

SPECIAL ISSUE: ENVIRONMENTAL HISTORY

## A Difficult Time with the Permit Process

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**Abstract.** In the 1970s, new forms of public scrutiny were applied to the research methods of field biologists in the United States, particularly those studying endangered species and marine mammals. This paper shows how such scrutiny affected researchers' choice of research methods through an analysis of a key moment in a decade-long controversy over the conservation of bowhead whales. In 1978, researchers at the Naval Arctic Research Laboratory received funding from the Bureau of Land Management to radio-tag bowhead whales. Although this promising but still largely untested technique might have answered one of the central scientific questions in the controversy, it ultimately went unused. Technical considerations played a role in the decision not to use the technique, but the most important factor was scientists' concerns about potential backlash from Iñupiat whalers and animal protectionists. The same forces that had made marine mammalogists more influential than ever and that had put into their hands the resources necessary to develop more effective research techniques also placed serious constraints on where, when, and how they could do their research.

**Keywords:** animal welfare, bowhead whales, endangered species, environmental regulation, indigenous hunting

The movement for endangered species protection in the late 1960s and 1970s was in most ways a boon for field biologists and ecologists in the United States. As historian Mark Barrow has argued, the legislative efforts that culminated in the Marine Mammal Protection Act (MMPA) of 1972 and the Endangered Species Act (ESA) of 1973 reflected the long-standing concerns of naturalists and gave them a central role in the implementation of new policies.<sup>1</sup> In the words of wildlife biologist Jack Ward Thomas, a leading player in the controversy over the protection of old-growth forests as habitat for the northern spotted owl in the

<sup>1</sup> Barrow, 2009, p. 341.

1980s and 1990s, the ESA and other forestry and wildlife protection bills enacted between 1969 and 1980 collectively amounted to a “Fish and Wildlife Biologists Full-Employment Program.” At the same time, however, scientists’ new centrality to environmental policy brought them under unprecedented and often intense scrutiny by policymakers, activists, and their fellow scientists. Whether scientists positioned themselves as disinterested, objective experts or as impassioned conservation biologists, their values inevitably came under fire.<sup>2</sup>

Research on the role of scientists in endangered species protection has focused largely on the use and abuse of scientific findings in the shaping of policy and public opinion. Examples include studies of the role of scientists in long-running controversies over predator control or of the U.S. Fish and Wildlife Service’s highly contested decisions about whether to list particular species or populations as “endangered.”<sup>3</sup> Disputes over scientific methods, in contrast, have gone largely unexamined except as an epiphenomenon of controversies over the application of scientific findings to policy decisions. That is, the practices of wildlife biologists have been seen as black boxes to be opened by historical actors and scholars only when their outputs are questioned. In fact, the techniques that wildlife biologists used to study wild animals were often questioned by non-scientists for reasons that had little or nothing to do with the kinds of data they produced or the sorts of decisions they supported. Moreover, the very environmental laws that privileged scientists in environmental decision-making also brought their methods under scrutiny. By requiring researchers to obtain permits before they could “take” endangered species or marine mammals – that is, harass, injure, capture, or kill them, or attempt to do so – the ESA and the MMPA both recognized that scientific research was a form of engagement with the natural world with potentially serious environmental consequences in its own right.<sup>4</sup>

As a consequence of the intensified scrutiny of scientific research practices that began in the 1970s, wildlife biologists were forced to evaluate their research methods not only in terms of their utility for answering particular research questions but also in terms of the impression that they were likely to make among fellow scientists, federal regulators, animal rights activists, indigenous hunters, and other advocacy groups. While obtaining collecting permits and gaining access

<sup>2</sup> Thomas, 2000, p. 4.

<sup>3</sup> E.g., on predator control, see Dunlap, 1988; on endangered species, see Yaffee, 1982; Clark et al., 1994.

<sup>4</sup> On the MMPA’s regulation of scientific “taking,” see Bean and Rowland, 1997, pp. 138–141.

to field sites had long been concerns for field biologists, the environmental laws of the late 1960s and 1970s placed powerful new tools in the hands of those who were willing to constrain field biologists' freedom of action for the sake of values other than the advance of scientific knowledge.<sup>5</sup> This paper describes the impact of such considerations on an attempt to radio-tag bowhead whales off the Arctic coast of Alaska in the late 1970s. Though the failure of this attempt depended on specific contingencies of time and place – particularly the relationship of the indigenous Iñupiat people to the U.S. federal government – it also reflected a broader shift in the way field biologists selected research methods in the wake of the environmental movement.

### **The Bowhead Controversy**

Bowhead whales (*Balaena mysticetus*) are baleen whales, members of the suborder Mysticeti and the family Balaenidae. Their common name comes from the bowed shape of their extremely large heads, which can account for as much as a third of the length of the body, and the corresponding arched shape of the upper jaw, which accommodates plates of baleen designed to strain zooplankton from giant mouthfuls of water. Clothed in a layer of blubber that is unusually thick even among whales, bowheads are specialized for life in arctic waters. As adults, they typically grow up to 12–18 m long. They reproduce slowly, females reaching sexual maturity after 15 years of age and giving birth to a single offspring on average once every 3 or 4 years. There are a number of distinct populations or “stocks” of bowheads, the largest of which is the Bering Sea stock, also known as the Western Arctic stock or Bering-Chukchi-Beaufort stock. In the spring, the Bering Sea stock migrates northwestward from its namesake sea, following the retreating ice along the coast of Alaska on its way to feeding grounds in Canadian waters; in the fall, it migrates southwestward in front of the returning sea ice.<sup>6</sup>

Bowheads have been hunted by humans, their only predators besides killer whales, for several thousand years, but human predation only began to have a significant impact on their populations after the sixteenth century, when Europeans began commercial whaling in the

<sup>5</sup> Early twentieth century ornithologists' concerns about permits for collecting are described in Barrow, 1998, pp. 122–124.

<sup>6</sup> On bowhead biology, see McLeod et al., 1993, p. 45; Haldiman and Tarpley, 1993, p. 71; Koski et al., 1993, pp. 268–269; Moore and Reeves, 1993.

