Appendix A: Federally Listed/Proposed Threatened and Endangered Species (Candidates Included)

Del Norte County

June 18, 2007
Document number: 902943973-11144

TYPE		SCIENTIFIC NAME	COMMON NAME	CATEGORY	CRITICAL HABITAT
Plants					
		Arabis macdonaldiana	McDonald's rock-cress	E	N
		Lilium occidentale	western lily	E	N
Invertebrates					
		Polites mardon	mardon skipper	C	N
		Speyeria zerene hippolyta	Oregon silverspot butterfly	T	Y
Fish					
		Eucyclogobius newberryi	tidewater goby	E	P
	*	*Oncorhynchus kisutch*	S. OR/N. CA coho salmon	T	Y
	*	*Oncorhynchus tshawytscha*	CA coastal chinook salmon	T	Y
Reptiles					
	*	*Caretta caretta*	loggerhead turtle	T	N
	*	*Chelonia mydas (incl. agassizi)*	green turtle	T	N
	*	*Dermochelys coriacea*	leatherback turtle	E	Y
	*	*Lepidochelys olivacea*	olive (=Pacific) ridley sea turtle	T	N
Birds					
		Brachyramphus marmoratus	marbled murrelet	T	P
		Charadrius alexandrinus nivosus	western snowy plover	T	P
		Coccyzus americanus	Western yellow-billed cuckoo	C	N
		Haliaeetus leucocephalus	bald eagle	T	N
		Pelecanus occidentalis	brown pelican	E	N
		Phoebastris albatrus	short-tailed albatross	E	N
		Strix occidentalis caurina	northern spotted owl	T	Y
Mammals					
	*	*Balaenoptera borealis*	sei whale	E	N
	*	*Balaenoptera musculus*	blue whale	E	N
	*	*Balaenoptera physalus*	fin whale	E	N
	*	*Eumetopias jubatus*	Steller (=northern) sea-lion	T	Y
		Martes pennanti pacifica	Pacific fisher	C	N
	*	*Megaptera novaengliae*	humpback whale	E	N
	*	*Physeter macrocephalus*	sperm whale	E	N

Humboldt County

June 18, 2007
Document number: 902943973-1114

TYPE		SCIENTIFIC NAME	COMMON NAME	CATEGORY	CRITICAL HABITAT
Plants					
		Erysimum menziesii	Menzies' wallflower	E	N
		Layia carnosa	beach layia	E	N
		Lilium occidentale	western lily	E	N
		Thlaspi californicum	Kneeland Prairie penny-cress	E	Y
Fish					
		Eucyclogobius newberryi	tidewater goby	E	P
	*	*Oncorhynchus kisutch*	S. OR/N. CA coho salmon	T	Y
	*	*Oncorhynchus mykiss*	Northern California steelhead	T	Y
	*	*Oncorhynchus tshawytscha*	CA coastal chinook salmon	T	Y
Reptiles					
	*	*Caretta caretta*	loggerhead turtle	T	N
	*	*Chelonia mydas (incl. agassizi)*	green turtle	T	N
	*	*Dermochelys coriacea*	leatherback turtle	E	Y
	*	*Lepidochelys olivacea*	olive (=Pacific) ridley sea turtle	T	N
Birds					
		Brachyramphus marmoratus	marbled murrelet	T	P
		Charadrius alexandrinus nivosus	western snowy plover	T	P
		Coccyzus americanus	Western yellow-billed cuckoo	C	N
		Haliaeetus leucocephalus	bald eagle	T	N
		Pelecanus occidentalis	brown pelican	E	N
		Phoebastris albatrus	short-tailed albatross	E	N
		Strix occidentalis caurina	northern spotted owl	T	Y
Mammals					
	*	*Balaenoptera borealis*	sei whale	E	N
	*	*Balaenoptera musculus*	blue whale	E	N
	*	*Balaenoptera physalus*	fin whale	E	N
	*	*Eumetopias jubatus*	Steller (=northern) sea-lion	T	Y
		Martes pennanti pacifica	Pacific fisher	C	N
	*	*Megaptera novaengliae*	humpback whale	E	N
	*	*Physeter macrocephalus*	sperm whale	E	N

KEY:
(PE) Proposed Endangered Proposed in the Federal Register as being in danger of extinction
(PT) Proposed Threatened Proposed as likely to become endangered within the foreseeable future
(E) Endangered Listed in the Federal Register as being in danger of extinction
(T) Threatened Listed as likely to become endangered within the foreseeable future
(C) Candidate Candidate which may become a proposed species Habitat Y = Designated, P = Proposed, N = None Designated
* Denotes a species Listed by the National Marine Fisheries Service

Appendix B: Bird Mortality Estimation

1.0. Summary

The Trustees' estimates of total bird mortality for each species are based upon reports by Ford (for all species except pelicans) and Jacques (for pelicans only). This appendix describes the Trustees' modifications to the estimates in those reports.

1.1. The Ford Report

The Ford report provides mortality estimates using several different methods, primarily based on the Maximum Instantaneous Oiling Rate and the Beached Bird Model. Because the oiled area of the ocean was relatively near-shore (i.e., within a few miles of shore) and search effort was fairly comprehensive on most beaches, the Beached Bird Model provides a reliable estimate for all species except pelicans and shorebirds. Ford specifically addresses shorebird mortality and provides a mortality estimate based upon surveys of oiled and unoiled live birds in the days after the spill. The Trustees have relied upon those results presented in Ford, with two modifications. First, the Trustees have removed 33 birds from the dataset, determining them to be non-spill-related. Second, the Trustees have incorporated likely mortality suffered by rehabilitated and released birds. The number of rehabilitated and released birds is presented in the Ford report, but no estimate of their fate is provided.

1.1.1. Additional Non-Spill-Related Birds

Of the 961 birds collected, the Trustees initially removed 10 birds from the data that were subsequently used by Ford in his analysis. Nine of these birds had suffered gunshot wounds or broken wings, possibly due to gunshot or collision with an object. All nine were not visibly oiled. The tenth bird appeared oiled (an American Coot collected within Humboldt Bay), but was identified at intake as having been oiled by a "lighter oil". After the completion of Ford's report, the Trustees determined that 23 additional birds should be removed. These 23 birds include one bird previously identified as a Marbled Murrelet, but later determined to be an unoiled Common Murre chick that, based on age at death, pre-dated the spill. The other 22 birds were all non-visibly oiled, unscavenged, and in an advanced state of decomposition. Thus, the Trustees have adjusted Ford's results accordingly, using the average Beached Bird Model mortality multiplier for the appropriate species group. For example, Ford's Beached Bird Model estimated that 343 waterfowl were killed, extrapolated from 230 that were collected (and initially determined to be spill-related). This implies a multiplier of 1.5. The Trustees have determined that 6 of the waterfowl originally identified as injured by the Kure oil spill were most likely not related to the spill, and thus have removed 9 (1.5 x 6 = 9) from the mortality estimate. This adjustment methodology was used for all of the species groups other than the Marbled Murrelet. For the Marbled Murrelet injury, the Beached Bird model was re-run by Ford after deducting the initially misidentified single bird.

1.1.2. Fate of Rehabilitated Birds

Additionally, the Trustees have evaluated the fate of rehabilitated and released birds. During the response, 386 birds were rehabilitated and released, including 147 Common Murres and 90 scoters. Although there is uncertainty associated with the fate of such birds, several studies have suggested that post-rehabilitation survival is extremely low (e.g., less than 10%), especially for alcids such as Common Murres (Sharp 1996). After the *Stuyvesant* oil spill in Humboldt County in 1999, the Oiled Wildlife Care Network conducted a telemetry study of Common Murres associated with the oil spill. Based on this study (Newman *et al*. 2004), the Trustees assumed that 75% of the rehabilitated birds died (n = 290), while 25% survived to join (or re-join) the breeding population.

1.2. The Jacques Report

The Jacques report examines impacts to Brown Pelicans as a result of the spill. It does not directly estimate total pelican mortality. Based upon surveys of pelican roost sites, the report conservatively estimates that 77 pelicans were oiled by the spill (61 were lightly oiled, 16 were moderately or heavily oiled). These birds may or may not have been collected by response teams, which collected five pelicans (two live and three dead). Of these five, one collected dead (unoiled) was determined to be non-spill related and one collected live was rehabilitated and released. Of the two oiled pelicans collected dead, one was heavily oiled and one was lightly oiled.

The Trustees have estimated total mortality for Brown Pelicans by summing the following: 1) all 16 pelicans that were moderately or heavily oiled; 2) 25% of the 61 pelicans (n=15) that were lightly oiled. Because only one pelican was rehabilitated and released, and the Trustees have assumed that 25% of released birds survive, no additional adjustment is made for the one bird. Note that Anderson et al. (1996) estimated low survival rates for oiled and rehabilitated pelicans. In conclusion, the total number of pelicans estimated killed is 31.

1.3. Final Results

The table below summarizes the results of Ford's estimates, the Trustees' two modifications to the Beached Bird Model results, and the Trustees' final mortality estimates.

Table B–1: Acute Mortality Estimates for the M/V Kure Spill by Species Grouping

Species Group	Ford: Maximum Instantaneous Oiling Rate Estimated Dead	Ford: Beached Bird Model Estimated Dead	Correction for non-spill-related birds	# of rehabbed birds estimated died	FINAL TRUSTEE ESTIMATE
Loons	508	61	0	14	**75**
Grebes	1097	136	0	32	**168**
Pelicans	Not estimated by Ford.			1	**31**
Cormorants	124	33	2	4	**35**
Gulls	1189	154	12	12	**154**
Murres, alcids	1809	611	2	110	**719**
Procellarids	8	196	10	5	**191**
Marbled Murrelets	36	151	21	NA	**130**
Shorebirds	5220*	286	0	33	**2033**
Waterfowl	5946	343	9	80	**414**
				TOTAL:	**3950**

*Ford compares the results of the two approaches and provides a conservative estimate of 2,000 dead shorebirds. The Trustees have relied upon this estimate, plus 33 additional birds that were rehabilitated and released.

Appendix C: Resource Equivalency Analysis (REA) Method

1.0. Background

There are two basic approaches to measuring the compensation for natural resources injuries. The "consumer valuation approach" focuses on the demand side; the "replacement cost" approach focuses on the supply side. In the former, we seek to measure the monetary value that the public puts on the natural resources (i.e., how much the public demands the services of natural resources); in the latter, we seek to measure how much it costs to replace the natural resource services that the public loses as a result of the injury (i.e., how much it costs to supply natural resource services). See the Glossary for complete definitions of some of the terms used here.

FIGURE C-1: Consumer Valuation versus Replacement Cost Approaches for Natural Resource Damage Calculation

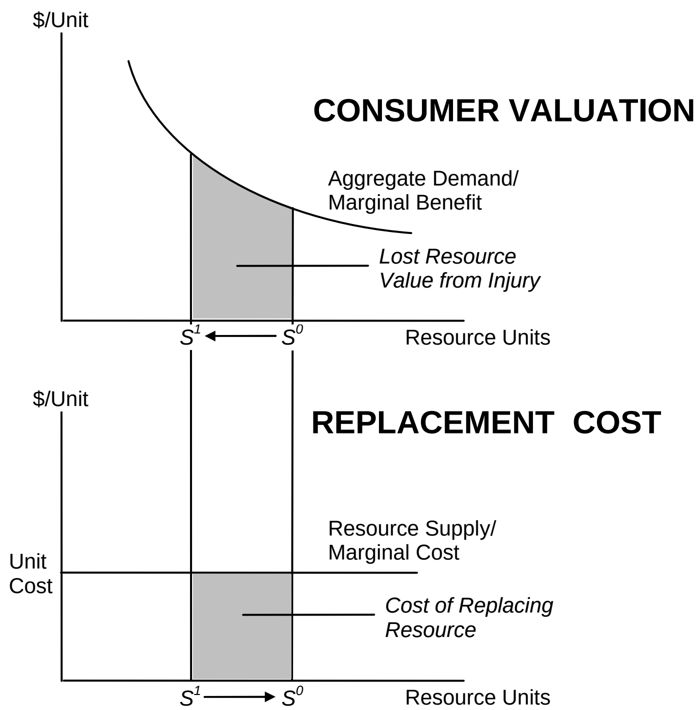


Figure C-1 illustrates the difference between these two approaches. In both graphs, the supply of natural resources shifts from S^0 to S^1 as a result of an incident (e.g., oil spill, sediment discharge into a stream, illegal removal of vegetation). The shaded area in the top graph illustrates the dollar value of the resource loss as measured by the monetary payment that would make the public indifferent to the incident. For example, if each individual in a 30 million person society would need a $0.05 payment (on average) to make them indifferent to the resource loss, the shaded area in the top graph would equal $1.5 million. Because the difficulty in observing market prices that reveal the level of cash payment that would compensate individuals for resource losses, the quantitative characteristics of the demand curve(s), and consequently the size of the shaded area in the upper graph, are difficult to measure. Contingent Valuation (CV) and other types of analyses are designed to estimate this dollar value. These methodologies typically involve large surveys and can be costly.

The lower graph illustrates a replacement cost approach. Beyond noting that the injured resource has value, the actual extent to which the public values it is not directly considered. Instead, the determination of adequate compensation depends on the level of natural resource provision (versus monetary payments) that compensates society for what it has lost as a result of the incident. The cost of providing this compensation becomes the estimate of damages. Resource Equivalency Analysis (REA) is the primary methodology for conducting this type of measurement in natural resource damage assessment. It is depicted by a resource supply shift in the lower graph from S^1 back to S^0. The shaded area is the total monetary cost of funding the supply shift. For example, if 2 acres of wetland enhancement are estimated to compensate for an incident that temporarily reduced the service value of 1 acre of wetland habitat, the cost of performing 2 acres of wetland enhancement becomes the estimate of damages.

It is clear from Figure 1 that the public's valuation of the resource (the shaded area in the top graph) is not necessarily equal to the total replacement cost (the shaded area in the bottom graph). This is especially true when unique resources or rare species are involved, as the slope of the aggregate demand curve (top figure) may be much steeper due to resource scarcity. This would result in a much larger monetary payment being necessary to compensate the public. In such a case, the replacement cost approach of REA may result in damages far less than the losses as valued by the public. However, because it is easier and less costly to measure the total replacement cost than the total public value, REA has an advantage over other methods, especially for small to medium-sized incidents with minimal impact on rare species.

1.1 Resource Equivalency Analysis

In this assessment, REA has been used to determine compensatory damages. This method is relatively inexpensive and relies primarily on biological information collected in the course of determining natural resource injuries caused by the spill. It is consistent with approaches recommended in the language of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and the Oil Pollution Act of 1990 (OPA).

