat of Washington, the sea shore offered ample opportunity for Baird to study oceanic life. He also was well aware that in this era Anton Dohrn, Charles Wyville Thomson, and other scientists throughout the world were turning their attention to the sea. All these investigators recognized that the study of the maritime environment was in its infancy. Oceanic fauna and flora were abundant, diverse and relatively simple compared with terrestrial forms. The overriding interest by natural scientists in organic evolution also could be served, since Charles Darwin and other evolutionists viewed the oceans as the ancestral home of all life.[2]

In 1870, while summering with his family at a then-obscure hamlet on Cape Cod known as Woods Hole, Baird became aware of an angry dispute involving the apparent decline of the coastal fisheries off southern Massachusetts and Rhode Island. In the opinion of many subsistence and sports fishermen, this situation resulted from the widespread use of coastal nets attached to posts, or of barriers made of boards or brush, that sometimes stretched more than a thousand feet into the sea. Called traps, fykes, pounds, or weirs, depending upon their configuration and composition, these fixed arrays captured enormous quantities of migrating fish, especially in the spring and early summer.

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To evaluate criticisms of these devices, and to undertake a general exploration of the apparent decline in the productivity of coastal and Great Lakes fisheries, Spencer Baird proposed to Congress that it establish the US Commission of Fish and Fisheries. In the spring of 1871, after skillful lobbying by Baird, Congress authorized that organization. Over the next sixteen years, Baird served as its director, a position that was in addition to his continuing duties as a Smithsonian official. Baird received no additional pay for his labours as the US Commissioner of Fish and Fisheries.[3]

Spencer Baird initially concentrated his attention on the coastal fisheries of southern New England.[4] Establishing a temporary laboratory at an unused Light House Board facility at Woods Hole, and using government-owned craft as his research vessels, Baird enlisted about ten scientists to work with the Commission during the summer of 1871. These investigators were attracted by the superb opportunity to obtain scientific collections from New England's coastal waters. Although master sets of these materials were earmarked for Baird's National Museum in Washington, duplicate specimens were deposited in the parent universities or museums of the Commission's scientific associates. Baird's scientific corps relished the prospect of working with stimulating colleagues. At a time when few publishing outlets existed for American scientists, they also valued the opportunity to publish their work in the Fish Commission's annual report.

