

PACIFIC SEABIRDS



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Dedicated to the Study and Conservation of Pacific Seabirds and Their Environment

The Pacific Seabird Group (PSG) was formed in 1972 due to the need for better communication among Pacific seabird researchers. The Group coordinates and stimulates the field activities of members involved in research, and it informs its members and the general public of conservation issues relating to Pacific Ocean seabirds and the marine environment. Group meetings are held annually, and the PSG publication, *Pacific Seabirds* (formerly the *PSG Bulletin*), is issued twice a year. Current activities include involvement in seabird sanctuaries, seabird restoration after oil spills, seabird/fisheries interactions, and endangered species. Policy statements are issued on conservation issues of critical importance. Although PSG's primary area of interest is the West Coast of North America and adjacent areas of the Pacific Ocean, it is hoped that seabird enthusiasts in other parts of the world will join and participate in PSG. PSG is a member of the U.S. Section of the International Council for Bird Preservation, the International Union for Conservation of Nature (IUCN), and the American Bird Conservancy. Annual dues for membership are \$25 (individual and family); \$15 (student, undergraduate and graduate); and \$750 (Life Membership, payable in five \$150 installments). Dues are payable to the Treasurer; see Membership/Order Form next to inside back cover for details and application.

Pacific Seabirds

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REPORT

MIDWAY ATOLL: PROBLEMS IN PARADISE?

Vivian M. Mendenhall

Midway Atoll is a major subtropical seabird colony. It also has endangered species, a coral lagoon, monuments to a battle that changed the course of history, a residential subdivision, and an eco-tourism industry. The PSG field trip to Midway on 10-17 February 2001 provided members with a superb week of watching and photographing seabirds in a very unusual setting.

Our first evening on Midway was a good introduction to its surreal aspects. Our 737 arrived at dusk and circled several times while a fire truck shoed albatrosses off the runway. A tourist van drove us to the hotel. Several of us decided to find dinner, although the main dining facility was closed for the evening. We walked along a street past manicured lawns, tropical flowering shrubs, and suburban houses. Every foot of ground was thronged with Laysan Albatrosses (*Phoebastria immutabilis*), and the warm night was filled with their honking, clattering, and twittering. Bonin Petrels (*Pterodroma hypoleuca*) fluttered past like gray-and-white ghosts. Presently we found a tiny back-room café that served delicate Sri Lankan crepes and lively curries. In other venues Mai Tais and gourmet French dinners were options. Back in our rooms, we had our choice of watching television or gazing at the bobbing and sky-pointing albatrosses directly below our windows.

Midway is a birder's paradise, and it offers the unique opportunity to mingle with seabirds while enjoying all the comforts of a modest resort. Our thoughts occasionally turned to the conditions in which biologists normally visit colonies—tents in the sand with the sun beating down,

counting every cup of fresh water, beans and granola bars for supper. Questions inevitably arose about the strategy of mingling birds and tourism on the same small islands. We learned a great deal during our stay about Midway Atoll National Wildlife Refuge, its problems, and the issues that must be resolved there in order to protect seabirds in the long term.

PRESENT-DAY MIDWAY

Midway Atoll consists of three low islands and a 10-km-wide circle of barrier reef (Figure 1). Sand Island is 2,960 ha (U.S. Fish and Wildlife Service [USFWS] 2000). There are two paved runways, a network of roads, several dozen buildings, and a small harbor. Park-like lawns and shade trees surround the buildings; beyond the settlement, most of the island is forested with ironwoods (*Casuarina equisetifolia*). Eastern Island is 825 ha and is largely covered with scrub. Structures have been removed, but there are still extensive areas of abandoned concrete runway. Spit Island is 15 ha of sand and low vegetation.

Midway's infrastructure derives from the Navy. Buildings include a dining hall, a medical clinic, houses, a small theater, and former barracks, two of which have been renovated as simple hotels. There are also a number of historic structures, from command buildings to underground bunkers. Paths lead to white sand beaches beside the radiantly blue lagoon. Sand Island could be a standard subtropical resort, except for the seabirds nesting on every lawn and the fact that visitor movements are restricted to minimize disturbance of wildlife.

Midway's islands and waters are under the jurisdiction of Midway Atoll National Wildlife Refuge, whose headquarters is on the island (which is unusual for a remote refuge). The refuge has a staff of six, including manager Ron Anglin, biologist Nancy Hoffman, and a recreation planner and ranger to handle visitors. Three other organizations also have offices on the island. A for-profit corporation, the Midway Phoenix Corporation (MPC), maintains the buildings, utilities, and airport, and provides support services to residents under a cooperative agreement with USFWS. In return, MPC runs an eco-tourism business that brings birdwatchers, devotees of military history, sport fishers and divers, and volunteers to the islands. The Oceanic Society, a nonprofit conservation group, runs field research and monitoring, in participation with USFWS, and leads eco-tours. Summer recreation is provided by another subcontractor, Midway Sport Fishing and Diving. The total resident population of Midway is about 160. Nonresident cooperators include the National Marine Fisheries Service (NMFS), which has principal responsibility for the endangered Hawaiian Monk Seal (*Monachus schauinslandi*) and shares jurisdiction over marine turtles with USFWS; the National Park Service, which helps with historic resources; the US Navy, which is removing contaminants; and the Friends of Midway, a nonprofit organization that assists with volunteers and funding.

HISTORY

In common with most oceanic islands, Midway Atoll underwent drastic changes in the last century. The

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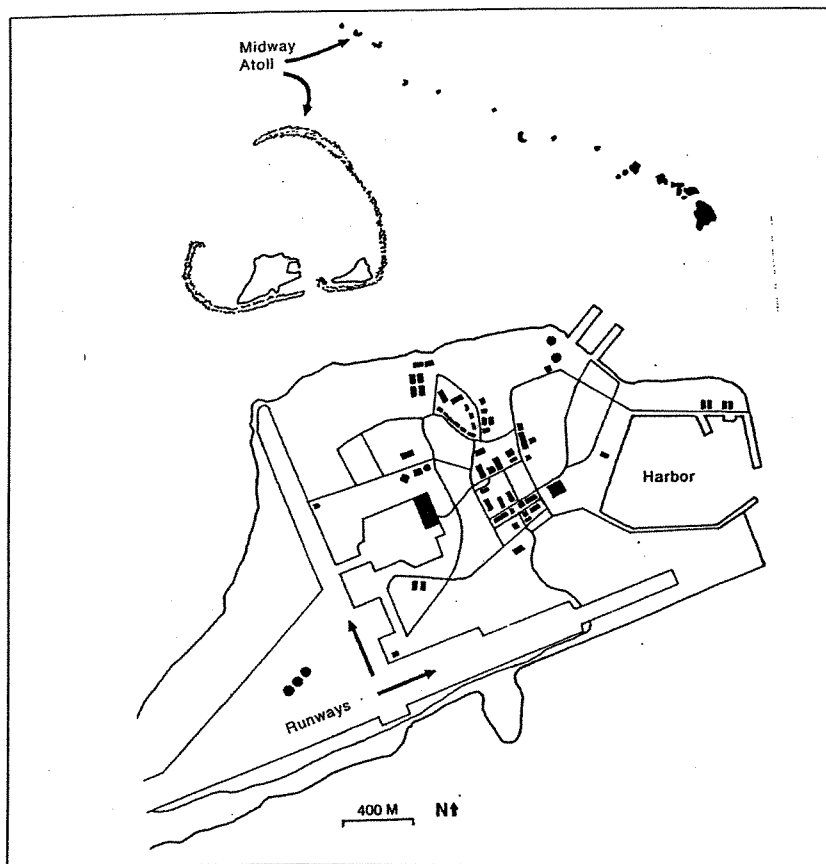


FIGURE 1. Midway Atoll. Top: Hawaiian Islands, showing location of Midway; middle: Midway Atoll; bottom: detail of Sand Island, with runways, paved roads, buildings (solid rectangles), and tanks (solid circles).

natural habitat of Eastern Island was grass and scrub; that of Sand Island was sparsely-vegetated sand dunes (Harrison 1990). The first known inhabitants of Midway were survivors of shipwrecks and poachers in the commercial feather trade. The islands' first permanent settlers were operators of the first trans-Pacific telephone cable just after 1900. Pacific Cable Company employees built colonial-style buildings (which are still standing), and they began modifying the desolate environment with imported topsoil, grass, and trees. Pan American Airways operated a hotel in the 1930s for passengers on its transpacific route.