REA involves determining the amount of "natural resource services" that the affected resource would have provided had it not been injured, and it equates the quantity of lost services with those created by proposed compensatory restoration projects that would provide similar services. The unit of measure may be acre-years, stream feet-years, or some other metric. The size of the restoration project is scaled to the injury first; the cost of restoration is then calculated after the scaling has been done. The cost of restoring a comparable amount of resources to those lost or injured is the basis for the compensatory damages. In this sense, REA calculates the *replacement cost* of the lost years of natural resource services.

Future years are discounted at 3% per year, consistent with National Oceanic and Atmospheric Administration recommendations for natural resource damage assessments. Discounting of future years is done based on the assumption that present services are more valuable than future services. When it comes to natural resources, the question of whether or not society should value the present more than future is a philosophical question (e.g., one can recall the "greenhouse effect" and the question of how much expense we should incur today to preserve the future).

However, the question of how much society actually discounts the value of future natural resources is an empirical one. The 3% figure is currently the standard accepted discount rate for natural resource damage assessments.

REA involves three steps: 1) the debit calculation, 2) the credit calculation, 3) the computation of the costs of restoration. These calculations may be done in a variety of ways, but the most common are to estimate the injury and the restoration benefits in terms of area years of habitat or animal years.

1.1.1. Habitat Example

For example, suppose a 10-acre area is degraded due to an oil spill such that it supplies only 30% of its previous habitat services during the year following the incident. In the second year after the incident, the habitat begins to recover, supplying 90% of its baseline services. By the third year it is fully recovered. In this case, the lost acre years of habitat services would be 70% x 10 acres x 1 year + 10% x 10 acres x 1 year = 8 acre years of habitat services. Figure 2 illustrates this example by showing the recovery path of the habitat over time.

As stated above, future years are discounted at a 3% rate, thus the injuries in the second year count a little less. Incorporating this, 7.97 acre years of habitat services were lost. This difference appears minimal here, but becomes significant (due to compounding) if injuries persist many years into the future.

The credit calculation focuses on the gain in habitat services that result from a restoration project. Creating acre years of habitat services is a function of both area and time. Hypothetically, compensation could involve taking 7.97 acres of land with no habitat value (e.g., a parking lot) and turning it into productive habitat for 1 year. Alternatively, we could achieve compensation by creating 1 acre for 7.97 years. In reality, most restoration projects involve taking previously degraded habitat (at another nearby location) and restoring it over a number of years, and maintaining it into the future.

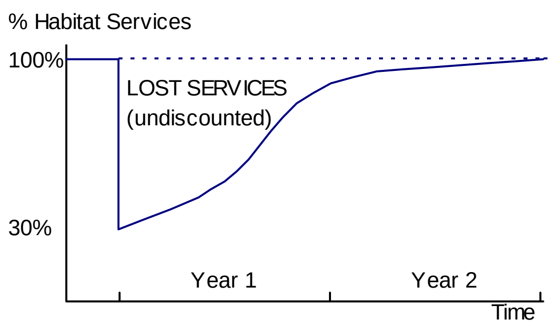


FIGURE 2: Biological Injury and Recovery

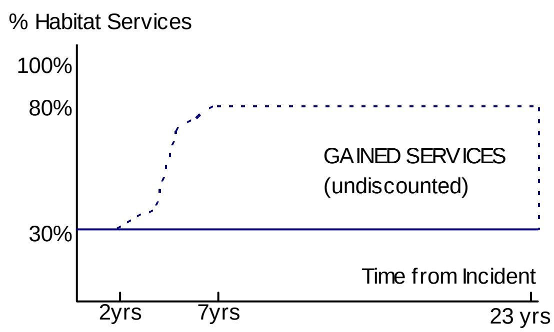


FIGURE 3: Restoration Trajectory/Credit

Suppose the restoration project improves the quality of a nearby degraded area, so that, if it previously provided only 30% of potential services, it would provide 80% of potential habitat services after restoration. Also suppose the project begins two years after the incident and it takes an additional 5 years for the 80% level to be achieved. Figure 3 provides an illustration of this restoration trajectory. In our hypothetical example, the project is expected to have a lifespan of 20 years. Note that, with future years discounted, the 20th year of the project (22–23 years after the incident) counts little; years after that are effectively completely discounted due to uncertainty regarding the future.

Mathematically, we seek to restore an area that will provide 7.97 acre years of services over the discounted 20-year phased-in life span of the restoration project. In this example, that would be an area of about 1.3 acres. That is to say, restoration of 1.3 acres for 20 years would compensate the public for the 7.97 lost acre years of habitat services due to the spill. Visually, the area identified in Figure 2 (multiplied by the affected acres and calculated to measure the present discounted value) should equal the area identified in Figure 3 (again, multiplied by the acres targeted for restoration and calculated to measure the present discounted value, thus discounting future years).

The percentage of habitat services lost (or gained, in the case of the restoration project) may be measured in a variety of ways. For our hypothetical oil spill case, three examples might include (1) the use of a habitat-wide evaluation index, (2) the use of one or more surrogate species, or (3) the use of an estimate based on the degree of oiling. Care must be taken when using a surrogate species to represent the entire affected habitat. Ideally, this surrogate is the population of one or more species that is immobile (that is, the animals do not move easily in and out of the affected area) and that has significant forward and/or backward ecological links to other species in the affected ecosystem. For example, the population of red crossbills, a bird that feeds primarily on pine cone seeds and migrates erratically from year to year, would be a poor surrogate for measuring injuries to a streambed. The aquatic macroinvertebrate community within the stream, however, provides an ideal surrogate, as they play a key role in the streambed food chain.

Likewise, on the restoration side, care must be taken when the project targets one or a few species rather than the entire habitat. Ideally, a project that seeks to restore the population of a key indicator species will also benefit the entire habitat and, thus, other species as well. Indeed, such projects typically focus directly on habitat improvements. However, it is important to verify that such a species-centered project is indeed benefiting the entire habitat.

1.1.2. Animal Example

When the injury is primarily to individual animals rather than a complete habitat, the REA may focus on lost animal-years. For example, suppose an oil spill causes negligible injury to a body of water, but results in the death of 100 ducks. Using information about the life history of the ducks (e.g., annual survival rate, average life expectancy, average fledging rate, etc.), we can estimate the “lost duck years” due to the spill. On the credit side, we can examine restoration projects designed to create duck nesting habitat and scale the size of the project such that it creates as many duck years as were lost in the incident.

1.1.3. Restoration Costs = Natural Resource Damages

Once the proposed restoration projects are scaled such that they will provide services equal to those lost due to the incident, the cost of the projects can be calculated. Note that this is the first time dollar figures enter the REA process. Until now, all the calculations of the “equivalency” have been in terms of years of resource services. The cost of the restoration projects is the compensatory damage of the incident.

For another explanation of the REA methodology (in its more specific form for habitats), see "Habitat Equivalency Analysis: An Overview", prepared by NOAA. Copies of this document are available at http://www.darrp.noaa.gov/library/pdf/heaoverv.pdf .

1.4. Glossary of Terms

Aggregate demand

the demand of all consumers combined; e.g., if there are 20,000 people in a town and each person demands two pieces of bread each day, the aggregate demand is 40,000 pieces of bread per day.

Compensatory restoration

a restoration project which seeks to compensate the public for temporal or permanent injuries to natural resources; e.g., if a marsh is injured by an oil spill and recovers slowly over ten years, a compensatory project (which may be off site) seeks to compensate the public for the ten years of diminished natural resources.

Discount rate

the rate at which the future is discounted, i.e., the rate at which the future does not count as much as the present; e.g., a dollar a year from now is worth less than a dollar today; if the bank offers a 3% rate, whereby $1.00 becomes $1.03 in one year, the future was discounted at 3%.

Primary restoration

a restoration project which seeks to help an injured area recover more quickly from an injury; e.g., if a marsh is injured by an oil spill and would recover slowly over ten years if left alone, a primary restoration project might seek to speed the recovery time of the marsh and achieve full recovery after five years.

Replacement cost

the cost of replacing that which was lost; e.g., if fifty acre-years of habitat services were lost due to an oil spill, the cost of creating fifty acre-years of similar habitat services would be the replacement cost.

Appendix D: Demographic Parameters and Bird-Year Loss Calculations for Non-Marbled Murrelet Species

D.0. Summary

This appendix outlines the bird-year loss calculations used to assess temporal implications of acute bird mortality from the M/V Kure spill. It briefly (1) outlines how lost bird-years were calculated for selected species, (2) describes the demographic parameter inputs used in these calculations, and (3) presents the resulting multipliers used to translate bird mortality to “bird-year” loss.

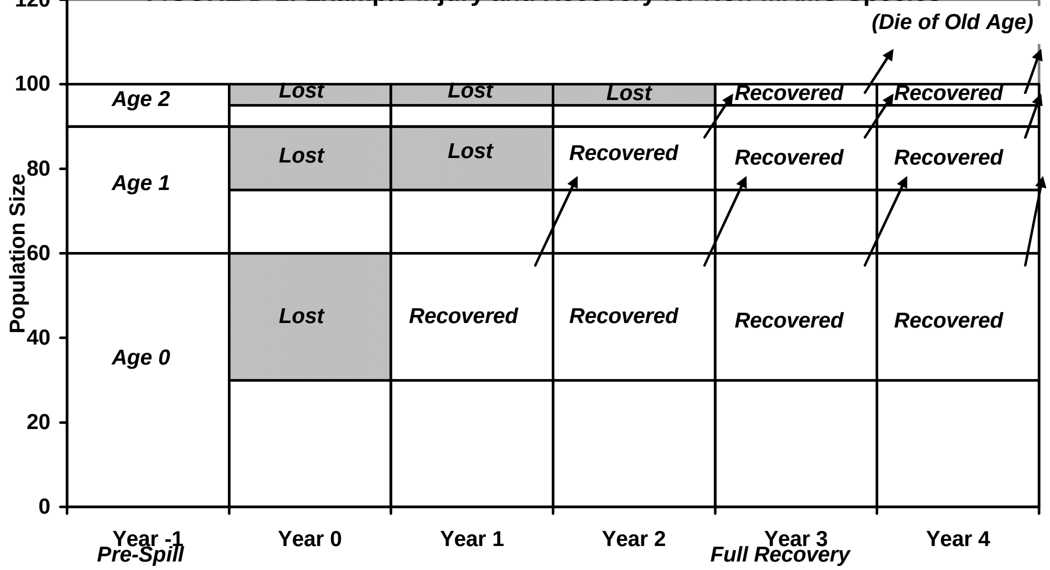
D.1. Methodology

The trustee assessment of bird-year loss follows roughly the same approach as used by Sperduto *et al*. (1999, 2003) for calculating “direct loss” for birds with “extended” recovery times. We conceptualize temporal injuries as the expected difference between injured and baseline population trajectories over time (i.e., population sizes *with* and *without* the spill). Calculations are based upon the following assumptions:

> ***Assumption 1:*** Acute spill mortality is distributed proportionately across the various age classes of the injured population.
>
> ***Assumption 2:*** Rates of juvenile and adult survivorship are constant before and after the spill.
>
> ***Assumption 3:*** The pre-spill and fully recovered populations are roughly constant in size and stable in age-distribution, as determined by demographic characteristics of the species (specifically survivorship and fecundity).
>
> ***Assumption 4:*** There is a maximum age beyond which no birds live.
>
> ***Assumption 5:*** Surviving adult birds match the total reproductive output that the surviving and impacted birds would have had in the breeding seasons after the spill had the spill not occurred (e.g., potentially because of non-breeding “floaters” in the area, reduced competition for high quality nesting sites, decreased competition for foraging around the breeding area).

Figure 1 provides an example of how these assumptions combine to describe biological recovery in a hypothetical population with three one-year age classes. Year -1 depicts the population’s pre-spill conditions. Year 0 shows population numbers prior to the first full year after the spill. The shaded area is the number of each age class killed, which is distributed proportionately between age classes (Assumption 1). The arrows describe how the recovered birds advance through each age class.

FIGURE D-1: Example Injury and Recovery for Non-MAMU Species



In the Year 1, the number of fledglings replaces the losses to the first age class (Assumption 5). The age classes from Year 0 all face annual mortality, with complete mortality for the third age class. This process continues in Year 2, with the recovered Age 0 juveniles from Year 1 facing mortality and growing one year older to reach Age 1. In Year 3, there is full recovery. These calculations do not include impacts to future generations of birds (i.e., "indirect loss" as considered by Sperduto *et al*. 1999, 2003).

We can formalize Assumptions 1–6 to write injury (*I*), measured in birds from year *t*, as:

$$I_t = N_M \sum_{i=t}^{k} p_i^* \quad \forall \quad i \le k \tag{1}$$

where N_M is the estimate of acute mortality for the given specie, *k* is the maximum age beyond which no birds live (from Assumption 4), and p_i^* is the proportion of the population that falls in age class *i* at a stable age distribution. The youngest age class is denoted Age 0, to reflect that they have yet to live a full year.

The total debit (*D*) for a given bird specie (in discounted bird-years) is therefore:

$$D = \sum_{j=0}^{k} \left[\frac{N_M}{(1+d)^{j+1}} \sum_{i=j}^{k} p_i^* \right] \tag{2}$$

where *d* is the discount rate. N_M, *k*, and p_i^* are defined above. This is simply the sum of each year's injury from Equation (1) discounted at rate *d*. For the purpose of our calculations we use *d*=0.03, consistent with common practice in natural resource damage assessments (e.g., see Julius 1999).

D.2. Demographic Parameters used in Injury Calculations

Table D-1 presents a list of selected species that suffered mortality from the M/V Kure spill. Because of the large number of species injured (over 52 species total for the spill), the trustees grouped the species into categories, and then chose a single proxy species for each group. Species were lumped together based upon a consideration of (1) life history characteristics; (2) the ability of species to benefit from similar restoration projects; and (3) acute mortality estimates. This section describes the demographic information used for each injury category.

D.2.1. Small Grebes (North Cape Grebe)

The North Cape REA (Spertudo *et al*. 1999) calculates injury to grebes by averaging demographic estimates for a variety of grebe species. The following set of roughly stationary demographic parameters is based upon their analysis:

- *Age of First Breeding: 2* Years Old
- *Female Offspring per Adult Female (Annual):* 0.91
- *Survivorship (From fledge to one year of age):* 60%
- *Annual Survivorship (Age 1+):* 64.7%
- *Maximum Age:* 24 Years Old

The only difference between these parameters and those used by Sperduto *et al*. (1999) is that annual survivorship beyond the first year has been increased 2.7%. This calibrates the life history to a population that maintains an approximately constant population size.

