RECOVERED?

FOUR YEARS AFTER THE *EXXON VALDEZ* SPILL IN PRINCE WILLIAM SOUND, SCIENTISTS DEBATE ITS IMPACT ON MARINE BIRDS.

By Blake Edgar

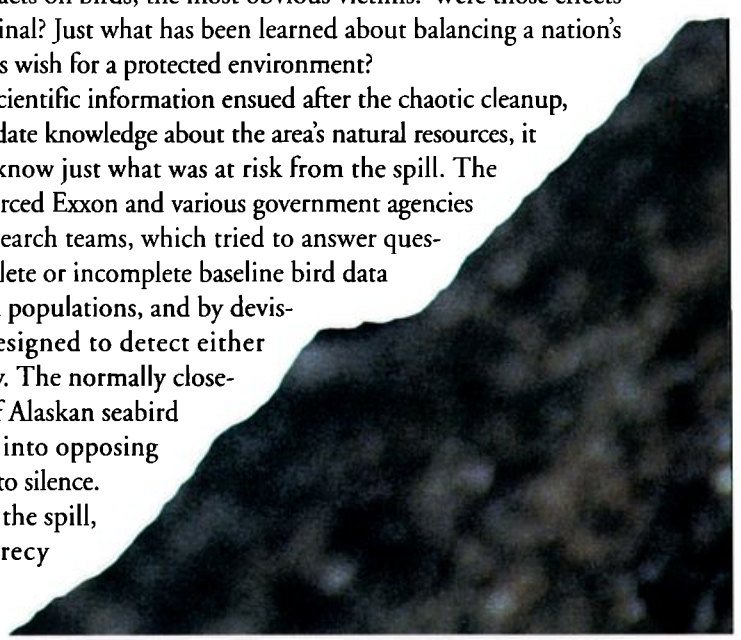
ON MARCH 24, 1989, AT 12:04 A.M., THE *EXXON VALDEZ* STRUCK Bligh Reef at the northern end of wildlife-rich Prince William Sound, pouring 11 million gallons of oil into a pristine place. Winds and currents swept the polluting cargo along the western side of the Sound, into the Gulf of Alaska, and along the Kenai and Alaska peninsulas—reaching 900 kilometers from where the accident occurred. It was the nation's largest oil disaster, and while 75 percent of the spill never left Prince William Sound, residue coated 2000 kilometers of coastline outside, including the shores of three national parks, five state parks, and four national wildlife refuges.

By summer's end, the carcasses of 37,000 birds had been collected from the Sound and the Gulf. Exactly what percentage of total bird deaths that represents is still debated. But John Piatt, a research biologist with the U.S. Fish and Wildlife Service in Alaska, puts it succinctly: The *Valdez* spill "was without doubt the largest seabird mortality ever documented from an oil spill."

Today, more than four years after the disaster, questions still linger. What were the spill's impacts on birds, the most obvious victims? Were those effects temporary, or terminal? Just what has been learned about balancing a nation's desire for oil with its wish for a protected environment?

A scramble for scientific information ensued after the chaotic cleanup, but without up-to-date knowledge about the area's natural resources, it was impossible to know just what was at risk from the spill. The threat of lawsuits forced Exxon and various government agencies to field separate research teams, which tried to answer questions by using obsolete or incomplete baseline bird data on the region's bird populations, and by devising new studies designed to detect either damage or recovery. The normally close-knit community of Alaskan seabird biologists was cast into opposing camps, each sworn to silence.