Midway was put under U.S. Navy jurisdiction in 1903. A full-scale naval air base was constructed in 1940-43. Buildings were put on Sand Island, runways on Eastern and then Sand

Island (Rauzon 2001). Midway was attacked on the same day as Pearl Harbor, killing four Americans. In June 1942 the Japanese Navy approached Midway with the intent of capturing all the Hawaiian Islands. The U.S. fleet won the Battle of Midway, thereby permanently seizing the momentum of the war in the Pacific. (When I was on Midway, people from both nations were touring historic buildings and watching seabirds—a fitting evolution in relations.) During the 1950's and 1960's the base was expanded. The airport was enlarged, and a permanent community of up to 3,500 people enjoyed a movie theater, school, church, and golf course.

The Navy closed down operations on Midway in 1993 and decommissioned the base in 1997. In the interim it removed equipment and some buildings, cleaned up major

contaminants, and prepared the island for civilian management. In 1996, USFWS formed a 20-year partnership with MPC to manage the island's facilities and provide wildlife-oriented recreation. The public began visiting the island in August of that year.

Wildlife management has coexisted with strategic uses of Midway during parts of its history. Theodore Roosevelt initiated Navy control of the atoll in order to discourage the slaughtering of birds by feather hunters (Rauzon 2001). Bird populations were severely reduced during the Cold War by habitat destruction, introduced predators, and direct kill (Baldwin and Fisher 1946). USFWS later assisted the Navy with wildlife management, and the island was accorded formal refuge status in 1988. When the Navy decommissioned the base, it removed or reduced various hazards to birds, such as antennas, bright lights, and contaminated soils. Black rats (*Rattus rattus*) were exterminated using snap traps and anticoagulant baits (Rauzon 2001; EB Flint, pers. comm.).

FAUNA AND TRENDS

Breeding populations of Midway's seabirds are listed in Table 1. The most numerous seabird on Midway is the Laysan Albatross; two-thirds of its world population nest on Midway. Whole-island counts have been conducted since 1996. Numbers of Laysans estimated on Midway have declined during the past decade (429,300 ± 83,067 pairs in 1992, 387,854 in 1996, and 284,600 in 2000; USFWS, unpubl. data). However, trends of albatrosses on Midway are not yet clear-cut; methods differed between 1992 (quadrats extrapolated to total area) and subsequent censuses (total counts of islands). Past trends are virtually unknown. Fisher and Baldwin (1946) estimated only 110,000 individuals (55,000 pairs), which suggests an increase since World War II. Birds may have been recovering from impacts of the war, feather hunting 40 years earlier, or both. Black-footed Albatrosses are less

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numerous (Table 1), but Midway's colony is second only to that on Laysan Island. Numbers of Black-foots have fluctuated on Midway without apparent overall trend (USFWS, unpubl. data). Laysan Albatrosses nest prolifically on open modified substrates on Midway, such as lawns. They even breed in woodland, although this habitat is less favorable. Black-foots prefer sandy substrates, and since at least the 1940's have largely been restricted to the periphery of Midway's islands (Fisher and Baldwin 1946, USFWS 2001). Ironically, Harrison et al. (1984) suggest that humans may inadvertently have improved this habitat for Black-foots by importing dune-stabilizing vegetation.

Productivity of albatrosses is monitored annually on 20 x 20m plots. Estimates for nest success since 1987 for Black-footed Albatrosses on Midway are 0.53-0.86 (USFWS, unpubl. data). Data also have been collected for Laysan Albatrosses but have not yet been summarized. Monitoring methods are being refined, although some improvements would require an increase in volunteers.

Midway's most renowned nonbreeding bird is the Short-tailed Albatross (*Phoebastria albatrus*). One or two individuals have been sighted in the Laysan/Black-foot colony since the 1940's; in recent years there have been two, one each on Sand and Eastern Islands. Two additional birds were sighted in January and March 2001 but did not remain. In an effort to expand the breeding range of this endangered species, decoys of Short-tails and recordings of their calls were placed on Eastern Island in October 2000.

Several species have been increasing since the eradication of rats. Rats reduced Bonin Petrel (*Pterodroma hypoleuca*) populations on Sand Island and eliminated them from Eastern Island (Rauzon 2001), but they are now breeding successfully and increasing on both islands (E. Flint, pers. comm). Brown Boobies (*Sula leucogaster*) also have returned since rats were removed; one nested on Eastern in 1999 (Ron Anglin, pers.

comm.). Bulwer's Petrel (*Bulweria bulwerii*) was extirpated on Midway by rats (Harrison et al. 1984); this species and Tristram's Storm-Petrels (*Oceanodroma tristrami*) have visited again recently but have not yet bred (E. Flint, pers. comm). Several other species such as Wedge-tailed Shearwaters (*Puffinus pacificus*) and Sooty Terns (*Sterna fuscata*) were reduced by rats (Harrison et al. 1984). They probably are increasing, but they have not been censused since rats were removed.

USFWS and its cooperators currently are monitoring breeding populations of albatrosses, Red-footed Booby, Great Frigatebird, and Gray-backed Tern. Reproductive success is monitored for the albatrosses and for the Bonin Petrel, Christmas Shearwater, Red-tailed and White-tailed Tropicbird, Brown Noddy, and White Tern.

Other birds on Midway include wintering shorebirds, such as Pacific Golden Plover (*Pluvialis fulva*) and Bristle-thighed Curlew (*Numenius tahitiensis*), and a large variety of occasional migrants. Two exotic songbirds are resident, the Common Myna (*Acridotheres tristis*) and Canary (*Serinus canarius*).

USFWS also manages Midway's lagoon and surrounding waters, which contain one of the Pacific's most northerly coral reef communities. The agency is studying two dominant predators, the spinner dolphin (*Stenella longirostris*) and giant trevally (*Caranx ignobilis*), the former in cooperation with the Oceanic Society. Most beaches are now off-limits to human activity for the benefit of the endangered Hawaiian monk seal and the threatened green sea turtle (*Chelonia mydas*). Monk seal use of Sand Island beaches has increased greatly, and a few are breeding on Eastern and Spit Islands. NMFS monitors seal populations, and the two agencies are cooperating on monitoring and tagging studies of the turtle. Two long-term projects are monitoring the health and species composition of corals in the lagoon, through joint

efforts of USFWS, U.S. Geological Survey, NMFS, the University of Hawaii, the Bishop Museum in Honolulu, and others. Recreational diving and catch-and-release sport fishing take place in the warmer months.

