

**FINAL DAMAGE ASSESSMENT AND RESTORATION PLAN/
ENVIRONMENTAL ASSESSMENT**

For the

M/S STAR EVVIVA OIL SPILL

SOUTH/NORTH CAROLINA COAST

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EXECUTIVE SUMMARY

The *M/S Star Evviva* is a cargo ship of Norwegian registry owned by Billabong II ANS (Billabong). Between approximately 0000 hours and 0600 hours on January 14, 1999, the *Star Evviva*'s engine room was unmanned as the ship sailed approximately 30 to 50 miles off the coast of South Carolina. Due to the malfunction of a fuel oil transfer system in the engine room during these hours, the *Star Evviva* pumped fuel oil onto the deck and overboard, spilling approximately 24,000 gallons into the Atlantic Ocean (the Spill). On January 16, 1999, oiled birds began washing ashore along South Carolina's and North Carolina's coastline from Folly Beach, South Carolina, to Topsail Beach, North Carolina. There were, however, no reports of or sightings of an oil spill.

Restoration funds for injuries to natural resources from the Spill were recovered under the Oil Pollution Act of 1990 (OPA), 33 U.S.C. 2701 *et seq.* Under the terms of the Consent Decree which was signed by Billabong on May 28, 2003, filed in the Federal District Court in Charleston, South Carolina, on July 1, 2003, and entered by the Court on September 12, 2003, \$1,875,946.00 in restoration funds were paid into the United States Department of the Interior's Natural Resource Damage Assessment and Restoration Account on September 29, 2003, and \$124,054 were paid to the United States Department of Justice and the South Carolina Department of Natural Resources for damage assessment costs. The restoration funds are solely for use as agreed by the Federal and State Trustees to pay costs incurred for restoring, rehabilitating, replacing, or acquiring the equivalent of the natural resources injured by the Spill. The Federal and State Trustees have the responsibility of planning and implementing the necessary project(s) pursuant to relevant statutory authorities and regulations.

This Final Damage Assessment and Restoration Plan and Environmental Assessment (DARP/EA) has been prepared on behalf of the public by State (Office of the Governor of the State of South Carolina and South Carolina Department of Natural Resources) and Federal (Department of the Interior, U. S. Fish and Wildlife Service) Natural Resource Trustees (Trustees) to address restoration of natural resources injured from the discharge of oil by the *M/S Star Evviva*. The DARP/EA describes the affected environment, restoration alternatives, the environmental consequences of the alternatives, and the selected restoration plan; also presented are comments received during the public comment period and the Trustees response to comments as well as the Finding of No Significant Impact under the National Environmental Policy Act. This DARP/EA was developed in accordance with OPA and its implementing regulations, 15 C.F.R. 900 *et seq.*; the National Environmental Policy Act (NEPA), 42 U.S.C. 4321 *et seq.* and its implementing regulations, 40 C.F.R. Parts 1500-1508; and applicable laws and regulations of the State of South Carolina.

The Trustees identified and considered five restoration alternatives: no action, acquisition of loon nesting habitat in Canada, acquisition of loon wintering habitat in South Carolina, construction of a bird rehabilitation center, and a combination of habitat acquisition and bird rehabilitation. Following consideration of public comments, the Trustees have selected the construction of a bird rehabilitation center (combined use avian medical center) as the restoration plan to be implemented. The selected plan would not have any significant adverse effects on the environment and would benefit wild bird populations through the treatment and rehabilitation of injured and oiled birds and their return to wild populations.

TABLE OF CONTENTS

EXECUTIVE SUMMARY	ii
TABLE OF CONTENTS.....	iii
LIST OF ACRONYMS	v
1.0 INTRODUCTION AND SUMMARY	1
1.1 Overview of the Incident	1
1.2 Natural Resource Injuries	2
1.3 Restoration Alternatives	2
1.4 Plan of this Document.....	2
2.0 PURPOSE AND NEED FOR NRDAR PLANNING AND RESTORATION IMPLEMENTATION.....	3
2.1 Summary of the Incident.....	3
2.2 Authority and Legal Requirements.....	3
2.2.1 Overview of OPA Requirements	4
2.2.2 NEPA Compliance.....	5
2.3 Coordination with the Responsible Party	5
2.4 Public Participation.....	6
3.0 DETERMINATIONS AND QUANTIFICATIONS	6
3.1 Overview of the Preassessment Phase	6
3.1.1 Affected Environment.....	7
3.1.2 Natural Resources of Concern	8
3.2 Assessment Strategy	9
4.0 RESTORATION ALTERNATIVES	11
4.1 Restoration Strategy.....	11
4.2 Restoration Alternatives	12
4.3 Restoration Alternative Scaling	14
5.0 SELECTION OF THE PREFERRED ALTERNATIVE.....	16
5.1 Selection Criteria	16
5.2 Alternatives Evaluation.....	17
5.2.1 No Action.....	17
5.2.2 Acquisition of Loon Nesting Habitat in Canada.....	17
5.2.3 Acquisition of Loon Wintering Habitat in South Carolina.....	18
5.2.4 Construction of a Bird Rehabilitation Center	18

5.2.4.1 Oiled Bird Rehabilitation Facility.....	19
5.2.4.2 Combined Use Avian Medical Center	20
5.2.5 Combination of Habitat Acquisition and Bird Rehabilitation	21
5.3 The Preferred Restoration Alternative	21
6.0 ENVIRONMENTAL CONSEQUENCES.....	22
6.1 No Action.....	22
6.2 Acquisition of Loon Nesting Habitat in Canada.....	22
6.3 Acquisition of Loon Wintering Habitat in South Carolina.....	22
6.4 Construction of a Bird Rehabilitation Center	22
6.4.1 Oiled Bird Rehabilitation Facility.....	22
6.4.2 Combined Use Avian Medical Center	23
6.5 Combination of Habitat Acquisition and Bird Rehabilitation	23
7.0 THE SELECTED RESTORATION PLAN.....	23
8.0 MONITORING PROGRAM AND PERFORMANCE CRITERIA	24
8.1 Construction of the Combined Use Avian Medical Center	24
8.2 Compilation of Data on Loon Mortality	24
9.0 REFERENCES	24
LIST OF PREPARERS.....	28
FIGURES	
Figure 1: Trackline of the <i>M/S Star Evivva</i> , 13-14 January 1999.....	29
TABLES	
Table 1: Number of Oiled Birds Retrieved and Treated.....	30
Table 2: Species of Oiled Birds Retrieved and Treated.....	31
APPENDIX A Supporting Analysis of Damages: Lost Bird-Years from the <i>Star Evviva</i> Oil Spill	
APPENDIX B Department of the Interior Finding of No Significant Impact under the National Environmental Policy Act for the Final Restoration Plan/Environmental Assessment for the <i>Star Evviva</i> Oil Spill	
APPENDIX C Public Comments Received and Trustee Response to Public Comments on the <i>Draft Damage Assessment and Restoration Plan/Environmental Assessment for the M/S Star Evviva Oil Spill</i>	

LIST OF ACRONYMS

CEQ - Council on Environmental Quality
C.F.R. - Code of Federal Regulations
DARP/EA - Damage Assessment and Restoration Plan and Environmental Assessment
DOI - Department of the Interior
EFH - Essential Fish Habitat
IBRRC - International Bird Rescue and Research Center
NEPA - National Environmental Policy Act
NOAA- National Oceanic and Atmospheric Administration
NRDA - Natural Resource Damage Assessment
NRDAR - Natural Resource Damage Assessment and Restoration
OPA- Oil Pollution Act of 1990
REA - Resource Equivalency Analysis
RP - Responsible Party
U.S.C. - United States Code
USCG - United States Coast Guard
USFWS- United States Fish and Wildlife Service
WRC - Wildlife Rehabilitation Center

1.0 INTRODUCTION AND SUMMARY

This Final Damage Assessment and Restoration Plan/Environmental Assessment (DARP/EA) has been prepared by State and Federal Natural Resource Trustees (the Trustees) to address the restoration of natural resources injured by the *M/S Star Evviva* on January 14, 1999 (the Spill). The DARP/EA describes the affected environment, restoration alternatives, the environmental consequences of the alternatives, and the selected restoration plan; also presented are comments received during the public comment period on the Draft DARP/EA and the Trustees' response to comments. This DARP/EA was developed in accordance with OPA and its implementing regulations, 15 C.F.R. 900 *et seq.*; the National Environmental Policy Act (NEPA), 42 U.S.C. 4321 *et seq.* and its implementing regulations, 40 C.F.R. Parts 1500-1508; and applicable laws and regulations of the State of South Carolina.

Under the terms of a Consent Decree signed by the Responsible Party (RP), Billabong II ANS (Billabong), on May 28, 2003, and filed in Federal District Court in Charleston, South Carolina, on July 1, 2003, the Trustees received 2 million dollars (\$1,875,946 for restoration and \$124,054 for recovered past costs). This sum is presently in the United States Department of the Interior's Natural Resource Damage Assessment and Restoration Fund. It will remain in that account, earning interest, until the final restoration plan is issued.

Injuries from the incident have been considered and alternatives have been evaluated according to established criteria. Following consideration of public comments, the construction of a combined use avian medical center alternative has been selected for implementation. The Trustees believe that the process taken to evaluate injuries to natural resources and services and to select the preferred restoration alternative, to make the public whole for losses resulting from this incident, has been consistent with regulatory requirements.

1.1 Overview of the Incident

The *M/S Star Evviva* is a cargo ship of Norwegian registry owned by Billabong. Between approximately 0000 hours and 0600 hours on January 14, 1999, the *Star Evviva*'s engine room was unmanned as the ship sailed approximately 30 to 50 miles off the coast of South Carolina. Due to the malfunction of a fuel oil transfer system in the engine room during these hours while oil was being transferred from one tank to another, the *Star Evviva* pumped fuel oil onto the deck and overboard, spilling approximately 24,000 gallons into the Atlantic Ocean. On January 16, 1999, oiled birds began washing ashore along the coastline from Folly Beach, South Carolina, to Topsail Beach, North Carolina. There were, however, no reports of or sightings of an oil spill.

1.2 Natural Resource Injuries

Between January 16 and February 10, 1999, a total of 194 birds were retrieved from Folly Beach, South Carolina, to Topsail Beach, North Carolina, a shoreline distance of approximately 195 miles. Of these 194 birds, 189 were oiled. These birds, primarily common loons but also

including red-throated loons, ring-billed gulls, cormorants, and surf scoters, were treated at a Wildlife Rehabilitation Center (WRC) set up in Myrtle Beach, South Carolina, by the Trustees and operated by Tri-State Bird Rescue and Research, Inc. A total of 93 birds were dead on arrival at the WRC; 101 birds were alive upon delivery but only 6 of those, including 2 unoiled ones, survived to be released. An unknown number of additional birds were retrieved but not delivered to the Myrtle Beach WRC. Oiled birds were not retrieved from barrier islands accessible only by boat, with the exception of one retrieval effort on barrier islands within the boundaries of the Cape Romain National Wildlife Refuge, nor from State-managed lands within the impact area due to limited retrieval personnel. No attempts were made to retrieve birds in the water; only those washed ashore along developed, public beaches were retrieved. Total bird mortality attributable to the Spill is likely substantially greater due to oiled birds' carcasses sinking, being scavenged, or being carried away from shore by winds and currents.

1.3 Restoration Alternatives

Pursuant to the National Environmental Policy Act (NEPA), restoration alternatives were selected based upon the following purpose and need respectively: Reduce winter mortality of loons and restore lost bird years.

The Trustees identified and considered five restoration alternatives to restore resources injured as a result of the *Star Evviva* oil spill:

- 1) no action
- 2) acquisition of loon nesting habitat in Canada
- 3) acquisition of loon wintering habitat in South Carolina,
- 4) construction of a bird rehabilitation center
- 5) combination of habitat acquisition and bird rehabilitation

1.4 Plan of this Document

Chapter 1 provides an overview.

Chapter 2 briefly summarizes the spill incident, the legal authority and regulatory requirements of the Trustees, and the role of the Responsible Party and the public in the Natural Resource Damage Assessment and Restoration (NRDAR) process.

Chapter 3 describes and quantifies the injuries caused by the incident, including an overview of Preassessment activities, a description of assessment strategies employed by the Trustees, and a presentation of assessment results.

Chapter 4 provides a discussion of restoration options considered and of the screening process and determines the scale of restoration, based on the nature and extent of injury.

Chapter 5 presents the criteria against which each restoration alternative was evaluated, evaluates each alternative, and presents the selected alternative.

Chapter 6 discusses the environmental consequences of the alternatives.

Chapter 7 presents the selected plan.

