# *Apex Houston* Trustee Council

# Final Report

March 2011

# THE PEOPLE WHO MADE IT POSSIBLE

## *Members of the Apex Houston Trustee Council*

**United States Fish and Wildlife Service**
Daniel Welsh, Chair of Trustee Council, 1995-2007
Janet Whitlock, Chair of Trustee Council, 2007-2011
Jean Takekawa
Joelle Buffa
Toby McBride

**National Oceanic and Atmospheric Administration**
Ed Ueber
Maria Brown
Jennifer Boyce
Miles Croom
Beth Mitchell
Katherine Pease

**California Department of Fish and Game**
Don Lollock
Paul Kelly
Steve Hampton

## *Scientific Team*

**Common Murre Restoration Project**

**United States Fish and Wildlife Service**
Michael Parker
Gerard McChesney

**Humboldt State University**
Richard Golightly
Harry Carter

**National Audubon Society**
Stephen Kress

**Marbled Murrelet Habitat Protection at Gazos Creek**

**Steven Singer Environmental & Ecological Services**
Steven Singer

**Hamer Environmental**
Thomas Hamer

**Cassin's Auklet Habitat Restoration, Farallon National Wildlife Refuge**

**United States Fish and Wildlife Service**
Joelle Buffa
Jesse Irwin

**Rhinoceros Auklet Habitat Enhancement, Año Nuevo State Reserve**

**Oikonos - Ecosystem Knowledge**
Michelle Hester

## *Other Contributors and Participants (partial list)*

Año Nuevo State Reserve
Armand and Eliane Neukermans
Cabrillo Unified School District
California Coastal National Monument
California Department of Fish and Game
California Department of Parks and Recreation
California Department of Transportation
Carter Biological Consulting
Duks Dekes
Filmmakers Collaborative
Fremont Unified School District
Fullframe Productions
Hostelling International USA
Huck Finn Sportfishing
Laguna Salada Unified School District
Mad River Decoy
National Oceanic and Atmospheric Administration
National Park Service
Pacifica, California Chamber of Commerce
Pillar Point Harbormaster
Point Reyes Bird Observatory
Robin Kohn Glazer
Roger Helm
San Leandro Unified School District
SeeMore Wildlife Systems
Sempervirens Fund
Telephone Pioneers
Union School District
United States Bureau of Land Management
United States Department of Agriculture – Wildlife Services
United States Department of Justice
United States Forest Service
United States Geological Survey

## CONTENTS

Overview . . . . . 1
*Apex Houston* Oil Spill . . . . . 2
*Apex Houston* Trustee Council . . . . . 3
Common Murres . . . . . 4
Marbled Murrelets . . . . . 4
The Common Murre Restoration Project . . . . . 5
Scientific Program Overview . . . . . 6
Devil's Slide Rock. . . . . 7
San Pedro Rock . . . . . 10
Monitoring of Other Colonies . . . . . 10
Additional Actions and Overall Benefit. . . . . 12
Environmental Education Program . . . . . 12
Other Outreach . . . . . 14
Marbled Murrelet Nesting Habitat Protection At Gazos Creek. . . . . 14
Other Projects . . . . . 16
Cassin's Auklet Habitat Restoration, Farallon Islands . . . . . 16
Rhinoceros Auklet Habitat Enhancement, Año Nuevo Island. . . . . 17
In Conclusion . . . . . 18
Financial Summary. . . . . 19
Literature Cited . . . . . 20
*Apex Houston* Publications, Reports, Theses . . . . . 22
Published manuscripts to date (as of January 2011) . . . . . 22
Published media . . . . . 22
Unpublished Reports, Theses. . . . . 23

Figure 1. Map of *Apex Houston* oil spill trajectory from Carter et al. 2003.
Reprinted with permission from *Marine Ornithology.*

## OVERVIEW

In 1995, the *Apex Houston* Trustee Council began the work of implementing the first seabird restoration program in California to repair injuries to seabirds from an oil spill. The Trustee Council, comprised of federal and state agencies, was charged with the task of using the funds to achieve the greatest possible benefits for seabirds affected by the spill and continued its work for a period of over 15 years. This document is the final report of the Trustee Council and provides an overview of ground-breaking restoration work benefiting thousands of seabirds.

In 1986 the *Apex Houston* oil spill impacted much of the central coast of California. The central coast is a dynamic, highly productive environment that is rich in marine life and home to diverse populations of seabirds, marine mammals, and fisheries. It includes many natural areas: national marine sanctuaries; national wildlife refuges; a national monument; state and national parks, seashores, reserves, and beaches. This region also includes a biosphere reserve and is a key area on the Pacific flyway of North America.

Biologists estimated that the oil spill killed over 9,000 birds with greatest mortality to a species of seabird known as the Common Murre (*Uria aalge*). In addition, endangered seabirds called Marbled Murrelets (*Brachyramphus marmoratus*) were killed. Concerned public agencies, non-governmental organizations, and local citizens took action and helped to catalog, rescue, and rehabilitate as many of the oiled birds as possible. On behalf of the public, state and federal agencies sued the company responsible for the spill. The responsible party eventually agreed to settle the lawsuit for $6.4 million, including $5.4 million for restoration efforts to benefit seabirds.

The *Apex Houston* Trustee Council used these funds to implement programs designed to directly benefit species injured from the spill. The restoration work included the first successful use of social attraction techniques to restore a Common Murre colony. This colony, at Devil's Slide Rock, was extirpated by the spill. Other projects included purchase of 120 acres of redwood forest habitat for the endangered Marbled Murrelet, seabird educational programs, and restoration to protect seabird nesting habitats at the Farallon National Wildlife Refuge and Año Nuevo State Reserve. The program also provided a tremendous amount of data regarding the impacts of human activities on seabirds. These data sets were used by the State of California to support increased restrictions of a gill-net fishery that caused substantial mortality to Common Murres and also to support agency efforts to reduce disturbance to seabird colonies. The efforts to reduce disturbance to seabirds continue and are funded by trustee councils for other oil spills. Since the time of the *Apex Houston* oil spill in 1986, the central California population of Common Murres increased from less than 50,000 breeding pairs to over 150,000 breeding pairs in 2006.

The restoration actions resulted from the work of many people who gathered information on the effects of the spill, worked to achieve settlement, served on the Trustee Council, and worked

on restoration efforts in the field. It is because of their efforts and belief in the need to provide restoration for dwindling populations of seabirds that the Trustee Council has completed its mission.

## *APEX HOUSTON* OIL SPILL

In early 1986, the oil barge *Apex Houston* discharged an undetermined amount of San Joaquin Valley crude oil while in transit from San Francisco Bay to Long Beach Harbor, California. In late January 1986, the crew neglected to place an ill-fitting hatch cover on an oil tank of the barge while it was docked at the Shell Oil Company refinery in Martinez. The unmanned *Apex Houston* was under tow by the tugboat *Inca* when it left the refinery and passed through the Golden Gate of San Francisco Bay. When the barge was near Long Beach, the *Inca* crew boarded the *Apex Houston* and discovered the hatch cover lying loose on the deck. Oil coated the deck and floated in the water around the barge. At least 616 barrels of oil, or 25,800 gallons, had been lost (Carter et al. 2003).

Oiled Common Murre.

In early February, state and federal agencies and non-governmental organizations began receiving reports of dead and dying oiled birds and tarballs on beaches in central California. The oiling extended from Salmon Creek Beach in Sonoma County to Point Lobos in Monterey County (Figure 1). Biologists surveyed beaches and ocean waters for oiled and at-risk seabirds and other wildlife. federal and state agencies and concerned citizens moved to action and worked to clean up the oil and rehabilitate oiled birds. Thousands of live oiled birds were recovered and transported to wildlife rehabilitation centers in the San Francisco and Monterey Bay areas, but large numbers of birds died.

Close to 9,000 birds were killed by the oil spill and included approximately 6,300 Common Murres, 1,300 Rhinoceros Auklets (*Cerorhinca monocerata),* 12 Marbled Murrelets, and close to 1,400 other birds including alcids, loons, grebes, scoters, cormorants, shorebirds, and gulls (Carter et al. 2003; Table 1). In addition, several wildlife areas of significance had been oiled including Gulf of the Farallones International Biosphere Reserve; Farallon National Wildlife Refuge; Gulf of the Farallones, Cordell Banks, and Monterey Bay National Marine Sanctuaries; Point Reyes National Seashore; Golden Gate National Recreation Area; California Islands Wildlife Sanctuary; Año Nuevo and Point Lobos State Reserves; and several other state parks and beaches.

Oiled Common Murre.