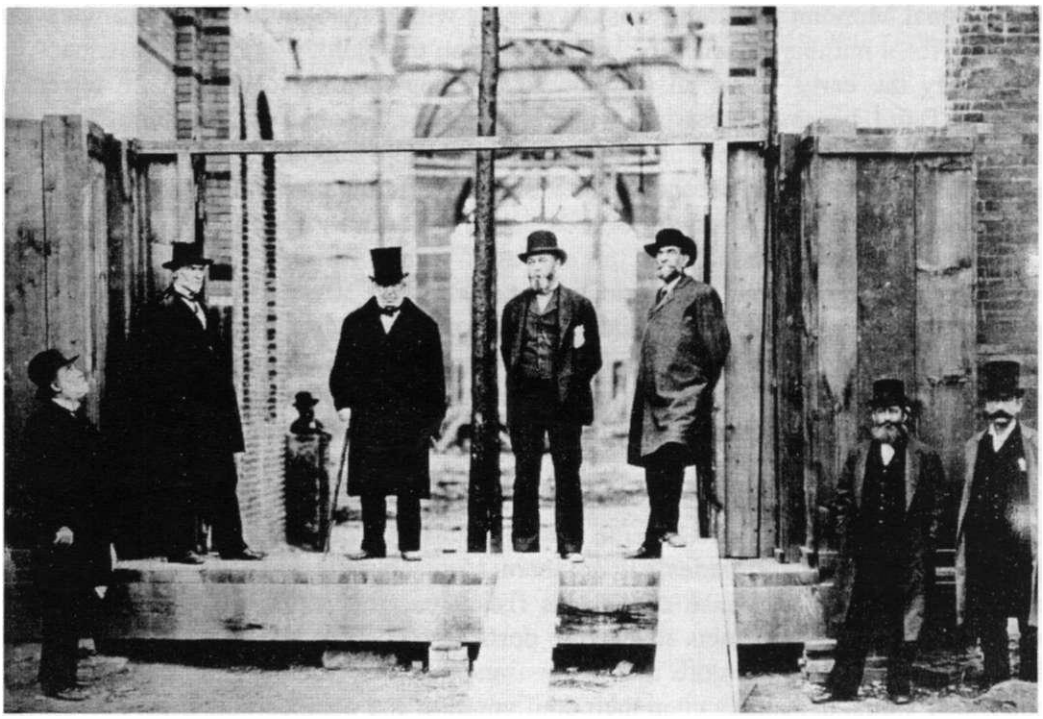

Figure 1: Spencer Baird (4th from left) with Smithsonian regents and employees at the Arts and Industries Building, which was then under construction in Washington, DC, 1878. The building was the home of Baird's National Museum.

Source: Courtesy of the Archives of the Smithsonian Institution.