Four years after the spill, the shroud of secrecy finally began to lift, and last June

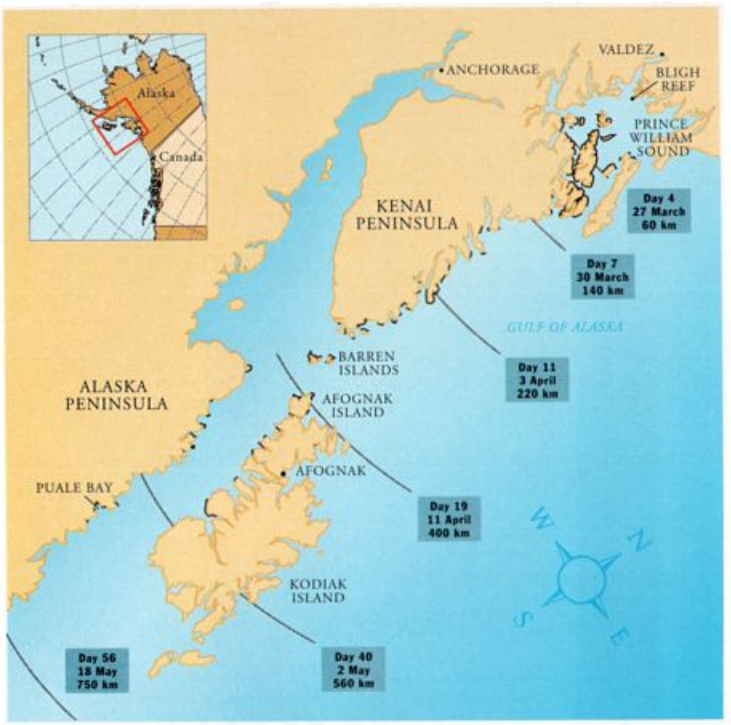


Pigeon Guillemot

PHOTO BY RALPH (JOHN) HYDE

scientists from both sides attended a special symposium at the 111th American Ornithologists' Union (AOU) meeting in Fairbanks. Like estranged relatives setting differences aside at a family reunion, biologists for Exxon and government agencies shared a podium for the first time and presented their research into the long-term effects on birds.

Most of the studies were ended after October 8, 1991, when state and federal agencies settled civil and criminal claims against Exxon. The oil company agreed to pay $1 billion in fines, to be administered by a Trustees Council of government agencies. Exxon came to the AOU meeting prepared to argue that the spill area and its inhabitants have recovered in the last four years, while the Trustees sought to show evidence of lingering impact. Each side was eager to hear and discuss what the other had concluded.



SHORELINE OILING BASED ON ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION (ADEC) OIL SPILL RESPONSE DATA. THESE INCLUDE THE 1989 AERIAL OVERFLIGHTS, FALL 1989 BEACH WALK SURVEY, SPRING 1990 AND 1991 ADEC/EXXON FIELD SURVEYS. CATEGORIES RANGE FROM HEAVY (>50%) TO VERY LIGHT (<1%)

No one denied the treacherous effects of the spill. Once oil contacts water, a lengthy process of weathering begins. First the liquid oil disperses. Lighter hydrocarbons start to evaporate from the surface, leaving a thicker slick that wind and waves churn into a sticky, pudding-like "mousse." The oil in mousse breaks down more slowly than crude oil because it is exposed to less air. This mousse forms floating mats that wash ashore, where microorganisms continue to break down the oil over time.

Both crude oil and mousse clog a bird's feathers, causing it to lose heat and possibly to sink and drown. Matted oil can be ingested from feathers or from food, with potential physiological and reproductive effects. Those species that spend more time on the water, such as alcids and diving ducks, or those that forage in the intertidal zone tend to be most vulnerable to initial oiling and later contamination.

Scientists serving both Exxon and the Trustees agreed that the oil spill's effect on Bald Eagles had been short-term. The Bald Eagle (*Haliaeetus leucocephalus*) thrives in Alaska, with a population around 39,000. An estimated 8000 inhabit Prince William Sound and the Alaska Peninsula, and as intertidal foragers that nest near shore, they were potentially at risk from oil.

