

**REPLACEMENT COSTS OF BIRDS
AND MAMMALS**

**Gardner Brown, Jr.
University of Washington
Seattle, WA 98195**

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I. INTRODUCTION AND SUMMARY

This report estimates values based on the costs of relocation, replacement and rehabilitation for some of the shorebirds, seabirds and the marine and terrestrial mammals that may have suffered injury or were destroyed in the Exxon Valdez oil spill.^{1,2} A likely range of costs is estimated and a best estimate is selected.

Most of the eagles, otters, seabirds, shorebirds, and other marine and terrestrial mammals in question are not the source of large use values. By their nature and location, few people see these creatures.³ While non-use values may exist in some instances for these species, no attempt is made to estimate non-use values in this report.

There are four ways to value the costs of relocation, replacement and rehabilitation for injured animals: (1) replacement--the cost of raising young to maturity; (2) the cost of relocating adults; (3) the cost of rehabilitation, and (4) the cost of restoration or enhancement projects. The first of these approaches makes a good deal of sense because it ensures that the animals will remain and not return to their original home. The first two techniques usually require the existence of a surplus population. The third usually is not feasible because often there are not enough animals

¹ The terms, replacement and relocation costs will be used interchangeably in subsequent discussions when distinctions are not important.

² At the time I was initially asked to do the study, the extent of possible injury to some of these animals was not clear. For example, no injury has ever been detected for the humpback whale. Nevertheless, all of the species originally identified for study remain in the report.

³ There are few studies estimating the use values of these animals. The studies that exist generally are specific to a particular species and region.

which qualify for rehabilitation. The costs of restoration or enhancement projects is another alternative approach. This is discussed briefly below.

Commercial replacement, relocation and rehabilitation costs, the basis for estimating economic damages in this report, comes from a variety of sources. Prices for wildlife losses often are obtained from wildlife brokers who contact aquariums, zoos and private rearing facilities for animals which are in surplus, have been rehabilitated or are available for other reasons. Rehabilitated animals typically lack certain characteristics of the species which have been killed. Birds may not fly or reproduce. Alternatively, animals have been captured in the wild and transported to other locations, as in the case of otters, eagles and other marine mammals. Mammals and birds reared in private facilities for release are more "whole" and generally are more expensive to procure.

There are several concerns with the relocation option. Generally permits to capture must be obtained from federal and/or state agencies and this usually requires a determination that there is a surplus in the area of origin and that there will be no negative impact on the species. Plans for capture and relocation must be designed and accepted by public authorities. Often veterinarians must accompany the capturing process and the transportation phases. When permits have been granted in the past to capture sea otters, the price has been as high as 50,000 dollars for one otter. Capturing hundreds of otters, assuming permits are granted, subject to the reservation below, would lower the cost to about ten thousand dollars. Most of the animals killed in the Exxon Valdez oil spill have **strong homing** instincts imprinted in them (sea otters are a possible exception). Either the animals return to their place of origin, in which case replacement has not really been achieved or they must be raised properly from an early age. This is feasible but expensive. Moreover, small survival rates magnify the costs. Illustratively, raising eagles from eggs to produce a surviving adult costs about 15,000 dollars.

Replacement costs are not estimates of forgone use values, nor are they, a precise estimate of what it would cost to replace a like animal in the specific region of the oil spill. The values for

animals reflect what it costs to raise them at other locations and are a lower bound estimate of what it would cost to raise an animal in the affected area, if one set out to do it in a similar fashion.

There are four useful points to keep in mind in using these replacement costs for valuing animals:

1. If replacement means that the animals must remain in the habitat where they were relocated, then these values may be an underestimate because some or all would return or try to return to the location originally imprinted within them. That location may or may not be where they were relocated under some circumstances.
2. These values are contingent on the granting of permits to capture and remove the animals.
3. Even if permits were granted, the actual benefits to society and the ecological sensibleness of "replacing" animals as compared to spending some funds on habitat restoration or enhancement projects should be compared.
4. These values are contingent on the showing that the animals to be replaced are surplus.

An alternative valuation approach involves the identification of enhancement projects, schemes that would improve habitat for one or more of the animals or projects that would increase the natural rates of survival. These may be least cost options for restoring one or more populations and potentially make good sense ecologically and in terms of human welfare. Identifying enhancement projects and computing the costs accurately is beyond the scope of this report.