TABLE D-1: Proxy Species for Bird Injury Calculations

Bird Category	Species Suffering Mortality from Kure Spill	Potential Source of Demographic Parameters
Small Grebes	Horned Grebe Eared Grebe	*North Cape* Grebe
Large Grebes	Western Grebe Clark's Grebe Red-necked Grebe Unknown Grebe	Western Grebe
Loons	Common Loon Pacific Loon Red-throated Loon	*North Cape* Loon
Non-Marbled Murrelet Alcids	Common Murre Cassin's Auklet	Common Murre
Gulls	Western Gull California Gull Heerman's Gull Glaucous-winged Gull Ring-billed Gull Mew Gull Unknown Gull	Western Gull

TABLE D-1 (Continued): Proxy Species for Bird Injury Calculations

Bird Category	Species Suffering Mortality from Kure Spill	Potential Source of Demographic Parameters
Procellarids	Northern Fulmar	Northern Fulmar
Cormorants	Pelagic Cormorant Double-crested Cormorant Brandt's Cormorant	Double-crested Cormorant
Pelicans	Brown Pelican	Brown Pelican
Waterfowl	White-winged Scoter Surf Scoter American Coot Greater Scaup Green-winged Teal American Widgeon Lesser Scaup Northern Shoveler Brant Bufflehead Northern Pintail Ruddy Duck Black Scoter Gadwall Red-breasted Merganser Tundra Swan Unknown Duck Unknown Scoter	*North Cape* Scoter
Shorebirds	Dunlin Virginia Rail Black Turnstone Least Sandpiper Long-billed Dowitcher Marbled Godwit Sanderling Western Sandpiper Willet	Dunlin

D.2.2. Large Grebes (Western Grebe)

Large grebe demographic parameters are modifications of those used for the small grebe (D.2.1. above) that account for information collected on Western Grebes at Clear Lake, California.

- *Age of First Breeding: 2* Years Old
- *Female Offspring per Adult Female (Annual):* 0.6
- *Survivorship (From fledge to one year of age):* 60%
- *Annual Survivorship (Age 1+):* 0.7355
- *Maximum Age:* 24 Years Old

This juvenile survivorship, age of first breeding, and maximum age is from Sperduto *et al*. (2002). The estimate of female offspring per female is from observations of Western Grebes during "non-disturbance years" at Clear Lake, California (Dan Anderson, personal communication). The adult survivorship parameter was chosen so that the combination of parameters was consistent with a population that was maintaining an approximately constant population size over time.

D.2.3. Loons (General Loon)

The North Cape REA (Spertudo *et al*. 1999) calculates injuries to loons based upon Common Loon demographics. The following set of roughly stationary demographic parameters is based upon their analysis:

- *Age of First Breeding:* 5 Years Old
- *Female Offspring per Female (Annual):* 0.27
- *Survivorship (From fledge to one year of age):* 76%
- *Survivorship (Age 1+):* 88.5%
- *Maximum Age:* 24 Years Old

The only difference between these parameters and those used by Sperduto *et al*. (1999) is that annual survivorship beyond the first year has been increased 0.5%. As with the grebe calibration, this adjusts the implied loon life history to maintain an approximately constant population size.

D.2.4. Non-Marbled Murrelet Alcids (Common Murre)

Nur *et al*. (1994) created a Common Murre demographic model for the Farallon Islands. The following parameters are based upon their work, but have been calibrated to imply a roughly constant population size:

- *Age of First Breeding:* 5 Years Old
- *Female Offspring per Female (Age 5):* 0.126
- *Female Offspring per Female (Age 6):* 0.310
- *Female Offspring per Female (Age 7):* 0.405
- *Female Offspring per Female (Age 8+):* 0.420
- *Survivorship (From fledge to one year of age):* 40%
- *Annual Survivorship (Age 1–2):* 80%
- *Annual Survivorship (Age 2–3):* 87%
- *Annual Survivorship (Age 3+):* 91.6%
- *Maximum Age:* 36 Years

The difference between these parameters and those used by Nur *et al*. (1994) is that annual survivorship beyond the first year has been decreased 1.7%.

D.2.5. Gulls (Western Gull)

Nur *et al*. (1994) created a population model for Western Gull at the Farallon Islands. The following parameters draw from their analysis:

- *Age of First Breeding:* 3 Years Old
- *Male Offspring per Male (Age 3):* 0.012
- *Male Offspring per Male (Age 4):* 0.152
- *Male Offspring per Male (Age 5):* 0.454
- *Male Offspring per Male (Age 6):* 0.660
- *Male Offspring per Male (Age 7):* 0.695

- *Male Offspring per Male (Age 8):* 0.765
- *Male Offspring per Male (Age 9):* 0.785
- *Male Offspring per Male (Age 10):* 0.750
- *Male Offspring per Male (Age 11):* 0.710
- *Male Offspring per Male (Age 12 and 13):* 0.725
- *Male Offspring per Male (Age 14):* 0.705
- *Male Offspring per Male (Age 15):* 0.660
- *Male Offspring per Male (Age 16+):* 0.610
- *Survivorship (From fledge to one year of age):* 60%
- *Annual Survivorship (Age 1–2):* 75%
- *Annual Survivorship (Age 2–3):* 82%
- *Annual Survivorship (Age 3–4 to 6-7):* 84%
- *Annual Survivorship (Age 7–8 and 8–9):* 83%
- *Annual Survivorship (Age 9–10 and 10–11):* 82%
- *Annual Survivorship (Age 11–12):* 81%
- *Annual Survivorship (Age 12–13 to 14–15):* 80%
- *Annual Survivorship (Age 15–16 and 16–17):* 78%
- *Annual Survivorship (Age 17–18):* 75%
- *Annual Survivorship (Age 18–19):* 67%
- *Annual Survivorship (Age 19–20):* 57%
- *Annual Survivorship (Age 20–21):* 50%
- *Maximum Age:* 22 Years Old

The Nur *et al*. (1994) model tracks males in the population (assuming a 1:1 sex ratio).[1] The difference between the above parameters and those used by Nur *et al*. (1994) is that the survivorship from fledge to one year of age has been increased 4.5% to calibrate the model to approximate stationarity. This 60% survivorship from fledge to Age 1 is still within the range considered by Nur *et al*. (1994).

D.2.6. Procellarids (Northern Fulmar)

The following northern fulmar demographic parameters have been calibrated to imply a roughly constant population size:

- *Age of First Breeding:* 5 Years Old
- *Female Offspring per Female (Age 5):* 0.013
- *Female Offspring per Female (Age 6):* 0.026
- *Female Offspring per Female (Age 7):* 0.039
- *Female Offspring per Female (Age 8):* 0.053
- *Female Offspring per Female (Age 9):* 0.066
- *Female Offspring per Female (Age 10):* 0.079
- *Female Offspring per Female (Age 11):* 0.092
- *Female Offspring per Female (Age 12):* 0.105
- *Female Offspring per Female (Age 13):* 0.118

[1] Male Western Gulls are perceived to be the limiting factor in western gull population growth (Nur *et al*. 1994, Pierotti and Annet 1995). During the 1970s, some Western Gull populations displayed male-female sex ratios close to 2:3, presumably due to the feminization of male embryos from DDT (Pierotti and Annet 1995). Since that time sex ratios have returned to "near equity" (Pierotti and Annet 1995).

- *Female Offspring per Female (Age 14):* 0.131
- *Female Offspring per Female (Age 15):* 0.144
- *Female Offspring per Female (Age 16):* 0.158
- *Female Offspring per Female (Age 17):* 0.171
- *Female Offspring per Female (Age 18):* 0.184
- *Female Offspring per Female (Age 19):* 0.197
- *Female Offspring per Female (Age 20+):* 0.21
- *Annual Survivorship (Age 69–70):* 6.9%
- *Annual Survivorship (Age 68–69):* 16.9%
- *Annual Survivorship (Age 67–68):* 26.9%
- *Annual Survivorship (Age 66–67):* 36.9%
- *Annual Survivorship (Age 65–66):* 46.9%
- *Annual Survivorship (Age 64–65):* 56.9%
- *Annual Survivorship (Age 63–64):* 66.9%
- *Annual Survivorship (Age 62–63):* 76.9%
- *Annual Survivorship (Age 61–62):* 86.9%
- *Annual Survivorship (Age 5–6 to 60–61):* 96.9%
- *Annual Survivorship (Age 4–5):* 89.6%
- *Annual Survivorship (Age 3–4):* 82.4%
- *Annual Survivorship (Age 2–3):* 75.1%
- *Annual Survivorship (Age 1–2):* 67.9%
- *Survivorship (From fledge to one year of age):* 60.6%
- *Maximum Age:* 71 Years

A review by Hatch and Nettleship (1998) provides the basis for these choices. Their summary includes the following information specific to deriving demographic model parameters specific to Northern Fulmar:[2]

- *Age of First Breeding:* Dunnet (1992) noted first evidence of breeding Northern Fulmars at five years of age.
- *Female Offspring per Female (Ages 20+):* Hatch and Nettleship (1998) presented unpublished data by Nettleship that show the proportion of fulmar pairs that produce a fledgling ranged from 37.2 – 46.9% in three "good" years, and 5.4 % in one "bad" year. If we assume (1) the productivity is at the midpoint of the range in good years (0.4205) and (2) a one-to-one sex ratio, then the full productivity of Northern Fulmars is (0.4205)(0.5) = 0.21025,
- *Female Offspring per Female (Age 5-19):* Dunnet (1992) found evidence that first breeding in Northern Fulmars occurs when the birds are between five and twenty years of age. We assume that the productive capacity of northern fulmar increases linearly such that it is 6.25% in Year 5, 12.5% in Year 6, etc. until 100% are breeding in Year 20.
- *Annual Survivorship (Age 5–6 to 60–61):* Hatch (1987b) estimated average annual survival rates of Northern Fulmars at 96.9%.
- *Maximum Age:* With a constant 96.9% adult survivorship it is reasonable for some Northern Fulmars to live a very long time (greater than 80 years). Evidence of their long lifespan was found in Scotland where several birds banded in 1951 were still breeding in 1990 at ages likely to be greater than 50 years old (Dunnet 1991). For the

[2] The below citations are cited as referenced in Hatch and Nettleship (1998). They are not cited as primary sources.

purpose of this analysis, we chose a maximum age of 71. Because of our belief that the adult survivorship will decline as a bird reaches the older age classes, we assume that, starting at Age 61, survivorship decreases 10% per year until zero birds advance from 70 years-of-age to their 71st year.

To calibrate the model, we assume that the survivorship from Ages 0–1 to 4–5 increases linearly each year such that 96.9% adult survivorship was achieved at Age 5-6. We then calibrate Age 0–1 survivorship so that the sequence is consistent with a population maintaining a constant population size.

D.2.7. Cormorants (Double-Crested Cormorant)

The following Double-crested Cormorant demographic parameters have been calibrated to imply a roughly constant population size:

- *Female Offspring per Female (Age 1):* 0.028
- *Female Offspring per Female (Age 2):* 0.12
- *Female Offspring per Female (Age 3):* 0.58
- *Female Offspring per Female (Age 4+):* 0.54
- *Survivorship (From fledge to one year of age):* 48%
- *Annual Survivorship (Age 1–2):* 74%
- *Annual Survivorship (Age 2+):* 83.5%
- *Maximum Age:* 21 Years

A review by Hatch and Weseloh (1999) provides the basis for these parameter choices.[3] Their summary includes the following information specific to deriving demographic model parameters specific to Double-crested Cormorants:

- *Female Fledges per Female (Age 1).* Observations by van der Veen (1973) suggest that 4.7% of females first breed at Age 1. Hatch and Weseloh's (1999) summary of numerous studies suggests that each Double-crested Cormorant nest produces 1.2–2.4 fledges per nest. If we assume the low end of that range (which we use to calibrate demographic information) and a one-to-one sex ratio, then each Age 1 female produces (.047)(1.2)(0.50) = 0.028 fledging females on average.
- *Female Fledges per Female (Age 2).* Observations by van der Veen (1973) suggest that 16.5% of females first breed at Age 2. If we assume that 90% of past breeders nest, a one-to-one sex ratio, and 1.2 fledges per nest, then Age 2 each female produces (0.165)(1.2)(0.50) + (.047)(1.2)(0.50)(0.9) = 0.12 fledging females on average.
- *Female Fledges per Female (Age 3).* Observations by van der Veen (1973) suggest that 78.8% of females first breed at Age 3. If we assume that 90% of past breeders nest, a one-to-one sex ratio and 1.2 fledges per nest, than each Age 3 female produces (0.788)(1.2)(0.50) + (0.212)(1.2)(0.50)(0.9) = 0.59 fledging female on average.
- *Female Fledges per Female (Age 4+).* Observations by van der Veen (1973) suggest that all Age 4 and later females have already bred once. If we assume that 90% of past breeders nest, a one-to-one sex ratio and 1.2 fledges per nest, then each Age 4+ female produces (1.2)(0.50)(0.9) = 0.54 fledging female on average.

[3] The below citations are cited as referenced in Hatch and Weseloh (1999). They are not cited as primary sources.

- *Survivorship (From fledge to one year of age).* van der Veen (1973) estimates Age 0 survival at 48%.
- *Annual Survivorship (Age 1).* van der Veen (1973) estimated Age 1 survival at 74%.
- *Annual Survivorship (Age 2+).* van der Veen (1973) estimated Age 1 survival at 85%. We chose the slightly lower value of 83.5% to calibrate the model to a population that maintains constant numbers over time.
- *Maximum Age.* Klimkiewicz and Futcher (1989) noted that the oldest banded bird in 5,589 encounters was 17 years 9 months old. We chose a maximum age of 21 because that is the oldest age that at least 1% of the cormorants will reach given the demographic assumptions presented above.

Overall, choosing low range values for (1) *Age 2+ Survivorship* and (2) *Fledges per Nest* calibrates the model.