HISTORIC PRESERVATION

Care of historic structures is part of USFWS's mandate on Midway. Many visitors come primarily for the island's history and approach it with the reverence of pilgrims. Seventy-eight structures and other objects are considered eligible for the National Register of Historic Places, and several are formally included in a National Historic Landmark. Midway Atoll was designated a National Memorial to the Battle of Midway by the Secretary of the Interior in early 2000.

Almost all the relict buildings are decaying; a few are slowly being stabilized and restored with the help of the Oceanic Society, Friends of Midway, Midway Phoenix Corporation, and volunteers. Among the few non-military relics, buildings of the Pacific Cable Company still surround a pleasant plaza. Pan American Airways' hotel complex deteriorated beyond the point of repair and was removed in 1957.

THREATS

Although great improvements have been made in management of seabirds on Midway, problems remain with exotic species, contaminants, marine litter, bird-aircraft conflicts, lights, structures, and human activity.

Exotic plants now occupy most of Sand and Eastern Islands. Ironwood trees, which are native to Australia, grow rapidly to over 15 m. Their woodlands and dense thickets reduce the habitat available to albatrosses, although some Laysans attempt to nest in stands of trees. USFWS has killed the ironwoods on Eastern Island with herbicide and is removing the snags. The extent to which ironwoods should be removed from Sand Island is still being debated. Many stands could be thinned or eliminated. However, trees

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now provide essential nesting habitat for several seabirds, such as White Terns, Black Noddies, and White-tailed Tropicbirds, which have increased on Midway since pre-settlement times (Harrison et al. 1984). Also, visitors and residents appreciate the shade from trees in the residential area.

The most pernicious introduced plant is a composite, the golden crown-beard (*Verbesina encelioides*). This weed is widespread on Sand and Eastern Islands. Meter-high thickets exclude albatrosses from nesting habitat; the birds will nest in clearings, but new growth entangles fledglings as they try to reach the sea. Control methods are being studied by USFWS. Volunteers currently control the plant in selected areas by repeated weeding. Areas not now occupied by *Verbesina*, including the present lawns, are likely to be invaded without constant control (R. Anglin and E.B. Flint, pers. comm.). *Verbesina*, sunflower (*Bidens alba*), and field mustard (*Brassica campestris*) harbor introduced mosquitoes that infect birds with avian pox (Harrison 1990, Rauzon 2001).

Exotic animals formerly included the black rat, which was introduced from Navy ships during World War II (Fisher and Baldwin 1946). This predator eliminated most burrow-nesting seabirds. Rats and habitat destruction caused the worldwide extinction of the Laysan Rail (*Porzana palmeri*), which itself was introduced to Midway in 1891 and survived only on this atoll by 1940 (Fisher and Baldwin 1946, Rauzon 2001). The black rat is gone, but other exotic species are still causing concern. A thriving population of house mice (*Mus musculus*) remains on Sand Island. Mynas are predators of small eggs and nestlings (Harrison et al. 1984). Exotic beetles attack native and introduced vegetation, and exotic ants attack the faces and feet of young White Terns (Harrison 1990). Methods to eradicate introduced ants are currently being tested on Midway.

Contaminants continue to linger from the military period. Although the Navy removed paint and soils that

contained lead, Myra Finkelstein from the University of California has found that albatross chicks in some locations still carry potentially lethal lead residues. Additional cleanup of walls and nearby soils is needed (Finkelstein et al. 2001). Other contaminants are being investigated by USFWS and Kater Bourdon of the University of Hawaii. A Navy contractor will remove three old shipwrecks from the lagoon this year and will bury PCB-contaminated soils. Several Navy seawalls constructed of sheet piling are rusting away. One of these walls supports a dump that contains asbestos and may soon contaminate the lagoon if the wall is not reinforced (R. Anglin, pers. comm.).

Marine debris is a chronic problem everywhere, including on Midway. In each of the last two years, USFWS and its cooperators and volunteers picked up over 11,000 kg of discarded netting and other trash on Midway. The Oceanic Society has requested informally that volunteers pick up plastic lighters from the ground in colonies. They have filled bins at their office with several thousand sun-bleached lighters. This dramatizes the problem very effectively, although presumably it does not reduce the number that are floating at sea.

Conflicts with aircraft have been a hazard to birds and people since the first landings on Midway. Approximately 100 birds formerly were struck each year (Harrison et al. 1984), although no human lives have been lost. Over 50,000 albatrosses were killed by the Navy from 1940 to 1970 in an effort to reduce numbers near the airport. However, the most effective measure was to remove sand dunes near the runway over which the birds were soaring (Rauzon 2001). As required by MPC's agreement with USFWS, aircraft are now asked to arrive and leave at night. This limitation is adhered to by MPC's charter flights. However, MPC also runs a refueling service for trans-Pacific flights. Private and military aircraft (although not airliners) stop at Midway one or more times each week,

and they arrive and depart at all times of day. USFWS is studying bird flight patterns in relation to wind speed and direction, time of day, and other variables in hopes of providing better advice to pilots.

Outdoor lights can be disorienting to nocturnal birds. Outdoor lighting has been reduced by USFWS, but some lights are necessary at night on roads and at the airport. Friends of Midway is planning to support the design and installation of light shades to reduce disorientation of birds.

Structures erected by humans are a potential hazard. Antennas that were struck by albatrosses and Sooty Terns (Harrison et al. 1984) were removed before the Navy left; the tallest structure at present is the water tower. Electric power and light poles remain along streets, and there is some mortality among albatrosses and other seabirds from collisions with poles. USFWS has not permitted the construction of new poles or permanent antennas.

Human visitors can disturb birds and damage habitat. Populations of most birds on Midway were reduced during World War II. A few species were persecuted intentionally, but most were harmed inadvertently by construction or outdoor recreation (Fisher and Baldwin 1946). The resident human population now is far lower than during the peak of Navy activity. Visitors arrive on organized tours and on their own, by air and occasionally on cruise ships. However, the refuge places limitations on visitor activities to keep them compatible with wildlife. Only 100 visitors may be on Midway at one time. People may go to any part of Sand Island, but they are restricted to roads, paths, and a small section of the beach (unless they are participating in approved field work). Eastern Island can be visited only on a tour with a biologist or ranger. Visitors have to move slowly on Sand Island—they may travel by foot, or they may rent golf carts or bicycles that have only one gear. USFWS must approve all activities on the island. The

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refuge tries to permit only those projects that are oriented towards wildlife or historic remains and that do not create a hazard for either.

USFWS has restricted outdoor sports, which mostly are played by residents. A softball field was eliminated, a tennis court was moved indoors, and cricket and golf are permitted only when ground-nesting birds are absent from the island, on ground without the burrows of ground-nesting birds. Volleyball is permitted on the public north beach.

Maintenance of outdoor amenities around buildings can entail conflicts with wildlife. Lawns within the settlement are mowed to keep up a park-like appearance, and to control seedlings of ironwood and *Verbesina* that otherwise would spread. USFWS has reduced the area mowed by half. Grounds crews also remove unattended eggs and dead birds in the interests of aesthetics (these items are delivered to USFWS). Even though mowing crews are careful and nesting albatrosses appear to tolerate passing mowers, there are potential conflicts between lawn-mowing and birds. Abandonment or destruction of nests could occur, and burrows of Bonin Petrels could be crushed. There are no data on the impacts of mowing on the productivity of lawn-nesting birds.

FUTURE SEABIRD MANAGEMENT NEEDS

Much progress has been made in the conservation of Midway's seabirds since USFWS began cooperating with the Navy, especially since full management of the atoll was assumed by the refuge. The refuge's first priority should be to continue programs that are currently underway, with expansion or modification of some. Additional needs for seabird management in the immediate future were suggested to me by refuge personnel, other informants, and my own observations. I have listed the ideas in approximate order of priority, but the list is not exhaustive. Most of the recommendations would require additional funds and personnel.