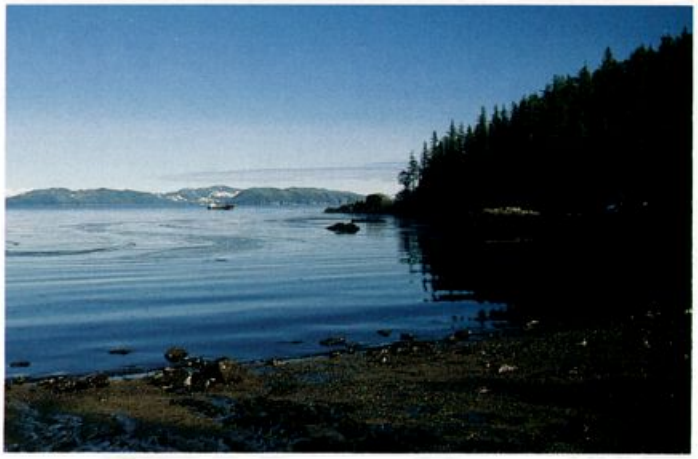
After the spill, 151 eagle carcasses were found, and estimates of the total number killed range from 500 to 900. Clean-up crews also disturbed nesting eagles in 1989. Both eggs and prey collected from nests showed oil contamination, and reproduction fell below normal that summer, with the loss of an estimated 133 chicks. In 1990, reproduction bounced to near normal levels and eagles returned to oiled stretches of shoreline. Some speculate that the Sound already had an overabundance of eagles due to an influx of hatchery-reared salmon, and that the spill killed mainly non-breeding birds that can account for half an adult population. Nesting eagles, spared harassment by non-breeders, may have rebounded with greater reproductive success a year later.

Exxon argues that the recovery evident in eagles occurred as dramatically in other birds. Colorado State University ornithologist John Wiens, who coordinated Exxon's seabird studies, says bird populations in the spill zone have returned to their "window of natural variability." Wiens says that an oil spill "may affect individuals, some of them profoundly—death is a profound influence—but we need to ask whether those become biologically important. In other words, are those effects translated into effects on population size or structure, reduced reproductive success, changing habitat occupancy or habitat use?"

The scenes immediately after the *Exxon Valdez* disaster shocked many. Birds were the most visible victims. From top left, clockwise: A bird carcass is retrieved at Katmai; oiled beach and slick at Elanor Island; an oiled loon at Applegate Rocks; an oiled Pigeon Guillemot at the Bird Rescue Center in Valdez; an oiled cormorant.

A study by Robert Day of Fairbanks-based Alaska Biological Research, Inc., looked at how quickly bird species returned to oiled habitats in Prince William Sound and the Kenai Peninsula. Boat surveys tracked 42 of 78 marine bird species at ten bays in the Sound. Of 20 species immediately harmed by the spill, six (Horned Grebe, Red-necked Grebe, Barrow's Goldeneye, Bufflehead, Mew Gull, and Northwestern Crow) had not recovered by the end of 1991.

For the Kenai, 34 species were studied, of which 12 were impacted and six (Double-crested Cormorant, Common Merganser, Glaucous-winged Gull, Common Loon, Sharp-shinned Hawk, and Ancient Murrelet) had not recovered. The long-term trends showed that the number of bird



MAP BY JONATHAN B. FOSTER | PHOTOS, CLOCKWISE FROM TOP LEFT: NATALIE FOBES; JOHN HYDE; JOHN HYDE; NATALIE FOBES; ALISSA CRANDALL; PHOTOS, BAILEY

species in the Sound hurt by the spill declined from over 50 percent in 1989 to nine percent by 1991.

But what constitutes recovery?

"I have no problems at all with Day's study. I just have have trouble with his interpretations," says toxicologist Michael Fry of the University of California, Davis, who reviewed studies for the Trustees. "Habitat use and recovery are two different things."

For example, Day's study cites the Black Oystercatcher (*Haematopus bachmani*) as a species that by 1991 had returned to feed in bays, regardless of how heavily oiled they had been. By Exxon's definition, the oystercatcher demonstrated "habitat recovery." But Exxon didn't consider the health of the birds.

Fish and Wildlife Service biologist Brad Andres has studied oystercatchers since the spill. He reports that these intertidal mussel foragers appear to need more time searching for food at oiled sites than at sites unaffected by the spill. The birds prefer unoiled areas to adjacent oiled areas, even if the latter have more mussels. Females at oiled sites appear to have fewer and smaller eggs, and young may take longer to mature, according to Andres' observations.