Chapter 8 discusses the monitoring and reporting requirements for the selected alternative.

Chapter 9 lists the references utilized in this document.

2.0 PURPOSE AND NEED FOR NRDAR PLANNING AND RESTORATION IMPLEMENTATION

2.1 Summary of the Incident

The *M/S Star Evviva* is a cargo ship of Norwegian registry owned by Billabong. It is approximately 179 meters long and 24,056 gross tons. Between approximately 0000 hours and 0600 hours on January 14, 1999, the *Star Evviva*'s engine room was unmanned as the ship sailed approximately 30 to 50 miles off the coast of South Carolina. Due to the malfunction of a fuel oil transfer system in the engine room during these hours, the *Star Evviva* pumped fuel oil onto the deck and overboard, spilling approximately 24,000 gallons into the Atlantic Ocean while oil was being transferred from one tank to another. On January 16, 1999, oiled birds began washing ashore along the coastline from Folly Beach, South Carolina, to Topsail Beach, North Carolina. There were, however, no reports of or sightings of an oil spill. On February 3, 1999, the U. S. Coast Guard (USCG) Marine Safety Office Charleston provided a news release identifying the vessel *M/S Star Evviva* as the source of the oil spill which oiled the birds found washed ashore along the South Carolina/North Carolina coast. The USCG determined the source after oil samples taken from birds recovered in both states were compared with samples taken from the vessel. USCG representatives were informed by company representatives that approximately 24,000 gallons of heavy fuel oil (No. 6) were released into the Atlantic Ocean on January 14, 1999, as the ship passed the coast of South Carolina (Figure 1). On February 17, 1999, the owners of the *Star Evviva* accepted designation under the Oil Pollution Act of 1990 (OPA) as the source of oil discharged from the vessel at sea between the hours of 12:00 midnight on January 13 and 6:00 A.M. on January 14, 1999. Funds for the rescue and rehabilitation of oiled birds were provided from the Oil Spill Liability Trust Fund administered by the USCG.

2.2 Authority and Legal Requirements

This DARP/EA has been prepared on behalf of the public by State (Office of the Governor of the State of South Carolina and the State of South Carolina Department of Natural Resources) and Federal (Department of the Interior, U. S. Fish and Wildlife Service) Natural Resource Trustees (Trustees) to address restoration of natural resources injured from the discharge of oil by the *M/S Star Evviva* on January 14, 1999. Each of these agencies is a designated Natural Resource

Trustee under OPA, 33 U.S.C. Section 2706 (b) and the National Contingency Plan, 40 C.F.R. Section 300.600, for natural resources injured by the *Star Evviva* oil spill. As a designated Trustee, each agency is authorized on behalf of the public under state and/or federal law to assess and recover natural resource damages and to plan and implement actions to restore natural resources and resource services injured or lost as a result of a discharge of oil. The DARP/EA describes the affected environment, evaluates restoration alternatives, assesses the environmental consequences of the alternatives, and presents a selected plan. It was developed in accordance with OPA, 33 U.S.C. 2701 *et seq.* and its implementing regulations, 15 CFR 900 *et seq.*; the NEPA, 42 U.S.C. 4321 *et seq.* and its implementing regulations, 40 C.F.R. Parts 1500-1508; and applicable laws and regulations of the State of South Carolina.

2.2.1 Overview of OPA Requirements

A natural resource damage assessment, as described under Section 1006 of OPA (33 U.S.C. §2706(c)) and the regulations for natural resource damage assessments under OPA at 15 C.F.R. Section 990, consists of three phases: 1) Preassessment; 2) Restoration Planning; and 3) Restoration Implementation. The Trustees may initiate a damage assessment provided that an incident has occurred; the incident is not from a public vessel or an onshore facility subject to the Trans-Alaska Pipeline Authority Act (43 U.S.C. 1651, *et. seq.*); the incident is not permitted under federal, state, or local law; and natural resources under the trusteeship of a trustee may have been injured or may be injured as the result of the incident (15 C.F.R. §990.41). Injury is defined as "an observable or measurable adverse change in a natural resource or impairment of a natural resource service" (15 C.F.R. §990.30).

Based on information collected during the Preassessment Phase, Trustees make a preliminary determination whether natural resources or services have been injured and/or are threatened by ongoing injury. Through coordination with response agencies (e.g., the USCG), Trustees next determine whether response actions will eliminate injury or the threat of ongoing injury. If injuries are expected to continue and feasible restoration alternatives exist to address such injuries, Trustees may proceed with the Restoration Planning Phase. Restoration planning also may be necessary if injuries are not expected to continue but are suspected to have resulted in interim losses of natural resources and services from the date of the incident until the date of recovery.

The purpose of the Restoration Planning Phase is to evaluate potential injuries to natural resources and services and to use that information to determine the need for and scale of restoration actions. Natural resources are defined as "land, fish, wildlife, biota, air, ground water, drinking water supplies, and other such resources belonging to, managed by, held in trust by, appertaining to, or otherwise controlled by the United States, any state or local government or Indian tribe" (15 C.F.R. §990.30). This phase provides the link between injury and restoration and has two basic components: injury assessment and restoration selection. The goal of injury assessment is to determine the nature and extent of injuries to natural resources and services, thus providing a factual basis for evaluating the need for, type of, and scale of restoration

actions. As the injury assessment progresses, Trustees develop a plan for restoring the injured natural resources and services. Trustees must identify a reasonable range of restoration alternatives, evaluate and select the preferred alternative(s), develop a Draft Restoration Plan presenting the alternative(s) to the public, solicit public comment on the Plan, and consider those comments before issuing a Final Restoration Plan.

During the Restoration Implementation Phase, the Final Restoration Plan is presented to the Responsible Parties to implement or to fund the Trustees' costs of implementing the plan. Should the Responsible Parties decline to fund or implement the plan, OPA authorizes Trustees to bring a civil action against Responsible Parties for damages or to seek disbursement from the Oil Spill Liability Trust Fund to implement preferred restoration projects. Components of damages are specified in sections 1002(b) and 1001(5) of OPA and include the costs of damage assessment [33 U.S.C. §§2702(b) and 2701(5)].

2.2.2 NEPA Compliance

Any restoration of natural resources under OPA must comply with the National Environmental Policy Act (42 U.S.C. §§4321-4347) and the Council on Environmental Quality (CEQ) regulations implementing NEPA (40 C.F.R. §500, *et seq.*). In compliance with NEPA and the CEQ regulations, this DARP/EA summarizes the current environmental setting, describes the purpose and need for action, identifies and evaluates alternative actions, selects a preferred alternative, assesses the environmental consequences of the alternatives, and summarizes opportunities for public participation in the decision process.

2.3 Coordination with the Responsible Party

In April 2000, the Trustees met with Billabong's representatives to initiate natural resource damages settlement negotiations. We received Billabong's proposal for restoration projects in October 2000. In December 2000, we met with Billabong's representatives to discuss the inadequacies in the proposal and to continue to work cooperatively with Billabong to develop an adequate restoration plan. Another proposal was provided by Billabong in September 2001; however, the Trustees also found this proposal inadequate. Following numerous phone conferences and data exchanges regarding injury quantification and restoration scaling, another meeting was held in December 2001. We received a third restoration project proposal from Billabong in May 2002. In a July 2002 meeting with Billabong's representatives, we reached an agreement in principle for restoration of natural resources injuries resulting from the *Star Evviva* oil spill. Attorneys for Billabong signed a Consent Decree in May 2003 settling natural resource damages and assessment costs arising from the Spill. The Consent Decree was filed in the Federal District Court in Charleston, South Carolina, on July 1, 2003, and was entered by the Court on September 12, 2003. Under the terms of the Consent Decree, on September 29, 2003, Billabong paid \$1,875,946 in restoration funds into the United States Department of the Interior's Natural Resource Damage Assessment and Restoration Account and \$124,054 in damage assessment costs to the United States Department of Justice and the South Carolina

Department of Natural Resources.

2.4 Public Participation

Public involvement is required in the development of a restoration plan. The purpose of the Restoration Planning Phase is to evaluate potential injuries to natural resources and services and to use that information to determine the need for and scale of restoration actions. During this phase, the Trustees must identify a reasonable range of restoration alternatives, evaluate and select the preferred alternative(s), develop a Draft Restoration Plan, solicit public comment on the plan, and consider those comments before issuing a Final Restoration Plan. Notice of the availability of the *Star Evviva* Draft DARP/EA for public review and comment was published in *The Post and Courier*, Charleston, South Carolina, on Wednesday, October 6, 2004, and on Sunday, October 10, 2004; the public comment period was open until November 4, 2004. A total of 60 letters were received and are included in this document as Appendix C.

Public review of the Draft DARP/EA is consistent with all state and federal laws and regulations that apply to the natural resource damage assessment process, including Section 1006 of OPA (33 U.S.C. §2706), the regulations for Natural Resource Damage Assessment under OPA (15 C.F.R. Part 990 *et seq.*), NEPA (43 U.S.C. §4371, *et seq.*), and the regulations implementing NEPA (40 C.F.R. Part 1500, *et seq.*).

3.0 DETERMINATIONS AND QUANTIFICATIONS

3.1 Overview of the Preassessment Phase

Natural resource trusteeship authority is designated according to Section 1006(b) of OPA and Subpart G of the National Oil and Hazardous Substances Pollution Contingency Plan (40 C.F.R. Part 300). Federal Trustees are designated by the President and State Trustees by the Governor. Action on behalf of the public as Trustees for the natural resources affected by the Spill, the DOI, through the U. S. Fish and Wildlife Service, the South Carolina Department of Natural Resources, and the Office of the Governor, are responsible for assessing injuries to trust resources resulting from the Spill and for developing and implementing a plan for the restoration, rehabilitation, replacement, or acquisition of the equivalent of the injured natural resources [OPA §1006(c)].

Pursuant to 15 C.F.R. Section 990.41, the Trustees determined that legal jurisdiction to pursue restoration under OPA exists for this incident. The Spill constitutes an "incident" within the meaning of Section 1001(14) of OPA; i.e., "an occurrence or series of occurrences having the same origin, involving one or more vessels, facilities or any combination thereof, resulting in the discharge or substantial threat of discharge of oil." Because the discharge was not authorized by a permit issued under federal, state, or local law and did not originate from a public vessel or an onshore facility subject to the Trans-Alaska Pipeline Authorization Act, the incident is not an

"excluded discharge" within the meaning of OPA Section 1002(c). Finally, natural resources under the trusteeship authority of the State of South Carolina and DOI have been injured as a result of the Spill. These factors establish jurisdiction to proceed with an assessment under OPA NRDA regulations.

Three requirements identified in OPA must be met before restoration planning can proceed:

- injuries have resulted, or are likely to result, from the incident;
- response actions have not adequately addressed, or are not expected to address, the injuries resulting from the incident; and
- feasible primary and/or compensatory actions exist to address the potential injuries.

As detailed in following sections of this document, each of these requirements is met relative to the *Star Evviva* spill.

3.1.1 Affected Environment

Pelagic habitats (the water column) off the South Carolina coast are utilized by a number of marine fish and shellfish managed under the Magnuson-Stevens Act, as well as a number of seabirds managed under the Migratory Bird Treaty Act. These waters have been designated as Essential Fish Habitats (EFH), specifically “those waters and substrates necessary for fish spawning, breeding, feeding, or growth to maturity” (South Atlantic Fishery Management Council 1998). Other EFHs off the South Carolina coast include the Gulf Stream; live hard bottom habitat, zones of highly concentrated invertebrate and algal growth, usually in association with marked deviations in relief that support substantial fish assemblages; the Charleston Bump (an underwater ridge/trough feature located southeast of Charleston) and the Charleston Gyre (a quasi-permanent, cyclonic eddy with attendant upwelling of nutrient-rich deep water). The latter two EFHs as well as areas with pelagic *Sargassum* are also identified as EFH-habitat areas of particular concern (South Atlantic Fishery Management Council 1998).

Most marine fish and shellfish broadcast spawn pelagic eggs, and thus most species utilize the water column during some portion of their early life history. Large numbers of fishes inhabit the water column as adults and the number of families represented in ichthyoplankton collections off the southeastern coast range from 40 to 91, depending upon location, season, and sampling method. Adults, juveniles, larvae, and eggs of numerous species utilizing pelagic habitat off South Carolina’s coast include penaeid and deepwater shrimp, black sea bass, red snapper, gag grouper, red porgy, red and black drum, king and Spanish mackerel, cobia, striped bass, American shad, hickory shad, blueback herring, menhaden, tunas, sharks, sailfish, and marlins. Marine mammals utilizing South Carolina’s offshore waters include the bottle-nosed and striped dolphin, Atlantic right whale, dwarf and pygmy sperm whales, humpback whale, and West Indian manatee, an endangered species (South Atlantic Fishery Management Council 1998).