D.2.8. Pelicans (Brown Pelicans)

Demographic information on Brown Pelicans was compiled by the California Office of Environmental Health Hazard Assessment and summarized in the Cal/Ecotox online database (http://www.oehha.org/cal_ecotox/default.htm). The Cal/Ecotox database (and the research papers cited therein) provides the primary data source for the below potential parameter choices:

- *Age of First Breeding:* 3 Years Old
- *Female Offspring per Adult Female:* 0.33
- *Annual Survivorship (Age 3+):* 88%
- *Annual Survivorship (Age 2–3):* 80%
- *Annual Survivorship (Age 1–2):* 72%
- *Survivorship (From fledge to one year of age):* 64%
- *Maximum Age:* 34 Years

These are based upon the following citations from the Cal/Ecotox database.[4]

- *Age of First Breeding:* Lovett and Joanen (1974) noted that the age of first nesting is at three years old.
- *Female Offspring per Adult Female:* Anderson *et al*. (1982) examined six years of data and found 0.18–0.88 fledglings per nest on West Anacapa Island (California) and 0.23–1.20 fledglings per nest on Isla Coronado Norte (California). If we assume (1) a midpoint of the overall 0.18–1.20 fledglings per nest range (0.69), (2) a one-to-one sex ratio, and (3) 95% adults breeding each year, then we get (0.69)(0.5)(0.95) = 0.33 female offspring per adult female.
- *Annual Survivorship (Age 3+):* Anderson et al. (1996) found that sixteen of seventeen Brown Pelicans (94%) combined from two separate studies survived 180 days. If we extrapolate to a full year, we find that this is equivalent to approximately an 88% annual adult survival rate.

To calibrate the model, we assume that the survivorship from Ages 0–2 increases linearly each year such that 88% adult survivorship was achieved at Age 3. We then calibrate Age 0 survivorship so that the sequence of Age 0 to Age 3 survivorship rates is consistent with a

[4] The below citations are cited as referenced in the Cal/Ecotox database. They are not cited as primary sources.

population maintaining a constant population size. We chose a maximum age of 31 because that is the oldest age that at least 1% of the Brown Pelicans would reach given the survivorship assumptions presented above.

D.2.9. Waterfowl and Wetland Birds (General Scoter)

The North Cape REA (Spertudo *et al*. 1999) calculates injury to scoters by combining demographic information for both surf scoters and black scoters. For the purpose of settlement, we suggest drawing on their parameters for calculating injuries for waterfowl/wetland birds. Specifically:

- *Age of First Breeding: 2* Years Old
- *Female Offspring per Adult Female (Annual):* 1.2025
- *Survivorship (From fledge to one year of age):* 37%
- *Annual Survivorship (Age 1+):* 69.375%
- *Maximum Age:* 15 Years Old

The difference between these parameters and those used by Sperduto *et al*. (1999) is that fecundity and survivorship parameters have been decreased by 7.5% of the *North Cape REA* values (1.3, 40%, 75%) to calibrate the life history parameters to be consistent with a constant population size.

D.2.10. Shorebirds (Dunlin)

We use Dunlin as the basis for this injury quantification. The specific parameters used are the following:

- *Age of First Breeding:* 1 Years Old
- *Female Offspring per Age 1 Female:* 0.3074
- *Female Offspring per Age 2+ Female:* 1.007
- *Survivorship (From fledge to one year of age):* 33%
- *Annual Survivorship (Year 1+):* 73%
- *Maximum Age:* 24 Years Old

A review by Warnock and Gill (1996) provides the basis for these parameter choices. They summarize the following information used to derive demographic model parameters for Dunlin:

- *Age of First Breeding:* Warnock and Gill (1996) cited research showing that some birds breed in their first year.
- *Survivorship (From fledge to one year of age):* Warnock (1994) noted that 31–35% of first-year birds return to their wintering grounds. We chose the midpoint of the range (33%).
- *Annual Survivorship (Year 1+):* Warnock (1994) noted 69–77% of adult birds return to their wintering grounds. We chose the midpoint of the range (73%).
- *Maximum Age:* Warnock and Gill (1996) cited documents that support one Dunlin being recaptured at a minimum age of 24 years old. We use this as the basis for our maximum age.

We calibrate the number of female offspring per female parameters so that the population demographics are consistent with a zero growth size. To achieve this, we use (1) personal communications that Warnock and Gill (1996) cited with R. Homes noting 29% of returning birds bred at Barrow, Alaska and (2) the assumption that 95% of all returning adult birds breed.

D.3. Application of Model and Demographic Parameters to Temporal Loss

Table 2 applies the bird-year multipliers calculated using the methods and parameters described above to the acute mortality for selected species from the *M/V Kure* spill. The first column is the estimated acute mortality described in the body of the report. The second column is the estimated bird-year multiplier. The third column is the result of applying the bird-year multiplier to the acute mortality.

TABLE D-2: Injuries to Bird Populations Due to Acute Mortality from the M/V Kure Spill

Bird Category	Estimated Acute Mortality (in Birds)	Estimated Bird-Year Multiplier (in Years)	Total Estimated Injury (in Bird-Years)
Small Grebes	87	2.6	226
Large Grebes	81	3.3	267
Loons	75	6.3	473
Gulls	154	4.4	678
Cormorants	35	4.4	154
Pelicans	31	5.9	183
Non-MAMU Alcids	719	7.2	5,177
Procellarids	191	12.7	2.426
Waterfowl	414	2.6	1,076
Shorebirds	2,033	2.8	5,692

D.4. References

Hatch, J.J. and D.V. Weseloh. 1999. Double-crested Cormorant: *Phalacrocorax auritus*. The Birds of North America: Life Histories for the 21st Century, No.441.

Hatch, S.A. and D.N. Nettleship. 1998. Northern Fulmar: *Fulmarus glacialis*. The Birds of North America: Life histories for the 21st Century, No. 361.

Julius, B. 1999. Discounting and the Treatment of Uncertainty in Natural Resource Damage Assessment. Technical Paper 99-1, NOAA Damage Assessment and Restoration Program, Silver Spring, MD.

Nur, N., R.G. Ford, and D.G. Ainley. 1994. Final Report: Computer Model of Farallon Seabird Populations. Point Reyes Bird Observatory.

Pierotti, R.J. and C.A. Annett. 1995. Western Gull: *Larus occidentalis*. The Birds of North America: Life Histories for the 21st Century, No. 174.

Sperduto, M., C. Hebert, M. Donlan, and S. Thompson. 1999. Injury Quantification and Restoration Scaling for Marine Birds Killed as a Result of the *North Cape* Oil Spill. March 25, 1999.

Warnock, N.D. and R.E. Gill. 1996. Dunlin (*Calidris alpine*). *In* The Birds of North America, No. 203 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

Appendix E: Loon/Grebe REA Details

E.1. Injury Calculation

Species	Total Estimated Dead	Bird-Year Multiplier	Total Lost Bird-Years
Loons	75	6.25	469
Small Grebes	87	2.64	230
Large Grebes	81	3.35	271
TOTAL	**243**		**970**

See Appendix D for derivation of bird-year multipliers.

E.2. Credit Calculation (projected restoration benefits)

Year	Pairs Protected	Increased Fledges	Increased Bird-Years	Discounted to 1997
2005	0	0	0	0
2006	940	278	843	646
2007	940	278	843	627
2008	0	0	0	0
	This data comes from Clear Lake (see below) and assumes 0.295 additional fledges per pair with project implementation.		Based on 3.04 bird-years per fledge (life expectancy of a fledge)	Discounted at 3% per year
Total Gained Bird-Years:				**1,274**

Note that delaying project implementation by one to three years does not affect the estimate of the appropriate project scale.

E.3. Note on Increased Fledge Calculation

Data regarding grebe productivity relative to human disturbance comes from Clear Lake, where 13 years of surveys (1992 – 2004) have documented post-breeding juvenile/adult ratios. In six of those years (1994, 1997, 1999, 2002, 2003, and 2004) definite, direct disturbances that resulted in low nesting productivity were recorded. These disturbances included boat traffic and fishing activities in and near nesting colonies, air boat activities associated with weed control within colonies and directly over nests, and marina construction activities near and through nesting colonies. Juvenile/adult ratios in years with major disturbance events averaged approximately 0.1. In other years, with lesser or no known disturbance, juvenile/adult ratios averaged approximately 0.5, which are within the normal range for Western Grebes (pers. comm. D. Anderson). Thus, the average juvenile/adult ratio over the 13-year period was 0.315. Without recurring disturbance, it would probably have been around 0.5 (the same as in non-disturbance years). Thus, recurring disturbance of nesting colonies results in an average annual loss of 0.185 juveniles per adult. Assuming that the number of pairs attempting to nest has been, on average, constant, the average number of lost fledges/pair would be twice that, or 0.369. For this project, the Trustees assume an 80% success rate, or that 0.369 x 0.80 = 0.295 fledges/nest that would likely be lost to disturbance events, will be protected by the project.

Appendix F: Cormorant/Gull/Pelican REA Details

F.1 Injury Calculation

Species	Total Estimated Dead	Bird-Year Multiplier	Total Lost Bird-Years
Brown Pelican	31	5.92	184
Cormorants	35	4.37	153
Gulls	154	4.44	684
TOTAL	**139**		**1,020**

See Appendix D for derivation of bird-year multipliers.

F.2. Credit Calculation (projected restoration benefits *per nest*)

For restoration scaling, the Trustees focused on the increase in cormorant nesting opportunity that would result from the Old Arcata Wharf refurbishment project. The remnants of this abandoned wharf continue to be used by Double-crested Cormorants for nesting and by gulls and pelicans for roosting. It was assumed that, without refurbishment, the wharf will continue to fall apart and eventually cease to exist as a roosting and nesting location for birds. The Trustees estimated the increased number of bird-years that would be derived from additional nests at the wharf if it was refurbished. Assuming that project benefits would begin in 2006 and continue for 50 years, the Trustees determined that such a project would generate 50 additional bird-years per nest. Because 1020 bird-years were lost due to the Spill, a total of 20–21 new nests would compensate for the injury to these birds. Accordingly, the Old Arcata Wharf project would need to be sufficient in size to provide for this number of new nests. Because surveys have shown one nest for every 11 square feet on the existing platform, approximately 220 square feet would be required to provide for 20 new nests.

Year	Increased Fledges	Increased Bird-Years	Discounted to 1997
2006	0	0	0
2007	0.78	2.50	1.86
2008	0.78	2.50	1.81
2009	0.78	2.50	1.75
2010	0.78	2.50	1.70
2011	0.78	2.50	1.65
2012	0.78	2.50	1.61
2013	0.78	2.50	1.56
2014	0.78	2.50	1.56
2015	0.78	2.50	1.47
Continues to 2057	Based on 0.78 fledges per nest.	Based on 3.21 bird-years per fledge (life expectancy of a fledge)	Discounted at 3% per year
Total Gained Bird-Years/Nest:			**50**

The number of new nests needed to compensate for the injuries would be 1020/50 ~ 20 to 21 nests**.** Note that delaying project implementation for one to three years affects the estimate of the appropriate project scale by less than ten percent.

Appendix G: Common Murre REA Details

G.1. Injury Calculation

Species	Total Estimated Dead	Bird-Year Multiplier	Total Lost Bird-Years
Procellarids	191	12.71	2428
Murres, large alcids	719	7.25	5213
TOTAL	**1,937**		**7,640**

See Appendix D for derivation of bird-year multipliers.

G.2. Credit Calculation (projected restoration benefits)

Year	Increased Nests	Increased Fledges	Increased Bird-Years	Discounted to 1997
2005	0	0	0	0
2006	6	4	17	13
2007	9	6	26	19
2008	14	10	40	29
2009	70	51	199	140
2010	98	71	279	190
2011	115	83	327	216
2012	123	89	350	224
2013	132	95	374	233
2014	141	102	400	242
Continues to 2105	Continues at 7% annual growth until maximum at 1,800 nests.	Based on 0.722 fledges per nest.	Based on 3.94 bird-years per fledge (life expectancy of a fledge)	Discounted at 3% per year
			Total:	**48,927**

Note: First seven years of nest numbers and fledges per nest based on data from Devil's Slide Rock Murre Re-colonization Project (McChesney et al. 2004).

Contribution toward similar project would be 7,640/48,927 = **16%**. Note that delaying project implementation for one to three years affects the estimate of the appropriate project scale by less than ten percent.

G.3. References

McChesney, G.J., A.H. Robinson, J.S. Koepke, H.A. Knechtel, N.M. Jones, C.M. Caurant, T.B. Poitras, H.R. Carter, R.T. Golightly, S.W. Kress, M.W. Parker, and J. Stankiewizc. 2004. Restoration of Common Murre Colonies in Central California: Annual Report 2003. Report to the Apex Houston Trustee Council. U.S. Fish and Wildlife Service, San Francisco Bay National Wildlife Refuge Complex. Newark, CA

Appendix H: Marbled Murrelet REA Details

H.1. Injury Calculation

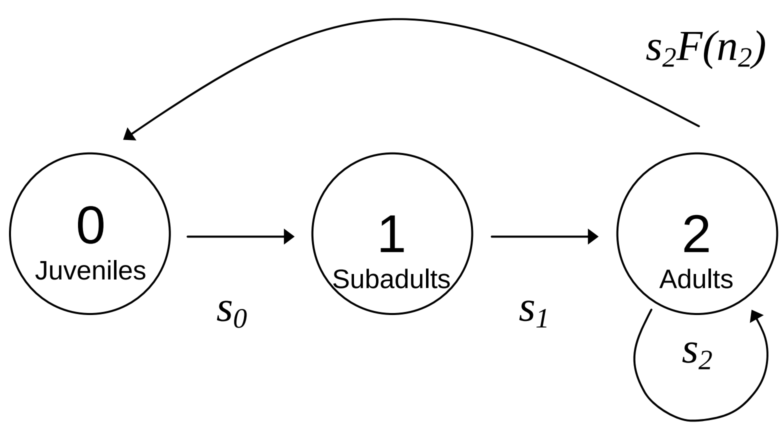
The Trustees calculated the injury to Marbled Murrelets based upon female bird-years, assuming a 1:1 sex ratio. This implies that a 130 bird acute mortality translates into an immediate loss of 65 female birds from the local population.

The discounted bird-year injury (or debit, *D*) was based upon the following formula:

$$D = \sum_{t=1997}^{2096} \frac{N_{BI,t} - N_{I,t}}{(1+d)^{t-1997}} \qquad \text{(H1)}$$

Here, $N_{BI,t}$ is the numbers of female birds in the subpopulation in period *t* had the spill not occurred, and $N_{I,t}$ is the number of female birds in the subpopulation at period *t* after the spill. For example, if we assume that the size of the injured population was 2100 females at the time of the spill and 65 females were killed, then $N_{BI,1997} = 2100$ and $N_{I,1997} = 2100 – 65 = 2035$. The parameter *d* is the discount rate. This is set at $d = 0.03$, consistent with federal NRDA guidance for a risk-free discount rate.

To calculate the trajectories $\{N_{BI,t}\}$and $\{N_{I,t}\}$, we use the following re-parameterization of the Beissinger (1995) model.