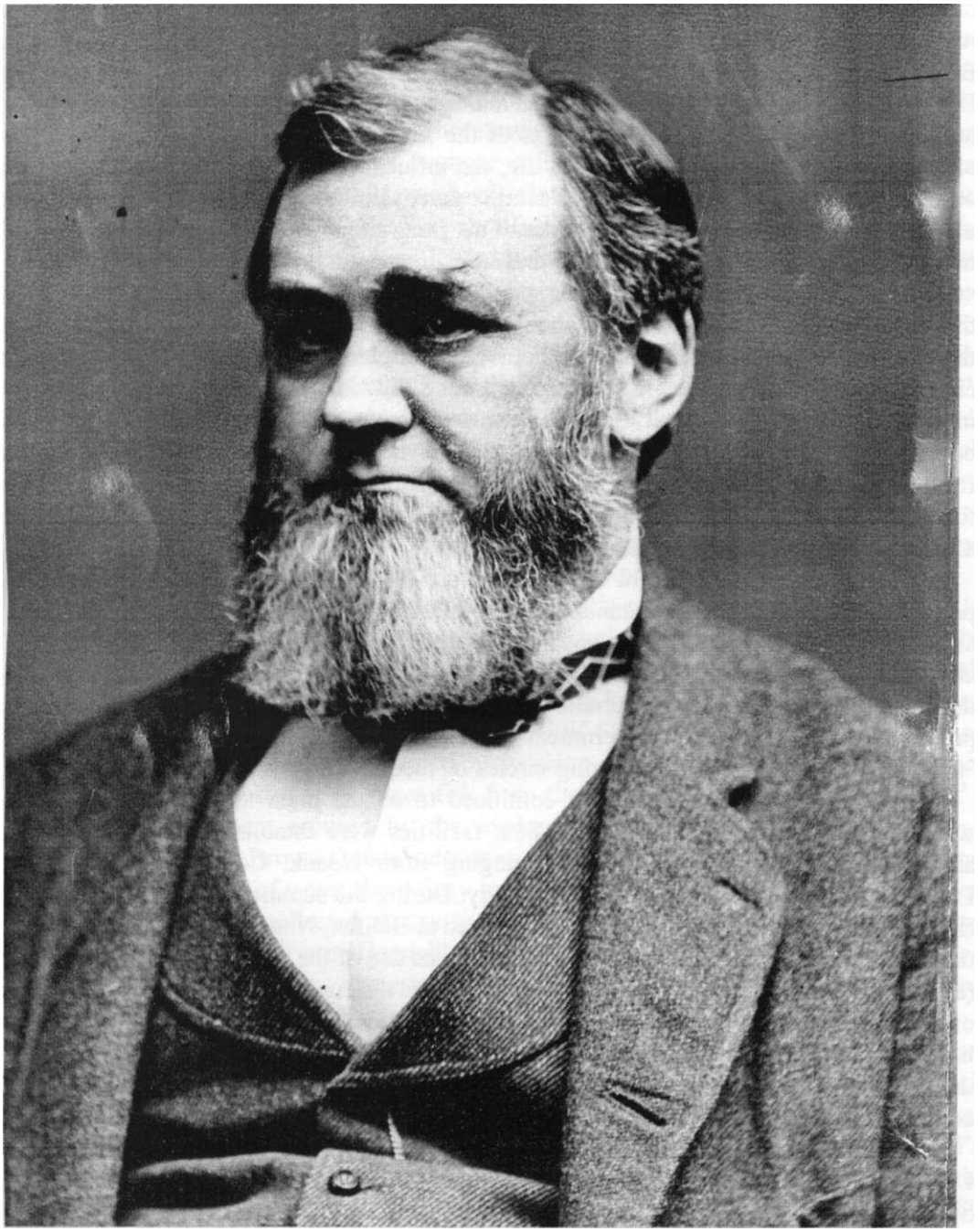

Figure 2: Spencer Fullerton Baird, about 1885.

Source: See figure 1.

Although the final objective of Baird and his scientific corps was to determine the dimensions, reasons, and remedies for the decline of commercial fishes, the investigators realized that it was essential to study the total environment in which those species existed. Baird's interest in ecology was a logical outgrowth of his scientific outlook as a Darwinian evolutionist. The breadth of his agenda was indicated by the studies he undertook, which included investigations of the food sources of commercial fishes; the effects of parasites and diseases on sea life; the influence of weather conditions; the role of physical conditions, including water temperature, salinity, and currents; and the impact of man's pollution and fishing activities. This programme continues to be admired by modern biologists for its sophisticated and holistic approach.[5]

Baird's initial conclusion, after spending the summer of 1871 in Woods Hole, was that the new fixed nets and barriers should be regulated because they had contributed to the decline of coastal fishes off southern New England. But to the Commissioner's chagrin, this finding seemed to be disproved in 1872, when there was a notable increase in fish populations. As a result, Baird became very cautious in making further judgements on fish stock dynamics. Nevertheless, this setback did not prevent the Fish Commission from initiating several other practical projects, including a major effort to hatch desirable food species to increase their supply, and a programme to provide many forms of direct assistance to the US commercial fishing industry.[6]

At the same time, Baird continued to use the Fish Commission as an engine to promote basic scientific understanding of the marine environment. He argued that such knowledge was essential to solve specific problems involving commercial fishes. But it also was valuable in itself.[7] Baird's position will remind scholars of the observation by the distinguished historian of American science, A. Hunter Dupree, that the "practical problems" attacked by US government scientific agencies in the nineteenth century "tended to reach out to ever-widening circles of theoretical considerations."[8]

Baird's summer laboratories continued to be the main means of pursuing his scientific agenda. Between 1871 and 1880, facilities were established at various points along the entire New England coast, ranging from Noank, Connecticut (near New London) to Eastport, ME, in the Bay of Fundy. During the summer of 1877, while acting as an adviser to an arbitral commission convened at Halifax, Nova Scotia, that determined the compensation owed by the United States for its use of the Canadian inshore fisheries (as granted in the 1871 Treaty of Washington), Baird also undertook a limited exploration of waters in that region. The exceptional opportunities presented to the Commission's investigators were suggested by one statistic from the summer of 1873, when no fewer than 750 species of fauna and flora, plus an equal number of minute organisms, were collected off southern New England. Many of these species were new to science.[9]

The central figure in Baird's scientific corps was Addison E. Verrill of Yale University. Verrill was a specialist in marine invertebrates who, in addition to carrying out his own investigations, was Baird's principal assistant in planning and managing the summer research program. The results of the Yale scientist's work during the first season were contained in his well-known *Report Upon Invertebrate Animals of Vineyard Sound... With an Account of the Physical Character of the Region,* published in the Commission's first annual report. Since invertebrate species were important food stocks for commercial fishes, this classic monograph had utilitarian implications. But the primary

thrust of Verrill's work was the scientific description of marine life and an assessment of its relationships with the physical and biological environment of which it was a part.[10]