- Rehabilitate the seawall that separates the dump from the lagoon.
- If there is concern about a declining population of any species, monitor it more frequently (e.g., every 2 years), so that statistically reliable trends can be determined within a reasonable time.
- Expand monitoring of albatross productivity, and monitor in early morning or late evening when chicks are most likely to be at nests.
- Monitor populations and productivity of additional seabird species, such as Wedge-tailed Shearwaters and Sooty Terns.
- Expand studies of methods to eradicate exotic vegetation and animals.
- Monitor effects (whether positive or negative) of eradication programs on breeding bird species.
- Restrict all aircraft operations to night, except for emergencies, and advertise this rule in Federal Aviation Administration manuals and commercial aviation publications.
- Place all electric poles underground, except for essential light poles.
- Eradicate house mice.
- Study the impacts on ground-nesting birds of mowing lawns. (This problem is more restricted in its impact than several others, however.)
- Remove remaining lead paint and lead-contaminated soil. (This problem is more restricted in its impact than most others, however.)

MANAGEMENT CONUNDRUMS

USFWS is mandated to "preserve, protect and restore the biological diversity and historic resources of Midway Atoll, while providing opportunity for wildlife-dependent recreation, education and scientific research" (USFWS 2001). This mission is similar to that for many other wildlife refuges. Midway is

unique among remote islands in possessing facilities that could be converted to a resort. It therefore is the only place under United States jurisdiction where the public can visit a Pacific atoll ecosystem and see a major seabird colony.

Visitors entail complications, some of which have not yet been resolved. It has been suggested that USFWS would do better to withdraw all residents from the island, except perhaps for two or three refuge staff, and make seasonal visits to monitor populations and restore habitats. Midway then could revert to the condition of other northwestern Hawaiian islands, with exotic plants and some relics of human occupation, but with sounds and movement only from birds, wind, and sea. In ways this is an appealing option.

However, a withdrawal of permanent residents from Midway would have major drawbacks. One loss would be the opportunity for the public to see a major seabird colony at close range and to learn about the atoll ecosystem, conservation, and scientific work. Midway offers a unique opportunity for this kind of education, and it thus can fill a vital niche in seabird conservation efforts. Visitors to Midway also are a direct asset to management of the refuge. USFWS makes use of volunteers nationwide, and their assistance on Midway is considerable. Ten to 14 volunteers spend 2 to 3 months each year on the islands; 3 to 8 are present at any one time. Approximately 100 other volunteers spend shorter times (a few hours to a few weeks) assisting with labor-intensive projects. Volunteers supply most of the manpower for many aspects of wildlife management on Midway, including seabird population counts and productivity monitoring, restoration of seabird habitat through removal of exotic plants, picking up marine debris from beaches and lagoon, renovation of historic structures, computer and graphic arts, and even maintenance. Long-term volunteers are supported by USFWS. Short-term volunteers arrive in groups organized by the Oceanic Society, Friends of Midway, and Elderhostel, or

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come on their own; the ad hoc help of interested tourists is recruited on many days. All short-term volunteers pay their own expenses.

Visitors and volunteers are permitted on the island because refuge staff are present to oversee their activities. Additional residents are needed to provide support services, such as electricity, water supply, meals, and a medical clinic (the latter is needed because other medical care is at least 7 hours away, counting the time for a plane to reach the island and return to Honolulu). The airfield makes these support facilities possible; in turn, it depends on personnel and infrastructure for safe operation. Without permanent residents, the airfield would be shut down, as has been done on Kure Atoll to the northwest of Midway. Cooperators and visitors then would be excluded from the island.

If all staff and volunteers were removed from Midway, USFWS presumably could establish a small field camp there. Temporary field camps operate on several northwestern Hawaiian islands, and a permanent one is on French Frigate Shoals. However, field camps could not support the current scale of monitoring and habitat restoration on Midway. The refuge would be unable to maintain some programs or to expand any of them. Another consequence would be further loss of albatross nesting habitat, because without regular weed control, aggressive plants like ironwood and *Verbesina* would invade habitats that are now free of them (R. Anglin, pers. comm.). Without refuge staff to enforce limits on human activity, there also is the danger that unauthorized visitors would disturb seabirds and damage habitats. This is a potential problem on many remote islands, but the problem is worse at Midway because access is easy there.

A problem that overshadows all management strategies on Midway is lack of funding. Small grants have been obtained to help with field work and historic restoration, and MPC also contributes to these activities. However, at present MPC is not earning enough from its eco-tourism

business on Midway to cover expenses, and the corporation is considering whether to terminate its operation. If this happened, USFWS would be likely to seek a new partnership. The alternative would be to end visitor access and many other USFWS programs.

CONCLUSIONS

Conservation of seabirds on Midway has advanced greatly in the last decade, thanks to a reduction in the number of human residents, enhanced protection from disturbance, and habitat restoration. Much more needs to be done, however. Some are proposing that humans should depart from Midway. However, others believe this would be short-sighted. Midway's seabirds are benefiting from habitat restoration, but an ongoing effort is needed to control exotic plants and animals and to clean up contaminants. Monitoring of seabird populations also is vital. It seems especially critical to improve conditions at Midway for Laysan and Black-footed Albatrosses, since the atoll supports a major part of both species' world populations, which may be declining (USFWS, unpubl. data).

Although the idea of "leaving it to Nature" is attractive, this often is a bad option where the ecosystem has been severely damaged by man. Midway will need our continued intervention for some time to come. Eco-tourism and education there also are of benefit to seabird conservation worldwide.

Solutions to Midway's funding problems are not simple. Eco-tourism can help support conservation on Midway, but it probably is unrealistic to think that private enterprise can do the whole job. This is especially true because some endeavors that can prove profitable for island corporations, such as agriculture or fishing port services, probably could not be permitted on Midway. More financial support for conservation on Midway is being sought from various sources. However, secure funding needs to be underpinned by the federal government. Responsibility for Midway's resources rests with USFWS, but this agency's stake in the

atoll is shared by the National Park Service, NMFS, and the Department of Defense.

Midway Atoll is significant to the entire nation. We need a national commitment to ensure its future.

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REPORTS

TABLE 1. Numbers of seabirds breeding on Midway Atoll (Sand, Eastern, and Spit Islands). Numbers are nesting pairs.

Species	Numbers	Year of census	Source
Black-footed Albatross (<i>Phoebastria nigripes</i>)	18,493	2000	USFWS unpubl.
Laysan Albatross (<i>Phoebastria immutabilis</i>)	264,600	2000	USFWS, unpubl.
Bonin Petrel (<i>Pterodroma hypoleuca</i>)	51,493	1998	USFWS unpubl.
Wedge-tailed Shearwater (<i>Puffinus pacificus</i>)	1,000	1990	USFWS unpubl.
Christmas Shearwater (<i>Puffinus nativitatis</i>)	166	1998	USFWS unpubl.
Red-tailed Tropicbird (<i>Phaethon rubricauda</i>)	4,000-5,000	1978 to 1982	Harrison et al. 1984
White-tailed Tropicbird (<i>Phaethon lepturus</i>)	2	??	USFWS unpubl.
Brown Booby (<i>Sula leucogaster</i>)	1	1999	USFWS unpubl.
Masked Booby (<i>Sula dactylatra</i>)	≤ 5	??	USFWS unpubl.
Red-footed Booby (<i>Sula sula</i>)	444	1998	USFWS unpubl.
Great Frigatebird (<i>Fregata minor</i>)	95	1998	USFWS unpubl.
Sooty Tern (<i>Sterna fuscata</i>)	30,000-45,000	1978 to 1982	Harrison et al. 1984
Gray-backed Tern (<i>Sterna lunata</i>)	507	1998	USFWS unpubl.
Brown Noddy (<i>Anous stolidus</i>)	500-1,000	1978 to 1982	Harrison et al. 1984
Black Noddy (<i>Anous tenuirostris</i>)	2,000-6,000	1978 to 1982	Harrison et al. 1984
White Tern (<i>Gygis alba</i>)	5,000-7,500	1978 to 1982	Harrison et al. 1984

SPECIAL ACHIEVEMENT AWARD

The Pacific Seabird Group occasionally honors outstanding contributors to seabird science and conservation with Lifetime Achievement or Special Achievement awards. PSG presented its Special Achievement Award to Dr. Hiroshi Hasegawa at the 28th annual meeting on 10 February 2001.