In 1989, state and federal agencies filed a natural resource damages claim against the responsible companies pursuant to the Clean Water Act; Marine Protection, Research, and Sanctuaries Act; and various state statutes. After years of litigation, the case was settled in 1994 for approximately $6.4 million, including $5.4 million for seabird restoration.

| Estimated numbers of seabirds injured by the *Apex Houston* oil spill, February 1-11, 1986. | | | | | | |
|---|---|---|---|---|---|---|
| | Oiled and Collected Live | | Dead Oiled | | Total | |
| Species[1] | Died | Survived >6 Months After Release | Washed Ashore | Lost At Sea | Oiled[2] | Oiled and Dead[3] |
| **Loons** | 106 | 35 | 133 | Unknown | 274 | 239 |
| **Grebes** | 156 | 53 | 412 | Unknown | 621 | 568 |
| **Scoters** | 52 | 17 | 187 | Unknown | 256 | 239 |
| **Common Murre** | 2,259 | 753 | 3,001 | 1,027 | 7,040 | 6,287 |
| **Small Alcids** | 6 | 2 | 118 | 56 | 182 | 180 |
| **Marbled Murrelet** | 2 | 0 | 10 | Unknown | 12 | 12 |
| **Rhinoceros Auklet** | 22 | 8 | 904 | 367 | 1,301 | 1,293 |
| **Other Species** | 31 | 10 | 129 | Unknown | 170 | 160 |
| **TOTAL** | 2,634 | 878 | 4,894 | 1,450 | 9,856 | 8,978 |

Table 1. Estimated Numbers of Birds Injured by *Apex Houston* Spill from Carter et al. 2003. Reprinted with permission from *Marine Ornithology.*

[1] For a detailed species list, see Page et al. 1990.
[2] Sum of four left hand columns.
[3] Sum of first, third and fourth columns.

## *Apex Houston* Trustee Council

In 1994, the U.S. Fish and Wildlife Service, National Oceanic and Atmospheric Administration, and California Department of Fish and Game entered into a Memorandum of Understanding that established the *Apex Houston* Trustee Council, the governing body that would oversee the use of settlement funds and restoration work. Each agency would appoint a voting member to the Trustee Council, each voting member would have equal authority in all decision-making, and all funding decisions would be unanimous.

The Trustee Council was charged with developing a restoration plan to determine how to best compensate for injuries to seabirds through restoration projects. The plan focused on projects for Common Murres and Marbled Murrelets, the seabird species most heavily impacted in the spill zone and of greatest concern. Following public review of the draft Restoration Plan, the plan was revised and made final by the Trustee Council (U.S. Fish and Wildlife Service 1995).

The Trustee Council, also charged with managing the settlement funds for restoration, invested the funding not immediately needed for restoration. Over the years, the funds earned over $2 million in interest. As a result, the Trustee Council was able to extend the duration of the projects benefitting Common Murres, fund development of management guidelines and monitoring for Marbled Murrelets at the Gazos Creek property, and fund additional restoration work to benefit Cassin's Auklets (*Ptychoramphus aleuticus)* and Rhinoceros Auklets, species that were also killed in the spill.

## Common Murres

The Common Murre is a relatively large seabird of the family Alcidae. In the Northeast Pacific Ocean, they breed from Alaska to central California. A highly social species, murres typically breed in large, dense colonies on offshore rocks, islands, and cliffs. Birds lay only one egg per year, which is laid directly on bare ground with no nest. Common Murres have high fidelity to their breeding sites year after year and typically return to breed at the colony where they were born. Murres forage in coastal waters on schooling fish, krill, and other prey. The central California population has several breeding colonies located from Point Reyes to Point Sur, with the largest colonies at the offshore Farallon Islands.

During the time of the *Apex Houston* oil spill, the central California Common Murre population was in sharp decline from a variety of factors, including high mortality from gill-net fishing, low productivity from a strong El Niño event in the early 1980s, and mortality from earlier oil spills. The *Apex Houston* spill exacerbated these declines and contributed to the loss of the breeding colony at Devil's Slide Rock as well as decline of the colonies at Castle Rocks & Mainland, Hurricane Point Rocks, and other colonies. After the oil spill, the Devil's Slide Rock colony, which held close to 3,000 breeding murres in the early 1980s, was extirpated as a breeding colony (Takekawa et al. 1990, Carter et al. 2001).

Aerial photo of Devil's Slide Rock in 1980 prior to the *Apex Houston* oil spill, showing colony of nearly 3,000 Common Murres (dark shaded areas).

Aerial photo of Devil's Slide Rock in 1986 after the *Apex Houston* oil spill, when the murre breeding colony was extirpated.

## Marbled Murrelets

The Marbled Murrelet is a small seabird found along the Pacific coast from Alaska to California. At sea, it feeds by diving for small fish in nearshore waters, typically within 5 km of the coastline. The Marbled Murrelet is a long-lived, slow-reproducing species, laying only one egg per year. It nests inland, typically in old-growth coniferous forests. In California, Marbled Murrelets nest almost

exclusively in coast redwood (*Sequoia sempervirens*) and Douglas-fir (*Pseudotsuga menziesii*) trees greater than 200 years old (Nelson 1997). Fewer than 5,000 birds nest in Humboldt and Del Norte Counties in northern California, while a small population of about 500 birds nests in the Santa Cruz Mountains just south of the San Francisco Bay area. It is this population that was impacted by the *Apex Houston* oil spill.

The Marbled Murrelet was listed as a California State Endangered Species in 1991 and a federal Threatened Species in 1992 due to dwindling populations from loss of old-growth forest breeding habitat, mortality from entanglement in gill nets, and effects from oil spills. The listings increased concern regarding injury from the spill to the small, remnant central California population which did not have the capacity for recovery and is threatened with extirpation. Coastal areas between Half Moon Bay and Santa Cruz were heavily oiled during the spill, especially in the vicinity of Año Nuevo Bay where murrelets concentrate. The entire central California population breeds in coastal old-growth redwood forests adjacent to the spill zone.

Marbled Murrelet.

## THE COMMON MURRE RESTORATION PROJECT

The Trustee Council allocated over $6.7 million to the restoration of Common Murres. The primary goals were to restore Common Murre colonies at Devil's Slide Rock and San Pedro Rock and included two components, a Scientific Program and an Education Program. The U.S. Fish and Wildlife Service–San Francisco Bay National Wildlife Refuge Complex was chosen to lead the project. The Farallon National Wildlife Refuge, managed by the U.S. Fish and Wildlife Service, hosts the largest seabird colony in the contiguous United States and the largest Common Murre colony in California. Because of declines noted on the Farallon National Wildlife Refuge in the mid-1980s, U.S. Fish and Wildlife Service was involved in documenting the extent and causes of murre declines in central California and had considerable experience working with central California murre population.

The project included many collaborators including the National Audubon Society, Humboldt State University, Carter Biological Consulting, U.S. Geological Survey (Biological Resources Division), and Point Reyes Bird Observatory. The National Audubon Society's Seabird Restoration Program developed the social attraction techniques that were used to restore the Common Murre colony at Devil's Slide Rock. Staff at Humboldt State University and Carter Biological Consulting had extensive expertise on the biology and population monitoring of Common Murres and other seabirds in California, including factors leading to declines and issues that would affect restoration. Humboldt State University staff assisted with development of initial study design, project

implementation, assessment of project success, and development of adaptive management strategies. Additional assistance was provided by California Department of Fish and Game, National Park Service (Point Reyes National Seashore), Gulf of the Farallones and Monterey Bay National Marine Sanctuaries, several local school districts, and many others.

Figure 2. Map of the study area showing locations of the Common Murre Restoration Project study colonies and colony complexes.

## Scientific Program Overview

The primary goal of the Scientific Program was the restoration of extirpated Common Murre colonies at Devil's Slide Rock and San Pedro Rock (Figure 2). Social attraction was used to recolonize these sites. The technique utilized decoys, recorded vocalizations, and mirrors to mimic an active seabird colony with the purpose of encouraging live birds to visit the area. If visiting birds remain long enough to encounter other live birds, they may begin to attend regularly, select breeding sites, find mates, and breed. Common Murres that have hatched, attended, or previously bred at the location are most likely to be attracted during the early stages of recolonization. Immature birds prospecting for breeding sites are also likely to be attracted to the restoration site. Additional components of the Scientific Program included using other techniques to help restore other depleted central California colonies, comparison of restoration sites with reference colonies, and assessing the changing status of the central California population.

Common Murre decoys on Devil's Slide Rock.

## Devil's Slide Rock

Crew unloads gear for decoy deployment.

During January 1996, social attraction equipment consisting of life-sized adult murre decoys, mirrors, and sound systems was installed on Devil's Slide Rock. Less than 24 hours following installation, a murre was observed visiting the former colony. Four murres were present within 48 hours. In April 1996, wooden eggs and chick decoys were placed among the adult decoys to complete the illusion of an active colony. Although biologists expected it to take up to several years to establish breeding, six pairs of Common Murres laid eggs and raised chicks that season, the first breeding on the rock in over 10 years (Parker et al. 2007). This core group of birds re-established Devil's Slide Rock as a breeding site and breeding has continued every year since 1996.