Karen Laing of the Fish and Wildlife Service also conducted bird surveys in Prince William Sound between 1989 and 1991. Her study covered the entire 4800-kilometer shoreline and did not distinguish areas by the amount of oil they received. Laing's study looked at population size, whereas Day's only addressed habitat use. The only pre-spill population surveys Laing could refer to were conducted by the Service in the early 1970s and in 1984. Using the same random survey technique designed to census noncolonial birds, Laing found declines in four shoreline and intertidal species (Harlequin Duck, Black Oystercatcher, Pigeon Guillemot, and Northwestern Crow) and in cormorants.

"We had declines for two years and not for a third, but I don't see that as recovery," she says. Laing cautions, however, that the declines cannot be linked with certainty to the spill. Populations of 11 bird species in the Sound were falling before 1989.

The Harlequin Duck (*Histrionicus histrionicus*) provided the most compelling challenge to Exxon's pronouncement of recovery. No Harlequin nests could be found in 1989, and only last year did broods begin to reappear along the edges of the spill zone. About 150 of the 2000 duck carcasses retrieved after the spill were Harlequins. Samuel Patten, Jr. of the Alaska Department of Fish and Game thinks that oil killed 400 ducks outright, but he found evidence for a more insidious impact: a three-year, nearly complete reproductive failure for Harlequins on the western side of Prince William Sound.

Harlequin pairs normally gather in May and search the streams entering the Sound for nest sites. Broods hatch in July and stay near fresh water until late summer. However, Patten saw no broods in the spill zone in 1990 and only one in 1991.

"If there's recovery to date it hasn't been very much," says Patten. "It's an open question."

Patten posits three possible causes for the apparent absence of ducks. The least likely is human disturbance along the shoreline, which peaked at more than 11,000 clean-up workers in 1989, but then dropped sharply. The death of most breeding females from the spill also could be to blame. However, Patten says the most likely culprit may be that food is still poisoned with oil.

Harlequins feed on mollusks in the shallow intertidal zone, and about ten percent of their diet consists of blue mussels. Scientists with the National Oceanographic and Atmospheric Administration (NOAA) discovered in 1991 that the dense mats of byssal threads anchoring many mussel beds trapped toxic, unweathered oil underneath. These beds contained the highest amounts of oil (up to 20,000 parts per million) found in any sediments of Prince William Sound, and the highest known concentration of contaminants occurred in the mussels themselves. After three years of study, some fifty mussel beds still contain large amounts of oil that has weathered little, according to Stanley Rice of the Auke Bay Laboratory. The oil may still contain high doses of toxic hydrocarbons, but no impact on mussel growth or reproduction has been shown. Also undemonstrated is whether Harlequin Ducks could be eating enough contaminated mussels to cause reproductive problems.

A Common Murre rookery in Alaska. Murres had the highest mortality rate of any seabird species after the oil spill. There is debate over whether the species has recovered. Some scientists say murres are experiencing normal breeding success. Others argue there is a lingering impact.

Exxon scientists accuse Patten of hyperbole in blaming duck declines on oiled mussels. Exxon funded a study in which Mallards were fed weathered *Exxon Valdez* crude oil with no ill effects. But despite John Wiens calling them "domestic versions of Harlequin Ducks," mallards are a different breed, and other studies suggest that wild birds are more susceptible to oil toxicity. Wiens says that Exxon did not study Harlequins because they had no indications of problems. However, even Exxon's study of habitat use detected an initial negative impact to Harlequin Ducks prior to 1991.

Tellingly, the bird killed in the largest numbers sparked the sharpest debate. The Common Murre (*Uria aalge*) and Thick-billed Murre (*Uria lomvia*) are numerous in Alaska, with perhaps several million statewide. Murres nest in huge colonies on islands and bays along the Gulf of Alaska coast, and the spill occurred just as they began massing at rookeries. Long-lived and resilient, murres have many opportunities to bounce back from years of reproductive failure. But every ecological blow weakens a population, and the sum can be more devastating than the individual impacts.