Coastal and offshore waters along the South Carolina coast also provide habitat for

approximately 30 commonly occurring species of marine and pelagic birds, plus a number of rarer species. Most are piscivorous, although omnivorous scavengers and benthic feeders are also widely represented. Ten species of birds are permanent residents of the coastal marine habitat, including the double-crested cormorant, eastern brown pelican, Forster's and royal terns, and herring, laughing, and ring-billed gulls, all of which are common. A significant number of primarily pelagic species occur offshore much of the time, including the gannet, greater shearwater, Audubon's shearwater, northern phalarope, and Wilson's petrel. Twenty-two species overwinter here with 12 species, including six species of waterfowl, considered winter residents. These include the common and red-throated loons, gannet, horned grebe, surf and black scoters, lesser scaup, canvasback, American goldeneye, and ruddy duck. Little information exists concerning the numbers of birds utilizing the marine coastal waters of South Carolina, but large concentrations of sea ducks, often numbering in the thousands, are frequently encountered in these waters during winter. Large flocks of loons, gannets, and cormorants are also frequently observed during winter months (Spitzer 1997).

Work by Dr. Paul Spitzer as well as the Service's mid-winter sea duck surveys and Christmas Bird counts have documented significant concentrations of loons and other marine birds along the Carolina coast. The Carolina coast, from Cape Lookout in North Carolina to Pawleys Island in South Carolina, has particular oceanographic features that make the area very valuable wintering habitat for loons and other marine birds. The area has an extended continental shelf that is bounded by the Gulf Stream. Both the water temperature and turbidity are stable, and the area serves as a winter sanctuary for fish, including peanut menhaden which form the prey base for loons and other marine birds. Wintering habitat selection is extremely important for loons, in that they experience an approximately one-month-long flightless period during molting of the remigial (primary flight) feathers during January-February. They are visual feeders and must have available relatively clear water and an abundance of prey to survive this flightless period. As evidenced by the *Star Evviva* oil spill, these birds are particularly vulnerable to oil spills along the Carolina coast during January and February. Depending upon the physical condition of the birds when they are again "hard-penned," there may be an additional vulnerable period (Spitzer 1997).

3.1.2 Natural Resources of Concern

The natural resource of primary concern related to the Spill is marine birds. While some degree of offshore water column injury would have occurred from the release of the oil and other EFHs may have been injured as well depending upon the fate of the spilled oil, there were no documented injuries to marine fishes or mammals. However, the data clearly indicate that birds were oiled by the *Star Evviva* oil spill. Oiling of the feathers can cause matting and loss of insulating and water-repellent properties, leading to hypothermia, starvation, or drowning (Fry and Lowenstine 1985; Holmes and Cronshaw 1977). Oil ingestion, primarily from preening behavior, can cause anemia, pneumonia, intestinal irritation, kidney damage, altered blood chemistry, decreased growth, impaired osmoregulation, and decreased production and viability of eggs (Crocker *et al.* 1974; Holmes and Cronshaw 1977; Miller *et al.* 1978; Ohlendorf *et al.*

1978; Stickel and Dieter 1979; Peakall and Gilman 1980; Peakall *et al.* 1981; Clark 1984. and Fry and Lowenstine 1985). Oil spills can also injure birds indirectly through habitat loss and disruption of nesting and foraging activities (Albers 1991). Due to the circumstances of the *Star Evviva* spill (30-50 miles offshore; low temperatures; flightless birds), it is believed that most of the birds exposed to oil likely died.

Tables 1 and 2 show that 194 birds were retrieved and transported to the Myrtle Beach Wildlife Rehabilitation Center (WRC) (101 were treated; 93 were dead on arrival). Of those retrieved, five birds were not oiled and one was oiled from an apparently different source. As shown in Table 2, species oiled as a result of the spill and brought to the WRC included the common loon, red-throated loon, gannet, double-crested cormorant, ring-billed gull, and surf scoter (one pelican was reported by a local veterinarian, but none were received at the WRC). Based on the birds retrieved, loons were the most affected: 177 were common loons and two were red-throated loons. Therefore, only loon injuries were assessed.

3.2 Assessment Strategy

The goal of injury assessment under OPA is to determine the nature and extent of injuries to natural resources and services, thus providing a technical basis for evaluating the need for, type of, and scale of restoration actions.

Injury determination begins with the identification and selection of potential injuries to investigate. Injury is defined by OPA regulations as an observable or measurable adverse change in a natural resource or impairment of a natural resource service which may occur directly or indirectly to a natural resource or service (15 C.F.R. §990.30). We have oiled, dead birds, a definite injury according to the regulations. Although there may have been other injuries, we did not consider any others since there were no other documented injuries and the National Oceanic and Atmospheric Administration (NOAA), which is the federal Trustee for marine resources, chose not to participate in the NRDA process involving this spill.

Once we have determined that a resource is injured, the injury must be quantified. The injury quantification process determines the degree and spatial and temporal extent of injury relative to baseline and forms the basis for scaling restoration activities.

Injury quantification begins with estimates of the magnitude of affected habitat and/or the number of animals killed or injured as a result of the incident. The Trustees also consider the number of young that these individuals would have produced (production forgone). Once the magnitude of the injury is established, the Trustees estimate the recovery time required for the resource to return to baseline (prior to the spill event) condition. This can vary significantly, depending upon the habitat and/or species affected. In general, species that are limited by food or habitat availability and/or enjoy rapid reproductive cycles may recover relatively quickly if the loss of some animals eases food or habitat constraints and/or new animals are reproduced quickly. Species with slower reproductive cycles or environmental constraints not eased by the

loss of some animals are likely to recover more slowly. The actual biological processes that determine recovery from an oil spill are more complex than these simple examples suggest, and the knowledge and data to estimate recovery times precisely are difficult and costly to obtain.

Both the magnitude of the injury and the recovery time must be considered in the injury quantification process. One way of accomplishing this is by multiplying the total number of lost animals (direct plus interim losses) by the recovery period; this gives an estimate of injury in terms of lost bird-years. Typically, injury estimates in later years are discounted at 3 percent per year, summed, and added to the injury in the year of the spill to generate an estimate of total injury. Also, since restoration of the resource will not occur until some time in the future, the total injury estimate is increased by 3 percent for each year between the injury and the date of expected restoration. The discount is applied to reflect the social rate of time preference, the rate at which society is willing to substitute between present and future consumption of natural resources. The real rate of interest and the government borrowing rate are recommended in the economics literature as the best measures of the social rate of time preference. Empirical evidence supports a 3 percent discount rate (Freeman 1993; NOAA 1999). Federal rulemakings also support a 3 percent discount rate for lost natural resource use valuation (61 FR 453; 61 FR 20584).

While only 179 loons that died as a result of exposure to the Spill were retrieved, total mortality attributable to the Spill is likely substantially greater due to oiled birds/carcasses sinking, being scavenged, or being carried away from shore via winds, currents, and/or entrainment in the Gulf Stream (in addition to our limited retrieval efforts). It is believed that the oil spilled from the *Star Evviva* most likely emulsified and was entrained in the Gulf Stream where it remained offshore and moved to the northeast (personal communication, LCDR Chuck Jennings, MSO Charleston, SC, February 4, 2000, to Diane Duncan, USFWS). This is based on a trajectory analysis provided by NOAA on January 25, 1999: "Winds south of Cape Hatteras, NC, showed 15-20 knots from the south on the 14th and into the 15th of January. By noon on the 15th winds became W to NW which would have kept the oil offshore and in the Gulf Stream. Once past Cape Hatteras, the Gulf Stream would have taken the oil offshore to the northeast" (memo from NOAA/Hazardous Materials Response Branch, Modeling and Simulation Studies, Seattle, WA, to NOAA SSC Brad Benggio/Gary Ott/Ed Levine, January 26, 1999). Likewise, it is believed that most of the birds oiled by this spill incident did not reach shore.

To arrive at an estimate of total acute loon mortality, one must apply a multiplier (based on a qualitative analysis of the factors influencing oil spill-related mortality) to the number of birds known to have died as a result of the oil spill. Tanis and Morzer Bruijns (1968) suggest that 8 to 11 times as many oiled birds are lost at sea as come to land, even when the oil reaches land, which it did not do in the case of the *Star Evviva*. In poorly documented spills, total mortality is often assumed to be 10 times the number of birds retrieved (Burger 1993). Hope-Jones *et al.* (1970) recovered only 20% of the dead, banded birds they put in to the Irish Sea, despite intensive beach checks. Despite diligent searching, Hlady and Burger (1993) recovered only 10% of the wooden drift-blocks simulating bird carcasses that they released offshore Vancouver

Island, British Columbia, and fewer than 1% of the blocks released 86 to 116 km (53 to 72 miles) offshore. The authors concluded that blocks are more likely to be recovered than carcasses, that wind has a significant effect on carcass recovery (also supported by other literature), and that seabird mortality following marine oil spills could be greatly underestimated, particularly in spills that occur far offshore.

Based on the particular circumstances of the *Star Evviva* oil spill and a review of the literature, we assume that very few of the oiled birds were retrieved. During the cooperative assessment with the RP, we selected a multiplier of 10; while many factors, including characteristics of the spilled oil, characteristics of the biological resources, and environmental conditions, affect the bird mortality multiplier, the selection of this factor ultimately still comes down to best professional judgment. Using the multiplier of 10, the estimated total acute loon mortality associated with the Spill is 1790 birds.

For the *Star Evviva* NRDA, the Trustees used the Resource Equivalency Analysis (REA) methodology (adapted from Unsworth and Bishop 1994; Jones and Pease 1997) (see Appendix A). We obtained and ran the injury quantification models utilized in the *North Cape* spill NRDA (Sperduto *et al.* 1999). Using all the same assumptions utilized in these models, with the exception of the multiplier (we used 10 rather than 6), we have determined that the total lost loon-years associated with the *Star Evviva* spill is 14,270 (Appendix A). Therefore, the need, under OPA and NEPA, is to replace 14,270 loon-years.

4.0 RESTORATION ALTERNATIVES

4.1 Restoration Strategy

Under the NRDA regulations, restoration means any action (or alternative), or combination of actions (or alternatives), to restore, rehabilitate, replace, or acquire the equivalent of injured natural resources and services (15 C.F.R. § 990.41).

Primary restoration is any action taken to accelerate the return of injured natural resources and services to their baseline condition. Natural recovery, in which no human intervention is taken to directly restore the injured natural resources or services to baseline conditions, is considered a primary restoration alternative. Compensatory restoration is any action taken to compensate for interim losses of natural resources and or services pending recovery to baseline. The scale of the required compensatory restoration is dependent on both the initial size of the injury and how quickly each resource or service returns to baseline.

Monitoring natural recovery of the loon population is the only primary restoration alternative that is feasible for loon injuries resulting from the Spill, since neither restocking loons nor altering harvest is applicable in this case. There are, however, several feasible compensatory actions based on two management options available: (1) increase recruitment into the population or (2) increase survival/reduce mortality. The specific restoration goal for the

Star Evviva oil spill as adopted by the Trustees is to restore losses through reduced mortality of juvenile and adult loons and other migratory birds in their wintering habitat along the South Carolina coast (the birds injured and the habitat in which they were injured). Restoring losses through reduced winter mortality also represents the purpose of the proposed Trustee action under NEPA.

4.2. Restoration Alternatives

The Trustees and the RP identified and considered five restoration alternatives to restore resources injured as a result of the *Star Evviva* oil spill. These restoration alternatives were scaled to ensure that their size appropriately reflects the magnitude of injuries resulting from the incident. Where feasible, the Trustees employ a resource to resource scaling methodology. Under this approach, the Trustees determine the scale of restoration actions that will provide natural resources and/or services of the same type and quality and of comparable value to those lost. Equivalency is obtained when resources lost are offset by those to be provided through restoration.

Below are the five restoration alternatives considered by the Trustees.

1. No Action

NEPA requires that the Trustees evaluate the no action alternative which is also an option that can be selected under OPA. Under this alternative, the Trustees would take no direct action to restore injured natural resources or to compensate the public for lost services pending environmental recovery.

2. Acquisition of Loon Nesting Habitat in Canada

Loons that winter along the coast of the Carolinas breed in the northeastern United States and/or Canada. While the protection of nesting habitat is important in maintaining the loon population, wintering mortality, including oil spill mortality, is and is likely to remain an important factor in the maintenance of the loon population. In May 2002, the RP proposed the purchase of 3,234 hectares of loon nesting habitat in Ontario, Canada, at a cost of

\$1,018, 710 (\$315 per hectare).