Decoy deployment on Devil's Slide Rock.

Social attraction methods were continued until 2005 to help assure that established birds returned each year and to help recruit new breeding birds. Each year following the breeding season, the decoys were removed from the rock, cleaned, and re-painted, and the sound system was turned off. Equipment was re-installed each winter in a way to encourage colony growth in core, dense breeding groups and so equipment could be gradually removed over time.

After the initial recolonization, numbers of breeding pairs and other birds visiting the rock increased nearly each year. An initial goal of establishing 100 breeding pairs in 10 years was reached in 2000, the fifth year of the project. Numbers increased to 190 breeding pairs by 2004 and close to 400 pairs in 2007 (Figures 3 and 4). Breeding success and production of young were also high during most of the period (Figure 5). These and other measures showed that the re-established colony was functioning much like other colonies in the region. In addition to the Devil's Slide Rock restoration site, in 2005 murres began breeding on the adjacent mainland where breeding had never before been documented. By 2007, the mainland subcolony had increased to 50 breeding pairs. This raised the number of murres restored to the Devil's Slide colony to nearly 450 pairs of breeding birds.

Observers monitoring Common Murres on Devil's Slide Rock.

As the Devil's Slide colony grew in size and density, tracking the history and success of murre breeding pairs from distant vantage points became more difficult. In 2005, a remote-controlled video system was installed on the rock to provide close-up views of all parts of the colony. This high-quality system allowed more effective monitoring of the colony and additional data collection. The video was also available live on the World Wide Web, allowing viewers to see the restored colony close-up. Live and archived video was also available for public viewing at the Point Montara Lighthouse Hostel and the Gulf of the Farallones National Marine Sanctuary Visitor's Center, where interpretive displays educated visitors about the project and about what they saw on screen.

Aerial photo of Brandt's Cormorants with nests and Common Murres on Devil's Slide Rock in 2007.

Close-up view of study plot with adult, chick, and egg decoys on Devil's Slide Rock.

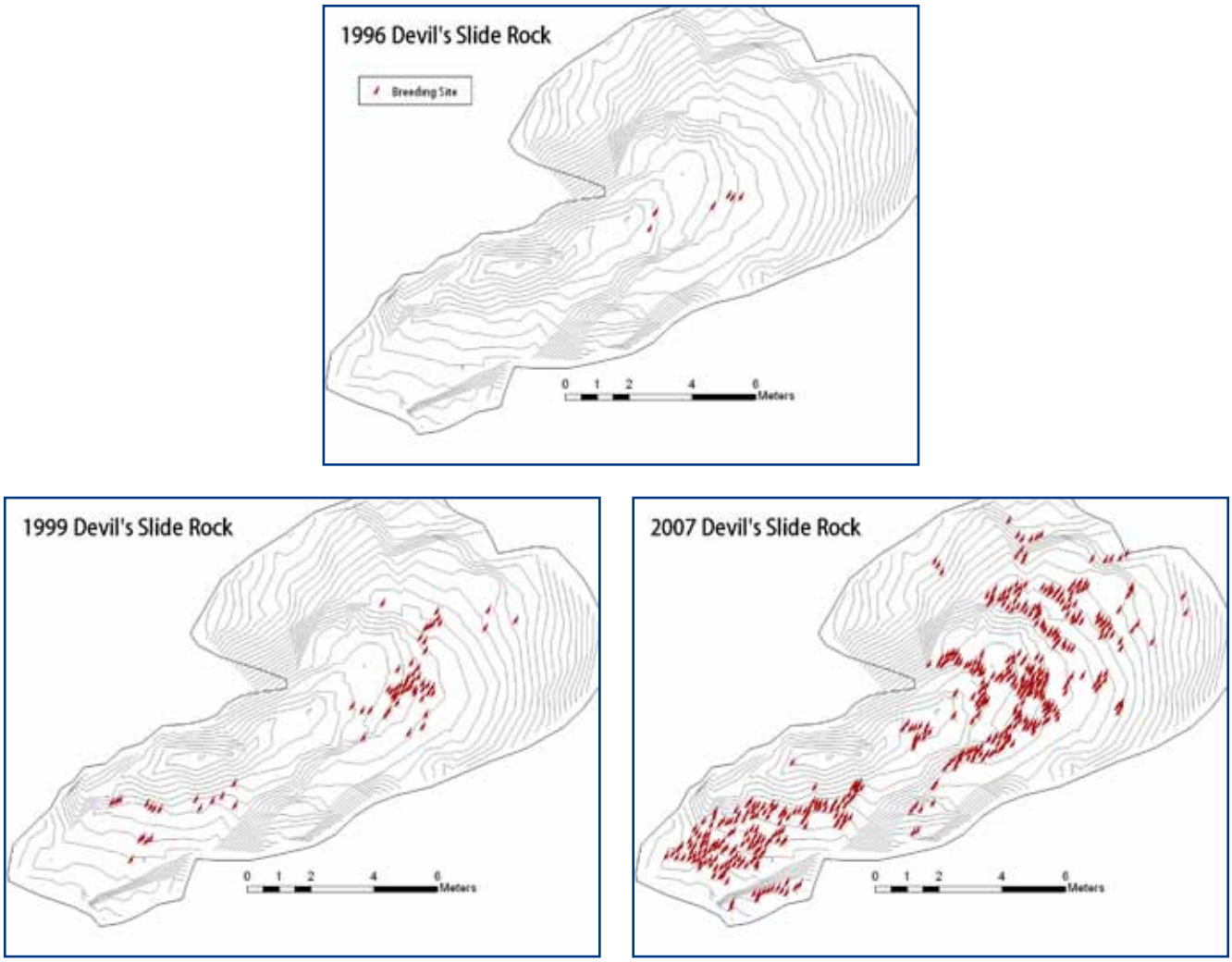



Figure 3. GIS maps showing Common Murre breeding sites on Devil's Slide Rock in 1996, 1999, and 2007.

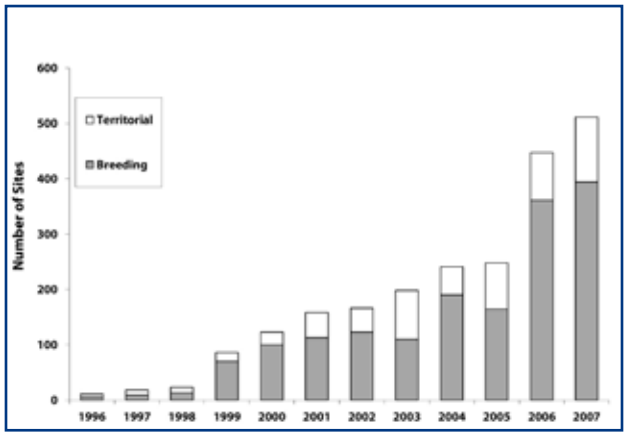



Figure 4. Number of Common Murre breeding and territorial pairs at Devil's Slide Rock, 1996–2007.

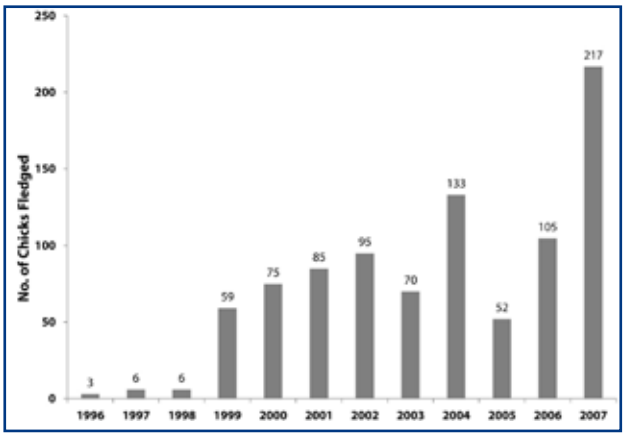



Figure 5. Number of Common Murre chicks fledged from Devil's Slide Rock, 1996–2007.

## San Pedro Rock

Attempts also were made to restore a Common Murre colony at San Pedro Rock, located just one mile north of Devil's Slide Rock. The San Pedro Rock colony was extirpated in the early 20th century from commercial collection of murre eggs (Carter et al. 2001). Although it was not impacted by the *Apex Houston* oil spill, recolonization of this site was identified as a goal to help restore murres impacted by the spill.

Common Murre and Brandt's Cormorant decoys on San Pedro Rock.

Installing decoys on San Pedro Rock.

Social attraction techniques were initiated at San Pedro Rock in April 1998. Over three hundred adult decoys were deployed along with mirror boxes and sound systems. Observations conducted after deploying decoys documented murres attending the rock, with a peak count of 26 birds.

Hauling solar panels used to power the sound system on San Pedro Rock.