(H2)

The parameters s_0, s_1, and s_2 are the survivorships for juveniles, subadults and adults, respectively. The term $s_2F(n_2)$ reflects the “post-breeding” census convention (i.e., bird-years are counted in the Fall). This implies that adult murrelets (n2) must survive (s_2) before they are able to attempt successful breeding ($F(n_2)$). In the model, fecundity increases as the population becomes smaller (i.e., $dF(n_2)/dn_2 < 0$). This reflects the possibility that, as a population declines, it will tend to decline faster in more marginal areas leaving the remaining birds in higher quality habitat.

Combining the trajectories projected from (2) into Equation (1) yields our injury estimate of lost bird-years.

H.2. Credit Calculation (projected restoration benefits)

The overall benefit of the land acquisition and management is scaled based upon the benefit of the project at an individual nest (in discounted female bird-years). The number of nests that need to be protected to compensate for the injury ($N_{Acquire}$) is based upon: (1) the size of the bird-year injury; and (2) the benefit of land acquisition to nesting birds and their offspring (in discounted female bird-years). This is written as:

$$N_{Acquire} = \frac{D}{B_{nest}} \quad \text{(H3)}$$

where D is the Marbled Murrelet injury from (1) (measured in discounted female bird-years), and B_{Nest} is the benefit of the project per nest affected (in discounted female bird-years per nest). The benefits per nest (B_{Nest}) are calculated over a 100 year period, according to the formula:

$$B_{Nest} = \sum_{t=t_{\log}}^{2098} \frac{N_{R,t} - N_{BR,t}}{(1+d)^{t-1997}} \quad \text{(H4)}$$

Here, $N_{R,t}$ is the expected numbers of female birds supported by a nest within an acquired site at time t.[5] $N_{BR,t}$ depicts the fate of the birds supported by the acquisition site at time t after logging. t_{log} is the number of years between spill and logging without the acquisition project. The parameter d is the discount rate, which is set at 0.03.

The trajectories for $N_{BR,t}$ and $N_{R,t}$ are based upon the same basic modeling framework as used in the injury calculation. However, there are two differences between the calculation performed here and the calculation used in the injury model. First, the model is applied at the "nest" scale, versus a local population scale. This implies that we follow the number of birds associated with a given nest (versus the entire local female population). Second, we assume that: (a) with acquisition, nests are sufficiently productive to maintain population levels ($\lambda = 1.0$); and (b) without acquisition, associated birds will reproduce at lower fecundity ($\lambda < 1.0$) after logging occurs (e.g., $t_{log} = 2007$).

[5] This would include one adult female per nest, along with corresponding sub-adults, juveniles, and potentially non-breeding adults.

Appendix I: Waterfowl REA Details

I.1. Injury Calculation

Species	Total Estimated Dead	Bird-Year Multiplier	Total Lost Bird-Years
Waterfowl	414	2.59	1,072

See Appendix D for derivation of bird-year multipliers. Total lost bird-days = 1072 bird-years x 365 days = **391,375**

I.2. Credit Calculation (projected restoration benefits *per acre*)

Year	Increased Bird-User Days/Year	Discounted to 1997	Year	Increased Bird-User Days/Year	Discounted to 1997
2008	0	0	2017	1,168	647
2009	130	91	2018	1,298	698
2010	260	177	2019	1,427	745
2011	389	257	2020	1,557	789
2012	519	333	2021	1,687	830
2013	649	404	2022	1,817	868
2014	779	471	2023	1,946	903
2015	908	534	2024	2,076	935
2016	1,038	592	2025	2,206	964
Continued on next three columns ↗			Continues to 2058	Based on year-round average of 7.1 birds per acre per day	Discounted at 3% per year
				Total:	**33,626**

Note: Average of 7.1 birds per acre derived from a conservative estimate using DFG waterfowl surveys in Humboldt Bay. Note that winter density is much greater than summer density. This estimate reflects a year-round average. Gradual phase-in is meant to reflect gradual increases in populations, as well as the gradual improvement in the restored habitat.

Number of acres needed for project would be 391,375/33,626 = **11.6 acres**.

Appendix J: Shorebird REA Details

J.1. Injury Calculation

Species	Total Estimated Dead	Bird-Year Multiplier	Total Lost Bird-Years
Shorebirds	2,033	2.83	5,753

See Appendix D for derivation of bird-year multipliers. Total lost bird-days = 5,753 bird-years x 365 days = **2,099,987**

J.2. Credit Calculation (projected restoration benefits *per acre*)

Year	Increased Bird-User Days/Year	Discounted to 1997	Year	Increased Bird-User Days/Year	Discounted to 1997
2008	0	0	2017	19,398	10,740
2009	2,155	1,512	2018	21,553	11,586
2010	4,311	2,935	2019	23,709	12,373
2011	6,466	4,275	2020	25,864	13,105
2012	8,621	5,534	2021	28,019	13,784
2013	10,777	6,716	2022	30,175	14,412
2014	12,932	7,824	2023	32,330	14,991
2015	15,087	8,862	2024	34,485	15,525
2016	17,243	9,833	2025	36,641	16,015
Continued on next three columns ↗			Continues to 2058	Based on year-round average of 118.1 birds per acre per day	Discounted at 3% per year
				Total:	**558,549**

Note: Average of 118.1 birds per acre derived from shorebird surveys in Humboldt Bay as described in Table 5 of Danufsky et al (2001). This estimate reflects a year-round average. Winter densities were assumed to encompass six months of the year, while spring, summer, and fall each encompass two months. Summer density was assumed to be zero for all species. Gradual phase-in is meant to reflect gradual increases in populations, as well as the gradual improvement in the restored habitat.

Number of acres needed for project would be 2,099,987/558,549 = **3.8 acres**.

J.3. References

Danufsky, T., M.A. Colwell, L.W. Leeman, R.L. Mathis and T.S. Leeman. 2001. Final Report. Humboldt Bay/Kure Oil Spill: Shorebird Abundance and Diversity at Oiled and Un-oiled Sites. Prepared for the California Department of Fish and Game, Sacramento, CA.

Appendix K: Shoreline HEA/REA Details

K.1. Injury Calculation

Table 4-18: Summary of Shoreline Injury

Habitat Type	Area (acres)	Initial Injury	Days to Full Recovery
Mudflat			
Heavy Impact	0.11	100%	90
Moderate Impact	2.31	50%	60
Lightly Swept	5902.21	10%	30
Sand and Gravel Beaches			
Heavy Impact	1.22	100%	120
Moderate Impact	1.00	50%	120
Light Impact	8.24	25%	120
Lightly Swept	199.33	10%	30
Marsh			
Heavy Impact	0.68	100%	730
Moderate Impact	69.16	50%	365
Light Impact	1.02	25%	180
Riprap			
Heavy Impact	1.34	100%	365
Moderate Impact	1.10	50%	180
Light Impact	4.07	25%	60

The Trustees calculate that this would result in approximately 44.5 acre-years lost (in 1997 resource service units)

K.2. Credit Calculation (projected restoration benefits *per acre*)

Year	Increased Resource Services (% Service Value per Acre)	Discounted acre-years to 1997 (at 3% annually)
2009	2%	0.01
2010	4%	0.03
2011	6%	0.04
2012	8%	0.05
2013	10%	0.06
2014	12%	0.07
2015	14%	0.08
2016	16%	0.09
2017	18%	0.10
2018	20%	0.11
2019	22%	0.11
2020	24%	0.12
2021	26%	0.13
2022	28%	0.13
2023	30%	0.14
2024	32%	0.14
2025	34%	0.15
2026	36%	0.15

2027	38%	0.16
2028	40%	0.16
2029	42%	0.16
2030	44%	0.17
2031	46%	0.17
2032	50%	0.18
2033	50%	0.17
2034	50%	0.17
2035	50%	0.16
2036	50%	0.16
2037	50%	0.15
2038	50%	0.15
2039	50%	0.14
2040	50%	0.14
2041	50%	0.14
2042	50%	0.13
2043	50%	0.13
2044	50%	0.12
2045	50%	0.12
2046	50%	0.12
2047	50%	0.11
2048	50%	0.11
2049	50%	0.11
2050	50%	0.10
2051	50%	0.10
2052	50%	0.10
2053	50%	0.10
2054	50%	0.09
2055	50%	0.09
2056	50%	0.09
2057	50%	0.08
2058	50%	0.08
	TOTAL:	5.98 Acre-years per Acre

The number of acres needed for the project is 44.5/5.98 = **7.5 acres**

Appendix L: Recreational Use Losses

L.0. Summary

This appendix describes and quantifies the lost human recreational use component of the Kure Oil Spill natural resource damage assessment (NRDA). The purpose of this assessment is to identify all impacts to human recreational uses that occurred as a result of the spill and to quantify the value of those lost uses.

Potential impacted activities include sea kayaking; surfing; camping; recreational boating; recreational crabbing, clamming, and fishing; and hunting. Based on surveys of concessionaires and land managers in the Humboldt Bay area, we have determined that quantifiable impacts occurred only with respect to sea kayaking, surfing, and camping. Impacts to the other activities were negligible and will not be quantified. This report only quantifies the value of lost trips; it does not estimate the diminished value of trips that were taken despite the spill. The value of a trip is estimated using the Benefits Transfer method, whereby estimates of trip value in the literature are examined and extrapolated to this setting. Table 1 summarizes the estimated damage to recreational uses affected by the Kure oil spill.

Table L-1: Summary of Lost Recreational Values

ACTIVITY	LOST DAYS	VALUE PER DAY*	TOTAL LOST VALUE
Sea kayaking	73	$61.57	$4,515
Surfing	400	$61.57	$24,628
Camping	294	$30.36	$8,926
		TOTAL:	**$38,069**

*In fourth quarter, 1996 dollars

Adjusted for inflation (24.7%), the total amount is approximately **$47,000**.

L.1. Impacts to Human Recreational Activities

An oil spill may impact recreational activities in two ways: 1) it may preclude the activities altogether, resulting in lost use; or 2) it may cause a loss of value to the activity, resulting in diminished use value. The former type of impact is rather objective and is typically the result of closures to beaches, waterways, or other venues. The latter type is more subjective, often requiring detailed knowledge of the impacted activity and the spill. Diminished use is often indicated when a recreational site is not closed due to a spill, but the number of visitors to the site decreases to levels well below normal. In that case, there is both lost use due to the decreased number of users, and quite likely diminished use for those users that went ahead with their activity.

This oil spill impacted most recreational activities for a relatively short period of time: a few days to a few weeks. Based on the rather limited impacts of this spill, and to simplify the assessment, we have not attempted to calculate diminished use. Instead, we have focused only on lost use that resulted from oiling and/or closures of beaches, waterways, or campgrounds.

We first identified activities that had the potential to be impacted. These included sea kayaking; surfing; camping; recreational boating; recreational crabbing, clamming, and fishing; and hunting. We then contacted concessionaires and land managers in the Humboldt Bay area who would have knowledge of the impacts to these activities. From these conversations, we determined that impacts to recreational boating; recreational crabbing, clamming, and fishing; and hunting may have occurred but were quite small. Thus, we have not attempted to quantify these impacts. We have determined that quantifiable impacts did occur with respect to sea kayaking, surfing, and camping.

Specifically, sea kayaking was impacted by the closure of Humboldt Bay to recreational watercraft. Surfing was impacted by oiling and cleanup activities around the North Jetty. Camping was impacted by the temporary closure of Samoa Park Campground. These impacts are detailed in Section V.

L.2. Methodology Overview: Benefits Transfer

Because many of these activities involve using publicly available resources and exact little marginal cost on the user, there is no observable market price. We cannot see how much the user is really willing to pay for it. Thus, we cannot see its true value to the user. Surfing provides an excellent example. The marginal cost of a surfing day may be nothing more than a few dollars to park the car. However, there are additional costs that can be examined. These may include the value of the surfer's time spent surfing and the fixed costs associated with equipment (e.g., surfboard, wetsuit, etc.). One may also want to consider foregone job opportunities and career earnings just to live near a good surfing area and have time available to surf. All of these provide a lower bound on the value of surfing. If it were not worth these costs, the person would not choose to surf. Because the individual made the decision to surf, the activity must be worth *at least* these costs. Note that the economist does not ask the question: what does it cost to do this activity? Instead, we ask: what is the value of this activity to the user and what would they be willing to pay to do it?

A vast economic literature has emerged attempting to consider these factors and estimate the value of a recreational activity. Some of the methods commonly used include Travel Cost Method, Contingent Valuation, and Conjoint Analysis. For purposes of minimizing assessment costs, especially given the relatively small impacts in this case, we have relied on Benefits Transfer. This method relies on previous studies in the literature and transfers those values to the particular situation, often making various adjustments to account for differences between the study areas and the impacted site. This method greatly minimized the amount of research and study required to estimate the value of the lost activities.

The first step, however, does require specific data from the impacted area. The basic approach is to estimate the number of lost user days of a specific activity and multiply that by the value per user day of that activity, as derived from the Benefits Transfer method. The equation below describes this formally:

# of lost user days x value of a lost user day = total value of lost user days

Note that the analysis may also be done using lost user trips or hours or some other metric.

Unfortunately, there are no economic analyses specifically regarding the value of sea kayaking and surfing. However, there are many studies to draw on that focus on the value of other recreational activities, such as fishing, hiking (including overnight backpacking), canoeing, whitewater rafting, and even snow-mobiling. These studies help provide a reasonable estimate of the value of the activities impacted by this spill.

L.3. Estimated Number of Lost User Days

L.3.1. Sea Kayaking

Based on conversations with Jay Dottle of Humboats, we estimate that a total of 220 boat hours were lost due to the spill. Dottle estimated that his concession lost 80 boat hours, while other sea kayak rental places and private individuals lost an additional 140 boat hours. Because we want to put the lost use in terms of user days, we have assumed that an average day trip lasted three hours. Thus, 220/3 = 73 user days were lost due to the spill.

L.3.2. Surfing

Based on communication with Kirk Johnson of Humboldt Surf Company, we estimate that 400 user days were lost due to the spill. Johnson notes that November offers prime surfing conditions at the North Jetty. He estimates that approximately 100 surfers per day would be expected to take advantage of this location. Indeed, at least two surfers were directly oiled at the beginning of the spill. Because the area could not be used for surfing for four days, we have estimated 400 lost user days.

L.3.3. Camping

The only place where camping was precluded due to the spill was at Samoa Park Campground. This campground had to be closed for several days due to cleanup and response activities. Bob Walsh, of Samoa Park Campground, stated that 84 camping reservations had to be cancelled. Walsh also estimates an average of three to four people per campsite. Assuming an average of 3.5 people per site, we have estimated that a total of 294 camping days were lost.