3. Acquisition of Loon Wintering Habitat in South Carolina

Salt marshes and associated tidal creeks provide forage fish spawning and rearing habitat as well as feeding habitat for the birds injured as a result of the *Star Evviva* oil spill. Protecting salt marsh habitat along South Carolina's coast would provide direct enhancement to the natural resource which was injured as a result of the Spill. As an alternative to purchasing loon nesting habitat in Canada, the RP proposed to join with The Nature

Conservancy in providing partial funding (\$1,018,710, based on the cost of land in Canada) for acquisition of Pine Island and North Williman Island located in southern Colleton County on the eastern side of the ACE Basin National Estuarine Research Reserve. Pine Island consists of approximately 88 acres of uplands and 2,643 acres of salt marsh, while North Williman Island has 464 acres of upland and 7,717 acres of tidal salt marsh. Loons, gannets, coots, and cormorants, species impacted by the spill, are among the numerous bird species that utilize this habitat.

4. Construction of a Bird Rehabilitation Center

a. Oiled Bird Rehabilitation Facility

The Trustees and the Responsible Party first considered acquisition of land for and construction of an oiled wildlife rehabilitation facility. Consultants for the responsible party prepared detailed specifications for the facility, based on recommendations for a wildlife rehabilitation facility prepared by Tri-State Bird Rescue & Research, Inc., the company which was engaged to clean the birds following the *Star Evviva* spill. The proposal presented minimum facility needs for rehabilitating 100-150 oiled animals during a single spill event. A number of properties in the Charleston area were evaluated by the consultants; they determined that the most promising lots were located on West Spartan Boulevard in the heavily commercial Ashley Phosphate Corridor. The proposed facility would be utilized only in the event of an oil spill and would remain in a mothballed condition at all other times.

In combination with a bird rehabilitation facility, the Trustees evaluated the need to compile data on loon mortality as this was the species most impacted by the Spill. A better understanding of the interdisciplinary diagnostic process following nonbreeding loon mortality events is needed. Exploration of recent, unexplained mortality case histories will further our understanding of loon mortality. Review of our knowledge of loon life history, ecology, and toxics in relationship to loon mortality will assist in identifying ways to minimize or eliminate these seasonal die-off events. A compilation of past and present research findings; relevant scientific literature; extensive material from current, unpublished research reports; and identification of data gaps and research strategies to fill them would be most useful to resource managers dealing with loon populations.

b. Combined Use Avian Medical Center

Because of uncertainty regarding the length of time it would take to restore 14,270 lost loon-years under an oil spill only scenario, the Trustees also evaluated the alternative of a combined use avian medical center in the Charleston area. Such a facility would have the capability to treat both injured, diseased, or displaced birds on a daily basis and oiled birds on an as needed basis. The Trustees would partner with an established bird rehabilitator to operate the center. The compilation of data on loon mortality would also be a component of

this alternative.

5. Combination of Habitat Acquisition and Bird Rehabilitation

The Trustees also considered an alternative that would combine 50% of alternative 3 and 50% of alternative 4a, which is the acquisition of 3,003 acres of wetlands in South Carolina to protect loon wintering habitat and the establishment of an oiled bird rehabilitation facility that would be able to treat 64 birds per year.

4.3 Restoration Alternative Scaling

Compensatory restoration refers to actions intended to replace interim lost services; i.e., in this case, 14,270 loon-years. With REA, replacement services are quantified in the same physical units of measure as the injury. Replacement project alternatives, such as habitat acquisition or bird rehabilitation, must be scaled so that the quantity of replacement services equals the quantity of lost services in present value terms. The replacement services are described in the REA as a proportional equivalent of baseline called *relative productivity*. Relative productivity describes the net services provided by a compensatory restoration option relative to the baseline productivity of the injured habitat or species (see Appendix A).

The REA was used to quantitatively characterize the replacement services provided by compensatory restoration. The scaling calculations for the restoration alternatives were either based on the REA in Appendix A to this document or similar methods combined with available data and the best professional judgment of the Trustees. The calculations use simplifying assumptions while seeking to fairly estimate the magnitude of restoration required as compensation for the injuries. The Trustees believe that more complex scaling calculations would be difficult and expensive to undertake and would not significantly improve the accuracy of the scaling results in this specific case.

Alternative 1 – No action

This alternative was not scaled.

Alternative 2 – Acquisition of loon nesting habitat in Canada.

The Trustees did not use the REA methodology to quantitatively characterize the replacement services that would be provided by the acquisition of loon nesting habitat in Canada because this alternative did not meet the Trustees' goals and objectives of reducing wintering mortality. The RP utilized a different methodology to scale this restoration alternative, which was presented to the Trustees in May 2002. They applied information developed in the *North Cape* NRDA which indicated that one loon nest was expected to provide 129 loon-years of compensation (Sperduto *et al.* 1999). Applying this to the estimated lost loon-years, the RP calculated that 161.7 loon nests would be needed to

compensate for losses incurred as a result of the *Star Evviva* spill. Based on information from Canadian government biologists, the RP assumed that approximately 20 hectares of land would be needed to secure the breeding habitat for one pair of loons. The need to protect 161.7 loon nests would therefore require purchase of approximately 3,234 hectares of land. Based on conversations with local conservation groups, the RP concluded that the current cost for private land in the selected area of northwestern Ontario was approximately \$189-\$315 per hectare. The RP therefore calculated the maximum cost for this purchase to be \$1,018,710 and proposed to contact and establish a fund with Nature Conservancy Canada to acquire the loon habitat and to provide the Conservancy with appropriate funds.

Alternative 3 – Acquisition of loon wintering habitat in South Carolina

This alternative was scaled using REA (see Appendix A). Using marsh productivity data and loon feeding rates, we estimated that 13.6 acres of marsh per bird per year (one bird-year) would be needed. By converting acres per bird-year into bird-years per acre and calculating the relative productivity in perpetuity, the public would get 2.38 bird-years per acre of salt marsh. Thus, to compensate for all injuries, 6,006.88 acres of salt marsh need to be acquired.

Alternative 4 – Construction of a bird rehabilitation center

Alternative 4a, an oiled bird rehabilitation center

This alternative was scaled using REA (see Appendix A). The issue for scaling this alternative was to identify the size of a facility that would compensate the public for the *StarEvviva* oil spill injury, since the size of the facility dictates how many birds could be rehabilitated. As detailed in Appendix A, rescuing one loon per year for 20 years would restore 112.21 loon-years. This represents the relative productivity of the rehabilitation facility. Dividing the relative productivity into the debit (14,270 lost loon-years) gives a credit of 127.18 loons. This means that a rehabilitation facility must be able to accommodate around 127 loons per year over 20 years to fully compensate the public for its losses. Since a variety of birds would be treated at a rehabilitation facility, we also determined the relative productivity of a facility treating a variety of water birds. In total, 72.93 bird-years may be restored by rehabilitating an "average" bird per year over 20 years. Based on an "average" sea bird, a rehabilitation facility must be able to accommodate 196 birds per year over 20 years to compensate the public for its losses. The compilation of data on loon mortality was not scaled.

Alternative 4b, a combined use avian medical center

The Trustees consulted with leading avian medical and oiled wildlife rehabilitation facilities around the world and the most qualified avian practitioners available to discuss how effective a combined avian medical center would be that provided the best available level of

medical care and husbandry to injured birds on a daily basis, while including all components required in an oil spill capacity. Using the “average” sea bird information of 196 birds per year over 20 years, we extrapolated that treating a wider variety of birds (seabirds, wading birds, and raptors) at the rate of 400-500 birds per year, would restore lost bird years within 7 to 10 years of operation. The compilation of data on loon mortality was not scaled.

Alternative 5 – Combination of habitat acquisition and bird rehabilitation

This alternative was scaled using REA (see Appendix A).

5.0 SELECTION OF THE PREFERRED ALTERNATIVE

5.1 Selection Criteria

After identifying a reasonable range of primary and compensatory restoration alternatives, OPA regulations require the Trustees to identify the preferred restoration alternative(s) based on the following criteria (15 C.F.R. §990.54):

- The extent to which each alternative is expected to meet the Trustees' goals and objectives in returning the injured natural resources and services to baseline and/or compensating for interim losses;
- The likelihood of success of each alternative;
- The extent to which each alternative will prevent future injury as a result of the incident, and avoid collateral injury as a result of implementing the alternative;
- The extent to which each alternative benefits more than one natural resource and/or service;
- The effect of each alternative on public health and safety; and
- The cost to carry out the alternative.

5.2 Alternatives Evaluation

5.2.1 No Action

The No Action alternative would not meet the Trustees' goals and objectives to reduce wintering mortality in coastal South Carolina; would not prevent future injury as a result of the incident; and would not benefit other natural resources and/or services. Furthermore, the

no action alternative would be unsuccessful in compensating the public for bird injuries that resulted from the *Star Evviva* spill. This alternative would have no collateral injury as a result of implementation, no effect on public health and safety, and no implementation costs.

The Trustees' responsibility to seek restoration for injured natural resources and/or compensation for interim losses pending environmental recovery is clearly set forth in OPA and cannot be addressed through a No Action alternative. Furthermore, natural recovery is threatened by the risk of further oil spills. Therefore, the No Action alternative was rejected because significant loon losses were sustained, natural recovery is expected to be very slow, and technically feasible and cost-effective alternatives exist to compensate for these losses.

5.2.2 Acquisition of Loon Nesting Habitat in Canada

The selection of 20 hectares of breeding habitat for one pair of loons is not supported. The size of a loon nesting territory varies significantly, based on topography, food source availability, the presence of competitors and predators, and several other factors. Breeding takes place in lakes with both shallow and deep water; nests are almost always built at the water's edge. Lakes smaller than 80 hectares generally support only one breeding pair. The size of territory per territorial nesting pair ranges from 39 hectares in Saskatchewan to 503 hectares in New Hampshire ("Wings Info Resources/Species Information and Management Abstracts Common Loon," The Nature Conservancy, <http://www.tnc.org>, 2000). Based on these data, the acreage requirement for loon nesting habitat would be significantly greater than the 3,234 hectares calculated by the RP. In addition, Trustees in the *North Cape* incident determined a per-nest protection requirement of 6,269 linear shoreline feet at an average cost of \$158,000 per nest site. Applying these parameters to the *Star Evviva* case, the cost of protecting sufficient nests would be more than \$25,000,000.

Protection of loon nesting habitat in Canada would theoretically result in increased recruitment to the loon population, but it would not meet the goals and objectives of reducing wintering mortality in South Carolina. This alternative would benefit a number of species that utilize loon habitat. It would not prevent future injury as a result of the incident; there would be no collateral injury as a result of implementing this alternative. Likelihood of success is moderate; lack of breeding habitat is only one of the causes of loon population declines, and increased habitat protection would not guarantee increased recruitment into the population. In addition, Trustee oversight and monitoring of this alternative would be difficult and expensive. This alternative would not affect public health and safety. Because this alternative would not meet the Trustees' goals and objectives of reducing wintering mortality in South Carolina, it was not further considered.

5.2.3 Acquisition of Loon Wintering Habitat in South Carolina

Protection of salt marsh habitat in South Carolina would meet Trustee goals and objectives and would benefit more than one natural resource. Since the properties proposed by the RP

have already been purchased by The Nature Conservancy and are no longer available, the likelihood of securing the 6,007 acres of salt marsh needed to restore lost bird-years is limited to moderate, as all salt marsh in South Carolina is considered public property unless one has documented a King's Grant for a given marsh. Furthermore, the cost of acquiring 6,007 acres of salt marsh is estimated to be around \$5,000,000, based on recent sales in coastal South Carolina, and the RP proposal of \$1,018,710 is not sufficient to acquire adequate salt marsh to fully compensate for the losses. The RP's proposal to contribute \$1,018,710 toward The Nature Conservancy's purchase of Pine and North Williman islands would not be adequate to fully compensate for losses. This alternative would not prevent future injury as a result of the incident, would not have any collateral injury associated with implementation, and would have no effect on public health and safety. This alternative was rejected because negotiated settlement funds are insufficient to acquire adequate salt marsh to fully compensate for the natural resource losses that resulted from the *Star Evviva* spill.

5.2.4 Construction of a Bird Rehabilitation Center

Vast numbers of migratory birds are killed and injured annually due to collisions with human structures and equipment, poisoning by pesticides and contaminants, and attacks by cats and other introduced predators. Oil spills may kill hundreds of thousands or more, depending on the severity and timing of the spill. Up to two millions birds are killed annually in oil and wastewater pits. Declining bird populations, including loon populations, are probably most often the result of combined or cumulative impacts of all mortality. Thus, addressing each of the contributing factors is a priority (U. S. Fish and Wildlife Service 2002).