The Gulf of Alaska has already been altered by recent El Niños, oil spills, gill netting, and changing prey availability. Warmer water temperatures and shifting food webs may have caused recent seabird population crashes. The fact is that many Alaskan seabirds were having a hard time before the spill, and those troubles have persisted. That undermines Exxon's contention of a full recovery from the spill, but also underscores the difficulty of assigning specific blame to the oil. Murres are a case in point.

"You just can't say things have recovered, and you can't say it's a disaster," says Piatt. "It's a blip in the history of murres." Last spring, he witnessed a natural die-off due to starvation of some 25,000 to 100,000 murres in the Gulf.

"They either do great or they bomb," he says. "They're rarely just doing OK."

Some early signs indicated that murres were not doing well after the spill. Three mainland murre colonies at Puale Bay received about two percent of the spilled oil five weeks after the accident. One beach at Puale became carpeted with mousse a foot deep and 30 feet across. Wildlife biologist Donna Dewhurst participated in daily surveys at Puale for four summers starting in 1989, the longest-running post-spill study. She says that 1991 population estimates for Puale, based on actual counts of 3000 birds, ranged from 35,000 to 40,000 murres, down from pre-spill estimates of at least 80,000. That same year, environmental scientist David Erikson of Dames and Moore, consultants for Exxon, counted more than 8000 murres at Puale. The question is, with different sets of researchers trying to count murres clustered on hundred-foot-high cliffs—often from a bobbing boat—whose numbers are accurate?

Nearly three-quarters of all bird carcasses found after the spill were murres. Published estimates of murre mortality —arrived at by counting actual carcasses and calculating what percentage of dead birds sank, were scavenged, or were never found—range from 100,000 to 645,000. Yet if hundreds of thousands of murres died, Exxon scientists argue, it should be evident in much reduced colony counts for subsequent years. Erikson looked at 32 murre colonies in 1991, ranging in size from fewer than 100 birds to tens of thousands. He concluded that all colonies in the spill's path remained occupied, and that murre numbers fell within the range of recent population estimates.

Erikson consulted the *Catalog of Alaskan Seabird Colonies*, a volume of recent historical counts, which reported a total of 330,000 murres for the entire spill area. Further digging turned up inadvertent doublings that inflated the total murre population figure by as many as 185,000 birds. This discrepancy, he says, led the Fish and Wildlife Service to report devastating decreases in murres.

"Unfortunately, they were laboring under the illusion of higher populations out there," says Erikson, "and that strongly affected their conclusions."

Since the 1991 murre colony counts by both Exxon and the Trustees were very similar, the choice of historical data becomes critical. Erikson concluded that 12 out of 31 murre colonies increased after the spill. But simply removing one Fish and Wildlife Service count made in 1978 under rough sea conditions, says John Piatt, alters Erikson's results to 26 colonies decreasing and only five increasing.

Disagreement over which pre-spill data to use reveals the value of continuous data from one site. P. Dee Boersma of the University of Washington studied murres at the Barren Islands, the Gulf of Alaska's largest seabird colonies, from 1976 to 1982. The Barrens received about ten percent of the spilled oil, and no large flocks were observed on or near the islands until late May, according to the Fish and Wildlife Service. Their data suggested that murres at the Barrens were down by 60 percent from a decade earlier.

"I had spent so much time in the Barrens," Boersma says, "that if they were decimated I would be able to determine it visually."