HIROSHI HASEGAWA

K. Morgan

In 1999, when the PSG Chair asked for suggestions for the Special Achievement Award one name instantly came to mind: that of a man I consider a hero, Hiroshi Hasegawa. In today's world it may seem odd for someone to use the term hero. However, I feel that what this dedicated man has done for seabird conservation truly places him in that lofty league. I nominated Dr. Hasegawa for the award, and I am pleased to report that the Pacific Seabird Group proudly honored him last February for his quarter-century of devotion to the conservation of the Short-tailed Albatross (*Phoebastria albatrus*).

Quoting from information that Hiroshi kindly provided to me, he was "... born in the countryside of central Japan and ... was fascinated with birds from my boyhood. Of course, insects, freshwater fishes, plants, minerals and rocks and so on interested me ..." One can immediately sense that very early on, he developed a keen interest in the natural world around him. Between 1967 and 1971, Hiroshi was enrolled in the Dept. of Agricultural Biology (Entomology) at Kyoto University. Upon completing his BA, he jumped into a MSc program in the Dept. of Zoology (Animal Ecology), again at Kyoto University. A month after completion of his MSc., Hiroshi set off again in pursuit of higher education in April 1973. He completed his PhD in 1976, then began a post-doctoral fellowship with the Japan Society for the Promotion of Sciences. From 1977

until today Hiroshi has taught at Toho University in the Chiba district, first as an Instructor in Marine Biology, then as a Lecturer in the Biology Department, and now as an Associate Professor in Animal Ecology.

Over the years Hiroshi has published on a variety of topics including avian physiology, seabirds of Japan, and nitrogen isotopes in the soils of seabird colonies. He has written on Gray Wagtails (*Motacilla cinerea*), Bewick's Swans (*Cygnus columbianus*), and Laysan Albatrosses (*Phoebastria immutabilis*). But his primary focus has been the Short-tailed Albatross; I counted at least 20 publications on this species, of which several were children's books. Hiroshi humbly stated that "I have published a large number of popular articles, essays ... to popularize the conservation issues of the Short-tailed Albatross, and my scientific contributions were not many." It is clear that he feels that the road to conservation must include educating our children—a lesson that many of us should follow.

Any summary of Hiroshi's accomplishments would not be complete without an overview of Torishima Island and the plight of the Short-tailed Albatross. The Short-tailed Albatross once bred in huge numbers in the Izu Bonin chain and the Ryuku Islands of Japan, in Taiwan, and probably on islands off China. Until the late 1880's the volcanic island of Torishima was seldom visited, perhaps because it lies about 600 km south of Tokyo or perhaps because it has limited protected anchorage. The pre-exploitation population of the Short-tailed Albatross is not known; however, the total number of birds harvested provides a

good estimate. In 1887, the first 12 harvesters settled on Torishima and the slaughter for feathers (for mattresses, pillows, bedspreads, quill pens and adornments for women's hats) began. Between 1887 and 1903, approximately 5 million Short-tails were killed; that averages out to more than 294,000 birds per year! In 1899 alone, 39.2 tons of feathers were shipped from the colony.

In 1932, in response to rumors that Torishima Island was going to be designated as a sanctuary, the feather harvesters killed the remaining 3,000 birds. In April 1949, the American ornithologist O. Austin circled Torishima; finding the island devoid of birds, he sadly concluded that the species was extinct. However, in 1950 a meteorological station was established on the island and on January 6, 1951 the station director, S. Yamamoto, "re-discovered" 10 birds. All early efforts to save the species fell on the shoulders of the meteorologists. However, that ended in 1965 when they evacuated the island. It would be another 8 years before the colony was revisited. In 1973, Dr. Lance Tickell conducted a detailed survey of Torishima to determine the species' status.

Later that same year, a young graduate student named Hiroshi Hasegawa met Tickell. That chance meeting dramatically influenced the course of Hiroshi's life. In March 1977, Hiroshi visited Torishima for the first time and was distressed to find only 15 chicks, down from 24 that had been seen 4 years earlier. He quickly concluded that the low reproductive output was a result of declining habitat conditions. With support from the Japanese Environment Agency and the

SPECIAL ACHIEVEMENT AWARD

Forestry Service, Hiroshi began to rehabilitate the colony. He embarked on a program of transplanting grass and building wooden terraces to stabilize the soil. The efforts immediately paid off with the breeding success rising from 44% to 67%. His next project was to fabricate wire-mesh rock berms to channel mudslides away from the colony, and he constructed several small rock dams on the cliff top to reduce flooding of nests. Nest success in the 2000-2001 season was 73%, the highest in recent years.

Concern had been growing about future volcanic eruptions, which could destroy the entire colony. (Major eruptions in 1902 and 1939 destroyed the island's village—now abandoned—and killed people.) Hiroshi decided in 1993 to try

establishing a second colony at the opposite end of the island. Using 70 wooden decoys and playing tapes of their calls, he began to lure Short-tails away from the original nesting site. In 1995 he was rewarded with finding the first egg at the new colony, and in the 1997/1998 nesting season a chick fledged. As a result of Hasegawa's efforts, the population of Short-tailed Albatrosses has been increasing by about 7% per year.

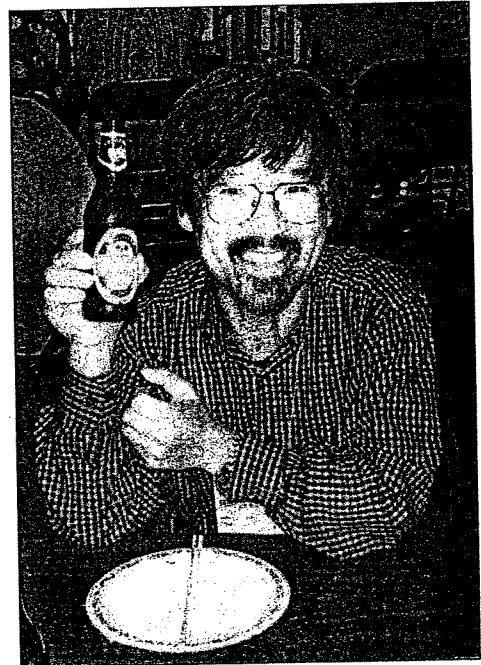
In 1971, a second suspected colony of 12 birds was found on Minami-kojima Island in the Senkaku group. Hasegawa confirmed the presence of chicks there for the first time in 1988. During the 2000-2001 season he estimated 40 nesting pairs with 24 chicks in the Senkaku group. He estimates that the world population

of the Short-tailed Albatross in 2001, including pre-breeding birds, may number around 1300. Although the Short-tail is still highly endangered, its population has increased dramatically since the 1970's and continues to grow at a healthy rate.