North Atlantic. The Bering Sea stock survived the onslaught longest, but like the other stocks it was commercially extinct by the beginning of the twentieth century.<sup>7</sup> Although bowheads were protected by treaty in 1931, an exemption was provided for whaling by the Iñupiat and Yupik people of northwestern Alaska.<sup>8</sup> For most of the twentieth century, all of the Alaskan coastal whaling villages together landed an average of about 15 whales per year using traditional methods augmented by Yankee whaling gear.<sup>9</sup> Even as the cash economy made increasing inroads into indigenous Arctic Alaskan life, bowheads remained a critical source of food and materials as well as a central focus of cultural life.<sup>10</sup>

In part because of its commercial extinction, the bowhead remained among the least studied of the world's whales into the 1970s, when, according to whaling historian John Bockstoce, it "almost overnight became the most studied species in history."<sup>11</sup> Several factors converged to bring attention to the species. One was a growing interest in cetaceans of all kinds. The failure of the International Whaling Commission (IWC) to prevent the decline of global whale populations at the hands of the whaling industry had become obvious in the 1960s, when the recommendations of the organization's own scientific advisors to reduce annual quotas were repeatedly ignored. At the same time, behavioral research on cetaceans had revealed complex social structures and rich repertoires of communicative behaviors. In the early 1970s, these factors combined with broader interest in protecting endangered species to inspire a "Save the Whales" movement justified on both environmental and humane grounds. The United States, whose whaling industry had collapsed at the end of the nineteenth century after decimating the Bering Sea stock, became an international leader of the movement and urged the IWC to declare a global moratorium on commercial whaling.<sup>12</sup>

Among the large whales, bowheads were singled out for special attention from American researchers because of the controversial issue of indigenous Iñupiat whaling. Like the existing international moratorium on commercial whaling for bowheads, which had been in place

<sup>7</sup> On Yankee bowhead whaling, see Bockstoce, 1986; Bockstoce and Burns, 1993.

<sup>8</sup> On whale protection treaties, see Cioc, 2009, pp. 104–147.

<sup>9</sup> For estimates of annual Iñupiat bowhead take, see Stoker and Krupnik, 1993, p. 616; Bockstoce, 1986, p. 477.

<sup>10</sup> On traditional Iñupiat whaling, see Stoker and Krupnik, "Subsistence Whaling"; McCartney, 2003.

<sup>11</sup> Bockstoce, 1986, p. 480.

<sup>12</sup> Beers, 2006, p. 193; Barrow, 2009, pp. 331–335.

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since 1931, the MMPA's prohibition on the "taking" of marine mammals included an exemption for subsistence hunting by Native Alaskans. The exemption was justified on several grounds, including the economic and cultural dependence of native communities on marine mammal products and the supposedly inherently ecologically balanced nature of indigenous hunting. The latter justification was especially central to the arguments provided by those few environmental groups that supported the native exemption.<sup>13</sup> For their part, Native Alaskans tended to emphasize the importance of marine mammal hunting to their economic and cultural survival. The editorial page of the *Tundra Times*, a Native Alaskan newspaper, described an early version of the bill as a "strange and unbelievable move in the Congress of the United States to restrict, and control, the killing of sea mammals by the people of Alaska" which "if successful, would kill the unique cultures of Alaska's Natives on the coastal regions of the state."<sup>14</sup>

Although the version of the MMPA signed by President Richard Nixon in October 1972 exempted native Alaskans from most of the act's restrictions on "taking," the issue of indigenous subsistence hunting remained controversial, especially where it was perceived as wasteful. In the late 1960s and 1970s, Iñupiat whaling effort had begun to increase after decades of stability. The development of the large deposits of oil and gas that had been discovered near Prudhoe Bay in 1968 brought jobs and cash to Iñupiat communities, making it possible for more men to purchase whaling equipment and support crews than ever before. The incentives to do so were strong; whaling was not only a significant source of food and materials such as baleen and bone but also a way for men to gain social standing in their communities.<sup>15</sup> Increased whaling effort led to more whales killed and landed as well as a higher proportion of whales struck but lost. In 1970, whalers landed 26 whales and struck and lost an additional 42 for a total of as many as 68 whales possibly killed.<sup>16</sup> The apparent wastefulness of the hunt led many conservationists to believe that bowheads would go extinct unless Iñupiat whaling was regulated. In 1977, for example, nature writer Barry Lopez told a correspondent at Friends of the Earth that he believed the environmental organization's defense of Iñupiat whaling was "coura-

<sup>13</sup> E.g., Friends of the Earth; see Anonymous, 1972a. On the image of the "ecological Indian," see Krech, 1999; Harkin and Lewis, 2007.

<sup>14</sup> Anonymous, 1972b.

<sup>15</sup> Whaling captainships had traditionally been inherited; Brewster, 2004, p. 214.

<sup>16</sup> Bockstoce, 1986, p. 481.

geous and humane” but that he was convinced that “wild creatures are not going to fare well at the hands of industrialized Eskimos.”<sup>17</sup>

Despite widespread concerns about increased Iñupiat whaling effort in the early 1970s, a serious attempt to census the population did not begin immediately. From 1973 to 1975, the National Marine Fisheries Service (NMFS) instead focused on documenting the extent of Iñupiat whaling, an approach that incidentally strengthened the case for restrictions on the hunt.<sup>18</sup> The first attempt to census the population took place in the spring of 1976, when NMFS researchers counted migrating whales as they passed through open leads in the ice near Barrow, the largest whaling town on the North Slope. In 1977, using these counts to arrive at an estimated population of between 600 and 2000 individuals, the IWC’s Scientific Committee concluded that current hunting rates would soon drive the Bering Sea stock to extinction and recommended eliminating the native exemption.<sup>19</sup> Caught between its commitment to indigenous rights and its campaign for a global moratorium on commercial whaling, the U.S. delegation abstained from the IWC’s vote on the matter, but many American marine mammalogists believed a moratorium was justified.<sup>20</sup> After the IWC imposed a zero quota on indigenous whaling, however, organized protest from the whalers and a new organization they had founded to represent them in the international arena, the Alaska Eskimo Whaling Commission (AEWC), forced a compromise. Although the exemption was not reinstated, the IWC voted to allow Alaska’s indigenous whalers a quota of 12 whales landed or 18 whales struck during 1978. Recognizing that the quota issue would remain contentious as long as a reliable estimate of the population size was lacking, NMFS further intensified its research program.<sup>21</sup>

Bowheads also received intensified attention from researchers because of plans for offshore oil and gas exploration in the Beaufort Sea. The federal agency responsible for leasing exploration and extraction rights on public land was the Bureau of Land Management (BLM), a unit of

<sup>17</sup> Letter, Barry Lopez to Tom Turner, 29 October 1977, Carton 39, Series 5, Records of the Friends of the Earth, David R. Brower Papers, MSS 79/9c, Bancroft Library, University of California, Berkeley, CA. Some whalers agreed that the increasing proportion of whales struck to landed was problematic; see Brewster, 2004, p. 155.