Wildlife rehabilitation is the treatment and temporary care of injured, diseased, and displaced indigenous wildlife and the subsequent return of healthy animals to appropriate habitats in the wild. Caring for oiled wildlife may return a significant percentage of animals, including endangered and threatened species, to their environment and help in the maintenance of populations. Based on 10 years of operation, the South Carolina Center for Birds of Prey reports that approximately 20% of injured birds in their care die, while approximately 15% must be euthanized. (Personal Communication, James D. Elliott, Jr., Executive Director, South Carolina Center For Birds of Prey, September 22, 2001, to Diane Duncan, USFWS). Successful rehabilitation of oiled wildlife has made remarkable progress in recent years and has proven to be a viable solution for animals affected by oil spills (Letter to Ms. Cindy Chaffee, U. S. Fish and Wildlife Service, Lacey, WA, April 13, 1999, from Dr. Erik Stauber, Professor and Head Small Animal Clinic, Washington State University, Pullman, WA, regarding the *Tenyo Maru* Oil Spill Restoration Plan). Release rates for oiled rehabilitated birds have recently ranged from 78% for king eiders (Tseng and Goodfriend 1997) to 90% for brown pelicans (Leggett 1997). Survival equaling those of unaffected wildlife has been achieved, ranging from 59% for Little Penguins in Australia (Goldsworthy *et al.* 1997) to 90% for African Penguins (Williams *et al.* 1997). Wolfhardt *et al.* (2003) report that there is no significant difference between the longer-term survival of rehabilitated oiled African Penguins and non-oiled birds based on banding studies. They suggest that there is no

survival penalty, either short-term or long-term, in being de-oiled for African Penguins. Wolfhardt *et al.* (2003) also report that a total of 17 different breeding success studies have been conducted since the oil spill in June 1994 and that there has been no significant difference in the breeding success between de-oiled and non-oiled birds. Chick growth studies showed overall there has been no difference in the growth rates of chicks from Apollo Sea and control nests, although detectable differences were found in two studies soon after the spill (Wolfhardt *et al.* 2003).

Many studies have documented the inverse correlation between the length of time until care is given oiled/injured birds and the long-term survival of these birds. As to oiled birds, Jay Holcomb, Executive Director of International Bird Rescue and Research Center stated in a letter to Ms. Cindy Chaffee, U. S. Fish and Wildlife Service, Lacey, WA, April 14, 1999, that "To this day the lack of functional oiled wildlife rehabilitation facilities remain the number one obstacle in oiled wildlife rehabilitation efforts throughout the world, often crippling attempts to rehabilitate oiled wildlife. IBRRC averages a fifty to eighty percent release rate with oiled birds when we have use of an appropriately designed oiled wildlife rehabilitation facility and are able to utilize the expertise of trained and experienced rehabilitation staff. These release rates are very encouraging but can only be achieved when all the essential components of an oiled wildlife rehabilitation program are in place. A functional facility is the key component of such a program."

5.2.4.1 Oiled Bird Rehabilitation Facility

The availability of an oiled bird rehabilitation facility in coastal South Carolina, would allow the Trustees to respond to oiled wildlife more quickly in the event of an oil spill. Such a facility would benefit more than one natural resource and has a high likelihood of providing for the successful return of oiled birds to wild populations. There would be no adverse effects on public health and safety. However, there is a great deal of uncertainty as to whether such a facility, which would be mothballed most of the time, would restore the injured resource within a reasonable period of time; since there is no certainty regarding the occurrence of an oil spill, there is no certainty that a stand-alone oiled bird rehabilitation facility would in fact meet the Trustees restoration goals and objectives. While the cost of the RP's proposed, stand-alone facility was not disclosed to the Trustees, such a facility would not be cost effective due the uncertainties discussed above. For these reasons, this alternative was rejected.

Compilation of data on loon mortality will assist in meeting the Trustee goals and objectives of reducing wintering mortality of loons in coastal South Carolina. The likelihood of success of this component is high. While compiling this data would not reduce future injury as a result of the incident, it could assist in reducing injuries resulting from future incidents. This action may also benefit more than one natural resource or service, in that the report will address ecological and toxicological issues that may be applicable to other species and their habitats. The estimated cost for this component is \$36,000.

5.2.4.2 Combined Use Avian Medical Center

Establishment of an oiled bird rehabilitation facility in partnership with an existing avian medical center would be more cost effective than a stand-alone oiled bird rehabilitation facility. This combined use facility would: 1) reduce migratory bird mortality in coastal South Carolina; 2) fulfill *Star Evviva* restoration goals and objectives; 3) benefit more than one natural resource; and 4) has a high likelihood of successfully returning injured and oiled birds to wild populations. While this alternative would not prevent future injury as a result of the *Star Evviva* incident, it would prevent and/or minimize injury from similar incidents in the future. This alternative would have no adverse effects on public health and safety and would in fact offer the opportunity for public outreach and educational opportunities.

The Trustees have worked in collaboration with other leading avian medical and oiled wildlife rehabilitation facilities around the world and the most qualified avian practitioners available to design a combined use avian medical center. Full consideration was given to providing the best available level of medical care and husbandry to injured birds on a daily basis, a function that differs significantly from that required in an oil spill event. The facility is programmed to include all components required in an oil spill capacity, utilizing shared space, equipment, resources, and staff wherever possible. The estimated cost to construct and equip a combined use facility, on lands owned by the partnering avian medical center, is approximately \$1.75 million. This would include an approximately 6000-square-foot medical clinic, site improvements/utilities, outdoor pools and enclosures, furniture, fixtures, supplies, and equipment and would have the capability to treat approximately 400 to 500 birds per year.

The compilation of data on loon mortality will have the same benefits as discussed in 5.2.4.1.

5.2.5 Combination of Habitat Acquisition and Bird Rehabilitation

Protection of salt marsh habitat in South Carolina and construction of an oiled bird facility would meet Trustee goals and objectives and would benefit more than one natural resource. Since the properties proposed by the RP have already been purchased by The Nature Conservancy and are no longer available, the likelihood of securing the 3,003 acres of salt marsh needed to restore lost bird-years is limited to moderate, as all salt marsh in South Carolina is considered public property unless one has documented a King's Grant for a given marsh. Although the cost of the RP proposed oil bird facility was not disclosed to the Trustees, the cost of acquiring 3,003 acres of salt marsh is estimated to be around \$2,500,000, based on recent sales in coastal South Carolina. Therefore, the cost of this alternative is likely to exceed the negotiated settlement funds. This alternative would not prevent future injury as a result of the incident, would not have any collateral injury

associated with implementation, and would have no effect on public health and safety. This alternative was rejected because negotiated settlement funds are insufficient for its implementation.

5.3 The Preferred Restoration Alternative

After careful evaluation of all alternatives consistent with OPA criteria, the Trustees' preferred restoration alternative is number 4b, the establishment of a combined use avian medical center that has the capability to treat both injured, diseased, and displaced birds on a daily basis. The facility would be constructed and operated under a cooperative partnership agreement with an established, permitted wildlife rehabilitator with a proven record of rehabilitating wild birds and returning them to their wild populations. This alternative would fully compensate the public for natural resource losses incurred as a result of the *Star Evviva* spill and is consistent with the goal of the U.S. Fish and Wildlife Service's recently adopted Migratory Bird Program Strategic Plan to "Protect, restore, and manage migratory bird populations to ensure their ecological sustainability and increase their socioeconomic benefits."

In addition to the combined use avian medical center, the Trustees would contract with a national expert on loon mortality to prepare a report on the Conservation Biology of Nonbreeding Loons. This report will review our knowledge of life history, ecology, and toxics, considering their relationship to loon mortality. Gaps in our knowledge and research strategies to fill them would be emphasized. Field study of nonbreeding common loons as bioindicators would also be emphasized, focusing on situations not covered by current publications. The report would detail past and present research findings; cover relevant scientific literature; and include extensive material from current unpublished research reports. This report would assist future management of loon populations.

6.0 ENVIRONMENTAL CONSEQUENCES

6.1 No Action

The environmental consequences of the No Action alternative would be adverse for the future of oiled and injured migratory birds along South Carolina's coast. The lost bird-years resulting from the *Star Evviva* oil spill would not be actively restored and the public would not be compensated for the natural resource injury.

6.2 Acquisition of Loon Nesting Habitat in Canada

There would be no adverse environmental effects from purchasing land in Canada for loon nesting habitat protection. We would anticipate that this alternative would have wholly beneficial effects to the target species. However, the lost bird-years resulting from the *Star Evviva* oil spill would not be wholly compensated with this alternative and the public would

not be fully compensated for the natural resource injury.

6.3 Acquisition of Loon Wintering Habitat in South Carolina

There would be no adverse environmental effects from purchasing land in South Carolina for loon wintering habitat protection. We would anticipate that this alternative would have wholly beneficial effects to the target species. However, the lost bird-years resulting from the *Star Evviva* oil spill would not be wholly compensated with this alternative and the public would not be fully compensated for the natural resource injury.

6.4 Construction of a Bird Rehabilitation Center

6.4.1 Oiled Bird Rehabilitation Facility

An oiled bird rehabilitation facility would provide benefits to oiled birds by allowing an expedited rehabilitation effort. As documented in the literature, time is of the essence in the successful rehabilitation of oiled birds. Construction impacts would be minimal in that the potential locations investigated for this facility are heavily developed, with existing access to power, water, and sewer. Increases in traffic and noise during construction would be minimal and short-lived. There would be no adverse impacts on fish and wildlife habitats, wetlands, or endangered and threatened species or critical habitats. Compilation of data on common loon mortality would have no adverse environmental consequences and would be beneficial in the future management of loon populations.

6.4.2 Combined Use Avian Medical Center

The environmental consequences of establishing a permanent combined use avian medical center are expected to be minimal. There is a slight possibility that adverse impacts, such as disease, could occur from the activities associated with rehabilitation and release of wild birds. However, rehabilitated animals may play a vital role in maintaining and improving their populations and in providing function to the ecosystem. Restoring populations through rehabilitating individuals and returning them to the wild population are expected to benefit the species directly.

No adverse impacts to wetlands, threatened or endangered species, critical habitats or cultural resources are anticipated. The footprint of the center would require the permanent removal of a small amount of upland vegetation; installing water and sewer lines would require the temporary removal of vegetation as well as trenching activities. During construction, local traffic and noise levels would temporarily increase; dust levels are likely to increase as well. Wildlife habitat around the center (including wetlands) would be maintained, both for the purposes of habitat conservation and buffering the center. Impacts of the facility would be beneficial to injured or oiled migratory birds in coastal South

Carolina. Compilation of data on common loon mortality would have no adverse environmental consequences and would be beneficial in the future management of loon populations.

6.5 Combination of Habitat Acquisition and Bird Rehabilitation

There would be no adverse environmental effects from purchasing land in South Carolina for loon wintering habitat protection. An oiled bird rehabilitation facility would provide benefits to oiled birds by allowing an expedited rehabilitation effort. As documented in the literature, time is of the essence in the successful rehabilitation of oiled birds. Construction impacts would be minimal in that the potential locations investigated for this facility are heavily developed, with existing access to power, water, and sewer. Increases in traffic and noise during construction would be minimal and short-lived. There would be no adverse impacts on fish and wildlife habitats, wetlands, or endangered and threatened species or critical habitats. However, the lost bird-years resulting from the *Star Evviva* oil spill would not be wholly compensated with this alternative and the public would not be fully compensated for the natural resource injury.

7.0 THE SELECTED RESTORATION PLAN

After careful evaluation of all alternatives consistent with OPA and NEPA criteria and following full consideration of public comments, the Trustees have selected number 4b, the establishment of a combined use avian medical center that has the capability to treat both injured, diseased, and displaced birds on a daily basis and oiled birds on an as needed basis, as the restoration plan to restore natural resources injured as a result of the *Star Evviva* oil spill. Compilation of data on loon mortality is also a component of the selected plan.

8.0 MONITORING PROGRAM AND PERFORMANCE CRITERIA

The recipients of the funding for the selected alternative will be required to report to the Trustees as follows:

8.1 Construction of the Combined Use Avian Medical Center

A minimum report regarding the status of the construction of the facility will be required one year after the receipt of funds, or upon completion of construction, whichever occurs first. Thereafter, minimal annual reporting will be required, to inform the Trustees regarding the number and kinds of birds treated per year until the required bird years are recovered. If the number of birds treated is less than the projected annual rate of 400-500 birds per year, the number of years of required operation will be extended until the total of 14,270 birds-years have been recovered.

8.2 Compilation of Data on Loon Mortality

The research component of this restoration will require an annual report until the data is compiled and the report written. A final report is expected to be submitted to the Trustees when the work is completed.