During the 1870s Baird's group of summer researchers continued to average about ten in number. In addition to Verrill, they included such men as Alpheus Hyatt, a specialist in invertebrates; marine botanists such as William G. Farlow; and the ichthyologist George Brown Goode. These established scientists also brought with them a number of graduate students or younger colleagues, including David Starr Jordan, Edmund B. Wilson, and C. Hart Merriam, all of whom were destined for scientific fame. A few of these investigators received small salaries as temporary employees of the Commission, while others worked entirely as volunteers. As the Commission extended its survey along the New England coast, the scientists produced scores of professional papers.[11]

In retrospect it is evident that between 1871 and 1880 the scientists recruited for Baird's summer labs were undertaking the first systematic biological study of America's seas. There also were other notable efforts in this period, including the research cruises by Alexander Agassiz in US Coast Survey vessels and the famed HMS *Challenger,* which spent a relatively short period of time in North American waters during its classic expedition of 1872-1876.[12] Nevertheless, the Fish Commission's program stands out as a major contributor to oceanic science, due to its sustained approach to the biological and physical exploration of a major coastal region of the Northwest Atlantic.

The year 1881 marked a watershed in Baird's scientific effort. Having largely completed its survey of the waters between Long Island Sound and the Bay of Fundy, the Commission now sought a permanent headquarters from which to continue this work and, at the same time, to turn its attention to the then little-known deep waters on the edge of the Continental Shelf, an area Baird called the Gulf Steam Slope. The amazing lack of knowledge of those waters was suggested by the claim of one prominent ichthyologist that in 1875 only fifty species of deep-sea fish from the Northwest Atlantic were known.[13]

The excitement aroused by the exploration of the Gulf Stream Slope was suggested by George Brown Goode's description of a haul taken by a Fish Commission vessel in 160 fathoms of water about forty miles east of Cape Ann during the summer of 1877. Several species collected at this time had never been seen before by scientists. Goode commented that "it seems incredible that American naturalists should not then have known that a few miles away there was a fauna as unlike that of our coast as could be found in the Indian Ocean or the seas of China."[14]

Due to other commitments, Baird was not able to return to deep-water exploration until 1880, when the Fish Commission diverted his newly completed fish hatchery vessel, *Fish Hawk,* from the duties for which it was designed and directed it to take its first station at the 100-fathom line on the outer limits of the Continental Shelf. In Baird's words, *Fish Hawk's* explorations revealed "a most wonderful fauna, vastly exceeding in richness and extent anything known to science."[15] It is no coincidence that later in 1880 Baird began a successful campaign to obtain Congressional approval to build the famed *Albatross,* which may well have been the world's first specially-built oceanic research vessel. Although Baird told Congress that he needed *Albatross* to locate new areas that could be used profitably by American fishermen, the ship also was designed and equipped for scientific research in oceanic waters beyond the range of most commercial species. In

fact, the ship's first station after being commissioned was a point well off the Continental Shelf where the ocean was more than 1400 fathoms deep.[16]

Baird never hesitated to apply science to practical ends and there is no doubt that, as he promised, *Albatross* was employed in locating new fishing grounds in the Western Atlantic and Gulf of Mexico that could be used by American fishermen. But Baird also used *Albatross* and his other vessels for the scientific exploration of the deep waters of the Northwest Atlantic, notably the Gulf Stream Slope. After Baird's death in 1887, *Albatross* continued to serve the US fisheries in both the Atlantic and Pacific oceans and to advance our basic understanding of the sea until 1921. The invaluable work of this pioneering oceanic research vessel represents one aspect of Baird's long-term contribution to marine science.[17]