The major species killed by the oil spill will be valued in the following sections of the report. Bird and mammal specialists would identify one or more feasible projects which would improve the natural rate of survival for each of the birds or mammals. Establishing sanctuaries or adopting strategies which reduce egg predation are illustrations of measures which would permit populations to flourish better, provided that other pressures on the population are not simultaneously binding.

II. SEA OTTERS

A. *Market Price for Otters*

Some otters have been sold in recent years for different *market prices*. Tag Gornall, a Seattle veterinarian who has captured, maintained and participated in the sale of otters says that otters delivered to zoos have a market price of 40,000 dollars including transportation cost. This can be called a *captive market price*. A Korean aquarium recently offered Gornall a captive market price of 50,000 dollars. Brian Hunt of the International Animal Exchange, a company which specializes in the sale of birds and animals, confirms that price of 50,000 dollars.

A market price could be used as the basis for valuation but on balance it may be an overestimate. The price of 40,000 - 50,000 dollars is not the market price for another otter *in situ*. A captive market includes services connected with preparing the animal for life in captivity and for transportation to the aquarium or zoo.⁴

B. *Otter Rehabilitation Costs*

The *Anchorage Daily News*⁵ reports Exxon's technical manager, Bob Mostracchio to have said that Exxon spent 90,000 dollars per released otter rescued in Prince William Sound. *Newsweek*⁶ reports a figure of 40,000 dollars and one of the article's authors says (personal communication) that Exxon provided that estimate. *Rehabilitation cost* probably is a controversial basis for three reasons. First, it appears that there are cheaper ways such as capture to obtain otters and these lower values should have precedence. Second, it could be argued that a bundle of "services" are being provided by rehabilitation facilities and efforts, including expiation of guilt and reduced pain and suffering. Thus for some people who contribute time and resources, the value of

⁴ Otters in captivity sell for 800 dollars, according to *Newsweek* citing San Diego Zoo. This is not a credible estimate. It does not bear much resemblance to the substantive data obtained and discussed below. For this reason I have not tried to discover the basis for the estimate.

⁵ *Anchorage Daily News* (April 17, 1990, p. A10).

⁶ *Newsweek* (9/18/89, p. 53).

restoring an otter injured by an oil spill encompasses more than mere restoration of an animal. What they are willing to pay extra for these additional services is a separate issue.

C. *Otter Relocation Costs*

Chuck Monnett of Inhydra Research Institute agreed to collect an otter for the Shedd Aquarium in Chicago for a value of 20,000 dollars. Monnett's value includes cost of capture, acclimatization and delivery to Cordova. Monnett also claims to have caught and sold otters for 5 - 10,000 dollars (not including shipping costs).

According to Brian Hunt,⁷ the *costs of relocating* 50 otters within a local region, and incurring minimal transportation costs would be 75,000 - 110,000 dollars, for an average value of 1,500 - 2,200 dollars per otter. Hunt also estimated the cost at 11,000 - 12,000 dollars if about twenty otters are replaced.

The disadvantages of using relocation costs need to be acknowledged at the outset. First, the idea of using relocation cost assumes that there are *surplus* otters some place. Currently, very few permits have been issued for otters captured in the U.S. Otters are an endangered species in Canada⁸ and it is difficult to obtain permits to capture otters for relocation in the U.S. even for scientific research or educational purposes. Informal inquiry suggests that Russia definitely would not sell otters. Since the Department of Interior (Office of Management Authority, Fish and Wildlife Service) both grants permits to collect otters and is a trustee in this case, there is an apparent conflict. If no permit is granted then no otters can be relocated. Therefore, the costs of relocation are not relevant because this option would not, in fact, be undertaken. Otters reportedly are recolonizing areas along the Pacific Coast where their numbers had been reduced prior to the ban on harvest in the Marine Mammal Protection Act of 1972. This suggests that there are no

⁷ Brian Hunt, International Animal Exchange, personal communication.

⁸ Personal communication with J. Button. Industrial Economics quotes a value of 8,000 - 12,000 dollars from a Canadian source. If a sale cannot legally occur if otters have endangered status in Canada, the value is not practically relevant.

surplus otters in these areas so a grant by the Department of Interior to remove an otter in one area would simply constitute a transfer to another area and would not be a net gain.