Hiroshi Hasegawa has visited the Short-tailed Albatross colony on Torishima 77 times so far and has devoted his career to saving this magnificent species. In the words of Rick Steiner, author of *Resurrection in the Wind* (International Wildlife, September/October 1998), Hasegawa "[has helped] to engineer one of the most extraordinary resurrections in avian history." For his achievement, we owe this humble hero a huge vote of thanks.



Ed Melvin presents the Special Achievement Award to Hiroshi Hasegawa at the 2001 annual banquet.



Hiroshi Hasegawa toasts albatrosses at the 2001 annual meeting.

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Craig Harrison

NEW EXECUTIVE ORDER ISSUED ON MIGRATORY BIRDS

On January 11, President Clinton issued an Executive Order that directs federal agencies' actions affecting migratory birds. The conservation community had advocated such an order since 1997, when the Clinton Administration adopted the position that the Migratory Bird Treaty Act did not apply to federal agencies or to their actions in taking birds (Pacific Seabirds 24:49-50, 1997). A few weeks before promulgation of the order, PSG Vice Chair for Conservation Craig S. Harrison and other conservationists met with U.S. Fish and Wildlife Service (USFWS) Director Jamie Clark. They sought a much broader order that would have required federal agencies to adhere to Partners in Flight conservation plans and better practices for bird conservation, especially regarding habitat management on federal lands. Unfortunately, inter-agency review requirements precluded any changes in the proposal that ultimately became the order—it was a “take it or leave it” situation.

In addition, as a result of the meeting with PSG and others, the USFWS Director issued a directive in December 2000 that the Migratory Bird Treaty Act applies to all federal agencies. The directive reiterated that agencies are prohibited from taking migratory birds without a permit. It implemented the court decision in *Humane Society of the United States v. Glickman*, 217 F.3d 882 (D.C. Cir. 2000) (Pacific Seabirds 27:24, 1997).

Under the new Executive Order, each federal agency whose actions have, or are likely to have, a measurable negative impact on migratory bird populations must develop and

implement a memorandum of understanding with USFWS for the conservation of migratory birds. In addition to avoiding or minimizing impacts on migratory bird populations, federal agencies must take reasonable steps to restore and enhance habitat, prevent or abate pollution affecting birds, and incorporate migratory bird conservation into agency planning processes whenever possible.

The order also directs that the agencies' environmental analyses for proposed federal actions, which are required under the National Environmental Policy Act, must evaluate the effects of those actions on migratory birds. Within the scope of agencies' regular activities, they are required to control the spread and establishment in the wild of exotic animals and plants that may harm migratory birds and their habitats. Finally, the order requires agencies to provide advance notice of any action that may result in the take of migratory birds or to report annually to USFWS on the numbers of each species taken during the conduct of any agency action.

USFWS HALTS NEW ENDANGERED LISTINGS

In November 2000, USFWS director Jamie Rappaport Clark issued a memorandum halting all further listing action under the Endangered Species Act until October 2001. Clark said that USFWS funds have been depleted fighting lawsuits, especially for critical habitat designations. She noted that the Clinton administration also tried to expand its listings discretion, but “the litigation explosion has been so bad, we couldn't even list species that were going over the edge. We asked the courts to let us set our own priorities, but they wouldn't budge.”

In the past, critical habitat designation was not generally deemed essential by USFWS because they thought that it duplicated other protections under the Endangered Species Act. Since the designation was seen to provide no additional protection for endangered species, and since it is very time-consuming and costly (requiring in-depth habitat surveys), it was given low priority. USFWS elected to “triage” its listing actions, pursuing the most essential cases first. However, this resulted in very few critical habitat designations. In 1997 the Ninth Circuit Court of Appeals in San Francisco decided, in a suit filed by the Natural Resources Defense Council, that USFWS must designate critical habitat for the California gnatcatcher. The court explained that the Endangered Species Act requires the agency to designate critical habitat concurrently with listing the species as threatened or endangered, “to the maximum extent prudent and determinable” (Pacific Seabirds 24:74-75, 1997). This precedent sparked a flood of similar suits, and in some decisions the courts ordered that very short deadlines must be met. Critical habitats then took precedence over all other listing activity and ate up USFWS's entire \$6.3 million budget for listing of endangered species.

The new Bush administration has proposed extending this moratorium. It also would relax some of the strictest mandates and deadlines in the Endangered Species Act for a year. This would give federal officials more discretion to decide which vanishing species to protect and how best to protect them. The proposal was included in USFWS's budget request. It would limit the ability of environmental groups to obtain court orders, which dictate almost all of the agency's efforts to preserve additional species and their natural habitats. Instead, the proposal would allow USFWS to set its own priorities and

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timetables for adding species to the threatened and endangered lists, although it would still be required to comply with existing court orders.

Acting Fish and Wildlife Director Marshall Jones said the measure would help create a "rational system" that could get his agency off the litigation treadmill that had led to the moratorium. "Right now, it's just a race-to-the-courthouse situation," Jones said. "We're in an impossible position, and this could provide a way out."

Some moderate environmental groups have expressed sympathy for USFWS's dilemma. However, others say the agency has proved that it will never act to protect species unless required to do so by a judge, no matter who is president. In California, for example, the annual listing rate has more than quadrupled since environmentalists began filing lawsuits a decade ago. Since then, 92% of the state's listings have been initiated by the citizen petitions and lawsuits that would be limited by the measure. The Center for Biological Diversity, for example, has filed 72 cases against USFWS, most of which were designed to force the agency to designate swaths of "critical habitat" for already-listed species. It has only lost one of those cases. The agency faces an additional 76 lawsuits over about 400 species, 39 of which are critical habitat lawsuits that covering 360 species. There are also another 95 notices of intent to sue covering 600 species.

These issues highlight the debate within the conservation community as to whether resources for recovery of endangered creatures—resources which are inherently limited—are best spent in the courtroom or on the ground.

EXTINCTION FOR GUADALUPE STORM- PETREL

In June 2000, the San Diego Natural History Museum, launched an expedition to Isla Guadalupe, in partnership with Bill Everett of the

Endangered Species Recovery Council and the Mexican Government. The island is located 150 miles off the west coast of Baja California. With funding from the National Science Foundation, they conducted the first comprehensive zoological survey of the island since 1908.

Guadalupe is notorious for the fact that no area of equal size (approximately 260 km²) in North or South America has experienced more extinctions of endemic plants and birds during the last 200 years. European explorers, whalers, and sealers arrived in the early 1800s and released goats, rats, and cats onto the island. By the time the first scientists visited Guadalupe in the 1870s, much of the unique flora and fauna had already been driven nearly to extinction by habitat destruction or predation. Many species now are barely surviving, such as huge, ancient trees that cannot reproduce because goats eat the young sprouts, and birds that depend on the dying forests of palm, cypress, and pine for habitat.

Although the 2000 expedition sought to determine the status of all the island's plant and animals, special attention was paid to searching for the Guadalupe Storm-Petrel (*Oceanodroma macrodactyla*) in hopes that it had somehow survived the many decades of predation and habitat destruction. The breeding colonies are located atop the rugged 1,280m-high island, among the roots of the towering pine and cypress trees. The 2000 expedition arrived at Guadalupe at precisely the time when storm-petrels should have been attending their nesting burrows. Researchers scoured the small abandoned nesting colonies for three days and nights. Not only were no birds detected, but the massive habitat destruction caused by goats had completely eliminated all suitable burrowing habitat for the species. It therefore is unlikely that any survive.