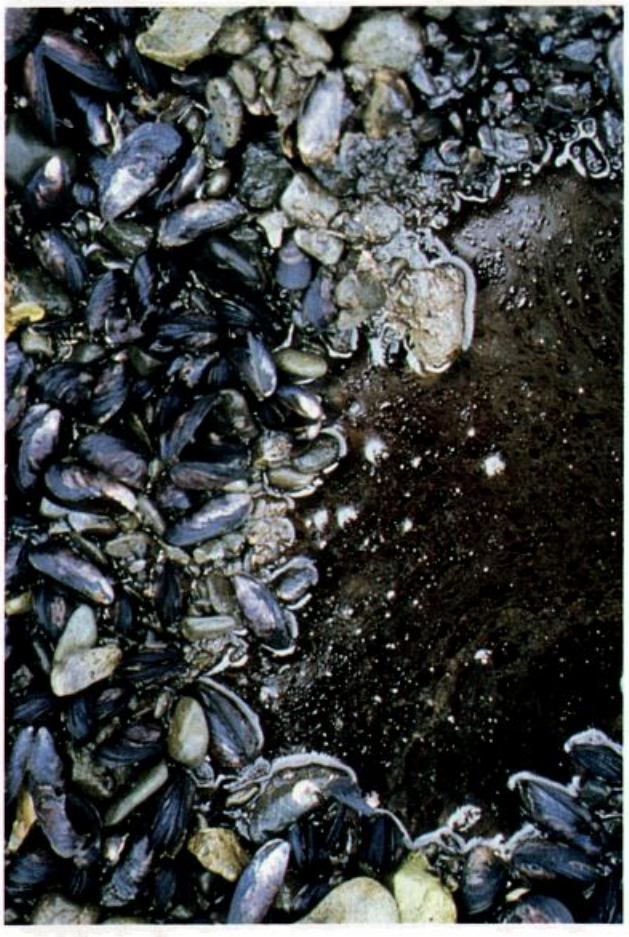
She returned in 1990 for three more summers, funded by Exxon and Mineral Management Service, to count murres and monitor reproduction at East Amatuli Island and adjacent Light Rock. Fish and Wildlife Service counts there from 1976 to 1979 ranged from 19,000 to 61,000 murres.

Studies have led to different conclusions on how Alaskan birdlife has fared since the spill. From top left, counterclockwise: Harlequin Duck; oiled mussel beds in Prince William Sound; Common Murres; and measuring a fledgling Black Oystercatcher.

Boersma believes that the East Amatuli population in the late 1970s was closer to 25,000, and her counts for the three post-spill years ranged from 31,000 to 37,000. Using obvious landmarks, she matched seven pre-spill photographs of murre colonies with her own 1991 photos of the same spots. She found no major difference in murre numbers and even counted more murres post-spill in four photos. A more detailed census counted 21 percent more murres in 1991 than in 1990—twice the usual rate of growth—suggesting that the population was responding to some recent blow, such as an oil spill.

The Fish and Wildlife Service used the high pre-spill estimate of 61,000 murres for comparison with their post-spill counts and concluded that the East Amatuli population had plummeted by more than half. While Boersma admits that the spill killed a lot of murres, she disagrees that colonies crashed and draws opposing conclusions about the murres' reproductive success in the Barrens. Boersma says the Service only made a single day's survey of East Amatuli, but a time-lapse camera in the 25 square-meter plot used in her earlier studies recorded normal breeding success.

"They say there was a failure in 1991, yet that's the year we had highest success," she says. "1992 was the lowest year we'd seen, yet they [Fish and Wildlife] had high reproduc-



PHOTOGRAPHS CLOCKWISE FROM TOP LEFT JOHN HYDE NATALIE FOBES JOHN HYDE NATALIE FOBES

tion, so you really wonder about their methods."

Dave Nysewander, a former wildlife biologist with the Fish and Wildlife Service who led the government murre study, says that the need to survey colonies throughout the Gulf of Alaska precluded doing an in-depth study like Boersma's. However, he remains cautious about what conclusions to draw from her results.

"She looked at the foot of the elephant, and we looked at the other parts of the elephant," says Nysewander. Boersma set up her camera on the best patch of murre habitat in the Barrens, the flat top of Light Rock. Nysewander says his team also found high murre productivity on Light Rock—higher than elsewhere in the Barrens. But when they looked at colonies on the sides of Light Rock and on East Amatuli, they found signs of decline. The evidence for population decreases and breeding delays mounted in other murre colonies surveyed after the spill, except at the Semidi Islands and Middleton Island, which were spared oil from the *Exxon Valdez*. Nysewander believes that the truth of the spill's damage to murres lies somewhere between a worst-case scenario and complete recovery.