<sup>18</sup> Early bowhead census efforts are described in Zeh et al., 1993, pp. 410–421.

<sup>19</sup> Bockstoce, 1986, p. 478.

<sup>20</sup> Among them was the chairman of the U.S. Marine Mammal Commission, Douglas Chapman; see Letter, Douglas G. Chapman to Robert Weeden, 21 July 1977, Box 22, Series 3, Alaska Conservation Society Papers, Elmer E. Rasmuson Library, University of Alaska, Fairbanks.

<sup>21</sup> Stoker and Krupnik, 1993, p. 617.

the Department of the Interior. The National Environmental Policy Act required BLM to assess the potential environmental impact of the leases before proceeding with the sale, while Section 7 of the ESA required it to assess the leases' potential impact on endangered species with the help of NMFS and the U.S. Fish and Wildlife Service. To fulfill these obligations, BLM launched the Outer Continental Shelf Environmental Assessment Program (OCSEAP), the arctic portion of which was administered out of BLM's Anchorage office. Through OCSEAP, BLM became a major player in bowhead research and other areas of marine mammalogy, diversifying a field that had been hitherto been dominated in the United States by NMFS and the Office of Naval Research (ONR). With the sale of leases in the Beaufort Sea expected to bring in as much as \$1 billion to the government and eventually many times that amount to oil and gas companies, much was at stake in the determination of whether oil and gas exploration would harm the bowhead population.<sup>22</sup>

Lacking the requisite scientific expertise and neither willing nor able to rely entirely on NMFS experts for its review, BLM contracted its research on bowheads to the Naval Arctic Research Laboratory (NARL), a U.S. Navy facility founded after the Second World War that served primarily as a logistics base for civilian researchers. NARL was located a few miles from the northernmost point of mainland Alaska, just outside of Barrow. For NARL, OCSEAP presented an opportunity to build on an existing program of bioacoustic research on bowhead whales and to extend the life of the laboratory despite the Navy's decision to shut it down by the end of the decade, perhaps long enough to find a new institutional sponsor. BLM began funding "Project Whales" in the fall of 1978 as a NARL-centered collaboration that also involved scientists and advisors from a number of institutions spread across the United States, including universities, Iñupiat organizations, private companies, and federal agencies.<sup>23</sup>

### **The Other Bowhead Controversy**

The centerpiece of the Project Whales proposal was the deployment of bioacoustic listening stations and visual observation posts at the edge of

<sup>22</sup> Montague, 1993, p. 11.

<sup>23</sup> On existing bioacoustic research at NARL, see Dronenburg, 1978. On the launching of Project Whales, see Laursen, 1979; Interview of John K. Kelley by Karen Brewster, June 25 and July 2, 1999, Fairbanks, AK, Oral History H99-20-03 and H99-20-04, Elmer E. Rasmuson Library, University of Alaska, Fairbanks.

the shore-fast ice during the spring migration, which NARL researchers argued would produce a more accurate census than existing methods. However, Project Whales also included other projects that took advantage of and provided employment opportunities for the variety of experts stationed at NARL. One of these experts was Erich Follmann, a postdoctoral fellow who had learned to use wildlife radiotelemetry as a graduate student at Southern Illinois University and was now using the technique to study captive and free-ranging arctic mammals at NARL. Despite having no experience working with bowheads or other marine mammals, Follmann proposed extending his radio-tagging work to bowheads as a part of Project Whales. Through Telonics, the Arizona-based company that supplied his biotelemetry equipment, Follmann learned that Bruce Mate, a marine mammalogist at Oregon State University, had been developing a radio tag for use on gray whales. Since bowheads were believed to migrate in the spring through open leads, it had seemed reasonable to count them from positions at the edge of the shore-fast ice. However, Iñupiat whalers claimed that whales often migrated far from shore in areas of thick ice, out of sight of NMFS observers, with obvious implications for total population estimates. Radio tracking held out the possibility of determining whether and in what numbers bowheads did in fact follow paths beyond the view of the observers.<sup>24</sup>

Follmann was not the first biologist to propose radio tagging bowheads. In the early 1960s, two biologists at the Woods Hole Oceanographic Institution, William Schevill and William Watkins, had spent several years attempting to radio-tag right whales off the coast of Cape Cod. After several years of frustrating failures, they temporarily abandoned the effort in 1965. By the early 1970s, however, technological advances and growing support for whale research had reignited the interest of Watkins and Schevill and a loose network of collaborators funded by the Office of Naval Research's Oceanic Biology Branch, known as Code 484. At a scientific conference on whales held in the summer of 1971, Watkins, Schevill, and their colleagues argued that radio tags would answer crucial questions about whale behavior, movements, and distribution. The main challenge was developing a reliable method of attaching the tags to large, unrestrained whales on the open ocean so that they remained attached for more than a few weeks. In the mid-1960s Schevill and Watkins had resorted to attempting to harpoon right whales with a radio dart from a helicopter, with little success.<sup>25</sup>

<sup>24</sup> Albert, 2001, p. 266; Anonymous, 1978a, b, 1979a.

<sup>25</sup> Watkins and Schevill, 1977; Schevill et al., 1974.



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Two other researchers supported by ONR's Code 484, G. Carleton Ray and Douglas Wartzok, seem to have been the first to propose radio-tagging bowheads. In the early 1970s, they joined with other Code 484-supported researchers to develop a radio tag that could be fired into a whale from a shotgun. In the spring of 1975, they applied to NMFS for a permit to radio-tag up to fifty bowhead whales in the Bering, Chukchi, and Beaufort Seas in order to determine their distribution, abundance, and movements in relation to sea ice. Although NMFS issued the permit, Ray and Wartzok did not immediately attempt to tag bowheads. Instead, in the summer of 1976, they tagged a single fin whale in Gulf of St. Lawrence, which they were able to track for a little more than a day before the tag failed. The same summer, NMFS bowhead researcher Michael Tillman tested the tag on humpback whales in Alaska's Prince William Sound, succeeding in tracking only one whale for 6 days. In their collective report on the tag, the group described it as having "potential" but noted it "has yet to be proved fully operational."<sup>26</sup>

By the time Follmann's Project Whales proposal received funding from the Bureau of Land Management in the fall of 1978, there was therefore already a well-established dialog among marine mammalogists about the use of radio tags to study bowheads. While Follmann was aware that others had been working on the technique, neither he nor Mate consulted closely with the Code 484-supported collaboration or with NMFS. That a new whale-tagging project could be developed and funded without extensive dialog with or sponsorship from ONR or NMFS reflected the new environment for marine mammal research of the 1970s as it had been transformed by the environmental movement. By requiring federal agencies to conduct environmental impact assessments, the new environmental laws had effectively created new mission-oriented science-funding bodies.<sup>27</sup> Agencies such as BLM often turned to the NMFS and the U.S. Fish and Wildlife Service for wildlife expertise, and in some cases they were statutorily required to do so, but they could also contract research from academic researchers, private consultancies, and other government units such as NARL. In doing so they created opportunities for a broader range of researchers to participate in marine mammalogy and other areas of relevant research, contributing to the "Full-Employment Act" for wildlife biologists that Jack Ward Thomas would describe several decades later and stepping on a few toes in the process.