L.4. Valuation of Human Use Impacts

While an extensive review of the literature and the development of a complex Benefits Transfer function are possible, we have chosen to simplify the analysis and employ a simple “value transfer”. That is, we will use average values from other studies as the basis for determining the value of the activities of interest. We will rely on a recent meta-analysis of economic studies: Rosenberger and Loomis, 2000. This report examines the results of 163 different studies, spanning 21 different outdoor recreational activities, and reports on 760 measures of benefits. Table L-2 summarizes some of the results.

Table L-2: Results of Rosenberger and Loomis Report for Selected Activities

ACTIVITY	n	MEAN VALUE/USER DAY
Camping	40	$30.36
Float boating	19	$61.57
Swimming	12	$21.08
Biking	5	$45.15
Snowmobiling	2	$69.97
Rock climbing	4	$52.96

n = number of estimates
Values are in fourth-quarter, 1996 dollars.

For the purposes of this damage assessment, we have decided to use the mean value for camping in this report to estimate the value of a camping day, and the mean value for float boating to estimate the value of a sea kayaking and surfing day.

L.4.1. Camping

While it is possible to examine the large number of camping studies and derive a Benefits Transfer function that takes into account various campground attributes, such an effort may not be efficient given the small magnitude of the impacts here. Thus, we have simply employed the mean value.

L.4.2. Sea Kayaking

The various studies that were encompassed in the float boating category included both calm water canoeing and whitewater rafting from a wide variety of locations. For lack of a compelling reason to make any adjustment, we have employed the mean value without any changes.

L.4.3. Surfing

While surfing has yet to be specifically studied, we have focused on its similarity to other outdoor activities that offer both physical challenge and thrills, such as rock climbing, snow-mobiling, and mountain biking. Note that mountain biking is a sub-category of the biking category, with an estimated value of approximately $59/user day (see Table 2 of Rosenberger and Loomis, 2000). Given the range of these values, it seems not unreasonable to apply the float boating value to surfing as well.

In conclusion, we have used the values described above and added 13% to these dollar figures to adjust for inflation. The results are as follows:

Value of a camping day: $34.31
Value of a sea kayaking day: $69.57
Value of a surfing day: $69.57

Multiplying these values by the number of lost user days will produce the total lost recreational value associated with the Kure oil spill. The results are presented in Table 1.

L.5. References

Rosenberger, R.S., and J.B. Loomis. 2001. Benefit transfer of outdoor recreation use values: A technical document supporting the Forest Service Strategic Plan (2000 revision). Gen. Tech. Rep. RMRS-GTR-72. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

Appendix M: Summary of Public Comments and Trustee Responses

The Kure Trustees received thoughtful and relevant comments on the Draft DARP/EA during the public review process. The Trustees grouped the comments below into similar subject matter headings and present responses after each comment/question.

1. What are the reasons for the Redding Rock common murre colony declines?

It appears that human disturbances as well as impacts from the Kure and Stuyvesant oil spills have impacted the colony. Human disturbances have been documented in the past from USCG staff, who access the rock during sensitive times of the year to maintain a signal light. One aspect of the project will be to support on-going coordination with the USCG. Also, encroachment or use of Redding Rock by fishermen is an additional possible cause of abandonment or disturbance.

2. Are there sea lions on Redding rock affecting nesting success of common murres?

Sea lions use Redding Rock as a haul out and rest site, and the numbers of sea lions using the rock has increased in recent years. However, it is unclear whether control measures for sea lions will be required to assist with improving murre populations. Sea lions may simply be increasing their use of the rock due to the decline in use by murres, rather than the other way around. The restoration project will include a component to assess the effects of the sea lion use of the rock on the murre breeding colony and, if warranted, steps will be taken to address the issue.

3. What is the restoration action at the Redding Rock murre colony?

The restoration project is aimed at increasing the number of murres and their nesting success at the Redding Rock murre colony by reducing disturbances to murres and, if necessary, utilizing ”social attraction” techniques that would predominately involve the use of bird decoys and sound systems. This is very challenging given the remote location of the site and logistical challenges. However, previous efforts to restore murres on Devil’s Slide Rock in central California have been highly successful despite the logistical challenges there (i.e., difficult site access).

4. What is the amount of the settlement and allocation to each project?

The final settlement includes acquisition of a conservation easement over approximately 300 acres of redwood forest, supported by a payment of $500,000 to monitor and enforce the terms of the conservation easement, plus approximately $2.5 million to fund other restoration projects. The settlement also requires payment of the balance of the trustees’ assessment costs (roughly $1.2 to $1.5 million).

The amount allocated to each of the projects is set forth in the Final DARP/EA.

5. Why isn’t lethal removal included in corvid management, e.g., around corvid nests?

Lethal removal of corvids is included as an option under the corvid management project, but it is not currently the method of choice. Initially we will utilize education of the public and garbage control improvements, and will annually monitor the resident corvid populations. The populations will need to meet certain threshold criteria indicating population decreases, and if these reductions are not sufficient, lethal means will then be considered.

It is important to note that data from other sites where lethal control has been used indicate that success using this method is only temporary, as new birds will move into the area as long as the attractive food source is present. Since Marbled Murrelets nest at low densities and corvid numbers will have to be suppressed throughout the entire murrelet nesting season, a project relying on lethal control as the primary control mechanism would need to be sustained at a high level of effort over a large area to remove both occupying and immigrating corvids before they depredate murrelet nests. In addition, there is no guarantee that such an extensive effort would be successful for a predator as clever as a corvid within the redwood forest environment where visibility is often disrupted by physical obstructions.

Thus, we believe that the removal or strict control of attractive food sources in areas where marbled murrelets nest is a necessary component of any successful corvid control project, as well as the best long term solution to reducing corvid numbers, and ultimately reducing corvid predation on marbled murrelet nests.

6. **Is there an example of a successful pelican project? Would the Trustees consider building structures?**

Some roost-site protection projects are currently in use in southern California, including for example, the salt ponds in south San Diego Bay where jetties that have broken up, essentially creating islands, are being specifically protected as roost sites. Other examples include fencing of jetty ends, creation of floating platforms, and protection measures of natural structures. It is doubtful that new manmade structures would be built in Humboldt Bay, as we feel there are sufficient natural structures that can be utilized with protection measures in place.

7. **Were shellfish considered in the NRDA?**

Commercial oyster farmers made a private claim against Kure, specifically for damages to their resources. The terms of their settlement with Kure are confidential. For the NRDA, shellfish were collected and analyzed for petroleum. These data were considered in the assessment of the duration and severity of injuries to the shoreline habitat (includes injuries to mudflats, riprap, beaches and wetlands habitat) rather than injuries to shellfish as a separate resource.

8. **Was there any attempt to assess fish impacts within Humboldt Bay?**

Yes, fish were collected and analyzed for petroleum after the Kure Spill. The data were used in the estimate of the severity and duration of injuries assessed for the shoreline habitat. The habitat restoration projects, specifically the McDaniel Slough wetland enhancement project which will restore tidal action, will benefit fish as a component of the aquatic environment. We did not have any evidence of significant fish mortality after the Kure Spill, unlike the 1999 Stuyvesant spill in Humboldt Bay when we documented thousands of dead shrimp at the mouth of the Bay and included those in the injury assessment.

9. What do the Trustees use for baseline data for birds?

For several bird species, there were pre-existing survey data from other sources. For example, for Marbled Murrelets we used pre-existing boat surveys conducted by Redwood Science Lab. We were then able to conduct post-spill surveys using the pre-existing transect lines, thus allowing us to compare to previous survey protocol. For waterfowl within Humboldt Bay, we used pre-existing DFG overflight survey data. In addition, during the spill, we had experts conduct shorebird surveys around the Bay. We were able to document shorebird occurrences both prior to oil reaching the location, as well as documenting oiled shorebirds on impacted shorelines after the oil arrived.

10. Was there any soil monitoring after the Spill? Are the Humboldt State University results available to the public?

Of the habitats affected, the marshes around Humboldt Bay were the most heavily oiled (particularly around Indian Island and the Samoa Boat Ramp). A survey conducted by CDFG (Lesh and Broadman 1999; included in the Kure Administrative Record) monitored selected habitat and shorelines in the hardest hit areas (e.g., near Samoa Boat Ramp). This monitoring was conducted in January 1998, November 1998 (approximately one year after the spill), and in July 1999. No visual differences could be observed in the density of marsh plant species between oiled and unoiled areas one year after the spill. An asphalt sample found on leaf sheaths in July 1999 exhibited some similarities to Kure oil but all of the lighter and most of the medium weight hydrocarbons had been degraded and were no longer present. The vast majority (99.9%) of impacted mud flat was very lightly oiled. Humboldt State University (HSU) monitored shorebird use of oiled and unoiled mudflats from March 1998 through March 1999. No difference in shorebird density between oiled and unoiled areas was observed, suggesting that shorebird use of oiled habitats of Humboldt Bay was not adversely affected by the Spill. These results are available to the public as part of the Kure Administrative Record.

11. How do the Trustees determine that habitat has recovered?

When determining the amount of restoration needed to restore injured habitats, the Trustees consider the data collected by Shoreline Cleanup Assessment Teams (SCAT data) regarding extent of oiling and cleanup efforts. In addition, the Trustees often conduct additional sampling to determine extent and degree of oiling. They also consider impacted species within the habitats and the ecology of those species to estimate how long it would take them to recover. This information is used in the Habitat Equivalency Analysis calculations. In addition, the habitat restoration projects contain a monitoring component to document the success of the project. In situations where natural recovery is selected as the preferred project alternative, Trustees often include a monitoring component to document recovery.

12. To what extent are funds locked into restoration projects instead of an evaluation and monitoring for baseline information?

We are statutorily bound to develop plans to restore, replace or acquire the equivalent of the lost resources. So, we are required to use the recovered damages to fund restoration projects rather than for baseline monitoring unrelated directly to the event. Further, , it is impractical to collect baseline information for all environments and species. Nor can we predict where the next oil spill will occur to target baseline data collection. However, we do use baseline information, where available, such as data from the Coastal Ocean Mammal and Bird Education and Research Surveys (Beach COMBERS) database. In addition, all of the restoration projects contain a monitoring component to evaluate whether the project has been successful.

13. Do birds that were rehabbed and released contribute to quantifying injury?

Yes. We recognize that many birds will die after they are rehabbed and released. We assume that 75% of the rehabilitated birds die or fail to contribute to the breeding population. This information is based on mean estimates from several studies that examine the survival of birds that are treated and released after oil spills. This included a specific rehab survival study for common murres conducted in the aftermath of the *Stuyvesant* oil spill.

14. Why did this case take so long?

Numerous case-specific factors contributed to the lengthy duration of this case. During the event and afterwards, there were contentions between the Trustees and the responsible party, both on the number of impacted species and on how to proceed with restoration. Specifically, the issues which required the most time to resolve involved the extent of injury to Marbled Murrelets, and the identification and evaluation of feasible restoration projects for those injuries. Thereafter, a considerable amount of time was spent selecting appropriate old growth parcels and negotiating the terms of a conservation easement with a non-party landowner. In addition, the responsible parties initiated and pursued for several years a lawsuit against the dock owner. Until that lawsuit was concluded, the responsible parties were not inclined to resolve the trustees' claims for natural resource damages. Also, there was an unusually high rate of turnover in the responsible party and trustee personnel involved in the case throughout the assessment and planning period, which slowed progress in reaching settlement.

15. Were effects on invertebrates, marine mammals, algae and vascular plants considered? Was there an assessment on the effects on ecosystem structure and function?

We did not have evidence of mortality to marine mammals. Invertebrates, algae and vascular plants were considered in the shoreline impacts which evaluated tidal mudflats and associated eelgrass beds, intertidal wetlands, riprap shoreline, and sand and gravel beach habitats. The shoreline habitats are a source of much of the primary productivity and nutrients supporting the Bay ecosystem. These habitats also support diverse invertebrate communities, many of which serve as important food sources for wading birds and shorebirds. Injuries to these habitats resulting in lost ecological services are considered in the shoreline injury quantification. The restoration project at McDaniel Slough will compensate for the lost natural resource services to these habitats as a result of the Spill.

Appendix N

Written Public Comments Received

"Peter A. Nelson"
<panelson@ucdavis.edu>
09/18/2007 04:33 PM

To Carolyn_Marn@fws.gov
cc
bcc
Subject Kure/HBay oil spill

History: This message has been forwarded.

Hi Carolyn:

What's the potential for entertaining alternative assessment/restoration proposals? Very briefly, I've been involved in an effort to collect baseline data on seabird mortality patterns (spatial and temporal), from Humboldt County North to the Canadian border, Alaska and Hawaii. We have data also on how seabird carcasses, once found, degrade, move, disappear and reappear. Support for the former would be very useful in the event of a future spill; the latter could directly inform our understanding of the effects of the Kure spill and aid in predicting the effects of other spills.

I'd also suggest that the effects on fishes should be addressed; there are several potential avenues along those lines that could be pursued. Similarly, effects on invertebrates, marine mammals, algae and vascular plants should be considered. In keeping with recent interest in pursing an holistic, ecosystem-based approach to natural resource management, it'd be worth considering an assessment on the effects on ecosystem structure and function too. Were there no proposals to attempt any of these?

Cheers,

Pete

Peter A. Nelson, Ph.D.
panelson@ucdavis.edu
phone: 707.443.8369
cell: 707.267.5896

"Robert Browne"
<bobb@mlfn.net>
09/19/2007 10:08 AM

To <Carolyn_Marn@fws.gov>
cc
bcc
Subject 1997 Humboldt Bay Oil Spill Restoration

History: This message has been forwarded.

Hello Carolyn,

I own 27 acres of property along the easterly shoreline of the Entrance Bay in Humboldt Bay. It is comprised of approximately 10 acres of upland at the base of the Elk River Spit and approximately 17 acres are submerged land along the westerly side of the railroad tracts. Fee title to the property was established in 1993 after a 13 year battle with the City of Eureka , The Harbor District and State Lands. I would like to know if this property may be affected or involved in the current restoration plan.

I believe a portion of the property would be suitable for your mitigation purposes and would be willing to discuss further that possibility with the appropriate agency.

Thank you

Robert Browne
(408) 691-4238

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Arcata Field Office
1695 Heindon Road
Arcata, CA 95521
www.ca.blm.gov/arcata

In Reply Refer To:
(CA330)P

October 29, 2007

Carolyn Marn
US Fish and Wildlife Service
2800 Cottage Way, Rm W-2605
Sacramento, CA 95825

Subject: Kure/Humboldt Bay Oil Spill Draft Damage Assessment and Restoration Plan/Environmental Assessment.