The government murre study was pulled from the AOU symposium schedule on short notice because of the controversy. Karen Gorbics of the Fish and Wildlife Service in Anchorage says that the Trustees will consider Exxon's allegations and reevaluate the government's conclusions.

If the spill did not wipe out seabird colonies, it certainly didn't help them. While it's certain that the death toll would have been higher if the spill had occurred at the peak of colony attendance, no one knows how much of the floating population of non-breeding murres died in the spill. Breeding murres may have been replaced by new immigrants or non-breeders, but no one knows if the populations now have stable age distributions, or if large numbers of inexperienced breeders at the colonies might spell declines in future years.

A Trustee Council formed from the heads of each state and federal agency that sued Exxon (Alaska departments of Fish and Game, Law, and Environmental Conservation; the federal Agriculture and Interior departments, and NOAA) have begun dispensing $900 million from the settlement to reimburse the government for its studies and legal costs and to help restore fish, birds, mammals, and other resources damaged by the spill. For instance, biologists have identified old-growth nesting habitat for Marbled Murrelets (*Brachyramphus marmoratus*) that could be purchased with restoration money. The Council provided $7.5 million to buy forest habitat at Kachemak Bay, and the $39 million spent on Seal Bay at Afognak Island will benefit murrelets and Harlequin Ducks. With restoration funds, contaminated sediments could be removed from oiled mussel beds.

The four years since the spill have shown how science can suffer in the arena of high-stakes litigation. If lawyers and internal reviewers direct the course of studies and cast aside data that interferes with legal arguments, how should the resulting research be evaluated? John Wiens agrees that conflicts could have been avoided if biologists on both sides had not been gagged by lawyers, but he denies that corporate-funded science is suspect. "The scientists designed the studies, and Exxon said, 'Fine, here's the money.'"

Others counter that no one knows what studies were funded, selected, or dropped by Exxon. (Government studies are a matter of public record.) There is also concern that "charismatic megafauna," such as seals or Bald Eagles, got the most attention—excluding less glamorous, but important, species such as fish and mussels from extensive study.

Many scientists plainly did not like the circumstances.

"Isolation keeps us from ideas and information that would help a study," says Karen Laing. "I think overall it's not a good way to do science."

John Piatt is more blunt: "The whole point of this mess is that the normal scientific process was circumvented and information was suppressed."

Now that the silence has ended, perhaps scientists can compare data and come to a consensus about the spill's impact. To date, only one paper—a 1990 report co-authored by Piatt in *The Auk*, on how the spill affected birds—has appeared in a peer-reviewed journal, and that was not funded by either Exxon or the Trustees. On the other hand, the opportunity to answer many questions about the *Exxon Valdez* spill may have vanished as soon as the oil poured into Prince William Sound. Wellesley College ornithologist Nick Rodenhouse says the symposium "exposed a tremendous amount of unanswered questions, and it exposed a lack of information about the ecology of the United States' natural resources."

The Bald Eagle is found in great numbers in Alaska. In the aftermath of the spill, this national symbol galvanized conservationists. But the eagle appears to have made a significant recovery since the *Exxon Valdez* tragedy.

The *Exxon Valdez* disaster was the costliest oil spill ever. The Trustees spent more than $100 million on studies, and Exxon has spent an estimated $2.5 billion on clean-up. And since Americans consume oil equal to 66 *Exxon Valdez* spills every day, big spills will inevitably happen again.

There is still money and time to repair some of the environmental degradation caused by the spill. But perhaps there is a larger lesson: If momentum to rigorously examine our natural resources—and to fine-tune research methods—fades quickly, then the spill and its aftermath will have been a total loss.

Blake Edgar is assistant editor of Pacific Discovery *magazine and is co-author of* Ancestors, *a book about human origins research due out in December.*