<sup>26</sup> Ray et al., 1978.

<sup>27</sup> These agencies produced "regulatory science"; see Jasanoff, 1990.

For the members of the Code 484-sponsored group and their collaborators at NMFS, Follmann's entry into the field represented a threat in two ways. If he succeeded in radio-tracking bowheads, he could steal credit for the technique from those who had been working on it for more than a decade; if he failed, he could discredit the entire endeavor.<sup>28</sup> Watkins, who had worked on whale tagging longer than anyone, was especially concerned about the potential for public backlash. After failing to convince Follmann to abandon his plans, Watkins told BLM's Anchorage office that bowheads were the wrong species to use for testing the technique. There were still too many unanswered questions: "Is the political scene capable of encouraging science? Would it be possible to modify, slow down, or halt [*sic*] an experimental program in progress? Could we test implanted radio tags and track tagged whales carefully enough to avoid exaggerated or adverse publicity?"<sup>29</sup> At Watkins' request, R. K. McGregor, ONR's head of arctic research, warned NARL director John Kelley that because of "the public sensitivity of tagging marine mammals" the proposed project "may so arouse vocal members of the community as to impede continued long-term development." Moreover, he added, if the "planned tagging program generates adverse publicity, the Navy, and especially ONR, may be embarrassed through [Follmann's] association with NARL." Mate, who had attended a meeting of the Code 484-group and NMFS researchers in October 1978, warned Follmann that most of the group felt "that you are likely to have a difficult time with the permit process and some of the political constraints in working with the bowhead as an endangered species, especially if it involves research and development of untested techniques."<sup>30</sup>

Watkins and his collaborators had good reasons to be concerned about the public response to radio tagging. In 1975, after Ray and Wartzok submitted their application for a permit to radio-tag 50 bowhead whales, a representative of the Monitor Consortium, a group of environmental and humane organizations, had written to the director of NMFS, Robert Schoning, with the consortium's concerns.

<sup>28</sup> On NARL's concerns about NMFS and the Code 484 group, see Notes, Whale Meeting, 6 September 1978, Box 63, Naval Arctic Research Laboratory Records, Accession 89-188, Alaska and Polar Regions Collections, Elmer E. Rasmuson Library, University of Alaska, Fairbanks.

<sup>29</sup> William A. Watkins to Gerhard Bienek, 18 October 1978, Box 63, NARL Records.

<sup>30</sup> Bruce R. Mate to Eric Folman [Erich Follmann], 24 October 1978, and attached Radio Whale Tag Review, 2 pp.; R. K. McGregor, Memorandum for the Commanding Officer, Naval Arctic Research Laboratory, 13 December 1978, Box 63, NARL Records.

Chief among these was that Ray and Wartzok had provided no evidence that the tags would lodge safely and humanely in the whale's blubber as the application had claimed. At a congressional hearing in the fall of 1975, after NMFS had issued the permit, a representative of the Animal Protection Institute accused NMFS of violating the spirit of the MMPA by approving research techniques that were "inhumane and detrimental to the health and well being and behavior patterns of the animals involved." Ray and Wartzok's shotgun-fired tag was singled out as a potentially "extremely hazardous" technique that had not been adequately reviewed.<sup>31</sup> These persistent attacks from animal protectionists may have played a role in Ray and Wartzok's decision to postpone testing the tag on bowheads until it had been furthered refined.

Though it seems likely that Follmann and his colleagues at NARL were aware of the sensitivity of tagging studies, particularly when they involved endangered whales, they were more concerned about another source of resistance: Iñupiat whalers. While many rank-and-file whalers were deeply skeptical or antagonistic toward science, especially after the IWC's vote for a moratorium in 1977, community leaders such as Eben Hopson, founding mayor of the North Slope Borough, believed in appropriating scientific methods in order to serve Iñupiat needs.<sup>32</sup> After the IWC vote, for example, Hopson had joined other Iñupiat leaders in sending an open letter to Jimmy Carter protesting the "unlawful actions now being proposed by a remote international commission, a zealous group of Federal bureaucrats and tyrannical conservationists who lack respect and understanding for the survival of the Eskimo people and their culture." The letter went on to criticize the visual counts on which the IWC's population estimates had been based, which ignored whalers' observations of bowheads migrating far from shore. The solution, Hopson and his coauthors argued, was not to abandon science but to conduct "appropriate objective and scientific studies."<sup>33</sup>

<sup>31</sup> For the permit notices, see Gehringer, 1975; Schoning, 1975. Testimony from Jane Risk of the Animal Protection Institute, including a description of the May 1975 letter about Ray and Wartzok's tagging proposal, is in House Committee on Merchant Marine and Fisheries, 1975, pp. 205–208.

<sup>32</sup> For an example of Hopson's support for science, see Brenneman, 1976. On the early history of the North Slope Borough, see McBeath and Morehouse, 1980, pp. 75–103.

<sup>33</sup> The letter is described in Anonymous, 1977. On rank-and-file whalers' skepticism, see Albert, 2001, p. 267. Along with Adams, whaling captain Harry Brower, Sr., played a key role in convincing whalers of the legitimacy and necessity of parts of Project Whales; see Brewster, 2004, pp. 153–154; Albert, 2001, pp. 267–268, 274.