Dear Ms. Marn:

The BLM has reviewed the Kure/Humboldt Bay Oil Spill Draft Damage Assessment and Restoration Plan/Environmental Assessment. We offer the following comment for your consideration;

1. Please include the California Coastal National Monument Resource Management Plan, September 2005, under Section 3.1.2-Compliance and Potentially Applicable Laws and Regulations of the Kure/Humboldt Bay Oil Spill Draft Damage Assessment and Restoration/Environmental Assessment.

We appreciate the opportunity to provide input and continued involvement in the Kure restoration efforts. If you have any questions, please contact Arlene Kosic @ 707-825-2345.

Sincerely,

Lynda J. Roush
Arcata Field Manager

Appendix O

NEPA Decision Document/Finding of No Significant Impact

NEPA Decision Document/Finding of No Significant Impact
For the Kure/Humboldt Bay Oil Spill
Damage Assessment and Restoration Plan/Environmental Assessment

U.S. Fish and Wildlife Service, Department of the Interior
April 2008

Background:

Under the Oil Pollution Act of 1990 (OPA), the Natural Resource Trustee Agencies (the Trustees), including the U.S. Fish and Wildlife Service (Service), the California Department of Fish and Game (CDFG), and the California State Lands Commission (CSLC) have prepared the *Kure/Humboldt Bay Oil Spill Final Damage Assessment and Restoration Plan/Environmental Assessment,* dated April, 2008 (DARP/EA). The DARP/EA assesses damages and evaluates restoration alternatives for natural resource injuries due to the November 5, 1997 spill of approximately 4,500 gallons of Intermediate Fuel Oil 180 into Humboldt Bay, near Eureka, California (the Spill). The Kure was tied to the dock and in the process of being repositioned for loading when its starboard hull struck a mooring "dolphin" that punctured the #3 fuel tank. Sorbent boom was deployed to contain the spill, but oil escaped the boom and spread with the tide. Personnel on the first overflights on November 6 identified black oil product as far as 17.5 miles north of the bay mouth; observers on subsequent overflights detected oily "mousse" just outside the surf zone as far north as Trinidad Head.

The DARP/EA proposes restoration projects that compensate for natural resource injuries caused by the Spill. Injuries to natural resources and recreational services included 3,950 birds estimated killed, 6,200 acres of mudflat, rocky intertidal, beach, and wetland habitat oiled, and 767 lost recreational user-days. The Trustees estimate that 46 bird species, including two federal and state listed threatened and endangered species (i.e., the Marbled Murrelet and California Brown Pelican) were injured. The Trustees prepared the DARP/EA which describes the injuries resulting from the Spill and proposed restoration alternatives. The plan was developed, in part, through cooperative studies with the Responsible Parties (i.e., Kure Shipping, S.A. and Patt Manfield & Co.).

Restoration Alternatives:

The DARP/EA evaluated several categories of restoration alternatives, including a "no action" alternative, and developed criteria to evaluate and prioritize the entire suite of restoration projects under consideration. The Trustees considered and rejected the no-action alternative, which relied on natural processes for recovery of the injured natural resources. Natural recovery does not allow for recovery of interim losses suffered by the resources and the OPA clearly establishes trustee responsibility to seek compensation for interim losses pending recovery of natural resources. Furthermore, technically feasible alternatives for restoration are available.
The six selected restoration actions are:

1. Protection of Western/Clark's Grebe Nesting Colonies at Northern California Lakes;
2. Brown Pelican Roost Site Protection;
3. Restoration of Common Murre Nesting Colony at Redding Rock;
4. Protection of Marbled Murrelet Nesting Habitat;
5. Protection of Marbled Murrelet Nesting Success through Corvid Management; and
6. Restoration of Salt Marsh Wetlands at McDaniel Slough

This decision document concludes that a Finding of No Significant Impact (FONSI) is appropriate for all of the restoration actions selected for implementation by the Trustees as identified in the DARP/EA and summarized here, with the possible exception of Brown Pelican Roost Site Protection and Restoration of Common Murre Nesting Colony at Redding Rock. As these projects are more fully developed, they may undergo additional environmental analysis prior to implementation.

Public Involvement:

The Trustees involved the public during development of the DARP/EA. The Trustees held a 45-day public review and comment period, from September 14 until October 29, 2007 for the draft DARP/EA. The Trustees also presented an overview of the draft DARP/EA and accepted public comments at a public meeting in Arcata, California on September 19, 2007. Written and oral comments received on the Draft DARP/EA are included as Appendices in the Final DARP/EA.

Alternatives Considered:

The Trustees grouped injured species in the DARP/EA in order to focus restoration projects for the 46 species of birds affected by the Spill. These groups are as follows: Loons and Grebes; Pelicans, Cormorants and Large Gulls; Alcids (except Marbled Murrelets) and Procellarids; Marbled Murrelets; Waterfowl, and Shorebirds. The remaining injury categories are shoreline habitat and human recreational use losses.

The DARP/EA evaluated specific project alternatives for each injury group specified above against certain criteria. The initial screening criteria included Consistency with Trustees' Restoration Goals, Technical Feasibility, Cost-Effectiveness, Relationship to Injured Resources and/or Services, Time to Provide Benefits, and Duration of Benefits. Additional screening criteria included Avoidance of Adverse Impacts, Likelihood of Success, Multiple Resource and Service Benefits, Compliance with Applicable Federal, State, and Local Laws and Policies, Public Health and Safety, Maintenance and Oversight of Project, Opportunities for Collaboration, Total Cost and Accuracy of Estimate, and Comprehensive Range of Projects. Supplemental screening criteria included, Ability to Document Benefits to the Public, Educational/Research Value, and Non-Duplication. The Trustees then selected the preferred alternatives based on the merits shown in the evaluation.

The specific project alternatives the Trustees considered for each injury category are listed below with the selected projects in italics.

Loons and Grebes:

- *Protection of Western/Clark's grebe nesting colonies at northern California lakes*
- Acquisition of land around Lake Earl to allow for higher lake levels and increase Western Grebe nesting

Pelicans, Cormorants and Gulls:

- *Brown Pelican roost site protection*
- South Spit of Smith River acquisition and management
- Island Roost at Lake Talawa—building up the island above high water
- Artificial pelican roosts—float at Samoa Bridge and tree in Crescent City Harbor
- Old Arcata Wharf restoration—refurbishing and enlarging of abandoned wharf
- South Spit of Humboldt Bay acquisition
- Pelican roost at North Jetty on North Spit—cut off to create an island
- Pelican signs on South Spit—to reduce human disturbances

Common Murres, Other Alcids (except Marbled Murrelet) and Procellarids:

- *Redding Rock murre re-colonization and protection*
- Trinidad seabird colonies—re-colonization of Tufted Puffin at Green and Puffin Rocks
- Trinidad seabird colonies—re-colonization of Common Murre at Sea Lion Rock
- Trinidad seabird colonies—enhance nesting habitats for Leach's Storm-Petrel at Little River and Prisoner Rocks
- Whaler Island restoration (Crescent City Harbor)—for Humboldt and Del Norte County seabird colonies
- Human disturbance reduction program—for Humboldt and Del Norte County seabird colonies
- Cape Vizcaino area seabird colonies—acquisition and management

Marbled Murrelets:

- *Preservation/Management of old growth/residual habitat at risk of logging;*
- *Corvid management at Redwood National and State Parks and vicinity;*
- *Silviculture of second growth forest to create nesting habitat*
- Captive breeding
- Artificial nest platforms

Waterfowl, Shorebirds and Shoreline Habitat:

- *McDaniel Slough Wetland Enhancement Project*
- Tract 20 acquisition for Humboldt Bay National Wildlife Refuge (NWR)
- Hunt Ranch acquisition and conversion to wetlands
- Eel River Wildlife Area acquisition and conversion to wetlands
- Mad River Slough Wildlife Area acquisition and conversion to wetlands
- Old Arcata drive-in theatre acquisition and conversion to wetlands
- White Slough Field restoration at Humboldt Bay NWR
- North Spit eelgrass bed restoration
- North Bay eelgrass bed restoration

- Hookton Slough restoration
- Bayview/Schmidbauer acquisition and restoration of wetlands
- Industrial shoreline enhancement—re-establish "natural" shoreline
- Shorebird viewing blinds and signs—south of Samoa Bridge
- Tide gate improvements
- Table Mountain heron/egret rookery acquisition for Humboldt Bay NWR
- Promotion of shellfish areas
- On-water seaduck roosting zones—protection from disturbance

Human Recreational Beach Use:

- *McDaniel Slough Wetland Enhancement Project*
- South Spit recreational access facilities
- Education center for Humboldt Bay NWR
- Interpretive signs at boat launches in Humboldt Bay
- Eel River boat ramp
- Wildlife Area parking areas at Eel River, Elk River, Fay Slough, and Mad River
- Education center for CDFG Wildlife Area
- EcoAtlas of Humboldt Bay watershed
- Interpretive displays at Arcata marsh, Woodley Island Marina, Elk River Wildlife Area
- Trinidad Bay/Trinidad Rancheria harbor improvements
- Ocean foods study—short and long-term effects of oil spills on consumers of ocean food resources
- Indian Island cleanup and restoration
- Humboldt Bay Trails Project

Environmental Consequences:

To comply with the National Environmental Policy Act (NEPA), the California Environmental Quality Act (CEQA), and other related State and Federal requirements, the Trustees analyzed the effects of each restoration project on the quality of the human environment. Specific measures are included, as appropriate, in some of the proposed projects to mitigate potential impacts. The Trustees will be responsible for ensuring that each project will be implemented as prescribed in the DARP/EA to address the injuries resulting from the Spill.

As contemplated in the NEPA regulations, the Brown Pelican Roost Site Protection Project and the Restoration of Common Murre Nesting Colony at Redding Rock project will undergo a subsequent phase of environmental analysis as project specific details are developed or when specific locations for habitat protection are identified. Attachment 1 includes a summary of the proposed projects, environmental consequences and any mitigation required at this time.

As documented in the DARP/EA, the Trustees determined the proposed actions will substantially benefit the resources targeted by the DARP/EA, and can be implemented without significant adverse effects to soil, air quality, water resources, floodplains, wetlands, vegetation, fisheries, wildlife, visual quality, aesthetics/recreation, wilderness, subsistence, cultural resources, park management, and the local economy.

The proposed actions are designed to make the environment and the public whole for injuries to, or lost use of natural resources and services from the Spill. The Service has determined that most of the proposed actions will not adversely affect any species listed under the federal Endangered Species Act. However, further consultation with the Service and NOAA Fisheries is required for the McDaniel Slough project prior to implementation of Phase II. Information on the potential project impacts is currently being collected and will be used to assess effects on currently listed species.

Cumulative Impact:

As required by NEPA, the DARP/EA addresses potential cumulative impacts of implementing the preferred alternative projects. The DARP/EA specifically examines Seabirds, Corvids, and Human Use.

Seabirds

The Trustees believe the preferred alternative projects selected in the DARP/EA that address injuries to seabirds, in conjunction with other existing and anticipated seabird restoration projects, including those funded from damage recoveries from other OPA cases, will have a local and regional, long term, moderate beneficial impact on seabird populations. The selected projects that benefit seabirds include: Protection of Western/Clark's Grebe Nesting Colonies on Northern California Lakes, Redding Rock Common Murre Re-colonization and Protection, Preservation/Management of Marbled Murrelet Nesting Habitat at Risk of Logging, Brown Pelican Roost Site Protection, and McDaniel Slough Wetland Enhancement.

Corvids

The Trustees have selected a project that will affect local jay and raven numbers near seabird nesting and roosting sites. The Trustees will provide funding to implement the Corvid Management Project at Redwood National and State Parks. Project components include public education and outreach, and removing anthropogenic food sources. If other measures to affect corvid densities are not successful, the project could potentially include lethal removal of a small number of jays and ravens in the future to ensure protection of Marbled Murrelet nests.

Because the selected projects are focused on relatively small geographical areas, and because only small numbers of corvids may be displaced or removed relative to their regional populations levels, the Trustees believe these alternatives will have a minor, local, medium term, negative impact on the local and regional population of corvids.

Human Use

The Trustees have selected five projects that may change human use of natural resources. The projects are Protection of Western/Clark's Grebe Nesting Colonies on Northern California Lakes; Corvid Management at Redwood National and State Parks; Redding Rock Common Murre Re-colonization and Protection; Brown Pelican Roost Site Protection; and McDaniel Slough Wetland Enhancement. Project components include public education and outreach and potentially limiting access to sensitive areas.

Overall, four of the selected projects will have local, medium term, minor impacts to humans. In addition, one of the projects will have beneficial impacts to humans, specifically benefits toward human recreation. All of the projects will have beneficial impacts to ecosystems of which humans are a part.

Summary

The Trustees believe that, overall, the alternatives selected in this restoration plan, when considered along with past and reasonably foreseeable future projects, will have long term, local and regional beneficial impacts to natural resources; short term, minor, negative impacts to some human recreation; and also beneficial impacts to other human recreation.

Environmentally Preferred Alternative:

The environmentally preferred alternative is the alternative that will promote NEPA, as expressed in Section 101 of NEPA. The environmentally preferred alternative is the one that best meets the following:

- Fulfill the responsibility of each generation as trustee of the environment for succeeding generations;
- Ensure for all Americans a safe, healthful, productive, and aesthetically and culturally pleasing surrounding;
- Attain the widest range of beneficial uses of the environment without degradation, risk of health or safety, or other undesirable and unintended consequences;
- Preserve important historic, cultural, and natural aspects of our national heritage, and maintain, wherever possible, an environment which supports diversity, and variety of individual choice;
- Achieve a balance between population and resource use which will permit high standards of living and a wide sharing of life's amenities; and
- Enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.

Based upon analyses of the proposed action when compared to the alternative projects (non-preferred) and the no action alternative, the proposed action meets the criteria above and is therefore also the agencies' environmentally preferred alternative.

Basis for Decision:

Implementation of the proposed action will have minimal short-term impacts on natural, cultural, and social resources. Attachment 1 contains a summary of the proposed action, environmental consequences and any mitigation proposed at this time. No highly uncertain or controversial impacts, unique or unknown risks, significant cumulative negative effects, or elements of precedence have been identified, and implementing the proposed and preferred alternative will not violate Federal, State, or local environmental protection laws.

Conclusion:

Based upon an environmental review and evaluation of the DARP/EA for the Kure/Humboldt Bay Oil Spill as summarized above, the Service has determined, except as noted below, that implementation of the restoration plan does not constitute a major Federal action significantly affecting the quality of the human environment under the meaning of Section 102(2)(c) of the National Environmental Policy Act of 1969 (as amended). Accordingly, an environmental impact statement is not required for this action. However, the Brown Pelican Roost Site Protection Project and Restoration of Common Murre Nesting Colony at Redding Rock Project may be subject to further environmental review. The DARP/EA is available upon request from the Service's Sacramento Fish and Wildlife Office, 2800 Cottage Way, Room W-2605, Sacramento, CA 95825.