In 1881, as Baird was planning the construction of *Albatross,* he also was thinking about establishing the Fish Commission's permanent base at Woods Hole. The location offered a deep-water port for *Albatross* and Baird's other ships that was within easy range of both the Gulf Stream Slope and the North Atlantic fishing grounds. The Commissioner also intended to construct at Woods Hole a fish hatchery for the propagation of marine species. Between 1882 and 1885, Baird obtained Congressional appropriations for the hatchery as well as for harbour improvements. Taking a broad interpretation of Congressional intent, Baird also used the funds to construct laboratory and residential spaces for the investigators undertaking his basic scientific programme.[18]

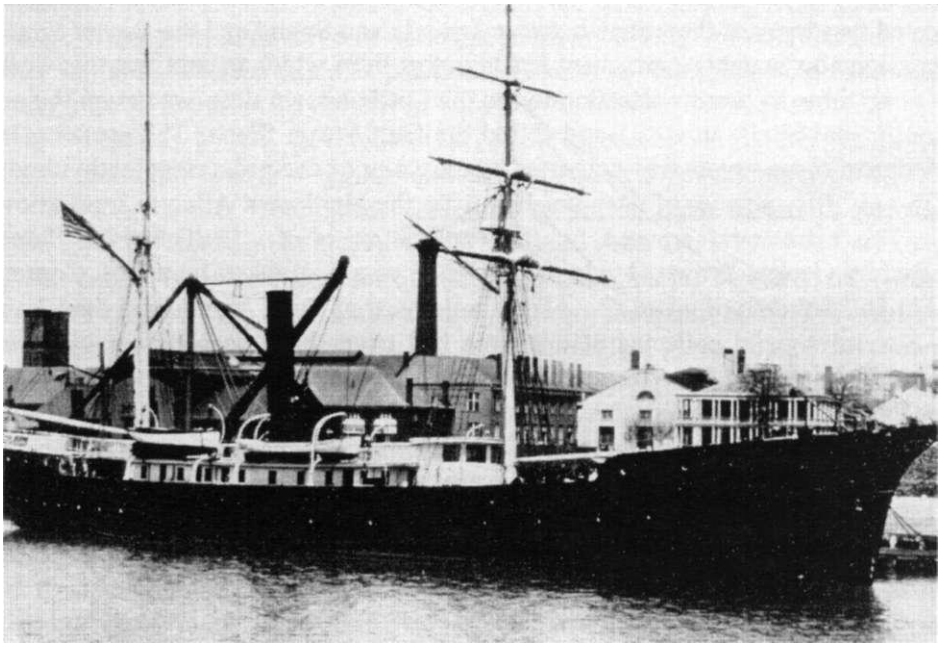

Figure 3: The Fish Commission's research vessel *Albatross.* The Washington Navy Yard is in the background.

Source: Courtesy of the US Fish and Wildlife Service.

Between 1881 and Baird's death in 1887, approximately a dozen volunteer or paid investigators worked each summer with the Fish Commission. Continuing his ecological approach, Baird asserted that their fundamental purpose was to understand the "mutual relationships and dependencies" of oceanic life forms.[19] Specific examples of the distinguished scientific results obtained by the Fish Commission in this period include the continuing study of marine invertebrates by Addison Verrill and his associates. Concentrating on the large collections taken on the Gulf Stream Slope, this group published numerous papers that extended into waters deeper than 100 fathoms the survey of coastal invertebrates and their environment that Verrill began in Vineyard Sound during the summer of 1871.

In this period, some of Baird's other associates included the physical oceanographer, William Libbey, Jr. of Princeton University; the embryologist, John A. Ryder; Edwin Linton, a specialist in oceanic parasites; and William G. Farlow, who studied marine botany. George Brown Goode continued to undertake ichthyological research for the Fish Commission. In addition, during the 1880s, Goode became Baird's principal assistant at the Smithsonian's National Museum, and was assigned by Baird to edit a classic maritime study, published in seven large volumes, entitled *The Fisheries and Fishery Industries of the United States*. In cooperation with Tarleton H. Bean, also a curator at the National Museum, Goode concentrated on studying fishes taken from the Gulf Stream Slope. For the most part these were collected by Fish Commission ships. Goode and Bean's study was published as *Oceanic Ichthyology* in 1895, eight years after Spencer Baird's death. That volume described forty-seven new *genera* and 147 new species which, in the judgement of the authors, were new to science. That book also revealed the nationalistic pride that Baird and his contemporaries often felt as they described American fauna and flora, a task typically performed in earlier years by European scientists. According to Goode and Bean, the materials available to them were more extensive than all the deep-water fish collected by HMS *Challenger* during its famed multi-year cruise around the world in the early 1870s.[20]