Social attraction equipment was installed in a similar fashion for seven consecutive seasons. Like Devil's Slide Rock, decoys were removed at the end of most seasons and re-installed the following winter. Despite intensive efforts, murres only occasionally visited the rock, and no breeding was recorded. To help document murre visitation, a remote-controlled video system was installed on San Pedro Rock in 2003. This system greatly assisted monitoring efforts by providing much better and more frequent viewing of the social attraction area. At distances of one kilometer from mainland vantage points, viewing previously was often prohibited by fog. However, because of a lack of success attracting breeding murres and difficult working conditions, social attraction efforts were suspended following the 2004 season.

## Monitoring of Other Colonies

The Common Murre Restoration Project included monitoring of other established murre colonies in central California to make comparisons to the restoration sites, to assess the potential need for restoration at other colonies such as the Castle–Hurricane Colony Complex, and to examine the broader-scale effects of murre restoration efforts. The monitoring included intensive efforts at Point Reyes and the Castle–Hurricane Colony Complex. In addition, special studies were conducted at

Murre colony on Lighthouse Rock, Point Reyes—dark shading indicates dense murre breeding areas.

Castle Rocks and Mainland.

the South Farallon Islands by Point Reyes Bird Observatory to provide information on murre winter and breeding season attendance patterns, colonization behavior, and to refine monitoring techniques. Aerial photographic surveys of murre colonies throughout California were conducted to document broader-scale success of restoration efforts and identify other potential population issues that may need to be addressed.

Murre study plot at Castle Rocks and Mainland.

Annual monitoring demonstrated that murres at Devil's Slide Rock behaved similarly, and with similar breeding success, to nearby reference colonies (Parker 2005, Kappes et al. 2011; Figure 6). These comparisons with reference colonies were important measures of the success of restoration efforts. Monitoring also showed that the Castle–Hurricane Colony Complex was recovering at a slower rate than most other central California colonies, likely a result of continued mortality of murres in a commercial gill-net fishery (Forney et al. 2001), high levels of human disturbance from low-flying aircraft and close-approaching boats (Rojek et al. 2007), and disturbance from Brown Pelicans (*Pelecanus occidentalis*) and Common Ravens (*Corvus corax*).

Murre study plot at Point Reyes.

## Additional Actions and Overall Benefit

Data gathered for the Trustee Council showed impacts to murres from a local gill-net fishery. These data sets were used by State of California resource managers to adopt stronger restrictions on gill-net fishing in central California waters in 2002 to protect murres and other affected species. Outreach, education, and enforcement efforts were employed to successfully reduce human disturbance at the Castle–Hurricane colonies. These early outreach and education efforts led to the formation of a broader-scale program called the Seabird Colony Protection Program, established in 2005 with funds from the *Command* Oil Spill Trustee Council. The overall restoration efforts helped lead to an increase in size of the central California Common Murre population from just under 50,000 breeding pairs in 1986, the year of the *Apex Houston* spill, to over 150,000 pairs by 2006.

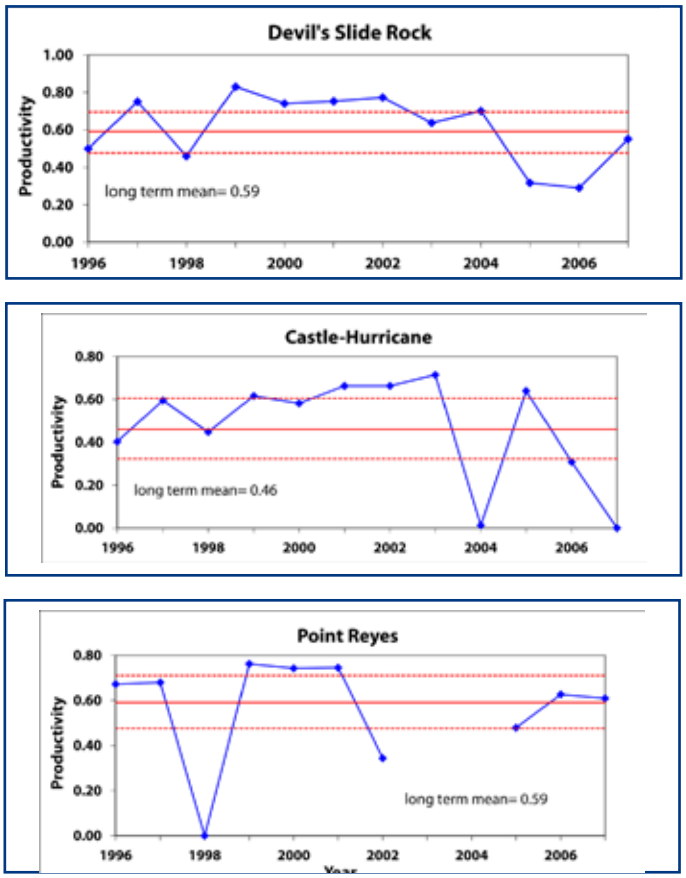



Figure 6. Long term murre productivity at Devil's Slide Rock, Castle–Hurricane, and Point Reyes.

## Environmental Education Program

The environmental education component of the Common Murre Restoration Project was implemented to provide education about seabirds to local children and assist the restoration project with maintenance of murre decoys. Over 6,000 students from the San Francisco Bay area (Montara, Pacifica, Half Moon Bay, El Granada, Fremont, San Jose, and San Leandro) participated in the program from 1996 to 2005. Over the years, the program reached 73 teachers from 15 schools and included classes from Kindergarten to 7th grade. This successful program was highly praised by teachers as an essential part of curriculum. Students learned about seabirds and marine conservation while directly helping the project by repainting murre decoys. Objectives of the program were accomplished through classroom instruction and activities that focused on:

Seabird education at local schools.

Seabird education at local schools.

1) natural history, ecology, biology and physiology related to seabirds, especially Common Murres; 2) the 1986 *Apex Houston* oil spill and its impact on the Common Murre colony at Devil's Slide Rock; 3) current and historical pressures affecting seabirds; and 4) the social attraction restoration efforts at Devil's Slide Rock and San Pedro Rock. Participating teachers were provided educational materials including videos, a seabird slideshow, books and posters for the classroom, and other resources recommending workshops and field trips. Murre Project educators visited each classroom on two separate occasions. The first classroom presentation included an activity which helped students explore seabird adaptations and a slideshow of the Common Murre Restoration Project. The second presentation included a review of seabird adaptations, an activity emphasizing the importance of coloring for camouflage, decoy painting, and a group activity involving the role of Common Murres in the ocean food web.

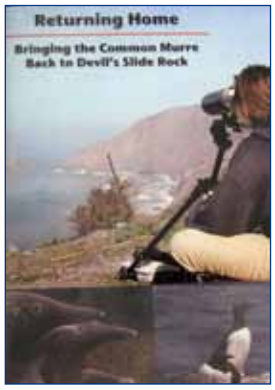
With the success of the restoration work for Common Murres on Devil's Slide Rock, biologists no longer needed to deploy decoys and could no longer offer decoy painting to schools. However, in 2005, environmental educators from the U.S. Fish and Wildlife Service developed a new program to extend the education component of the Common Murre Restoration Project. This new coastal marine educational program, entitled "Webs under Waves", explores the food webs of the central California coastal marine environment and teaches students about the habitats of the Farallon National Wildlife Refuge, Devil's Slide Rock, and Gulf of the Farallones National Marine Sanctuary. The program includes information on adaptations of the Common Murre and instructs students on how they can help protect the marine environment. "Webs under Waves" provides on-line activities for teachers to use as a supplement to their ocean education programs. Over 10 years, the environmental education component of the Common Murre Restoration Project has provided outreach for the project and helped foster community involvement and awareness of seabird conservation issues.

Murre decoys painted in a local classroom.

## Other Outreach

Sponsored in part by the *Apex Houston* Trustee Council, the documentary *Returning Home: Bringing the Common Murre Back to Devil's Slide Rock* chronicles the history of the Common Murre Restoration Project. The film was first produced in 1999 by Full Frame Productions and updated in 2006 by Filmmakers Collaborative with new footage to show the progression of the project. The 2006 version was featured on the Emmy Award-winning Public Broadcasting System series *Natural Heroes*, has been shown at several environmental film festivals, and is available on DVD.

Murre display at Point Montara Lighthouse Hostel.




*Returning Home* film.

Other education efforts around the San Francisco Bay area included interpretive displays about Common Murres and the Common Murre Restoration Project at the Pacifica Chamber of Commerce, Point Montara Lighthouse Hostel, Monterey Bay Aquarium, and the Gulf of the Farallones National Marine Sanctuary.