Despite their support for science, leaders of the whaling communities did have serious concerns about particular kinds of scientific practice. In the fall of 1977, the AEWG had issued a report on bowheads that suggested tagging as a possible research method but also expressed concerns about the effect of such a technological “parasite” on the whales.<sup>34</sup> In early October 1978, when NARL staff met with whaling captain and political leader Jacob Adams to discuss Project Whales, Adams told them that he would oppose the use of the Code 484 group’s shotgun-fired tag but would consider the tag that Mate had developed, which was smaller and was attached with a pole rather than with a shotgun.<sup>35</sup> Despite what Kelley characterized to the Project Whales funders in BLM’s Anchorage office as a “relatively good working relationship” between NARL and the Iñupiat community in Barrow, discussions of tagging were tense and slow-moving. More than any other technique, tagging would involve direct harassment of and potential injury to whales and would probably interfere with the hunt.<sup>36</sup> NARL staff met with Adams, Hopson, and several other whaling captains in late November 1978 to further discuss the issue. Afterwards Kelley told BLM’s Anchorage office that Hopson did “not want these animals harassed in any way nor marked in any way” regardless of the “size of tag or method of attachment.” The other whaling captains had not expressed strong opinions but would follow Hopson’s lead; as a result, Kelley concluded, “resistance from the native community will definitely occur if we proceed with the bowhead study.”<sup>37</sup>

Although NARL’s leadership had no legal obligation to respect the wishes of the whalers, it had strong incentives to maintain a good working relationship with local political leaders. With Navy support for NARL expected to come to an end by 1980, Kelley recognized that support from the North Slope Borough, the Arctic Slope Regional

<sup>34</sup> “Proposed Scope of Work for an Ocean Information System to Identify and Keep Track of the Bowhead Whale to Permit Specie [*sic*] Management,” August 1977, Prepared for U.S. Department of the Interior by Alaska Eskimo Whalers Commission, Barrow Whalers Association, Arctic Slope Regional Corporation, and North Slope Borough Department of Conservation and Environmental Security by Charles Edwardsen, Alaska and Arctic Enterprises, Inc., Severna Park, MD, in Carton 39, Series 5, Brower Papers.

<sup>35</sup> Notes, G. Hufford/GAL [Gary A. Laursen] Telecon [Teleconference], 3 October 1978, Box 63, NARL Records.

<sup>36</sup> On traditional taboos around whaling, see Brewster, 2004, pp. 22–23; on the cosmologies of arctic hunting peoples, see Brody, 2000.

<sup>37</sup> John J. Kelley to Gary Hufford, 22 November 1978; Notes, Whales/Meeting, 20 November 1978, Box 63, NARL Records.

Corporation, and the Ukpeaġvik Iñupiat Corporation that governed Barrow was essential to a post-Navy future for the laboratory. Alienating whalers and local political leaders by forcing through an unwanted research program would have undermined the primary non-scientific goal of Project Whales, which was to demonstrate the usefulness of a facility to North Slope residents. When Hopson died in 1980, NARL published a memorial note in its newsletter describing him as “a long-time advocate of environmental safeguards” for the North Slope who had called on the federal government “to adopt an overall policy to include stable and continuous funding for arctic environmental research.”<sup>38</sup> After several years of negotiations, NARL’s facilities were transferred to the Ukpeaġvik Iñupiat Corporation, which took in the North Slope Borough’s Department of Wildlife Management as its first paying tenant in 1985 and eventually hosted the civilian successor to NARL that Kelley had dreamed of.<sup>39</sup>

By the end of 1978, it was clear that Follmann’s plan to radio-tag bowheads faced an array of formidable opponents. These included Watkins and his colleagues and funders, Iñupiat whaling captains and political leaders, and the animal protectionists and environmentalists who had not yet weighed in but would, on the basis of past experience, be likely to do so if a formal permit application were submitted to NMFS. Because of this opposition, NARL’s leadership decided to postpone the attempt to radio-tag bowheads. Mate had suggested that BLM funds could be used to test the tags on a “less sensitive species,” namely, gray whales, for which Mate already had a tagging permit in Mexico. A success there, he argued, might make it easier to convince whaling captains to allow the technique to be used on bowheads.<sup>40</sup> In early 1979 Follmann and Mate succeeded in radio-tracking one gray whale tagged in Baja California as it migrated north along the coast of California, Oregon, and the Aleutian Islands. The result was the longest track that had yet been achieved with any kind of marine mammal (Figure 1).<sup>41</sup>

Despite this success, faltering support for Project Whales at BLM meant that Follmann’s chances of using the tags on bowheads, even if he had been able to convince the whalers to allow it, remained small. In March 1979, the executive director of the Marine Mammal Commission, John R. Twiss, Jr., sent a scathing report on Project Whales to the

<sup>38</sup> Anonymous, 1980.

<sup>39</sup> Arctic Institute of North America, 1997; Albert, 2001, pp. 267–268.

<sup>40</sup> Bruce R. Mate to Eric Folman [Erich Follmann], 24 October 1978, and attached “Radio Whale Tag Review,” 2 pp., Box 63, NARL Records.

<sup>41</sup> Follmann, 1979a, b, c.



*Figure 1.* Bruce Mate and Erich Follmann tested radio tagging techniques on gray whales in Baja California's San Ignacio Lagoon in early 1979 (*Source:* Folder 379-A, Box 64, Naval Arctic Research Laboratory Records, Accession 89-188, Elmer E. Rasmuson Library, University of Alaska, Fairbanks)

director of BLM. Twiss argued that NARL's proposal was not "fully responsive" to BLM's work statement, which itself was not fully responsive to NMFS's recommendations as required under Section 7 of the ESA, which in turn were "not as detailed and as well justified as would have been desired." As a result, Twiss concluded, NARL's project would not provide all of the information needed to assess the impact of oil and gas development on bowheads, and much of the information it would provide was already being generated by researchers at NMFS. Twiss recommended eliminating funding for Project Whales, consulting more closely with NMFS, and delaying the sale until the necessary research had been completed. Because of BLM's concerns about the project, funding for almost all Project Whales work was temporarily put on hold in March.<sup>42</sup> Though Project Whales survived these attacks, Kelley learned in late June that BLM had decided to cancel Follmann's project.<sup>43</sup> While other components of Project Whales

<sup>42</sup> Commanding Officer [Mike Brown] to Technical Director [John K. Kelley], 17 March 1979; John R. Twiss, Jr., to Frank Gregg, 22 March 1979, Box 66, NARL Records.