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Figure 1. Trackline of the *M/S Star Evviva*, 13-14 January 1999.

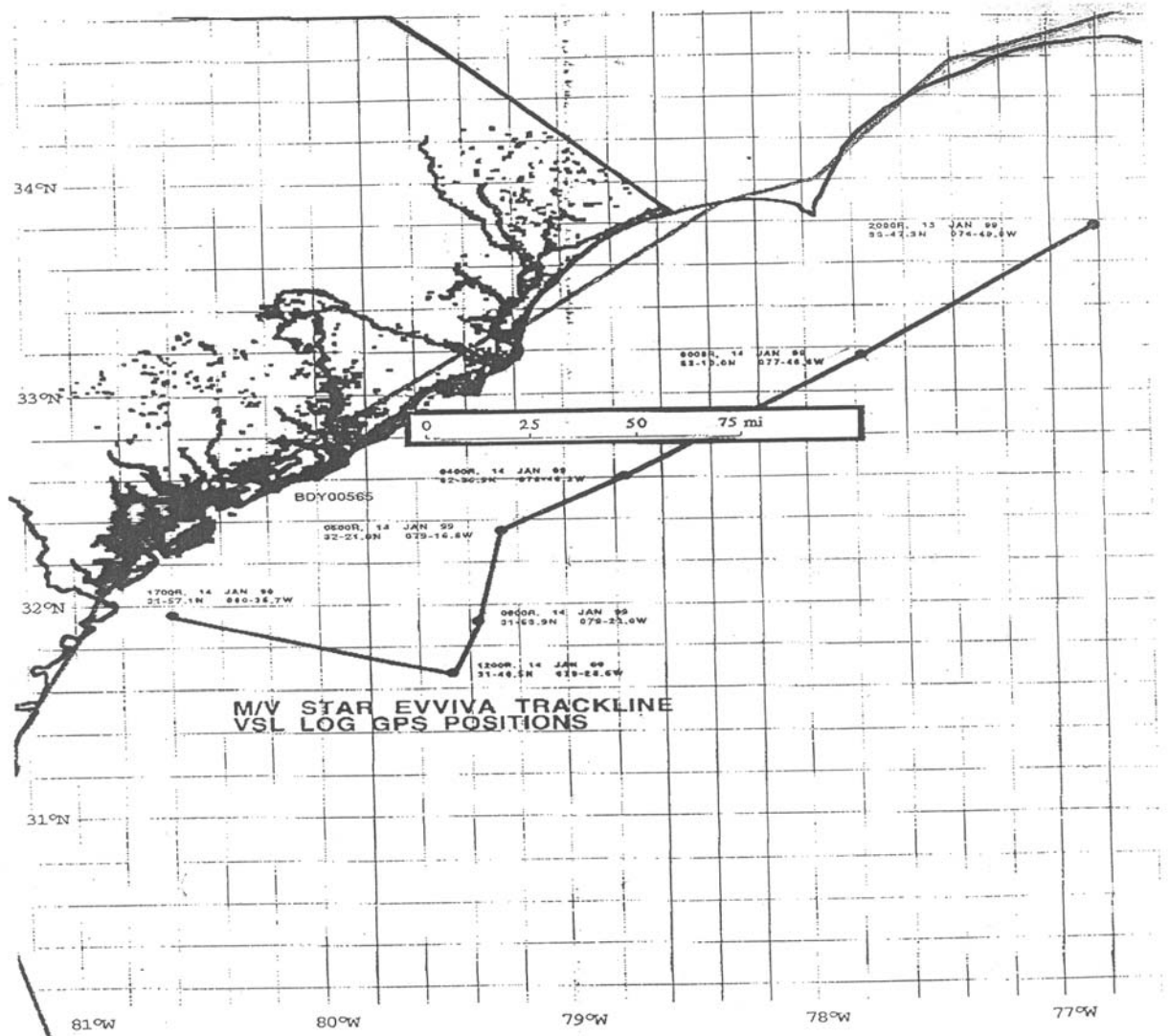


Table 1. Number of Oiled Birds Retrieved and Treated

Number of Birds Retrieved/Processed at the Myrtle Beach WRC between January 21 and February 14, 1999	194*
Number of Non-oiled Birds	5
Number of Oiled Birds apparently not related to <i>M/S Star Evviva</i> (From near a marina at Wrightsville Beach, NC, on February 6; Oil appeared fresh)	1
Number of Birds from SC/NC	157/37
Number of Birds Dead on Arrival	93
Number of Birds Treated at the WRC	101
Number of Treated Birds that Died/Euthanized	95
Number of Birds Released (One released was not oiled)	6
Number of Carcasses in USFWS possession	188**
Number of Birds Dead as a Result of Exposure to the Star Evviva oil spill	183

*We are aware of other oiled, dead birds: 5 were stolen from the back of a truck; an unknown number picked up the weekend of January 16-17 were discarded; one pelican died while being cleaned and was discarded. Birds were not retrieved from coastal islands accessible only by boat (except at Cape Romain National Wildlife Refuge). Also, we have reports of some birds that were cleaned and released (one confirmed) and some that remained in the care of local citizens.

**One, a wood stork from the Isle of Palms was not oiled and did not appear to be a victim of the spill. This carcass was sent to the University of Georgia for necropsy/tissue analysis. This number includes 4 of the 5 non-oiled birds and the oiled loon apparently not related to the *Star Evviva*; i.e. five birds that did not die as a result of exposure to the *Star Evviva* oil s

Table 2. Species of Oiled Birds Retrieved and Treated

Species Involved: Common Loon, Red-throated Loon, Gannet, Double-crested Cormorant, Ring-billed Gull, Surf Scoter (Pelican reported by local veterinarian, but none received at WRC)

Also treated were one Grebe and one American Coot which were not oiled

Of the 101 birds treated
at the WRC:

Common Loons = 97
Red-throated Loons = 1
Northern Gannet = 1
Grebe = 1
American Coot = 1

Life Stages of the Common
Loons treated at the WRC:

38% Juvenile
10% Immatures
52% Adults

Birds Released:

1 Northern Gannet (immature)-2/8/99*
1 Grebe (adult, not oiled)-2/8/99*
4 Common Loons**
2 adults and one immature-2/11/99
1 adult-2/13/99

*Huntington Beach State Park

**Cape Romain National Wildlife Refuge

APPENDIX A

**SUPPORTING ANALYSIS OF DAMAGES:
LOST BIRD-YEARS FROM THE *STAR EVVIVA* OIL SPILL**

AUGUST 18, 2003

Prepared by:

**Kristin E. Skrabis, Ph.D.
Office of Policy Analysis
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Table of Contents

Summary.....	1
Introduction	2
Background Narrative	2
Interim Loss Calculations	3
Calculating Direct Interim Loss.....	3
Calculating Indirect Interim Loss.....	4
Total Lost Bird-Years.....	6
Calculating the Relative Productivity of Compensatory Restoration.....	7
Option 1 – Build a Bird Rehabilitation Center.....	7
Option 2 – Acquisition of Wetlands to Provide Loon Habitat.....	11
Option 3 – Combination of Rehabilitation Center and Acquisition of Wetlands	11
References	13

Tables

Table 1. Sample Calculations for Direct Lost Bird-Years in Current Value	3
Table 2. Direct Lost Bird-Years Lost from Loons Killed by the Star Evviva Oil Spill	4
Table 3. Indirect Injury – Common Loons	6
Table 4. Indirect Injury – Red-Throated Loons.....	6
Table 5. Total Bird-Years (Debit)	6
Table 6. Sample Calculation of Restored Services from One Loon in 2004.....	8
Table 7. Sample Calculation of Restored Services from the Fledges of One Loon	8
Rehabilitated in 2004	
Table 8. Restored Services from One Loon Per Year (Bird-Years Per Rehabilitated Loon)	9
Table 9. Rehabilitation Center Credit for Lost Bird-Years – Loons	9
Table 10. Restored Services from One “Average” Bird Per Year.....	10
Table 11. Rehabilitation Center Credit for Lost Bird-Years – “Average” Bird	10
Table 12. Acquisition Credit for Lost Bird-Years	11
Table 13. Combination of Projects Using Restored Loon Services for the Rehabilitation Center.....	11
Table 14. Combination of Projects Using Restored “Average” Bird Services for the	11
Rehabilitation Center	
Table 15. Summary of the Credits from Sample Compensatory Restoration Projects	12

Figures

Figure 1. Direct Interim Loss from the Star Evviva Oil Spill.....	5
Figure 2. Expected Value of Having One Fledged Loon Survive Through Its Average Life	5
Expectancy (Fledged in 2000; Dies in 2005)	

**Supporting Analysis of Damages:
Lost Bird-Years from the Star Evviva Oil Spill**

Summary

Injury from the Star Evviva oil spill is estimated as follows:

Total Lost Bird-Years (Debit)

11,755.82	direct interim loss
+	
2,514.20	indirect interim loss
<hr/>	
= 14,270.02	total lost bird-years

The resulting credit from a proposed loon rehabilitations center is:

Rehabilitation Center Credit for Lost Bird-Years – Loons

14,270.02	total lost bird-years (debit)
.	
112.21	bird-years/bird included in project
<hr/>	
127.18	birds restored per year for 20 years (credit)

The resulting credit from a proposed general sea bird rehabilitations center is:

Rehabilitation Center Credit for Lost Bird-Years – “Average” Sea Bird

14,270.02	total lost bird-years (debit)
.	
72.93	bird-years/bird included in project
<hr/>	
195.66	birds restored per year for 20 years (credit)

The resulting credit for wetland acquisition to provide loon habitat is:

Acquisition Credit for Lost Loon Bird-Years

14,270.02	total lost bird-years (debit)
.	
2.38	bird-years/acre included in project
<hr/>	
6,006.88	acres credit

Introduction

This report provides the supporting analysis of damages for lost bird-years from the Star Evviva oil spill off the coast of South Carolina. Dead birds were discovered on January 16, 2000. These damages are in addition to other applicable claims for assessment costs. Estimates reflect inputs from the natural resource trustees' preliminary determination of injuries and potential restoration options (by US Fish & Wildlife Service (US FWS), and results from the North Cape natural resource damage assessment (NRDA) settlement.

The remainder of this report is presented in three sections. The first section provides background information on the release incident and associated lost services.¹ The second section provides an overview of the methodology used to calculate the interim loss to the public. Using resource equivalency analysis (REA), this section includes an analysis of the lost services, and a characterization of the replacement services provided by two compensatory restoration² options. Calculation of the project scale for each of the options and the results are provided in the third section.

Background Narrative

An NRDA determines whether a release or discharge has harmed any natural resources. If it did, the assessment determines what actions or funds, if any, are needed to "restore, replace, or acquire" the equivalent of the injured resources. The interim losses, which are the losses over time for which resources are in a depleted condition and less available to the public, are considered in this case. Compensatory restoration projects are used to offset the interim losses. The fundamental question being evaluated is: What resource services would the public have if the Star Evviva oil spill never happened? The flip side, then, is what resource services does the public have to forego because of the oil spill?

Discussions with the US FWS indicate that 179 loons were killed by the Star Evviva oil spill; 177 were common loons and 2 were red-throated loons. Although actual mortality is likely to be much higher, a conservative multiplier of 10 is used in this analysis, resulting in 1790 dead loons. There are two types of injury to the loons: direct mortality and indirect injury from potentially lost fledges. Like the North Cape case, given the uncertainty associated with modeling multiple generations of birds, only one generation of fledges is considered. No primary restoration is planned beyond natural recovery. Interim losses are calculated based on the time it takes the services to recover to baseline.

The value of these services is difficult to quantify in economic terms. Exactly what are sea birds worth to the public? An alternative approach to economic valuation is resource equivalency analysis (REA) (adapted from Unsworth and Bishop 1994; Jones and Pease 1997). With REA, the replacement services are quantified in physical units of measure such as bird-years, which are the services provided by one bird for one year. The selected projects are scaled so that the quantity of replacement services equals the quantity of lost services in present value terms.³ In the end, responsible parties pay for or implement (with Trustee oversight) restoration projects that are sufficient to cover the public's interim losses. Because the services provided by compensatory restoration are qualitatively

¹Lost services refer to the interim loss of the physical and biological functions performed by natural resources, including human use, between the time hazardous substances are released and the time injured natural resources and services are returned fully to their baseline conditions.

²*Compensatory restoration* refers to the actions intended to replace the interim lost services.

³Services provided in the future are discounted at an appropriate rate of discount to reflect the social rate of time preference, the rate at which society is willing to substitute between present and future consumption of natural resources.

equivalent

to the services lost due to the release, REA can avoid dollar valuation altogether.