Another of Baird's long-term contributions to the advancement of oceanic science was his influence in making Woods Hole the renowned research centre it is today.[21] The famed Marine Biological Laboratory (MBL) was founded in 1888, the year after Baird's death, largely through the leadership of Alpheus Hyatt, one of the first scientists associated with the Fish Commission. As Hyatt pointed out, the MBL was directly inspired by Baird's efforts to establish a national research and educational institution at Woods Hole that could benefit from the Commission's collections, facilities, and distinguished scientific staff. In return, the Woods Hole Océanographie Institute and other research institutions established in the area during the twentieth century were inspired by the MBL and the traditions begun by Spencer Baird.

But the immediate issue addressed in this article is Baird's distinguished exploration of the Continental Shelf and Gulf Stream Slope. This work was a significant chapter in the history of oceanography. It featured descriptions of marine life forms and their histories, conclusions regarding patterns of geographic distribution, and assessments of ecological relationships.[22] Baird also recognized that the broader significance of all of this work was to elucidate the evolutionary process. One modern authority, John Hobbie, observes that Baird's efforts were notable in that they "set modern fisheries" research "off

in an holistic, ecological direction." Hobbie identifies Baird as one of the pioneers in ecology who created "new approaches to questions of interactions of organisms and their physical, chemical, and biological environment."[23]

William Keith Brooks, a distinguished Johns Hopkins University biologist and a contemporary of Baird, may or may not have been guilty of the national chauvinism, sometimes found within the US scientific community, when he made another assertion about the work of the Fish Commission. Brooks claimed that its efforts in the Northwest Atlantic represented the "first...exhaustive scientific exploration of the ocean" by any government in the world."[24] In an undeveloped nation like the US in the nineteenth century, it is not surprising that a governmental scientific organization played a leading role in intellectual development.[25] But it also needs to be recognized that by the time of Baird's death in 1887, the American research university, inspired by European academic institutions, was emerging as the major source of learning.[26] The distinction, freedom, and broad scope of much nineteenth-century government science also was being challenged by *laissez faire* principles suggesting that it was not legitimate for the federal government to engage in basic research.[27] It is thus not surprising that after Baird's death the Fish Commission and its successor organizations adopted a more utilitarian approach to the study of the ocean and its abundant and fascinating life.[28]

Nevertheless, during the period that Baird directed the Fish Commission it was the single most important force promoting the study of oceanography in the US. Baird's essential achievement was to organize and support a long-term, pioneering and cooperative biological and physical study of the Northwest Atlantic. Scores of scientific contributions were made under the Commission's auspices by a large group of competent investigators. Rich research collections were sent to American universities and museums, where they encouraged and supported the future study of marine biology. The seed planted by Baird at Woods Hole blossomed into today's world-renowned research centre. The contributions made by the research vessel *Albatross* over more than forty years also attest to the Commission's long-term impact. All these achievements deserve to be remembered by modern maritime historians.

NOTES

* Dean Allard retired in 1995 as the US Navy's Director of Naval History. His publications deal primarily with naval history and the history of nineteenth century marine science.

1. For accounts of Baird, see Dean C. Allard, *Spencer Fullerton Baird and the U.S. Fish Commission (New* York, 1978); William Healey Dall, *Spencer Fullerton Baird: A Biography* (Philadelphia, 1915); E.F. Rivinus and E.M. Youssef, *Spencer Baird of the Smithsonian* (Washington, DC, 1992); and Paul S. Galtsoff, *The Story of the Bureau of Commercial Fisheries Biological Laboratory, Woods Hole, Massachusetts*^ashington, DC, 1962).