<sup>43</sup> John J. Kelley to Anne Mae Weston, 25 June 1979, Box 64, NARL Records.

continued, the Navy began transitioning NARL into “caretaker” status with the goal of completing all research projects before the end of 1980.<sup>44</sup>

Radio tags ultimately played no role in resolving controversies over indigenous whaling or offshore oil and gas exploration in the 1970s and 1980s. Over the course of the 1980s, on the basis of aerial surveys, shore- and ice-based visual counts, and bioacoustic techniques first developed at NARL, each successive annual estimate of the bowhead population rose higher above the estimate that had led to the IWC moratorium in 1977. In 1981 the AEW and NMFS agreed on a comanagement scheme under which the IWC would set quotas but the whaling communities would be responsible for implementing and enforcing them and for generating the research on which they were based. Many researchers who had participated in Project Whales stayed in Barrow or Fairbanks and a few took full-time positions in the North Slope Borough’s Department of Wildlife Management. In 1981, the AEW’s scientific advisory committee, of which Kelley and other Project Whales alumni were members, suggested focusing research efforts on bioacoustic methods that were both scientifically effective and unobjectionable to whalers.<sup>45</sup> As bioacoustic data were increasingly given more weight in the estimation and as the whale population increased in size, IWC population estimates rose to more than 8000 by the mid-1990s, and the annual quotas rose accordingly. While the very existence of an IWC quota continued to generate resentment among many whalers, the quota eventually grew high enough that whalers failed to reach it in most years.<sup>46</sup> Follmann was among those who continued to advise the AEW and the North Slope Borough. After a largely unsuccessful second attempt to tag gray whales in the spring of 1980, he had abandoned his plans to radio-tag bowheads. In 1983, however, he received a contract from the AEW to develop a radio tag that could be attached to harpoons. Rather than using the technique to study living whales, he was now hoping to use it to increase the efficiency of the hunt.<sup>47</sup>

While Follmann had abandoned the radio-tracking of whales, others continued to work on the technique. With funding from BLM as part of the ongoing OCSEAP program, Mate refined his tag design in tests on gray whales and other species. Over the course of the 1980s, other researchers radio-tagged a handful of bowhead whales but failed to

<sup>44</sup> On plans to close NARL, see Anonymous, 1979b; Kelley, 1980.

<sup>45</sup> Alaska Eskimo Whaling Commission, 1981.

<sup>46</sup> Albert, 2001, pp. 271–273; Wohlforth, 2004, pp. 14–23.

<sup>47</sup> Follmann, 1980; Follmann and Manning, 1989.

obtain much significant data.<sup>48</sup> Although whalers' opposition to tagging seemed to have mellowed by the early 1980s, scientists did not collaborate closely with whalers on the development of tagging techniques, with the exception of Follmann's work on a harpoon tag.<sup>49</sup> In 1982, Mate shifted his focus from conventional radio tags that had to be tracked by ship or aircraft to more powerful tags that could be tracked by satellite. When BLM's Minerals Management Service sponsored a meeting on large cetacean radio-tracking in 1987, Mate and the other attendees concluded that although the electronics had improved, a reliable long-term attachment method remained elusive. It was only in the early 1990s, after successfully testing the satellite tag on other species of whales, that Mate successfully tagged and tracked a number of bowheads in the Beaufort Sea.<sup>50</sup> A little more than a decade later, the first large-scale tagging effort took place as a collaboration between Iñupiat whalers and the Alaska Department of Fish and Game, with the whalers participating in tagging and tracking operations.<sup>51</sup>

## Conclusion

In his memoir, Alaskan native land rights activist and political leader William Ig̃giagr̃uk Hensley briefly describes how Iñupiat whalers in the late 1970s mounted "a lengthy campaign to show that scientists were using flawed methodology to measure the population of whales."<sup>52</sup> Like other commentators, Hensley focuses on the way in which biologists' "flawed methodology" produced an inaccurate representation of nature that operated to the disadvantage of native hunters. From this perspective, the solution to the flawed methodologies of modern science and their often unjust consequences is the incorporation of traditional ecological knowledge into wildlife research and management. In the scholarly literature on traditional ecological knowledge, the bowhead controversy has been seen as a model both epistemologically and politically. Iñupiat whalers who believed that whales were sufficiently

<sup>48</sup> E.g., Watkins et al., 1989.

<sup>49</sup> On whalers' waning opposition, see Howard Braham, "Report of the 'Bowhead Whale Research Technical Coordination Meeting', March 11–12, 1982, Northwest and Alaska Fisheries Center, Seattle, Washington," Box 2, Chapman Papers.

<sup>50</sup> Montgomery, 1987; Mate and Krutzikowsky, 1995.

<sup>51</sup> The project is described by Lori Quakenbush of the Alaska Department of Fish and Game at <http://www.wc.adfg.state.ak.us/index.cfm?adfg=marinemammals.bowhead>.

<sup>52</sup> Hensley, 2009, p. 152.



abundant to support hunting were eventually vindicated by scientific research that took their knowledge into account, and the bowhead population has subsequently grown steadily under comanagement by the whaling community and the federal government.<sup>53</sup>

Though accurate as far as it goes, this story is incomplete. It leaves out the fact that the production of knowledge entails the creation of particular relationships with the objects of knowing and that the values embodied in these relationships have been contested by historical actors.<sup>54</sup> In this paper, I have argued that the ability of a particular research method – radio tracking – to accurately represent nature was only one of the factors that influenced the decision about whether to use it. In other domains, such as biomedical research on humans, this conclusion would not be particularly surprising, but it is one that has largely eluded scholars of the history of conservation biology and traditional ecological knowledge.<sup>55</sup> When Hopson told Project Whales staff in the fall of 1978 that he opposed any form of artificial marking, it was not because the technique would produce a flawed estimate of the abundance of whales or because it would justify constraints on indigenous hunting, but because it threatened to disrupt the whalers' relationship to the whales. Although this paper has focused on radio tracking, other research techniques were also evaluated in these terms. According to Thomas Albert, a biologist with Project Whales who later led the North Slope Borough's bowhead research program, Iñupiat whalers also regarded aerial surveys and active sonar as potential threats to the success of the hunt.<sup>56</sup> The eventual dominance of shore-based visual surveys and passive bioacoustic methods was due not merely to their efficacy but also to the fact that they did not significantly disrupt Iñupiat whalers' way of life.

Although the specifics of Iñupiat concerns about research on bowheads were unique, they were part of a broader intensification of scrutiny of wildlife biologists' practices in the 1970s. The advocacy groups that took advantage of the flawed but powerful transparency and public review provisions of the ESA and MMPA included several with which the whalers were at loggerheads, particularly animal protectionists and environmentalists. When whalers questioned the wisdom of Follmann's

<sup>53</sup> E.g., Stoker and Krupnik, 1993, pp. 618–620.

<sup>54</sup> On traditional ecological knowledge as a way of knowing rather than as static body of knowledge, see Ingold, 2004, p. viii; Cruikshank, 2004, p. 23.

<sup>55</sup> For other examples of the disruption of indigenous hunters' relationship with animals by scientific research, see Fienup-Riordan, 1990, pp. 184–185; Kofinas, 2005.