Second, the costs of relocation exhibit a great range, from 1,500 to 20,000 dollars per otter. The broad price range arises for two reasons. The market is very thin. There may be one or a few willing buyers and there may be one or a few willing sellers but the market for otters probably is not competitive. The seller's price of an otter may depend on the characteristics of the buyer, whether it is a public zoo or an oil company; whether the price agreed upon today influences the level of future business; and other considerations. Competitive forces may not be disciplining the price of the transactions. Additionally, those granted permits to remove birds and mammals from the public domain are not allowed to make a profit. Calculating the cost of doing business is difficult when the necessary resources are unique such as the value (opportunity cost) of one who is especially skilled at collecting otters.

D. Best Estimate of the Replacement Cost of Otters

The market price or the costs of relocating otters vary from 1,500 - 50,000 dollars per otter. If no permit for capture and relocation is available, the cost would be toward the higher end of the range. My subjective estimate is that otters have a value below 50,000 dollars. My best estimate is 20,000 dollars, assuming a permit is possible if it is just one or two otters and 11,500 dollars if more than twenty otters are involved.

III. OTHER MARINE MAMMALS

While the largest numerical loss of marine mammals occurred to the sea otter population, as of 1989 it appeared that there may have been losses to other marine mammals as well, including killer whales, sea lions, humpback whales and harbor seals. Very little trade seems to take place in the other marine mammals of interest in this case. Tinney (1989) provided an estimate for stellar sea lions of 4,000 dollars: International Animal Exchange estimates the cost at 5,500 dollars if

more than a dozen are replaced but 20,000 dollars if one is replaced. Tinney and International Zoological Distributors estimate the replacement cost of harbor seals at 500 dollars, while International Animal Exchange puts the cost at 1,200 dollars if more than a dozen are replaced and 20,000 dollars if only one is replaced. See Table 1. International Zoological Distributors made a very speculative guess of 1 million dollars for a young female killer whale and 100,000 dollars for a humpback whale. International Animal Exchange estimated the value of harbor seals to be 1,200 dollars each if twenty are relocated and the replacement value of a killer whale to be 300,000 dollars for one but only 50,000 for a second whale. It never had captured a killer whale.⁹ Best estimates of cost based largely on averaging the values from several sources for single or multiple losses for mammals are displayed in Table 1.

IV. TERRESTRIAL MAMMALS

Deer, brown and black bears, river otters and mink may have been killed by the oil spill. A range of replacement values and a best estimate is provided for each species in Table 1. Estimates were obtained through personal communication with International Animal Exchange, International Zoo Distributors and Assiniboine Park Zoo, Canada. The estimates do not include transporting the animal to Alaska. The cost per animal replaced is more than 50 dollars and typically under 500 dollars. The exception is a cost of 1,500 dollars for a female river otter. How well these animals survive in the wilderness after having lived in a zoo is not known.

Another source is Industrial Economics. Its study exhibits a range of values for river otters between 32 dollars (West Virginia) and 510 dollars (New Hampshire) which various states use. The basis for many of these estimates is unknown. The province of Alberta uses a value of 81 dollars (1989 dollars) per river otter based on "relative market value as live animals." North Carolina uses a value of 300 dollars based in part on the cost of purchasing suitable habitat to

⁹ Personal communication, Brian Hunt.

enhance the existing river otter population. It well may be true that habitat enhancement is a lower cost alternative to replacement. For the present, the best estimate of value for river otters is 390 dollars, the average of extreme values of the range, excluding the high value for a female.

V. EAGLES

A. *Replacement Cost of Eagles*

The following valuation is based on personal communication with professionals involved in three programs that raise and distribute eagles. First, for the last seven years a "hacking" program, financially supported in part by the U.S. Fish and Wildlife Service, has shipped 4-6 week old fledglings surplus from Saskatchewan to the Pennsylvania Game Commission.¹⁰ When birds of prey are to be released or "hacked into the wild," they are put in an artificial nest, the hacking tower, and cared for in a way which avoids human contact. The uncompounded cost of reintroducing 85 eagles which successfully have reached the age at which they can be placed in hacking towers has been 385,000 dollars or about 4,500 dollars per eagle. The mortality rate after the hacking tower stage until adulthood is about 80 percent.¹¹ Thus 4,500 dollars per eagle is an underestimate of the value of an adult eagle assuming that the annual cost figures of 55,000 dollars (based on a total cost of 385,000 dollars) for 7 years have been properly constructed. At a mortality rate of 80 percent, it would take 5 eagles hacked to produce one adult eagle. Thus the cost of a surviving adult eagle is 22,500 dollars.