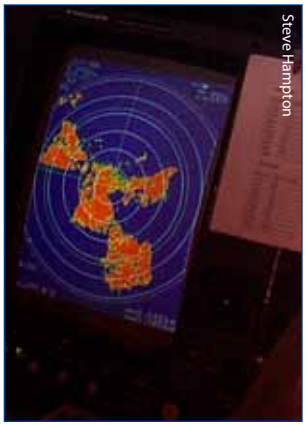
## MARBLED MURRELET NESTING HABITAT PROTECTION AT GAZOS CREEK

In 1998, the *Apex Houston* Trustee Council contributed $500,000 to the Sempervirens Fund for the purchase of Marbled Murrelet breeding habitat in the Gazos Creek Watershed of the Santa Cruz Mountains (Figure 7). Combining these funds with other contributions, the Sempervirens Fund was able to purchase the Gazos Mountain Camp property for about $1.5 million. The 120-acre parcel includes a mix of old-growth and second-growth trees, all to be managed for Marbled Murrelet nesting habitat. The property also contains a 12-acre developed camp area with buildings and other facilities. In 2000, the Sempervirens Fund conveyed the property to the California

Figure 7. Map Showing Gazos Mountain Camp.

Gazos Mountain Camp.

Truck with radar equipment.




Radar used for detecting murrelets.

Department of Parks and Recreation as an addition to Butano State Park. The developed portion of the property is now leased to the Pescadero Conservation Alliance and is used for environmental education and scientific studies in accordance with a set of habitat management guidelines funded by the *Apex Houston* Trustee Council and prepared by the Sempervirens Fund and the Trustee Council (Singer 1999).

In addition to the purchase of the Gazos Creek property and development of management guidelines for the acquired habitat, the Trustee Council funded a murrelet monitoring program. Two types of surveys have been conducted: audio/visual surveys at the parcel (Figure 8) and radar surveys within the larger Gazos Creek Watershed (Figure 9). The audio/visual surveys were funded through 2004. The radar surveys were conducted every other year and continued through 2010. Together, the surveys have shown relatively steady murrelet use, especially when compared to the drastic declines documented at other locations in the Santa Cruz Mountains (e.g., Suddjian 2008). Although breeding is very difficult to confirm, murrelet behavior in the area has been consistent with local breeding.

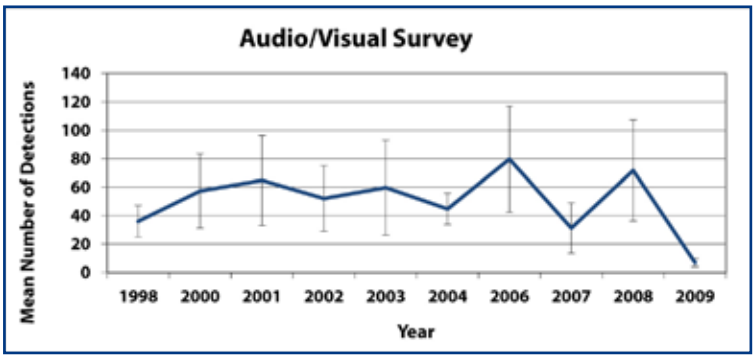



Figure 8. Mean number of murrelet detections from Audio/Visual Survey 1999–2009 (Error bars represent 1 standard deviation).

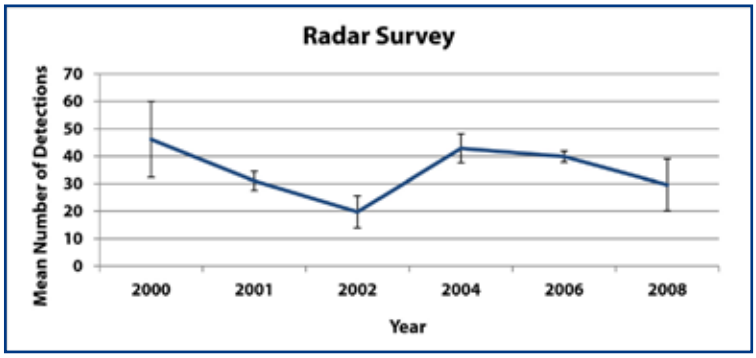



Figure 9. Mean number of murrelet detections from Radar Survey 2000–2008 (Error bars represent 1 standard deviation).

Attendance patterns of Marbled Murrelets at the Gazos Creek property indicative of breeding show the importance of protecting this habitat for this declining species. Benefits of the acquisition should grow over the coming decades and centuries as the second-growth portions of the property develop more of the old-growth characteristics used most by the murrelets.

## OTHER PROJECTS

### Cassin's Auklet Habitat Restoration, Farallon Islands

Farallon Auklet boardwalk.

The Cassin's Auklet is a small seabird of the family Alcidae. These colonial breeders nest in underground burrows or rock crevices on offshore rocks and islands. The colony on the South Farallon Islands, which are part of the Farallon National Wildlife Refuge, is the largest in California and one of the largest in the contiguous United States (Carter et al. 1992, Manuwal and Thoreson 1993). However, this colony has declined considerably since the early 1970s from a combination of factors including increased predation by gulls, degradation of habitat, and possibly declines in prey (Carter et al. 1992, Lee et al. 2007).

Most of the Farallon auklet colony is on the largest island of the group, Southeast Farallon, where auklets are found in soil and rocky habitats. This island hosts a permanent research station and is used by biologists and land managers. To conduct monitoring of breeding seabirds and maintain facilities, the biologists and managers must traverse unpaved portions of the island including sensitive habitat used by the burrow-nesting auklets. To avoid trampling of burrows, a boardwalk system is used in certain highly traveled areas. However, the boardwalks were decades old and in a dilapidated state resulting in trampling of burrows underneath when old wooden boards failed.

Auklet burrow between boards of boardwalk.

To protect and enhance auklet nesting habitat on Southeast Farallon Island, over 800 feet of dilapidated wooden boardwalks were replaced with heavy duty recycled plastic lumber. These boardwalks were constructed by the Telephone Pioneers in 2000 with funding support from the *Apex Houston* Trustee Council, Farallon Islands Foundation, San Francisco Bay Wildlife Society, and University of California Berkeley Seismological Laboratory. Since auklets often burrow under rocks and other structures, the boardwalks were designed to allow researchers and caretakers to traverse these auklet nesting areas and also to provide auklet habitat. New boardwalk sections were constructed with a "trough" design that leaves space for auklets to crawl underneath and excavate burrows.

The success of the new boardwalks in providing habitat enhancement for auklets was monitored from 2001 to 2009. The study included monitoring the numbers of burrows and rate of auklet occupancy in those burrows (which is more indicative of breeding by auklets) under boardwalks (Figure 10). Auklets began nesting under the new boardwalks the very first breeding season following construction, when 52 burrows were counted. Since then, numbers have increased dramatically, reaching a peak of 138 burrows in 2004 with 67% confirmed as used for breeding. The numbers of occupied burrows reached near peak level in 2008–2009. While most active burrows are used by Cassin's Auklets, some are used by Rhinoceros Auklets. Monitoring indicates burrow densities are considerably higher under the boardwalks than in similar adjacent habitats, making this project successful in improving auklet nesting habitat.

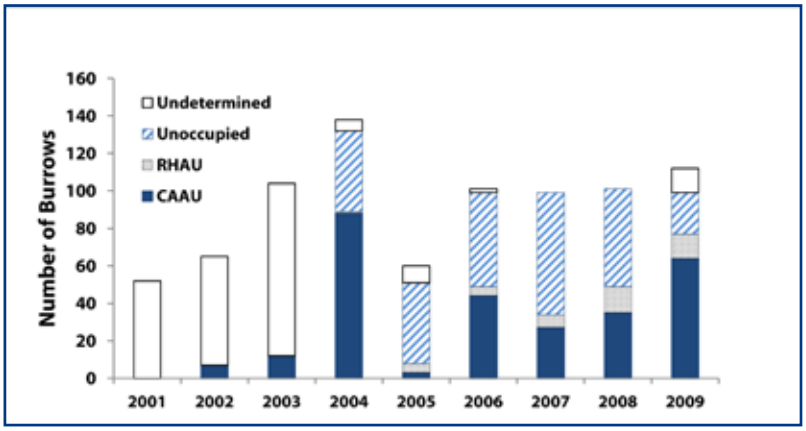



Figure 10. 2001–2009 auklet boardwalk survey on Southeast Farallon Island. RHAU=Rhinoceros Auklet. CAAU= Cassin's Auklet.

## Rhinoceros Auklet Habitat Enhancement, Año Nuevo Island

The Rhinoceros Auklet is a relatively large member of the family Alcidae which is most closely related to the puffins. Much like the Cassin's Auklet, they are colonial breeders that nest in underground burrows or rock crevices on offshore rocks and islands. Año Nuevo Island, part of Año Nuevo State Reserve, is one of only three significant breeding colonies for Rhinoceros Auklets in California. Biologists and land managers were concerned about the continued existence of the nesting habitat at Año Nuevo Island as it was eroding away over time. In 2001, a successful, collaborative effort began to stabilize the underground nesting habitat through native plant restoration and erosion control. However, in 2006 the restored nesting habitat was in jeopardy when high numbers of California sea lions (*Zalophus californianus*) began hauling out in the restoration area. Sea lions can cause extensive habitat degradation for nesting auklets because they disturb top soil, trample plants, crush burrows, and alter soil nutrients. When they depart in early winter to return to their pupping beaches further south, the soil is unprotected and rapidly erodes from wind and rain.