<sup>56</sup> Albert, 2001, p. 271.

tagging proposal, they were echoing the questions that animal protectionists had posed regarding Ray and Wartzok's similar proposal several years earlier. This does not mean that their reasons for questioning were identical, but they did share a belief that research practices could constitute significant and sometime unwanted interventions into existing or ideal relationships between humans and nonhumans. Questions about the proper means of interacting with the natural or nonhuman world could not be postponed until after the results of research were known; on the contrary, such questions had to be answered in order to even begin doing research.

The influence of the formal regulatory system on scientists' selection of research methods was often indirect. In the case of Follmann's radio-tagging proposal, the process established by the ESA and MMPA to regulate research on endangered species and marine mammals helped frame the discussion, but ultimately the decision was negotiated in less formal forums and included a broader array of reasons than those encompassed by the regulatory process. In this and in many other cases, the likelihood of a "difficult time with the permit process" discouraged scientists from submitting permit applications in the first place. Many scientists were genuinely concerned about the impact of their research and took the initiative to adjust their own practices or to censure less thoughtful colleagues, but their propensity to do so was enhanced by the pressure of increased scrutiny and the possibility of scandal. Some scientists have argued that the regulatory system as it has evolved since the 1970s has prevented studies from being conducted that would have benefited the species in question and have sought, with some success, to reduce public oversight of scientific practice.<sup>57</sup> Whatever the merits of this perspective, a regulatory system that incorporated non-scientific voices and values would not have been functioning if it had not sometimes prevented scientists, individually or as a community, from doing things they believed they were justified in doing.

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<sup>57</sup> E.g., Ralls and Brownell, 1989.

## References

- Alaska Eskimo Whaling Commission. 1981. *Prospectus and Proceedings of the Science Advisory Committee of the Alaska Eskimo Whaling Commission, October 1980 to May 1981*. Barrow, AK: Alaska Eskimo Whaling Commission.
- Albert, Thomas F. Jr. 2001. "The influence of Harry Brower, Sr., an Iñupiak Eskimo Hunter, on the Bowhead Whale Research Program Conducted at the UIC-NARL Facility by the North Slope Borough." David W. Norton (ed.), *Fifty More Years Below Zero: Tributes and Meditations for the Naval Arctic Research Laboratory's First Half Century at Barrow, Alaska*. Fairbanks: Arctic Institute of North America and University of Alaska Press, pp. 265–276.
- Anonymous. 1972a. "Conservationists Back Natives." *Tundra Times*, 17 May.
- 1972b. "Importance of Sea Mammals to Natives." *Tundra Times*, 29 March.
- 1977. "Arctic Eskimos Fight Whale Ban." *Tundra Times*, 17 August.
- 1978a. "Scientific Programs at the NARL." *NARL News* 2, March, 1.
- 1978b. "Project Whales – New Research Program Proposed for NARL." *NARL News* 2, September, 1–2.
- 1979a. "Plans for Project Whales Spring Experiment Underway." *NARL News* 3, January, 7.
- 1979b. "Arctic Research Workshop Held at the NARL." *NARL News* 3, December, 1–2.
- 1980. "The NARL Mourns the Death of Mayor Eben Hopson." *NARL News* 4, July, 1.
- Arctic Institute of North America. 1997. *Remembrances on the Event of the 50th Anniversary of the NARL, 1947–1997*. Fairbanks, AK: Arctic Institute of North America.
- Barrow, Mark V. Jr. 1998. *A Passion for Birds: American Ornithology After Audubon*. Princeton, NJ: Princeton University Press.
- 2009. *Nature's Ghosts: Confronting Extinction from the Age of Jefferson to the Age of Ecology*. Chicago: University of Chicago Press.
- Bean, Michael J. and Rowland, Melanie J. 1997. *The Evolution of National Wildlife Law*. Westport, CT: Praeger.
- Beers, Diane L. 2006. *For the Prevention of Cruelty: The History and Legacy of Animal Rights Activism in the United States*. Athens: Swallow Press/Ohio University Press.
- Bockstoce, John R. 1986. *Whales, Ice, and Men: The History of Whaling in the Western Arctic*. Seattle: University of Washington Press.
- Bockstoce, John R. and Burns, John J. 1993. "Commercial Whaling in the North Pacific Sector." John J. Burns, J. Jerome Montague and Cleveland J. Cowles (eds.), *The Bowhead Whale*. Lawrence, KS: Society for Marine Mammalogy, pp. 563–577.
- Brenneman, Betsy. 1976. "27th Annual Science Conference." *Tundra Times*, 11 August.
- Brewster, Karen. 2004. *The Whales, They Give Themselves: Conversations with Harry Brower, Sr.* Fairbanks: University of Alaska Press.
- Brody, Hugh. 2000. *The Other Side of Eden: Hunters, Farmers, and the Shaping of the World*. New York: North Point.
- Cioc, Mark. 2009. *The Game of Conservation: International Treaties to Protect the World's Migratory Animals*. Athens: Ohio University Press.
- Clark, Tim W., Reading, Richard P. and Clarke, Alice L. (eds.). 1994. *Endangered Species Recovery: Finding the Lessons, Improving the Process*. Washington, DC: Island Press.