Interim Loss Calculations

The following provides a detailed analysis of the direct and indirect interim loss calculations. The direct losses refer to the actual injury to the loons. The indirect losses refer to the foregone fledges. The total lost services are then identified relative to the replacement services provided by compensatory restoration options.

Calculating Direct Interim Loss

The first step in REA is to quantitatively identify lost services until resources are restored to baseline. Like the North Cape NRDA case, this analysis assumes that the recovery period to baseline is equal to the amount of time the birds would have lived in the absence of the spill (Sperduto et al., 1999: 3). The US FWS estimates that 1790 loons were killed by the Star Evviva oil spill. The actual age of the loons killed by the spill is unknown. The North Cape Oil Spill report made the assumption that the average age of loons killed is the average age of the loon population – 7.16 years old (Sperduto et al., 1999: Table 3, Part 2). They used a “snapshot” approach where each age class is weighted by the relative number of birds expected in that class and the probability of survival to the next age class (Sperduto et al., 1999: 5). The loons were expected to live 17 more years (loons average a 24-year life span) (Sperduto et al., 1999: Table 3, Part 2). Thus, the public loses the services of some of the loons from age 7.16 years to 24 years, and any resulting fledges.

The loons are assumed to have an 88 percent survival rate from one year to the next (Sperduto et al., 1999: 10). The mid-point of 94% provides average bird-services for the first year instead of overvaluing services at the beginning of the year or undervaluing at the end of the year. This means that 94% of the 1790 dead loons ($0.94 \times 1790 = 1682.6$) would have lived through July of the year 2000. Approximately 1481 loons would have survived one more year until 2001 ($0.94 \times 0.88 \times 1790 = 1480.7$), and so on. The expected survival rate per year multiplied by the number of dead loons gives the lost bird-years in current value. Sample calculations are provided in Table 1.

Table 1
Sample Calculations for Direct Lost Bird-Years in Current Value

Year 2000 = 94% survival rate at mid-point * 1790 dead loons = 1682.6 lost bird-years
Year 2001 = 82.7% survival rate (0.94×0.88) * 1790 dead loons = 1480.7 lost bird-years

Using a discount rate of 3 percent,⁴ the annual discount factor may be calculated as $(1+r)^{P-t}$, where r is the discount rate, P is the present time period, and t is the time period of lost services. In 2003, for example, the discount factor is 1.0, because any number raised to the zero power equals 1.0 ($1.03^{(2003-2003=0)} = 1.0$). Similarly, the discount factor in 2013 is 0.74 ($1.03^{(2003-2013=-10)} = 0.74$). The discount factor declines over time because consumers do not value future services as highly as present ones. Conversely, the discount factor in 2002 of 1.03 is higher than 1.0, because the past is valued more highly than the present. All present values are provided for the year 2003.

By multiplying the lost bird-years in current value by the corresponding discount factor, the present value (discounted value) of lost bird-years results. In total, the value of lost services from direct injury to loons discounted to 2003 is **11,755.8 bird-years** (11624.47 common loon + 131.35 red-throated loon bird-years). This

⁴The real rate of interest and the government borrowing rate are recommended in the economics literature as the best measures of the social rate of time preference. Empirical evidence supports a 3 percent discount rate (e.g., Freeman 1993; NOAA 1999). Federal rulemakings also support a 3 percent discount rate for lost natural resource use valuation (61 FR 453; 61 FR 20584).

figure may be viewed as part of the total *debit* created by the natural resource injury. A summary of direct interim lost services is presented in Table 2. A graphical depiction of the direct interim loss is provided in Figure 1.

Calculating Indirect Interim Loss

In addition to the direct injury to the loons, one generation of lost fledges is considered. Using the North Cape approach:

- C 88 percent of adult loons survive every year (94% at mid-point for the first year);
 - C 66 percent of the loons that survive are expected to breed;
 - C Loons breed for 6 years; and
 - C Each loon that breeds averages 0.27 fledges;
 - C 76 percent of the fledges are expected to survive one year;
 - C Each fledge that survives one year then has an 88 percent chance of surviving the next year; and
 - C Average life expectancy of a newly hatched loon is approximately 5 years.
- (Sperduto et al., 1999: 7-9. Tables 5-7)

The first step in estimating indirect loss is to identify how many adults would have reproduced “but for” the Star Evviva oil spill based on expected annual survival (see Table 2), the six-year breeding period, and the 66 percent breeding rate. The second step is to multiply the number of breeding loons by the estimated 0.27 fledges per loon (i.e., breeding success) to estimate the total number of lost fledges in current value. Figure 2 shows the expected value of *each* lost fledge in terms of lost bird-years in current (undiscounted) value (1.96 bird-years per fledge). The expected value of a lost fledge over the five-year average life expectancy is adjusted to present value (2.0 bird-years per fledge). The third step is to multiply the total number of lost fledges by the expected value of each fledge in present value to estimate the **2,486.11** total indirect lost bird-years. Tables 3 and 4 provide the final results for indirect lost bird-years for one generation of fledges. The bird-years/fledge in PV for 2000 to 2001 (i.e., 2.00) is calculated by multiplying the bird-years from Figure 2 by the relevant discount factor and summing. For each subsequent year shown below, the total estimated bird-years are discounted by an additional 3% (i.e., $2.00 \times 0.97 = 1.94$, $1.94 \times 0.97 = 1.88$).

Table 2
Direct Lost Bird-Years Lost from Loons Killed by the Star Evviva Oil Spill

Year	Survival Rate of Loons	Discount Factor	Common Loons		Red-Throated Loons	
			Lost Bird-Years	Discounted Bird-Years	Lost Bird-Years	Discounted Bird-Years
2000	94.00%	1.09	1663.80	1818.08	18.80	20.54
2001	82.72%	1.06	1464.14	1553.31	16.54	17.55
2002	72.79%	1.03	1288.45	1327.10	14.56	15.00
2003	64.06%	1.00	1133.83	1133.83	12.81	12.81
2004	56.37%	0.97	997.77	968.71	11.27	10.95
2005	49.61%	0.94	878.04	827.64	9.92	9.35
2006	43.65%	0.92	772.68	707.11	8.73	7.99
2007	38.42%	0.89	679.95	604.13	7.68	6.83
2008	33.81%	0.86	598.36	516.15	6.76	5.83
2009	29.75%	0.84	526.56	440.98	5.95	4.98
2010	26.18%	0.81	463.37	376.76	5.24	4.26
2011	23.04%	0.79	407.77	321.89	4.61	3.64
2012	20.27%	0.77	358.83	275.02	4.05	3.11
2013	17.84%	0.74	315.77	234.97	3.57	2.65
2014	15.70%	0.72	277.88	200.75	3.14	2.27
2015	13.82%	0.70	244.54	171.51	2.76	1.94

2016	12.16%	0.68	215.19	146.53	2.43	1.66
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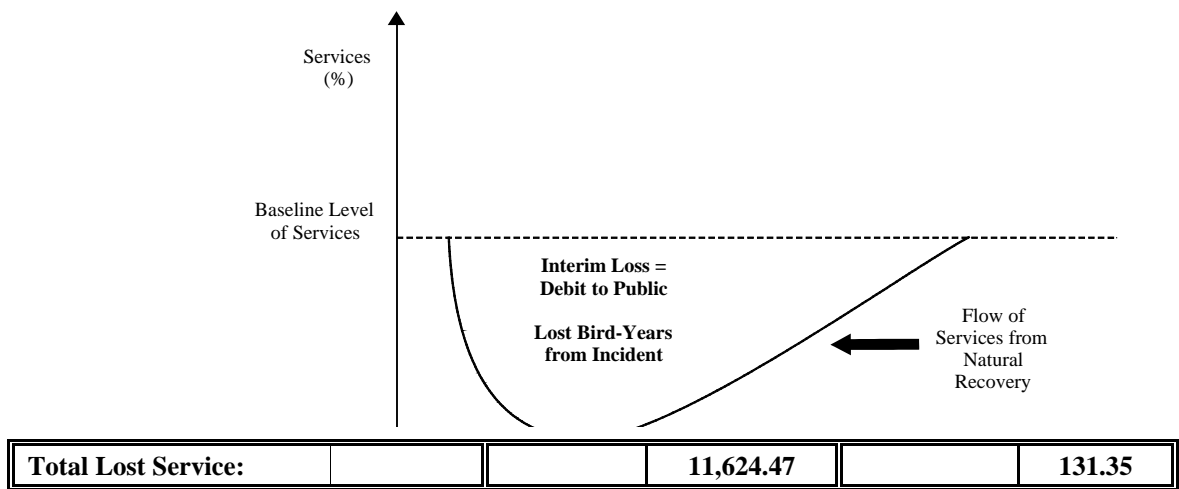


Figure 1
Direct Interim Loss from the Star Evviva Oil Spill

Figure 2
Expected Value of Having One Fledged Loon
Survive Through Its Average Life Expectancy
(Fledged in 2000; Dies in 2005)

Table 3
Indirect Injury – Common Loons

Year	Total Breeding (# Birds)*	Breeding Rate	# Breeding Loons	Fledge Rate	Total Fledges		Bird-Years/ Fledge in PV		Lost Bird-Years in PV**
2000	1663.80	* 0.66=	1098.11	* 0.27=	296.49	*	2.00	=	593.59
2001	1464.14		966.34		260.91		1.94		506.69
2002	1288.45		850.37		229.60		1.88		432.51
2003	1133.83		748.33		202.05		1.83		369.19
2004	997.77		658.53		177.80		1.77		315.14
2005	878.04		579.51		156.47		1.72		269.00
Totals:									2,486.11

*Total lost bird-years provided in Table 2 represents the number of birds each year which would have been available to reproduce.

**Numbers may not sum to totals due to rounding.

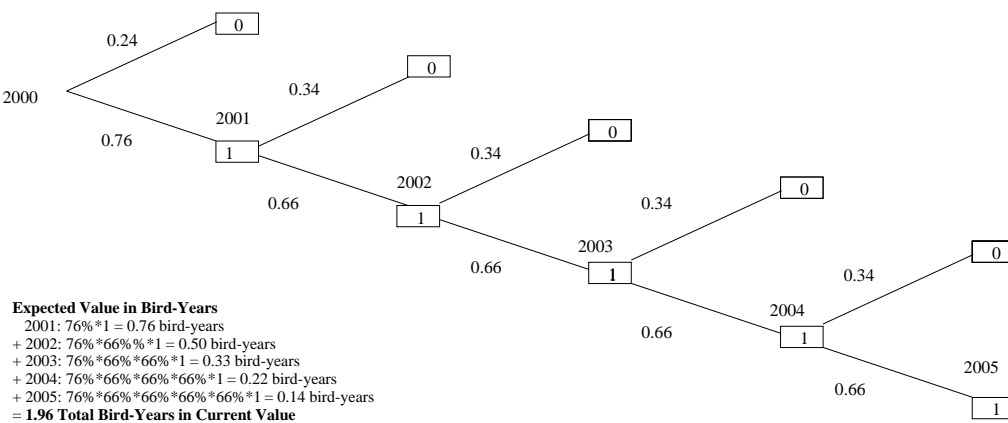


Table 4
Indirect Injury – Red-Throated Loons

Year	Total Breeding (# Birds)*	Breeding Rate	# Breeding Loons	Fledge Rate	Total Fledges		Bird-Years/ Fledge in PV		Lost Bird-Years in PV**
2000	18.80	* 0.66=	12.41	* 0.27=	3.35	*	2.00	=	6.71
2001	16.54		10.92		2.95		1.94		5.73
2002	14.56		9.61		2.59		1.88		4.89
2003	12.81		8.46		2.28		1.83		4.17
2004	11.27		7.44		2.01		1.77		3.56
2005	9.92		6.55		1.77		1.72		3.04
Totals:									28.09

*Total lost bird-years provided in Table 2 represents the number of birds each year which would have been available to reproduce.

**Numbers may not sum to totals due to rounding.

Total Lost Bird-Years

Direct interim loss and indirect interim loss are additive for a total debit of **14,270.02 bird-years**, as shown in Table 5.

Table 5
Total Lost Bird-Years (Debit)

11,755.82	direct interim loss
+	
2,514.20	indirect interim loss
=	14,270.02 total lost bird-years

Calculating the Relative Productivity of Compensatory Restoration

The second step in REA is to quantitatively characterize the replacement services provided by compensatory restoration. At each point in time, replacement services are described as a proportional equivalent of baseline called *relative productivity*. Relative productivity describes the net services provided by a compensatory restoration option relative to the baseline productivity of the injured habitat or species. In this analysis, three compensatory restoration options are considered: (1) bird rehabilitation facility, (2) acquisition of loon habitat, and (3) a combination of the two. The relative productivity of each project is estimated by calculating the present value bird-years that may be provided over time.