Working on a section of the temporary fence.

In 2006–2008, to prevent further damage to the habitat, California sea lions were excluded from hauling out in the burrow nesting area with a temporary fence. For three months during the peak of California sea lion attendance (August to October), a temporary fence was installed and successfully prevented high numbers of sea lions from entering a small one-acre plot, prime habitat for nesting auklets. The *Apex Houston* Trustee Council helped fund installation of the fence.

A section of the temporary sea lion fence.

## IN CONCLUSION

The *Apex Houston* Trustee Council and its partners have restored the Common Murre colony at Devil's Slide Rock, protected important nesting habitat for Marbled Murrelets in the Gazos Creek watershed, and enhanced nesting habitat for Cassin's Auklets and Rhinoceros Auklets at the Farallon Islands and Año Nuevo Island, respectively. Through the work of the *Apex Houston* Trustee Council, we have gained a better understanding of human impacts to seabirds and an understanding of how we can benefit seabirds when human actions cause injury. From the time of the 1986 *Apex Houston* Oil spill to 2006, numbers of breeding Common Murres increased from less than 100,000 breeding birds to nearly 400,000 breeding birds, an increase greatly influenced by the work of the *Apex Houston* Trustee Council. Today, the existence of some of our most important seabird colonies are assured and enhanced due to the restoration efforts described above, and we have helped with the critical task of educating children, the future stewards of our precious coastal resources.

# FINANCIAL SUMMARY

## Income:

| | |
|---|---|
| **Settlement Restoration Funds:** | |
| Seabird Restoration | $4,916,460 |
| Marbled Murrelet Habitat Acquisition | $500,000 |
| **Interest Earned:** | |
| Seabird Restoration | $2,089,000 |
| Habitat Acquisition | $60,000 |
| **Total Funding Available** | **$7,565,000** |

## Expenditures:

| | |
|---|---|
| Common Murre Restoration Project | $6,781,000 |
| Marbled Murrelet Habitat Acquisition | $560,000 |
| Cassin's Auklet Project | $48,000 |
| Rhinoceros Auklet Project | $37,000 |
| Trustee Council Oversight | $139,000 |
| **Total Allocations** | **$7,565,000** |

## LITERATURE CITED

Carter, H.R., G.J. McChesney, D.L. Jaques, C.S. Strong, M.W. Parker, J.E. Takekawa, D.L. Jory, and D.L. Whitworth. 1992. Breeding populations of seabirds in California, 1989-1991. Vols. 1 and 2. Unpublished draft report, U.S. Fish and Wildlife Service, Northern Prairie Wildlife Research Center, Dixon, California.

Carter, H.R., U.W. Wilson, R.W. Lowe, D.A. Manuwal, M.S. Rodway, J.E. Takekawa, and J.L. Yee. 2001. Population trends of the Common Murre (*Uria aalge californica*). Pp. 33-133 in Manuwal, D.A., H.R. Carter, T.S. Zimmerman, and D.L. Orthmeyer (eds.), Biology and conservation of the Common Murre in California, Oregon, Washington, and British Columbia. Volume 1: Natural History and population trends. U.S. Geological Survey, Information and Technology Report, USGS/BRD/ITR-2000-0012, Washington, D.C.

Carter, H.R., V.A. Lee, G.W. Page, M.W. Parker, R.G. Ford, G. Swartzman, S.W. Kress, B.R. Siskin, S.W. Singer, and D.M. Fry. 2003. The 1986 *Apex Houston* oil spill in central California: seabird injury assessment and litigation process. Marine Ornithology 31:9-19.

Forney, K.A., S.R. Benson, and G.A. Cameron. 2001. Central California gillnet effort and bycatch of sensitive species, 1990-1998. Pp. 141-160 *in* E.F. Melvin and J.K. Parrish (eds.), Seabird bycatch: trends, roadblocks, and solutions. University of Alaska Sea Grant, Fairbanks, Alaska.

Kappes, P.J., G.J. McChesney, M.W. Parker, H.R. Carter, S.W. Kress, and R.T. Golightly. 2011. Use of time-activity budgets to measure early progress of a social attraction restoration project. Biological Conservation 144:620-626.

Lee, D.E., N. Nur, and W.J. Sydeman. 2007. Climate and demography of the planktivorous Cassin's Auklet *Ptychoramphus aleuticus* off northern California: implications for population change. Journal of Animal Ecology 76:337–347.

Manuwal, D., and A. C. Thoreson. 1993. Cassin's Auklet (*Ptychoramphus aleuticus*). *In* The Birds of North America, No. 50 (A. Poole and F. Gill, Eds). The Academy of Natural Sciences, Philadelphia, PA and The American Ornithologists' Union, Washington, D.C.

Nelson, S.K. 1997. Marbled Murrelet (*Brachyramphus marmoratus*). *In* The Birds of North America, No. 313 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia, PA and The American Ornithologists' Union, Washington, D.C.

Page, G.W., H.R. Carter, and R.G. Ford. 1990. Numbers of seabirds killed or debilitated in the 1986 *Apex Houston* oil spill in central California. Pp. 164-174 *in* Sealy, S.G. (ed.), Auks at sea. Studies in Avian Biology 14.

Parker, M.W. 2005. Comparison of breeding performance, co-attendance, and chick provisioning rates of breeding Common Murres (*Uria aalge*) as early indicators for ecological monitoring. Unpublished M.S. Thesis, Humboldt State University, Arcata, California.

Parker, M.W., S.W. Kress, R.T. Golightly, H.R. Carter, E.B. Parsons, S.E. Schubel, J.A. Boyce, G.J. McChesney, and S.M. Wisely. 2007. Assessment of social attraction techniques used to restore a Common Murre colony in central California. Waterbirds 30:17-28.

Rojek, N.A., M.W. Parker, H.R. Carter, and G.J. McChesney. 2007. Aircraft and vessel disturbances to Common Murres *Uria aalge* at breeding colonies in central California, 1997-1999. Marine Ornithology 35:61-69.

Singer, S.W. 1999. Murrelet habitat management guidelines for the Gazos Mountain Camp property. Unpublished report, Steven Singer Environmental and Ecological Services, Santa Cruz, California.

Suddjian, D.L. 2008. Summary of 2007 Marbled Murrelet monitoring surveys in the Santa Cruz Mountains. Unpublished report prepared for the *Command* Oil Spill Trustee Council.

Takekawa, J.E., H.R. Carter, and T.E. Harvey. 1990. Decline of the Common Murre in central California 1980-1986. Pp. 149-163 *in* Sealy, S.G. (ed.), Auks at sea. Studies in Avian Biology 14.

U.S. Fish and Wildlife Service. 1995. Notice of availability, final *Apex Houston* oil spill restoration plan. Federal Register 60(81):20739-20749.

## *APEX HOUSTON* PUBLICATIONS, REPORTS, THESES

### Published manuscripts to date (as of January 2011)

Capitolo, P.J., H.R. Carter, G.J. McChesney, and M.W. Parker. 2005. Common Murres prospecting within cormorant colonies in Del Norte and Humboldt Counties, California, 1996-2004. Northwestern Naturalist 86:144-150.

Carter, H.R., V.A. Lee, G.W. Page, M.W. Parker, R.G. Ford, G. Swartzman, S.W. Kress, B.R. Siskin, S.W. Singer, and D.M. Fry. 2003. The 1986 *Apex Houston* oil spill in central California: seabird injury assessment and litigation process. Marine Ornithology 31:9-19.

Jones, N.M., G.J. McChesney, M.W. Parker, J.L. Yee, H.R. Carter, and R.T. Golightly. 2008. Breeding phenology and reproductive success of the Brandt's Cormorant at three nearshore colonies in central California, 1997-2001. Waterbirds 31:505-519.

Kappes, P.J., G.J. McChesney, M.W. Parker, H.R. Carter, S.W. Kress, and R.T. Golightly. 2011. Use of time-activity budgets to measure early progress of a social attraction restoration project. Biological Conservation 144:620-626.

Manuwal, D.A., H.R. Carter, T.S. Zimmerman, and D.L. Orthmeyer (Editors). 2001. Biology and conservation of the Common Murre in California, Oregon, Washington, and British Columbia. Volume 1: Natural history and population trends. U.S. Geological Survey, Information and Technology Report USGS/BRD/ITR-2000-0012, Washington, D.C.

McChesney, G.J., H.R. Carter, and M.W. Parker. 2000. Nesting of Ashy Storm-Petrels and Cassin's Auklets in Monterey County, California. Western Birds 31:178-183.