Second, the Sutton Avian Research Center in Oklahoma, supported by Phillips 66, has been collecting eagle eggs in Florida, husbanding them approximately 8 weeks at which time fledglings are distributed to various areas in the U.S. Seventy-four eggs were gathered in 1989-90. Since the artificial success rate before the fledglings reach 8 weeks of age is double the natural

¹⁰ Personal communication, J. Byerly of that commission.

¹¹ P. Schemph, personal communication.

rate,¹² one can argue that the quantities of fledglings raised in captivity, or at least one-half of them, are surplus. Colbert estimates the cost of rearing one egg plus hacking and release at 5,000 dollars, excluding capital costs. I'll put the range of total cost at 5,000 - 6,000 dollars assuming either no capital cost or a capital cost of 1,000 dollars. Ted Simons, National Park Service, one of the recipients of birds from Sutton reported in a personal communication that 60 percent mortality occurs between the fledgling and breeding state. It therefore takes 2.5 fledglings to produce one adult eagle. This raises the cost to 12,500 - 15,000 dollars. Insofar as adult eagles were killed in the oil spill, then one needs to value the real cost of raising a bird to maturity. Even if the young are released into the wild, there is a real economic cost of there not being an adult eagle until the fledglings reach maturity.

Third, for the last 5 - 20 years, the State of Alaska has cooperated with New York to restore eagles to this state. Alaska captures and delivers chicks to New York where they are raised in captivity and released. Phil Schemph, U.S. Fish and Wildlife Service stated that it costs 43,000 dollars to successfully establish a breeding pair of eagles for each success or 21,500 dollars per eagle.¹³

Combining these estimates puts the range of the cost of a eagle at 12,500 - 22,500 dollars. The estimates exhibit a clustering around 22,000 dollars for each eagle which can be regarded as a best estimate (Table 1).¹⁴ The estimate neglects the symbolic importance of eagles or any other non-use values that can occur if eagles are killed. The costs of relocation and rehabilitation are mentioned briefly below for the sake of completeness.

¹² Personal communication, Keven Colbert, Development Director of the Center.

¹³ Personal communication, Phil Schemph.

¹⁴ Industrial Economics exhibits a range of values of 253 - 6,315 dollars for eagles obtained from five different states. The maximum is said to be a replacement value, of unknown origin, whereas the replacement value in the text has been carefully documented. Two of the other values 253 and 1,173 dollars are also from an unknown origin according to Industrial Economics. Talhelm (1990) recommended values for many species in his report, under contract for the State of Minnesota, including 20,000 dollars for an eagle. Not all of the assumptions underlying his recommendation would command widespread support by natural resource economists. In any event, the State of Minnesota adopted a value of 4,000 dollars for eagles, based on Talhelm's recommendation, public comment and the professional judgment of state officials, according to Industrial Economics. Texas adopted a value of 3,164 dollars based on the "wildlife's social and economic value."

B. Cost of Relocating Adult Eagles

Brian Hunt, International Animal Exchange, reports that it costs 1,000 - 1,500 dollars to capture and relocate an adult eagle and that this cost per eagle is the same whether 1 or 50 eagles are relocated. There are two shortcomings to this approach at valuation. Adult eagles will attempt to home or return to their original habitat to breed. Thus a relocated adult eagle is not equivalent to an established breeding adult. One would need to know the fraction which homes to calculate the true cost of relocating a given number of eagles permanently. Moreover, from a national perspective an eagle relocated is just a transfer and not a true replacement. There can only be true replacement if the region of "export" has a surplus of eagles.

C. Cost of Rehabilitation of Eagles

Exxon reports it spent 1.5 million dollars in 1989 (Mastracchio, technical manager, Exxon, *MacWeek*, 11/21) or 100,000 dollars per eagle (*New York Times*, 9/19/89) to save eagles. I will not pursue this avenue for estimating the value of dead eagles for the reasons presented above.¹⁵ Finally, there probably aren't 200 - 500 eagles available for rehabilitation so other means of replacement would have to be found.

VI. SEABIRDS, SHOREBIRDS AND FALCONS

A variety of seabirds were killed by the oil spill. The list of birds lost is reproduced in Table 2. A reasonable and comparatively easy way to estimate the value of seabirds is to use replacement cost but there is an important reason why replacement cost is inadequate for seabirds-- their homing instinct, discussed below.

¹⁵ Parenthetically, an eagle at the Wildlife Center of Virginia was rehabilitated for a cost of 3,000 - 5,000 dollars in orthopedic expenses (personal communication).