On a more positive note, several Guadalupe Juncos (*Junco [hyemalis] insularis*) were found, and the population of this critically endangered species is now estimated to be in excess of 1,000. Plans are now underway to remove the goats and

protect the remnants of the island's ecosystems. The expedition also discovered two small new colonies of nesting Laysan Albatross (*Phoebastria immutabilis*) (about 50 pairs total) on small islets off the south end of Guadalupe. The results of the expedition will soon be published, with full details on the search for the storm-petrel and the other species that still exist on this remote desert island.

—Bill Everett

PSG COMMENTS ON THE LATEST ENVIRONMENTAL ASSESSMENT ON CASPIAN TERNS

In March 2001, the Pacific Seabird Group filed comments on the Environmental Assessment by the U.S. Army Corps of Engineers on its Caspian Tern (*Sterna caspia*) relocation project in the Columbia River estuary. PSG emphasized its support for creating alternative nesting habitat for Caspian Terns. We also reiterated our support for the immediate creation and implementation of a regional plan that would guide restoration efforts for Caspian Terns in Washington, Oregon and California. PSG first requested that USFWS prepare such a report in April 1999. PSG noted that restoring former colonies or establishing new colonies would mitigate for the ongoing destruction of the colony at Rice Island, and the apparent failure of the Corps and the National Marine Fisheries Service (NMFS) to provide sufficient suitable alternative habitat.

With respect to environmental assessment, PSG again objected to the Corps' refusal to prepare a full environmental impact statement (EIS) under the National Environmental Policy Act. The Corps lost several legal battles on this issue during 2000 (*National Audubon Society v. Butler*). Last fall, even the Caspian Tern Working Group, an inter-agency group of scientists working on this issue, urged the Corps to prepare an EIS. USFWS has twice urged the Corps to

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prepare an EIS. Instead the Corps has again refused to do so, and it has failed to evaluate all of the reasonable and feasible alternatives to the proposed action. We understand that the Corps believes that preparing an EIS is time-consuming. Had they prepared an EIS in 1998 as PSG then suggested, this issue would now be moot.

PSG objected to activities that interfere with Caspian Terns nesting at Rice Island until the federal agencies have created sufficient suitable habitat elsewhere. This year Caspian Terns will lose their nesting habitat at the ASARCo site in southern Puget Sound, so that another 1,500 to 2,000 terns will be seeking additional nesting habitat near the Columbia River estuary. PSG successfully persuaded the Corps to slightly increase the 1.6 ha of nesting habitat on East Sand Island that they are preparing for the 2001 nesting season.

In addition, the Corps has based its decisions on seriously flawed science, in particular their assumption that there is a simple, positive relationship between numbers of smolt and adult salmon. The salmon runs in 2000 were the best in about 40 years, belying the assumption that Caspian Terns are harming salmon runs in the Columbia River. This indicates that a potential 1999 "regime shift" in the Pacific Ocean may be much more important to salmon returns than Caspian Tern predation.

USFWS FAILS TO MAKE INITIAL DETERMINATION CONCERNING REFUGE STATUS FOR EAST SAND ISLAND

As reported in *Pacific Seabirds* 27:65 (2000), PSG asked USFWS in late September 2000 to take steps to acquire East Sand Island in the Columbia River estuary as a national wildlife refuge. The island is owned by the U.S. Army Corps of Engineers. It has important seabird resources, including the largest Caspian Tern colony on earth and the largest Double-

crested Cormorant (*Phalacrocorax auritus*) colony on the west coast of North America. It also has the largest roost site of Brown Pelicans (*Pelecanus occidentalis*) in the Pacific Northwest (3,400 birds in 2000) and a major colony of Western/Glaucous-winged Gulls (*Larus occidentalis/L. glaucescens*) (7,000 nesting pairs). Although acquiring East Sand Island seems to be well within the objectives of the National Wildlife Refuge System and of USFWS's seabird policy for Region 1, the agency has failed to make an initial determination during the past six months.

CONSERVATION OF NEWELL'S SHEARWATERS

PSG asked Kauai Electric in March 2001 to reconsider its proposed installation of utility wires 85-110 feet high when it builds the Hanamaula electric generating facility. This line placement is very likely to increase mortality of the federally threatened Newell's Shearwater (*Puffinus newelli*), which appears to be declining. In particular, PSG expressed concern with the failure of Kauai Electric to adopt the management recommendations of the Scientific Advisory Panel published in 1996 by the Electric Power Research Institute regarding the placement of the elevated utility wires. Kauai Electric has not addressed these guidelines in the Environmental Impact Statement prepared for this project.

PSG asked Kauai Electric to take the following actions:

- Proceed with a Section 10 Consultation under the Endangered Species Act with the USFWS in order to obtain an incidental take permit;
- Place lines underground near the Hanamaula generation facility, since it is the site of a major flight corridor for shearwaters and also is near a ballpark which is brightly illuminated during night games; and

- Relocate, lower and redesign power lines so that they present a smaller target to flying shearwaters.

INTERIOR DETERMINES THAT MIGRATORY BIRD TREATY ACT EXTENDS BEYOND THREE MILES

In a "midnight" determination on the eve of the change in administrations, the U.S. Department of the Interior's Office of Solicitor released a legal opinion concerning the application of the Migratory Bird Treaty Act in waters beyond the three-nautical mile territorial sea of the United States. On January 19, 2000, the Solicitor concluded that the Act can be enforced extraterritorially in the following circumstances: (1) against US citizens for acts taken in US waters beyond three nautical miles from the coastline and in international waters; and (2) against citizens of any country for acts taken on US-flagged vessels in US waters beyond three nautical miles from the coastline and in international waters. PSG has been active in supporting this interpretation of the law for well over a decade. In 1996, USFWS enforcement officials were unable to prosecute wanton and intentional destruction of seabirds in Alaska because the activities occurred too far offshore (*Pacific Seabirds* 23(2):14 [1996]).

The opinion cannot be implemented for six months. This allows NMFS until mid-July to appeal the opinion to the Office of Legal Counsel of the U.S. Department of Justice. In April 1996, PSG wrote to the Department of Justice and requested that it render such an opinion. At that time, the department responded that because Interior was reviewing this issue, "any formal Department of Justice involvement in the issue would be premature." The resolution of this issue apparently takes a great deal of patience (see "With Friends Like These, Who Needs Enemies?" *Pacific Seabirds* 24:49-50 [1997]).

SHORT-TAILED ALBATROSS EXPANDS RANGE TO OGASAWARA ISLANDS

The endangered Short-tailed Albatross (*Phoebastria albatrus*) was discovered breeding on Yomejima island of the Ogasawara Islands this fall, according to the Japanese newspaper Yomiuri Shimbun. Other known breeding islands are Torishima in the Izu Islands and Minamikojima in the Senkaku Island group. The population on Torishima island is now about 1,000 birds, and an undetermined but much smaller number breed on Minamikojima.

Yomejima is a deserted island located southernmost among the Mukojima Islands and is part of the Ogasawara Island chain. A researcher spotted two birds that appeared to be albatrosses on the island in November. Based on this information, a search was carried out, leading to the discovery of one albatross incubating an egg in a nest on December 14, 2000.

The local metropolitan government has indicated that it wants the island to become a new habitat for the albatrosses. Researchers will monitor the breeding activity of the pair to determine whether they successfully fledge a chick.