Murphy, M., N. Jones and M.W. Parker. 2005. Common Murre egg recovery. Waterbirds 28:402-403.

Parker, M.W., S.W. Kress, R.T. Golightly, H.R. Carter, E.B. Parsons, S.E. Schubel, J.A. Boyce, G.J. McChesney, and S.M. Wisely. 2007. Assessment of social attraction techniques used to restore a Common Murre colony in central California. Waterbirds 30:17-28.

Rojek, N.A., M.W. Parker, H.R. Carter, and G.J. McChesney. 2007. Aircraft and vessel disturbances to Common Murres *Uria aalge* at breeding colonies in central California, 1997-1999. Marine Ornithology 35:61-69.

### Published media

Returning Home: Bringing the Common Murre Back to Devil's Slide Rock. 1999 (original version). Full Frame Productions (Produced by K. White). Available on VHS.

Returning Home: Bringing the Common Murre Back to Devil's Slide Rock. 2006 (updated version). Filmmakers Collaborative (Produced by K. White). Available on DVD.

## Unpublished Reports, Theses

Capitolo, P.J., H.R. Carter, and M.W. Parker. 2002. Protocol for identification of areas used for counting seabirds from aerial photographs at the South Farallon Islands, California. Unpublished report, Humboldt State University, Department of Wildlife, Arcata, California; and U.S. Fish and Wildlife Service, San Francisco Bay National Wildlife Refuge Complex, Newark, California.

Capitolo, P.J., H.R. Carter, R.J. Young, G.J. McChesney, R.T. Golightly, and F. Gress. 2004. Changes in population size of Brandt's and Double-crested Cormorants in California, 1975-2003. Unpublished report, Humboldt State University, Department of Wildlife, Arcata, California; and U.S. Fish and Wildlife Service, San Francisco Bay National Wildlife Refuge Complex, Newark, California.

Capitolo, P.J., G.J. McChesney, H.R. Carter, M.W. Parker, J.N. Hall, R.J. Young, and R.T. Golightly. 2006. Whole-colony counts of Common Murres, Brandt's Cormorants and Double-crested Cormorants at sample colonies in northern and central California, 1996-2004. Unpublished report, Department of Wildlife, Humboldt State University, Arcata, California; and U.S. Fish and Wildlife Service, San Francisco Bay National Wildlife Refuge Complex, Newark, California.

Carter, H.R., P.J. Capitolo, M.W. Parker, R.T. Golightly, and J.L. Yee. 2003. Population impacts to Common Murres at the Drake's Bay Colony Complex, California. Pages 43-67 *in* H.R. Carter, and R.T. Golightly (eds.). Seabird injuries from the 1997-1998 Point Reyes Tarball Incidents. Unpublished report, Humboldt State University, Department of Wildlife, Arcata, California.

Coffman, Z., and J. Irwin. 2007. Boardwalk burrow study, Farallon National Wildlife Refuge: 2007 monitoring results and project summary. Unpublished report, U.S. Fish and Wildlife Service, Farallon National Wildlife Refuge, Newark, California.

Eigner, L.E. 2009. Spatial and temporal variation in prey use of Common Murres at two disjunct colonies in the California Current System. Unpublished M.S. thesis, Humboldt State University, Arcata, California.

Hastings, K., M. Hester, J. Nusbaum, P. Pyle, and W. Sydeman. 1999. Common Murre (*Uria aalge*) attendance patterns on the South Farallon Islands during the non-breeding season, 1996-1999. Unpublished report, Point Reyes Bird Observatory, Stinson Beach, California.

Hester, M.M. and W.J. Sydeman. 1999. Common Murre breeding season attendance patterns at Southeast Farallon Island, California, 1996-1998. Unpublished report, Point Reyes Bird Observatory, Stinson Beach, California.

Hester, M.M. 2009. Año Nuevo Island seabird habitat restoration resource protection: Temporary fence 2008 report. Unpublished report, Oikonos - Ecosystem Knowledge, Benicia, California.

Irwin, J. 2004. Cassin's Auklet under the boardwalks. Unpublished report, U.S. Fish and Wildlife Service, Farallon National Wildlife Refuge, Newark, California.

Irwin, J. 2005. Boardwalk burrow study, Farallon National Wildlife Refuge: 2005 monitoring results and project summary. Unpublished report, U.S. Fish and Wildlife Service, Farallon National Wildlife Refuge, Newark, California.

Irwin, J. 2006. Boardwalk burrow study, Farallon National Wildlife Refuge: 2006 monitoring results and project summary. Unpublished report, U.S. Fish and Wildlife Service, Farallon National Wildlife Refuge, Newark, California.

Knechtel, H., N.M. Jones, M.A. Murphy, A.H. Robinson, K.J. Vickers, G.J. McChesney, M.W. Parker, J. Buffa, H.R. Carter, S.W. Kress, R.J. Golightly, and K.A. Peluso. 2003. Restoration of Common Murre colonies in central California: Annual Report 2002. Unpublished report, U.S. Fish and Wildlife Service, San Francisco Bay National Wildlife Refuge Complex, Newark, California.

McChesney, G.J., H.R. Carter, M.W. Parker, J.E. Takekawa and J.L. Yee. 1998. Population trends and subcolony use of Common Murres and Brandt's Cormorants at Point Reyes Headlands, California, 1979-1997. Unpublished report, U.S. Geological Survey, Biological Resources Division, Western Ecological Research Center, Dixon, California; Humboldt State University, Department of Wildlife, Arcata, California; and U.S. Fish and Wildlife Service, San Francisco Bay National Wildlife Refuge Complex, Newark, California.

McChesney, G.J., H.R. Carter, M.W. Parker, P.J. Capitolo, J.E. Takekawa, and J.L. Yee. 1999. Population trends and subcolony use of Common Murres and Brandt's Cormorants at the Castle/Hurricane Colony Complex, California, 1979-1997. Unpublished report, U.S. Geological Survey, Biological Resources Division, Western Ecological Research Center, Dixon, California; Department of Wildlife, Humboldt State University, Arcata, California; and U.S. Fish and Wildlife Service, San Francisco Bay National Wildlife Refuge Complex, Newark, California. 65 pp.

McChesney, G.J., A.H. Robinson, J.S. Koepke, H.A. Knechtel, N.M. Jones, C.M. Caurant, R.T. Golightly, H.R. Carter, S.W. Kress, and J. Stankiewizc. 2004. Restoration of Common Murre colonies in central California: Annual report 2003. Unpublished report, U.S. Fish and Wildlife Service, San Francisco Bay National Wildlife Refuge Complex, Newark, California.

McChesney, G.J., N.M. Jones, T.B. Poitras, K.J. Vickers, L.E. Eigner, H.R. Carter, R.T. Golightly, S.W. Kress, M.W. Parker, K. Studnicki, P.J. Capitolo, and J.N. Hall. 2005. Restoration of Common Murre colonies in central California: Annual report 2004. Unpublished report, U.S. Fish and Wildlife Service, San Francisco Bay National Wildlife Refuge Complex, Newark, California.

McChesney, G.J., L.E. Eigner, T.B. Poitras, P.J. Kappes, D. Le Fer, L.T. Nason, P.J. Capitolo, H. Beeler, C.E. Fitzpatrick, R.T. Golightly, K.S. Bixler, H.R. Carter, S.W. Kress, and M.W. Parker. 2006. Restoration of Common Murre colonies in central California: Annual report 2005. Unpublished report, U. S. Fish and Wildlife Service, San Francisco Bay National Wildlife Refuge Complex, Newark, California.

McChesney, G.J., L.E. Eigner, T.B. Poitras, P.J. Kappes, N.M. Jones, D.N. Lontoh, P.J. Capitolo, R.T. Golightly, D. Le Fer, H.R. Carter, S.W. Kress, and M.W. Parker. 2007. Restoration of Common Murre colonies in central California: Annual report 2006. Unpublished report, U.S. Fish and Wildlife Service, San Francisco Bay National Wildlife Refuge Complex, Newark, California.

McChesney, G.J., L.E. Eigner, P.J. Kappes, T.B. Poitras, D.N. Lontoh, S.J. Rhoades, N.J. Metheny, R.T. Golightly, P.J. Capitolo, H.R. Carter, S.W. Kress, and M.W. Parker. 2008. Restoration of Common Murre colonies in central California: Annual report 2007. Unpublished report, U.S. Fish and Wildlife Service, San Francisco Bay National Wildlife Refuge Complex, Newark, California.

McChesney, G.J., D.N. Lontoh, S.J. Rhoades, K.A. Borg, E.L. Donnelly, M.E. Gilmour, P.J. Kappes, L.E. Eigner, and R.T. Golightly. 2009. Restoration of Common Murre colonies in central California: annual report 2008. Unpublished report, U.S. Fish and Wildlife Service, San Francisco Bay National Wildlife Refuge Complex, Newark, California.