The third step in REA is to identify the project scale that will equate the total discounted quantity of replacement services to the total discounted quantity of lost services. The result is a credit just equal to the debit to compensate the public for the loon injury from the Star Evviva oil spill.

Option 1 – Build a Bird Rehabilitation Center. The first option under consideration by the USFWS is to build a bird rehabilitation center. The center would help restore loons and other birds injured by oil spills. The issue for scaling is to identify the size of a center that would compensate the public for the Star Evviva oil spill injury. The size of the center dictates how many birds could be rehabilitated. Two approaches are considered. The first identifies the net gains of a rehabilitation center focusing only on rehabilitating loons. In reality, though, this center would benefit a wide variety of birds. The alternative, then, is to consider the net benefit to rehabilitating an “average” sea bird, which is based on a variety of seabirds.

In both cases, the relative productivity of a rehabilitation center is based on restored bird-years when **one bird per year** is rescued over a **20-year period**, starting in 2004. This analysis assumes that the oiled bird would have been killed without the rehabilitation center. Thus, direct bird-years are restored through survival and indirect bird-years are restored by providing one generation of fledges.

Using the same inputs as in the direct injury analysis, Table 6 shows a sample calculation for one loon rescued in 2004. Like on the injury side of things, the loon is assumed to be an average age of 7 years old and may be expected to live to 24 years of age. Approximately 88 percent are expected to survive until 2005 with 94% being the average services for the first year. Thus, rescuing one loon in 2004 provides 5.67 bird-years of direct benefit. As shown in Table 7, 66 percent of the rehabilitated loons may be expected to produce 0.27 fledges annually for six years. The fledges average five years of survival. Approximately 76% of the loons may be expected to survive the first year after which they follow adult survival rates. Rescuing one loon in 2004 provides **1.71 bird-years** of indirect benefit from 2005 through 2010. Table 8 provides the results of restoring one loon per year over a 20-year period. In total, **112.21 bird-years** may be restored. This represents the relative productivity of the rehabilitation center. As shown in Table 9, by dividing the relative productivity into the debit, the credit of **127.18 birds** results. This means that a center must be able to accommodate around 127 birds per year over 20 years to fully compensate the public for its losses.

It may not be appropriate to focus on restoring loon services when a variety of birds are likely to be rehabilitated at a center. Thus, an “average” bird is considered which looks at the restored services from the loon, grebe, merganser, scoter, goldeneye, bufflehead, and eider. All of the inputs are taken from the North Cape case. The methods are the same as described above. Table 10 provides the results of restoring one “average” bird per year over 20 years. In total, **72.93 bird-years** may be restored by rehabilitating one “average” bird per year over 20 years.

Table 6
Sample Calculation of Restored Services from One Loon in 2004

Year	Discount Factor	Survival Rate of Loons	Restored Bird-Years	Discounted Restored Bird-Years
2005	0.94	94.00%	0.94	0.89
2006	0.92	82.72%	0.92	0.76
2007	0.89	72.79%	0.89	0.65
2008	0.86	64.06%	0.86	0.55
2009	0.84	56.37%	0.84	0.47
2010	0.81	49.61%	0.81	0.40
2011	0.79	43.65%	0.79	0.34
2012	0.77	38.42%	0.77	0.29
2013	0.74	33.81%	0.74	0.25
2014	0.72	29.75%	0.72	0.21
2015	0.70	26.18%	0.70	0.18
2016	0.68	23.04%	0.68	0.16
2017	0.66	20.27%	0.66	0.13
2018	0.64	17.84%	0.64	0.11

2019	0.62	15.70%	0.62	0.10
2020	0.61	13.82%	0.61	0.08
2021	0.59	12.16%	0.59	0.07
Total Restored Service:				5.67

Table 7
Sample Calculation of Restored Services from the Fledges
of One Loon Rehabilitated in 2004

Year	Total Breeding (# Birds)*	Breeding Rate	# Breeding Loons	Fledge Rate	Total Fledges		Bird-Years/ Fledge in PV		Lost Bird-Years in PV**
2005	1	* 0.66=	0.66	* 0.27=	0.18	*	1.73	=	0.31
2006					0.18		1.68		0.30
2007					0.18		1.62		0.29
2008					0.18		1.58		0.28
2009					0.18		1.53		0.27
2010					0.18		1.48		0.26
Totals:									1.71

*Total lost bird-years provided in Table 2 represents the number of birds each year which would be available to reproduce.

**Numbers may not sum to totals due to rounding.

Table 8
Restored Services from One Loon Per Year
(Bird-Years Per Rehabilitated Loon)

Year	Direct (Bird-Years)	Indirect (Bird-Years)	Discounted Total (Bird-Years)
2005	5.67	1.71	7.38
2006	5.50	1.66	7.16
2007	5.33	1.61	6.94
2008	5.17	1.56	6.73
2009	5.02	1.52	6.53
2010	4.86	1.47	6.34
2011	4.72	1.43	6.15
2012	4.58	1.38	5.96
2013	4.44	1.34	5.78
2014	4.31	1.30	5.61
2015	4.18	1.26	5.44
2016	4.05	1.23	5.28
2017	3.93	1.19	5.12
2018	3.81	1.15	4.97
2019	3.70	1.12	4.82
2020	3.59	1.09	4.67
2021	3.48	1.05	4.53
2022	3.38	1.02	4.40
2023	3.27	0.99	4.26
2024	3.18	0.96	4.14
Total Restored Services:			112.21

Table 9
Rehabilitation Center Credit for Lost Bird-Years – Loons

14,270.02 total lost bird-years (debit)
112.21 bird-years/bird included in project
<hr/>
127.18 birds restored per year for 20 years (credit)

Table 10
Restored Services from One “Average” Bird Per Year

Year	Direct (Bird-Years)	Indirect (Bird-Years)	Discounted Total (Bird-Years)
2005	3.10	1.70	4.80
2006	3.00	1.65	4.65
2007	2.91	1.60	4.51
2008	2.83	1.55	4.38
2009	2.74	1.51	4.25
2010	2.66	1.46	4.12
2011	2.58	1.42	3.99
2012	2.50	1.37	3.88
2013	2.43	1.33	3.76
2014	2.35	1.29	3.65
2015	2.28	1.25	3.54
2016	2.21	1.22	3.43
2017	2.15	1.18	3.33
2018	2.08	1.14	3.23
2019	2.02	1.11	3.13
2020	1.96	1.08	3.04
2021	1.90	1.04	2.95
2022	1.84	1.01	2.86
2023	1.79	0.98	2.77
2024	1.74	0.95	2.69
Total Restored Services:			72.93

As shown in Table 11, by dividing the relative productivity into the debit, the credit of **195.66 birds** results. This means that a center must be able to accommodate 196 birds per year over 20 years to fully compensate the public for its losses.

Table 11
Rehabilitation Center Credit for Lost Bird-Years – “Average” Bird

14,270.02 total lost bird-years (debit)
72.93 bird-years/bird included in project
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195.66 birds restored per year for 20 years (credit)

Option 2 – Acquisition of Wetlands to Provide Loon Habitat. The USFWS estimates that 13.6 acres of marsh per bird per year (one bird-year) are needed, assuming 25% productivity of the land. By converting from acres per bird-year into bird-years per acre ($1/13.6 = 0.07$) and calculating the relative productivity in perpetuity, the public gets 2.38 birds-years per acre included in the project. As shown in Table 12, if acquisition of marsh is used to compensate for all injuries, then **6,006.88 acres** will need to be acquired.

Table 12
Acquisition Credit for Lost Bird-Years

14,270.02 total lost bird-years (debit)
2.38 bird-years/acre included in project
6,006.88 acres credit

Option 3 – Combination of Rehabilitation Center and Acquisition of Wetlands. To consider a mix of options, the trustees need to decide how to weigh them. The results may be obtained using the following formulas shown in Tables 13 and 14:

Table 13
Combination of Projects Using Restored Loon Services
for the Rehabilitation Center

Build a Loon Facility	Acquire Wetlands
14,270.02 total lost bird-years	14,270.02 total lost bird-years
Credit = (W ₁) -----	+ (W ₂) -----
-	
112.21 bird-years per bird	2.38 bird-years/acre

Table 14
Combination of Projects Using Restored “Average” Bird Services
for the Rehabilitation Center

Build a Loon Facility	Acquire Wetlands
14,270.02 total lost bird-years	14,270.02 total lost bird-years
Credit = (W ₁) -----	+ (W ₂) -----
-	
72.93 bird-years per bird	2.38 bird-years/acre

For example, if the trustees want a 50-50 split between projects, then a rehabilitation facility would need to accommodate 64 birds per year over 20 years $[0.5 * (14270.2 / 112.21)]$ if the loon services are used for the rehabilitation center, and approximately 3,003 acres of wetlands would need to be acquired $[0.5 * (14270.2 / 2.38)]$. A range of results is provided in Table 15.

Table 15
Summary of the Credits from Sample Compensatory Restoration Projects

Compensatory Restoration	Debit (Bird-	Relative Productivity	Credit*
Option 1A – Rehabilitation Center (Loon Services)	14,270.2	112.21	127 birds
Option 1B – Rehabilitation Center (“Average” Bird Services)		72.93	196 birds
Option 2 – Acquisition of Loon Habitat		2.38	6007 acres
Option 3 – 50-50 Combination of Option 1A and Option 2		112.21 2.38	64 birds 3003
Option 3 – 30-70 Combination of Option 1A and Option 2		112.21 2.38	38 birds 4205
Option 3 – 50-50 Combination of Option 1B and Option 2		112.21 72.93	98 birds 3003
Option 3 – 30-70 Combination of Option 1B and Option 2		112.21 72.93	59 birds 4205

*Numbers may not sum to totals due to rounding.

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APPENDIX B

**DEPARTMENT OF THE INTERIOR
FINDING OF NO SIGNIFICANT IMPACT
UNDER THE NATIONAL ENVIRONMENTAL POLICY ACT
FOR THE *STAR EVVIVA* OIL SPILL**

NOVEMBER 2004

Finding of No Significant Impact

Project Description. The Department of the Interior, U. S. Fish and Wildlife Service (Service), proposes to restore and compensate for injuries to natural resources caused by the *M/S Star Evviva* oil spill off the coast of South Carolina on January 14, 1999. Our partners are the State of South Carolina ,Office of the Governor and the South Carolina Department of Natural Resources. The proposed restoration actions are more thoroughly described in the *Final Damage Assessment and Restoration Plan/Environmental Assessment, November 2004* (DARP/EA), to which this Finding of No Significant Impact is attached as Appendix B.

Coordination. The Service has coordinated this project with other Federal and State Resource Agencies and the interested public.

Environmental Impacts. The approval of this project is in compliance with all applicable environmental laws.

Determination. I have determined that this action does not constitute a major Federal action significantly affecting the quality of the human environment. Therefore, the action does not require the preparation of a detailed statement under Section 102 (2) (c) of the National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.). My determination was made considering the following factors discussed in the DARP/EA.

- a. The restoration project would not adversely impact any threatened or endangered species potentially occurring in the project area.
- b. No apparent unacceptable adverse cumulative or secondary impacts would result from restoration project implementation.
- c. All cultural resource issues would be addressed prior to implementing any of the proposed actions.
- d. All wetland and waters of the U.S. issues would be addressed prior to project construction.
- e. The proposed project raised no Environmental Justice concerns.

Findings. Approval of the final restoration plan as proposed by the Service would result in no significant environmental impacts and is the alternative that represents sound engineering practices and meets environmental standards.

Sam D. Hamilton
Regional Director, Southeast Region

APPENDIX C

**PUBLIC COMMENTS RECEIVED AND TRUSTEE RESPONSE
TO PUBLIC COMMENTS ON THE
*DRAFT DAMAGE ASSESSMENT AND RESTORATION PLAN/
ENVIRONMENTAL ASSESSMENT
FOR THE M/S STAR EVVIVA OIL SPILL***

NOVEMBER 2004

The Natural Resource Trustees received a total of 60 written comments during the public comment period for the *Draft Damage Assessment and Restoration Plan/Environmental Assessment September 2004* (DARP/EA). Without exception, all those providing comments are in support of the preferred alternative as presented in the DARP/EA (Alternative 4b, the combined use avian medical center). The Trustees thank each of you for taking the time to review the DARP/EA and to provide written comments. We also thank you for your support for the combined use avian medical center.

* There is no electronic version of the written comments received. For a hard copy, please call Ms. Karen McGee (843 727-4707 x203) or Ms. Diane Duncan (843 727-4707 x218).