[signature] 5-9-08

Regional Director, California and Nevada Region — Date

Authorized Official, Department of the Interior

7

Attachment 1

Each alternative project evaluated in the DARP/EA is presented below according to the injury category for which it is evaluated. Selected alternatives are presented in *italic*. Alternative projects not selected are presented in regular type. The presentation includes a summary of the selected project, rationale for selecting or rejecting the project, and discussion of environmental consequences and any mitigation proposed at this time.

1) Loons and Grebes:

- *Protection of Western/Clark's Grebe nesting colonies at northern California lakes*
- Acquisition of land around Lake Earl to allow for higher lake levels and increase Western Grebe nesting

The Trustees selected the nesting colony protection project as the preferred project because it will provide widespread benefits at lower cost than the Lake Earl project. Restoration for Common Loons would require actions far removed from the spill area, most likely in Canada or Alaska. Specific restoration projects in these areas have not been identified.

The nesting colony protection project would contribute funds to implement many of the recommendations of the California Grebe Management Plan, designed to protect Western and Clark's Grebe nesting colonies from human disturbances. These recommendations include public education and outreach, as well as the establishment of small seasonal buffers around grebe nesting colonies. The primary colonies targeted for protection are located at Clear Lake, where a pilot project is underway. Additional work may be implemented to protect colonies at other areas including Eagle Lake, Thermolito Forebay, Lake Almanor, and Tule Lake National Wildlife Refuge.

The Trustees do not anticipate significant adverse impacts for other species of wildlife and habitat because this project will protect areas from human disturbance. Experience indicates that there will be only minor inconveniences to boaters and users of personal watercraft because grebe colonies will be seasonally protected by buffers that restrict boating access. However, these buffers are relatively small, extending only 50 to 100 meters from shore, and span only the length of shoreline where the colonies are located. Given the large size of these lakes, these buffers typically represent less than 1 percent of the total lake surface area. Additionally, the buffers are seasonal because they are only needed during the breeding season (primarily May through August). As such, any impacts to human use of these areas are expected not to be significant.

This project will expand upon a current pilot project at Clear Lake initiated by the *American Trader* Oil Spill Trustee Council. The Kure settlement funds allocated for this project total $250,000.

2) Pelicans, Cormorants, and Gulls:

- *Brown Pelican roost site protection*
- South Spit of Smith River acquisition and management
- Island Roost at Lake Talawa
- Artificial pelican roosts
- Old Arcata Wharf restoration
- South Spit of Humboldt Bay acquisition
- Pelican roost at North Jetty on North Spit
- Pelican signs on South Spit

After evaluating these projects using the initial and additional screening criteria, the Trustees identified the Old Arcata Wharf project as the preferred project in the Draft DARP/EA. Land acquisition and increasing the size of the island at Lake Talawa were deemed not cost effective; the South Spit of Humboldt Bay has recently been acquired and is being managed to protect the natural resources; and other projects are more proximal than the Crescent City project. However, since the preparation of the draft DARP/EA, the Trustees obtained more information indicating that the Arcata Wharf project is potentially in conflict with other agency goals to focus on more natural solutions. Therefore, the Trustees selected the Pelican roost site protection project as the preferred project for this restoration category. Protection of pelicans on the North Jetty and South Spit can be incorporated into the project.

The objective of this project is to protect Brown Pelican roost sites from human disturbance. There are plentiful roosting locations within Humboldt Bay during low tide on exposed mudflats. However, high tide roost sites are much more limited. This project may partner with State and local governments and the Bureau of Land Management (BLM) to protect pelican roosts in the Humboldt Bay area, as well as to the north in Del Norte County. The project will flexibly respond to disturbance issues as they arise or are anticipated. While specific measures will be tailored to the needs at each location, potential project elements include:

- Initial survey to identify vulnerable pelican roosts
- Public education and outreach via signs and educational materials
- Placement of buoys at strategic locations
- Protective fencing or signage
- Other measures to protect pelican roost sites
- Annual monitoring and adaptive management

Protection of pelican roosts will have positive benefits to pelicans by reducing energy costs associated with commuting between prey and roosts, and with flushing and relocating due to human disturbance. Cormorants and gulls often roost and nest at the same locations where pelicans roost. To the extent that this occurs at locations protected by this project, these species will benefit as well. This project will rely primarily on education and outreach, encouraging voluntary compliance to protect roosting pelicans. This project has the potential to restrict human access to small areas (e.g. tips of jetties) seasonally; any access restrictions will be carefully considered. Likewise, signs will be carefully designed and located so as not to detract from the natural beauty of any area.

The Kure settlement funds allocated for this project total $250,000.

3) Common Murres, Other Alcids (except Marbled Murrelet) and Procellarids:

- *Redding Rock Common Murre re-colonization and protection*
- Trinidad Seabird Colonies—re-colonization of Tufted Puffin at Green and Puffin Rocks
- Trinidad Seabird Colonies—re-colonization of Common Murre at Sea Lion Rock
- Trinidad Seabird Colonies—enhance nesting habitats for Leach's Storm-Petrel at Little River and Prisoner Rocks
- Whaler Island Restoration (Crescent City Harbor)—re-establish as a seabird colony
- Human Disturbance Reduction Program for Humboldt and Del Norte County seabird colonies
- Cape Vizcaino Area seabird colonies—acquisition and management

Restoration options for Procellarids (in this case, primarily shearwaters) are quite limited. As a result, the Trustees did not identify any practicable restoration options for these species. Instead the Trustee-RP technical working group focused on Common Murres, the species most impacted by the spill (with respect to number of individuals oiled). While restoration options exist for some of the other alcids besides Common Murres, the projects brought to the Trustees' attention were rather small and experimental.

Because Common Murres represent the vast majority of birds in this category, and were determined by the technical working group to be a surrogate for all other species in this category, those projects which do not benefit murres were screened out. After evaluating the remaining Common Murre projects using the initial and additional screening criteria, the Trustees identified contribution to the restoration of a nearly extirpated murre colony at Redding Rock as the preferred project. This project will restore murres at a location most proximate to the spill site and redress impacts caused from past and on-going human disturbance. In addition, it will benefit a highly impacted murre colony using restoration methods that are known to be effective.

Restoration actions may include efforts to prevent human disturbance of murres during the nesting season through education and public outreach and use of social attraction techniques to attract murres to Redding Rock. By employing several restoration techniques in the next few years, permanent colony extirpation may be avoided and the colony should return to higher levels than seen since 1979, given the amount of suitable nesting habitat available.

The adverse impacts associated with this project are minimal. A balance will be sought between minimizing the impacts on the resource and preserving quality opportunities for recreation. If appropriate, additional environmental review/analysis specifically for this project will be conducted prior to implementation.

The available Kure settlement funds for this project total $450,000.

4) Marbled Murrelets:

- *Preservation/management of nesting habitat at risk of logging*
- *Corvid management programs at Redwood National and State Parks*
- Silviculture of second growth forest to create nesting habitat
- Captive breeding
- Artificial nest platforms

Captive breeding, silviculture and the use of artificial nests are relatively untested concepts and were therefore not considered by the Trustees to be feasible projects having an adequate likelihood of success. In general, restoration options for Marbled Murrelets are limited by the lack of information on the survival and reproductive requirements of the species, as well as its unusual life history. The Trustees identified the Preservation/management of nesting habitat and corvid management as the preferred restoration projects for murrelet restoration. Preservation and management of old growth habitat will permanently protect from logging, and enhance, murrelet nesting habitat. Corvid management will maintain or increase murrelet nest productivity in the region.

Preservation/Management of Murrelet Habitat

The Trustees considered three different projects that included preservation of old growth forest: (1) contribution to the acquisition and management of the Grizzly Creek Marbled Murrelet Conservation Area (MMCA) located in Humboldt County; (2) acquisition of a parcel located near Redwoods National Park in Del Norte County owned by Green Diamond Resource Company and commonly referred to as "W-530"; and (3) a conservation easement on parcels containing old growth stands owned by Green Diamond Resource Company and commonly known as the "Big Mynot/E.F. Hunter Complex" in Del Norte County. The Trustees prefer the Big Mynot/E.F. Hunter Complex project to the W-530 proposal because it contains 45 more acres of un-entered old growth and provides superior Marbled Murrelet nesting habitat. They prefer the Big Mynot/E.F. Hunter Complex project to the MMCA project because it is more cost-effective and because the Green Diamond properties are at greater threat of harvesting than the MMCA.

Under the conservation easement, to be held by a non-profit organization whose purposes include the protection and enhancement of old growth redwood forests, Green Diamond Resource Company would agree to refrain from timber harvesting and other disturbance-causing activities in the Big Mynot/E.F. Hunter Complex stands as well as in the specified buffer areas (second growth forest) around the stands. Furthermore, Green Diamond Resource Company would agree to management practices (carried out by the Trustees or their representatives) for the enhancement of Marbled Murrelet habitat and reproduction in the parcels.

The Big Mynot/E.F. Hunter Complex project will protect nesting Marbled Murrelet habitat and guarantee that it remains in existence primarily for the benefit of Marbled Murrelets in the future. It is known that murrelets have nested within the Big Mynot/E.F. Hunter parcels and that they would not be able to do so if the area were logged. There are no obvious adverse impacts of the Big Mynot/E.F. Hunter Complex project to wildlife or habitat provided that the habitat is managed according to approved Marbled Murrelet habitat management guidelines. Nor will human use be affected as the parcels subject to the conservation easement are not presently accessible to the public and their present use will not change.

Corvid Management at Redwood National and State Parks and vicinity

This project would contribute to on-going management efforts to limit anthropogenic food sources that result in unnaturally large corvid (*i.e.,* Steller's Jay, Common Raven, American Crow) populations. The corvid management project is intended to improve Marbled Murrelet nest success through a decrease in predation caused by ravens, crows, and jays. Sustaining the Marbled Murrelet population through the next few decades will enable future murrelets to access increasing amounts of protected old growth forest and second growth forest as it matures into suitable nesting habitat.

The corvid management project will educate the public about imbalances in the ecosystem that may be caused as different species respond positively and negatively to human actions. The corvid management project will have direct impacts upon both campers at campground and picnic areas and upon corvids and possibly other animals that scavenge food waste at these sites. Campers will be made more aware of existing rules and restrictions upon their food management and may be subject to enforcement actions should they fail to comply. While corvids and other animals such as raccoons will not be trapped and removed, they will likely experience a reduction in their available food supply. For corvids, this may lead to decreased fledgling survival and lower reproductive success. These adverse impacts are an inevitable part of the transition from artificially (through human activities) elevated population levels to lower, more natural population levels. Corvids, raccoons, and other animals currently living outside of the campgrounds are not likely to be impacted.

The Kure settlement funds allocated to this project total $750,000.

5) Waterfowl, Shorebirds, Shoreline Habitat, and Human Recreational Use:

- *McDaniel Slough Wetland Enhancement Project*
- Tract 20 acquisition for Humboldt NWR
- Hunt Ranch acquisition and conversion back to wetlands
- Eel River Wildlife Area acquisition and conversion to wetlands
- Mad River Slough Wildlife Area acquisition and conversion to wetlands
- Old Arcata drive-in theatre acquisition and conversion to wetlands
- White Slough Field at Humboldt Bay NWR – restore tidal action with setback levee
- North Spit eelgrass bed restoration – remove fill on 10 acres
- North Bay eelgrass bed restoration – remove oyster shell debris on 100 acres
- Hookton Slough restoration – move levee to restore tidal action to 140 acres
- Bayview/Schmidbauer acquisition – restore to wetlands
- Industrial shoreline enhancement – re-establish "natural" shoreline
- Shorebird viewing blinds and signs – south of Samoa Bridge
- Tide gate improvements – to restore some tidal action to various streams
- Table Mountain heron/egret rookery acquisition for Humboldt Bay NWR

- Promotion of shellfish areas – to establish more shell fish areas
- On-water seaduck roosting zones – protection from disturbance

All of the projects except Hookton and McDaniel Slough were screened out either because they would have benefited only a single or narrow range of resources or they would have benefited mostly brackish, freshwater, or eelgrass habitats which were not among those habitats injured by the Spill. The Trustees initially identified a contribution toward wetlands restoration at Hookton Slough as a tentative preferred project. However, the McDaniel Slough Wetland Enhancement project in Humboldt County will provide resource benefits very similar to those originally anticipated from the Hookton Slough project, but in a more cost-effective and timely manner, and with identified partnering funds. The McDaniel Slough Wetland Enhancement project will provide multiple resource and service benefits. Contributing to this project's cost-effectiveness is the fact that this project also will provide benefits to address the Human Recreational Beach Use injury category.

The McDaniel Slough project will return tidal action to tidelands in Humboldt Bay that were diked and drained about 100 years ago. The project is planned for a 240-acre parcel of land located at the southwest corner of the City of Arcata and owned by the State of California and the City of Arcata. To restore the tidal connection between Humboldt Bay and 200 acres of the site, the tide gates at McDaniel Slough will be removed to create a breach in the bay-front levee. The project will restore 200 acres of salt marsh habitat, creating a mosaic of vegetated habitats, mudflats, tidal sloughs, and other intertidal wetlands. This will benefit a variety of birds, including egrets, waterfowl, shorebirds, and other wetland species by providing food, shelter, and nest sites. The proposed project also includes trails, wildlife viewing structures, benches, and information kiosks that will provide recreational and educational benefits in addition to the ecological benefits provided by the habitat restoration

The environmental effects of the project are described in detail in the Environmental Impact Report (EIR) prepared by the City of Arcata (2006), along with mitigation strategies for potential adverse effects. There will be a permanent change in the type of habitat at the site from terrestrial or seasonally wet habitat to tidal wetland habitat, which may adversely affect terrestrial wildlife species. Tidal wetlands will replace freshwater or brackish wetlands. These impacts are mitigated by the large amount of tidal habitat that will be restored and by the creation of 40 acres of brackish and freshwater ponds on 40 acres of the project area that are not being restored to tidal action.

This project should result in positive benefits to humans by enhancing the quality and amount of public use near the areas affected by the spill. Improvements to public access will also be implemented in ways that protect and minimize future adverse impacts to habitats subject to frequent human use/visitation. Implementation of these projects will result in improved public education regarding the project areas and will expand appropriate public access to areas that could not formerly be accessed safely or without harm to habitats.

Settlement funds allocated for this project total $420,000.