Nur, N. and W.J. Sydeman. 2002. Statistical analysis of the 'k' correction factor used in population assessments of murres: implications for monitoring. Unpublished report, Point Reyes Bird Observatory, Stinson Beach, California.

Parker, M.W. 2005. Comparison of breeding performance, co-attendance, and chick provisioning rates of breeding Common Murres (*Uria aalge*) as early indicators for ecological monitoring. Unpublished M.S. Thesis, Humboldt State University, Arcata, California.

Parker, M.W., E.B. McLaren, S.E. Schubel, J.A. Boyce, P.J. Capitolo, M.A. Ortwerth, S.W. Kress, H.R. Carter, and A. Hutzel. 1997. Restoration of Common Murre colonies in central coastal California: Annual Report 1996. Unpublished report, U.S. Fish and Wildlife Service, San Francisco Bay National Wildlife Refuge Complex, Newark, California.

Parker, M.W., E.B. McLaren, J.A. Boyce, V. Collins, D.A. Nothhelfer, R. J. Young, S.W. Kress, H.R. Carter, and A.M. Hutzel. 1998. Restoration of Common Murre colonies in central California: Annual Report 1997. Unpublished report, U.S. Fish and Wildlife Service, San Francisco Bay National Wildlife Refuge Complex, Newark, California.

Parker, M.W., J.A. Boyce, E.N. Craig, H. Gellerman, D.A. Nothhelfer, R.J. Young, S.W. Kress, H.R. Carter, and G. Moore. 1999. Restoration of Common Murre colonies in central California: Annual Report 1998. Unpublished report, U.S. Fish and Wildlife Service, San Francisco Bay National Wildlife Refuge Complex, Newark, California.

Parker, M.W., J.A. Boyce,R. Young, N. Rojek, C. Hamilton, V. Slowik, H. Gellerman, S. Kress, H. Carter, G. Moore, L.J. Cohen. 2000. Restoration of Common Murre colonies in central California: Annual Report 1999. Unpublished report, U.S. Fish and Wildlife Service, San Francisco Bay National Wildlife Refuge Complex, Newark, California.

Parker, M., C. Hamilton, I. Harrald, H. Knechtel, M. Murphy, V. Slowik, H. Carter, S. Kress, R. Golightly and S. Boehm. 2001. Restoration of Common Murre colonies in central California: Annual Report 2000. Unpublished report, U.S. Fish and Wildlife Service, San Francisco Bay National Wildlife Refuge Complex, Newark, California.

Parker, M.W., H. Knechtel, M. Murphy, N. Jones, C. Hamilton, C. Caurant, B. Acord. 2002. Restoration of Common Murre colonies in central California: Annual Report 2001. Unpublished report, U.S. Fish and Wildlife Service, San Francisco Bay National Wildlife Refuge Complex, Newark, California.

Singer, S.W. 1999. Murrelet habitat management guidelines for the Gazos Mountain Camp property. Unpublished report, Steven Singer Environmental and Ecological Services, Santa Cruz, California.

Singer, S. 2007. Gazos Mountain Camp murrelet monitoring program. Unpublished report, Singer Environmental & Ecological Services, Santa Cruz, California.*

Singer, S. 2009. Results of 2009 Marbled Murrelet surveys at Gazos Mountain Camp. Unpublished report, Singer Environmental & Ecological Services, Santa Cruz, California.*

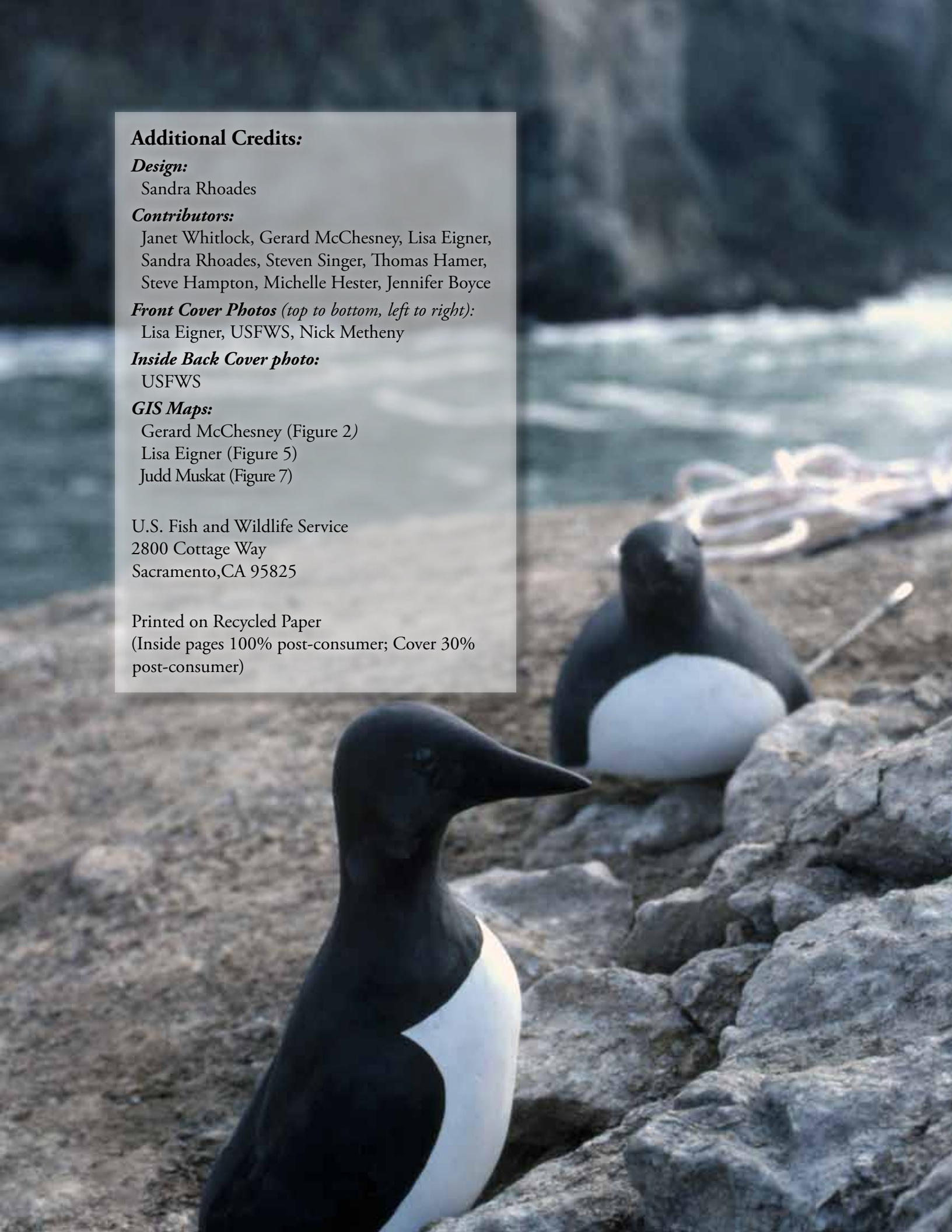
Singer, S., and T. Hamer. 2004. Gazos Creek Marbled Murrelet monitoring program: Biannual report 2004. Unpublished report, Singer Environmental & Ecological Services, Santa Cruz, California, and Hamer Environmental, Vernon, Washington.

Singer, S., and T. Hamer. 2006. Gazos Creek Marbled Murrelet monitoring program: Biannual report 2006. Unpublished report, Singer Environmental & Ecological Services, Santa Cruz, California, and Hamer Environmental, Vernon, Washington.

Singer, S., and T. Hamer. 2008. Gazos Creek Marbled Murrelet monitoring program: Biannual report 2008. Unpublished report, Singer Environmental & Ecological Services, Santa Cruz, California, and Hamer Environmental, Vernon, Washington.

Sydeman, W.J., J.A. Thayer, M.M. Hester, and N.P. Fairman. 1998. Colony formation and nest site selection of Common Murres on Southeast Farallon Island, California, 1984-1997. Unpublished report, Point Reyes Bird Observatory, Stinson Beach, California.

**Reports not funded by Apex Houston but associated with the Apex Houston funded project.*



## Additional Credits*:*

***Design:***
Sandra Rhoades

***Contributors:***
Janet Whitlock, Gerard McChesney, Lisa Eigner, Sandra Rhoades, Steven Singer, Thomas Hamer, Steve Hampton, Michelle Hester, Jennifer Boyce

***Front Cover Photos*** *(top to bottom, left to right):*
Lisa Eigner, USFWS, Nick Metheny

***Inside Back Cover photo:***
USFWS

***GIS Maps:***
Gerard McChesney (Figure 2*)*
Lisa Eigner (Figure 5)
Judd Muskat (Figure 7)

U.S. Fish and Wildlife Service
2800 Cottage Way
Sacramento,CA 95825

Printed on Recycled Paper
(Inside pages 100% post-consumer; Cover 30% post-consumer)