2. Allard, *Spencer Fullerton Baird,* 64-68. See also the discussions in Margaret Deacon, *Scientists and the Sea. 1650-1900: A Study of Marine Science* (London, 1971), 251-394; and Susan Schlee, *The Edge of an Unfamiliar World: A History of Oceanography* (New York, 1973), 107-138.

3. Allard, *Spencer Fullerton Baird,* 69-86.

4. The legislation establishingthe Fish Commission also charged Baird with investigating conditions on the Great Lakes. He delegated this task to James W. Milner; see Milner, "Report on the Fisheries of the Great Lakes," in United States, Commission of Fish and Fisheries (CFC), *Report*

of the Commissioner for 1872 and 1873 (Washington, DC, 1874). For Baird's initial work in Woods Hole, see US, CFC, *Report for 1871 and 1872* (Washington, DC, 1873).

5. Galtsoff, *Story,* 11 and 16; and Marine Biological Laboratory (MBL), "Notice of Centennial Lecture by John Hobbie," 5 August 1988.

6. Dean C. Allard, "Spencer Fullerton Baird and the Foundations of American Marine Science," *Marine Fisheries Review,* L, No. 4 (1988), 125-127.

7. US, CFC, *Report for 1872 and 1873,* viii-ix.

8. A. Hunter Dupree, *Science in the Federal Government* (Cambridge, MA, 1957), 64.

9. Allard, "Baird," 127-128; and US, CFC, *Report for 1872 and 1873,* viii.

10. Allard, *Spencer Fullerton Baird,* 105-106.

11. *Ibid.,* 164-179.

12. Schlee, *Edge,* 128-131.

13. US, CFC, *Report for 1881* (Washington, DC, 1882), xxix-xxx and xxxviii-xxxix. George Brown Goode made the claim referred to in a volume co-authored with Tarleton H. Bean, *Oceanic Ichthyology* (2 vols., Washington, DC, 1895), I, vii.

14. Quoted in Henry Fairfield Osborn, "Goode as Naturalist," in *A Memorial to George Brown Goode* (Washington, DC, 1901), 22.

15. US National Archives, Record Group 22, Baird to George Perkins Marsh, 31 October 1881.

16. Edwin Linton, "Reminiscences of the Woods Hole Laboratory of the Bureau of Fisheries, 1882-1889," *Science,XU* (21 May 1915), 745; and Joel W. Hedgpeth, "The United States Fish Commission Steamer *Albatross," American Neptune,* V (January 1945).

17. See Hedgpeth, "United States Fish Commission Steamer *Albatross."*

18. Allard. *Spencer Fullerton Baird,* 320-328.

19. US, CFC, *Report for 1883* (Washington, DC, 1884), xvii and lvi.

20. The Commission's scientific work and achievements are discussed in Allard, *Spencer Fullerton Baird,* 329-341.

21. Dean C. Allard, "The Fish Commission Laboratory and Its Influence on the Founding of the Marine Biological Laboratory," *Journal of the History of Biology,* XXIII, No. 2 (1990), 251-270.

22. *Ibid.,* 259 and 261-262.

23. MBL, "Notice," 5 August 1988.

24. See United States, Congress, Senate, Subcommittee of the Committee on Fisheries, "Testimony...in the Investigation of the U.S. Fish Commission" (51st Cong. 2nd sess., Senate Misc. Doc. 77), 544-545.

25. On the relative freedom and distinction of the federal government's scientific programs in this period, see, for example, Robert V. Bruce, *The Launching of Modern American Science, 1846-1876* (New York, 1987), 238-239.

26. Laurence R. Veysey, *The Emergence of the American University(Chic&go,* 1965), *passim.;* and Philip J. Pauly, *Controlling Life: Jacques Loeb and the Engineering Ideal in Biology* (New York, 1987), 55-69.

27. Dupree, *Science,* 215-231.

28. Allard, "Fish Commission," 267-270.