Several firms act as wildlife brokers and supply specific types of birds for a fee. When a bird is requested, the firms locate a source of supply. The birds are captured or procured from a private breeder, another institution or rearing facility, transported to and cared for at intermediary locations and then shipped to their final destination. In some cases, an aquarium has a surplus of some kinds of birds. Values quoted to the Sterling Hobe Corporation represent the two lowest values obtained when they contacted a sample of aquariums.¹⁶ Table 2 exhibits four sets of estimated costs. Estimates from Brian Hunt, International Animal Exchange, in the table assume that a substantial number of birds have been collected, say 100. If only one or two birds were to be replaced, estimates from International Animal Exchange would be higher. Hunt estimates that it costs about 20,000 dollars to initiate a capture and relocation activity in which a permit for collection is required, as it typically is for seabirds and shorebirds obtained in the wild. Administration and regulations require essentially the same surveys, documentation, medical treatment and surveillance whether there are one or many birds involved. This method of replacement is feasible, but would not normally be undertaken for one or two birds because usually there is no market for representative birds at this cost.

There are two disadvantages of using a cost which merely reflects the expenses of moving birds from one place to another. Seabirds migrate, generally returning to the region from which they departed. If one thousand juvenile or adult guillemots and murrelets were collected from one region and transported to Prince William Sound, migrated and returned to their original habitat, not to Prince William Sound, these birds are not equivalent to those killed. They would not home to the area in question. In principle, the birds replaced should have a similar age distribution, have the same expected life and reproduction capabilities and the same migratory pattern.

The second drawback to using an estimate of the cost of mere relocation is that one or more public agencies would have to give permits to remove tens of thousands of birds from a region

¹⁶ Alternatively, birds can be captured and their offspring can be held until the new environment is imprinted on them, then released.

designated to have surplus populations and permit shipment of these nestlings or birds to the Prince William Sound area. Permits for removing small numbers of seabirds generally are available for non-endangered species for scientific and educational purposes.¹⁷ Whether such permits would be available for a broad relocation program is unknown. Too little is known about seabird populations to definitively determine in a short period where there is an excess population of particular seabirds.

The best estimate is the average of the estimates, excluding Sterling Hobe Corporation's values for reasons just given. One exception is gulls where it seemed prudent to exclude the largest values. Table 2 summarizes the estimated losses for the birds in question. The best estimate of value for a seabird or a shorebird or a falcon varies from 167 dollars for a gull to 6,000 dollars for a peregrine falcon.

¹⁷ M. Fry, personal communication.

TABLE 1
MARINE MAMMALS
(1989 Dollars)

	Range of Values Per Unit	Best Estimate (Value per Unit)*
Sea Otters	1,500 - 50,000	20,000 (11,500)
Killer Whales	50,000 - 1,000,000	300,000 (50,000)
Stellar Sea Lions	4,000 - 10,000	20,000 (5,000)
Harbor Seals	500 - 1200	700
Humpback Whales	100,000	100,000

* The figure in the parentheses applies when many mammals are killed. See text.

TERRESTRIAL MAMMALS
(1989 Dollars)

	Value Per Unit	Best Estimate
Deer (White-Tailed)	125-250 (700 young)	125-250
Brown Bears	300 - 500	300-500
Black Bears	150 - 300	150-300
River Otters	81 - 700 (1,500 female)	390
Mink	300 - 400	300-400

TABLE 2
REPLACEMENT VALUES FOR SEABIRDS AND EAGLES
(1989 Dollars)

	Tinney (1990)	International Zoological Distributors*	International Animal Exchange*	Sterling Hobe Corp.**	Best Estimate
Murres	222	300	200-400	114-225	274
Seaducks		300	200-400		300
Cormorants	331	300	200-400	70	310
Procellariids			200-400		300
Gulls	167	600-700			167
Marbelled Murrelets	222		200-400	350	261
Guillemots	222	500	200-400	282	341
Grebes			200-400	184	300
Loons		500	200-400	184	400
Puffins	223	300	400		308
Peregrine Falcons		2000(M) 6000(F)		2,000-6,000	
Blacklegged Kittiwakes			200-400		300
Storm Petrels			200-400		300
Eagles					22,000

* International Zoo Distributors, M. Jean Bureau; and International Animal Exchange, Mr. Brian Hunt, personal communication.

** Sterling Hobe Corporation, 1985. Damages to the Point Reyes--Farallon Islands National Marine Sanctuary resulting from the T/V Puerto Rican incident. Preliminary research tasks for U.S. Department of Commerce, NOAA, Washington, D.C.

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