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- Cruikshank, Julie. 2004. "Uses and Abuses of 'Traditional Knowledge': Perspectives from the Yukon Territory." David G. Anderson and Mark Nuttall (eds.), *Cultivating Arctic Landscapes: Knowing and Managing Animals in the Circumpolar North*. New York: Berghahn, pp. 17–32.
- Dronenburg, Ray. 1978. "Marine Bioacoustics." *NARL News* 2, May, 1.
- Dunlap, Thomas. 1988. *Saving America's Wildlife: Ecology and the American Mind, 1850–1990*. Princeton, NJ: Princeton University Press.
- Fienup-Riordan, Ann. 1990. *Eskimo Essays: Yup'ik Lives and How We See Them*. New Brunswick: Rutgers University Press.
- Follmann, Erich. 1979a. "Gray Whales Radio-Tagged in Mexico." *NARL News* 3, March, 5–6.
- 1979b. "Tagged Grey Whale Located off West Coast." *NARL News* 3, May, 1.
- 1979c. "Flash!! Grey Whale with Radio Tag Located at Unimak Pass." *NARL News* 3, June, 4.
- 1980. "Two Gray Whales Tagged in Mexico." *NARL News* 4, April, 3.
- Follmann, Erich H. and Manning, Arthur E. 1989. "The Use of Radio Telemetry as an Aid in the Retrieval of Bowhead Whales (*Balaena mysticetus*) Struck During the Annual Eskimo Subsistence Hunt in Alaska." *Arctic* 42: 189–198.
- Gehringer, Jack W. 1975. "G. Carleton Ray and Douglas Wartzok: Issuance of Permit for Marine Mammals." *Federal Register* 40: 25702.
- Haldiman, Jerrold T. and Tarpley, Raymond J. 1993. "Anatomy and Physiology." John J. Burns, J. Jerome Montague and Cleveland J. Cowles (eds.), *The Bowhead Whale*. Lawrence, KS: Society for Marine Mammalogy, pp. 71–156.
- Harkin, Michael E. and Lewis, David Rich (eds.). 2007. *Native Americans and the Environment: Perspectives on the Ecological Indian*. Lincoln: University of Nebraska Press.
- Hensley, William L. Iggiagruk. 2009. *Fifty Miles from Tomorrow: A Memoir of Alaska and the Real People*. New York: Sarah Crichton.
- House Committee on Merchant Marine and Fisheries. 1975. *Hearings Before the Subcommittee on Fisheries and Wildlife Conservation and the Environment of the Committee on Merchant Marine and Fisheries, House of Representatives, Ninety-Fourth Congress, on Oversight of the Marine Mammal Protection Act of 1972; To Review the Implementation, Administration, and Enforcement of the Act, October 21, 29, 30, December 9, 1975*. Washington, DC: Government Printing Office.
- Ingold, Tom. 2004. "Foreword". David G. Anderson and Mark Nuttall (eds.), *Cultivating Arctic Landscapes: Knowing and Managing Animals in the Circumpolar North*. New York: Berghahn, pp. vii–xiii.
- Jasanoff, Sheila. 1990. *The Fifth Branch: Science Advisers as Policymakers*. Cambridge, MA: Harvard University Press.
- Kelley, John J. 1980. "Plans for NARL Operations During 1980." *NARL News* 3, August, 1.
- Kofinas, Gary P. 2005. "Caribou Hunters and Researchers at the Co-management Interface: Emergent Dilemmas and the Dynamics of Legitimacy in Power Sharing." *Anthropologica* 47: 179–196.
- Koski, William R., Davis, Rolph A., Miller, Gary W. and Withrow, David E. 1993. "Reproduction." John J. Burns, J. Jerome Montague, and Cleveland J. Cowles (eds.), *The Bowhead Whale*. Lawrence, KS: Society for Marine Mammalogy, pp. 239–274.
- Krech, Shepard, III. 1999. *The Ecological Indian: Myth and History*. New York: W.W. Norton.
- Laursen, Gary A. 1979. BLM/NARL Project Whales. *NARL News* 3, April, 2.

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- Mate, Bruce and Krutzikowsky, Gregory K. 1995. *Application of Remote Methods of Large Cetacean Tracking: Bowhead Whales, Final Report, MMS 95-0053*. Washington, DC: Bureau of Land Management, Minerals Management Service.
- McBeath, Gerald A. and Morehouse, Thomas A. 1980. *The Dynamics of Alaska Native Self-Government*. Lanham, MD: University Press of America.
- McCartney, Allen P. (ed.). 2003. *Indigenous Ways to the Present: Native Whaling in the Western Arctic*. Edmonton: Canadian Circumpolar Institute Press.
- McLeod, Samuel A., Whitmore, Frank C. Jr. and Barnes, Lawrence G. 1993. "Evolutionary Relationships and Classification." John J. Burns, J. Jerome Montague and Cleveland J. Cowles (eds.), *The Bowhead Whale*. Lawrence, KS: Society for Marine Mammalogy, pp. 45–70.
- Montague, J. Jerome. 1993. "Introduction." John J. Burns, J. Jerome Montague and Cleveland J. Cowles (eds.), *The Bowhead Whale*. Lawrence, KS: Society for Marine Mammalogy, pp. 1–21.
- Montgomery, Suzanne (ed.). 1987. *Report on the 24–26 February 1987 Workshop to Assess Possible Systems for Tracking Large Cetaceans*. Washington, DC: Marine Mammal Commission.
- Moore, Sue E. and Reeves, Randall R. 1993. "Distribution and Movement." John J. Burns, J. Jerome Montague, and Cleveland J. Cowles (eds.), *The Bowhead Whale*. Lawrence, KS: Society for Marine Mammalogy, pp. 313–386.
- Ralls, Katherine and Brownell, Robert L. Jr. 1989. "Protected Species: Research Permits and the Value of Basic Research." *BioScience* 39: 394–396.
- Ray, G.C., Mitchell, E.D., Wartzok, D., Kozicki, V.M. and Maiefski, R. 1978. "Radio Tracking of a Fin Whale (*Baleoptera physalus*)." *Science* 202: 524–541.
- Schevill, William E., Ray, G. Carleton and Norris, Kenneth S. (eds.). 1974. *The Whale Problem: A Status Report*. Cambridge, MA: Harvard University Press.
- Schoning, Robert W. 1975. "G. Carleton Ray and Douglas Wartzok: Issuance of Endangered Species Permit." *Federal Register* 40: 31824.
- Stoker, Sam W. and Krupnik, Igor I. 1993. "Subsistence Whaling." John J. Burns, J. Jerome Montague and Cleveland J. Cowles (eds.), *The Bowhead Whale*. Lawrence, KS: Society for Marine Mammalogy, pp. 579–629.
- Thomas, Jack Ward. 2000. "From Managing a Deer Herd to Moving a Mountain: One Pilgrim's Progress." *Journal of Wildlife Management* 64: 1–10.
- Watkins, W.A., Wartzok, D., Würsig, B., Kelly, B.P. and Fistrup, K. 1989. "Radio Tracking of Bowhead Whales." *Proceedings of the Eighth Biennial Conference on the Biology of Marine Mammals*, Asilomar, CA.
- Watkins, William A. and Schevill, William E. 1977. *Development and Testing of a Radio Whale Tag, Technical Report 77–58*. Woods Hole, MA: Woods Hole Oceanographic Institution.
- Wohlforth, Charles P. 2004. *The Whale and the Supercomputer: On the Northern Front of Climate Change*. New York: North Point Press.
- Yaffee, Steven L. 1982. *Prohibitive Policy: Implementing the Federal Endangered Species Act*. Cambridge, MA: MIT Press.
- Zeh, Judith E., Clark, Christopher W., George, John C., Withrow, David, Carroll, Geoffrey M. and Koski, William R. 1993. "Current Population Size and Dynamics." John J. Burns, J. Jerome Montague and Cleveland J. Cowles (eds.), *The Bowhead Whale*. Lawrence, KS: Society for Marine Mammalogy, pp. 409–489.