NEW SHORT-TAILED ALBATROSSES SEEN ON MIDWAY

One to three adult Short-tailed Albatrosses have been observed on Midway Atoll, in the northwest Hawaiian Islands, during many breeding seasons in the past half-century. In recent years there have been two "regulars", both banded by Hiroshi Hasegawa as fledglings on Torishima. One is a 19-year old that consistently visits Sand Island; the other is either 12 or 15 years old and frequents Eastern Island. There has been little evidence of breeding, although the Sand Island bird laid an egg in November 1993, and she

performed courtship displays in March 1994 with another Short-tail that has not been seen since (S.A. Richardson 1994, *Elepaio* 54[6]:35-36). Last year, decoys and recordings of Short-tails were installed on Eastern Island in hopes of attracting additional birds. In January 2001 a new Short-tailed Albatross, an 8-year-old in subadult plumage, was observed briefly on Sand Island. It was discovered by a 9-year-old boy from Maui, Dolan Stanton, and confirmed by the (initially skeptical) refuge staff. Another new Short-tail was observed in March (R. Shallenberger, pers. comm.). Neither bird stayed for long.

—Vivian Mendenhall

FAO PLAN TO HALT PIRATE FISHING RIDDLED WITH LOOPHOLES

At a meeting of the Committee on Fisheries of the United Nations Food and Agriculture Organization (FAO) in Rome in March 2001, BirdLife International condemned the failure of the world's nations to take tougher actions against pirate fishing. More than 90 FAO member countries met to finalize an International Plan of Action, which aims to "prevent, deter and eliminate illegal, unreported and unregulated (IUU) fishing." Pirate fishing in the Southern Ocean has killed 100,000 - 250,000 seabirds during the last four years, including nearly 70,000 globally threatened albatrosses.

While the International Plan of Action tightens the net in some respects, the end product is a compromise that still leaves many loopholes for pirate fishing. It "will hardly leave pirate fishers quaking in their boots. For many it will be business as usual for plundering the world's dwindling fish stocks and driving albatrosses towards extinction," said Euan Dunn, Royal Society for the Preservation of Birds Fisheries Officer. Pirate fishing is the biggest single threat to global fish stocks and kills tens of thousands of seabirds as by-

catch every year. Pirate fishing has doubled in the last 10 years and now accounts for one quarter of the world's fish catch. Tanzania referred to "IUUU" fishing - the extra 'U' for 'Unfair' because of the disproportionately serious impact that pirate fishing has on developing countries.

With the UN conceding that international efforts have so far been powerless to curb the runaway piracy of fish stocks on the high seas, the challenge was to draw up a Plan of Action which would clamp down hard on IUU fishing. However, an initially promising plan was weakened in successive drafts, mainly by Mexico, which blocked recommendations for stronger measures. Canada also resisted toughening one key part of the plan, and other parties including the European Union failed to resist Mexico's proposals to weaken the plan.

The Plan of Action, which is voluntary, leaves much to the discretion of nations. Yet in several key areas it calls for weaker measures than those already agreed upon in regional fishery management organizations. For example, it fails to require severe sanctions against traders in pirated fish. Another major loophole is the plan's failure to consistently extend measures that would combat the activities of support vessels for pirate fishing, including supply and transfer vessels. "Unless the trade in IUU fish is declared illegal, the plan is deeply flawed. Those who benefit commercially from the sale or purchase of pirated fish must be punished," said Dunn.

BirdLife International noted that the plan encourages nations to cooperate in identifying companies and individuals engaged in pirate fishing. Strong measures also were agreed for port nations, including the requirement of vessels to give advance notice of arrival at port and allowing the port nation to assess whether vessels have been involved in IUU fishing. As a whole, Dunn said, "The plan certainly offers fishing nations some valuable new tools to help curb pirate fishing, but in the end the parties have not buried their differences to mount a

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powerful enough attack on the pirate fishing problem.”

ENVIRONMENTAL IMPACT STATEMENT ON ALASKAN GROUND FISH FISHERIES INCLUDES EVALUATION OF IMPACTS ON SEABIRDS

The National Marine Fisheries Service (NMFS) issued a new Draft Programmatic Supplementary Environmental Impact Statement (PSEIS) on the impacts of offshore groundfish fisheries in January 2001. Alaska has by far the largest commercial fisheries in North America. Groundfish include walleye pollock, sablefish, Pacific cod, Atka mackerel, and rockfish. The North Pacific Fishery Management Council sets yearly allowable catches, bycatch limits, fishing methods, locations, and other management parameters, after listening to recommendations by NMFS biologists, the fishing industry, and the public. The first environmental impact statement for the management of this fishery was written in 1978 to 1981, and by the late 1990's it was badly outdated.

Fisheries managers have historically tried to conserve fish stocks, but recently their attention has also been drawn to the effects of fisheries on the environment. Groundfish fisheries affect seabirds both indirectly, through alteration of prey food chains, and directly, through

bycatch of birds on longlines and in trawls. NMFS has addressed bycatch problems by issuing regulations that require measures by fishermen to deter birds from getting caught on longlines, the agency has supported research on the effectiveness of deterrents (see abstract by Melvin et al. in this issue). PSG has supported seabird conservation in the fishery by writing letters, testifying, and commenting on proposed regulations.

In 1998 NMFS issued an updated EIS on the impacts fishery catch limits in the Alaskan groundfish fishery. The document considered seabirds and marine mammals as well as fish stocks (seabird sections were contributed by USFWS, at the invitation of NMFS). However, the courts found that a broader range of management issues needed to be addressed, including fishing methods, locations, and cumulative impacts. NMFS “went back to the drawing board” and produced the current draft EIS. The document retains and expands the seabird sections that were published in 1998.

The PSEIS reviews the biology of affected species, from target fish to benthic mammal and seabirds, and describes the complex management of fisheries. It then proposes six alternative management schemes: (1) Continue the current management system. (2) Emphasize protection for marine mammals and seabirds. Possible measures include expansion of no-fishing zones and periods, more research on bycatch deterrents, establishment of incidental catch limits for all seabird species (such limits exist

already for marine mammals, but among birds only for the Short-tailed Albatross), and reduction of the bycatch limit for the Short-tailed Albatross. (3) Emphasize protection for target fish species. (4) Emphasize protection for non-target and forage fish species. (5) Emphasize protection for marine habitats. (6) Emphasize socioeconomic benefits to fishermen and communities. Potential impacts of all these alternatives are evaluated, including those on seabirds from food chain effects and bycatch. The final document is likely to combine elements from several proposed alternatives.

The draft PSEIS is an immense document (3,300 pages), owing to the complexity of the fisheries management program. NMFS has made a sincere effort to consider the full range of problems faced by the Alaskan marine ecosystem, both from fisheries and from other influences such as climate change. It is to be hoped that seabirds will benefit from improved fishery management. However, problems remain to be solved before fisheries can be reconciled with conservation of seabirds. The biggest of these problems, as the PSEIS points out, is that we still have little information on the diets or distribution of Alaskan seabirds in fall, winter, and spring. The impacts of fisheries on the prey of seabirds therefore remain largely unknown. PSG has reviewed the draft PSEIS and will submit comments to NMFS. Comments are due by 25 July 2001.

—Vivian Mendenhall

PSG NEWS

ELECTIONS TO EXECUTIVE COUNCIL

EXECUTIVE COUNCIL FOR 2001

The following officers were elected in fall 2000 and have joined (or continue) on the Executive Council:

- Chair-elect: Lisa Ballance
- Vice-chair for Conservation: Craig Harrison
- Treasurer: Breck Tyler
- Southern California: Pat Mock
- Canada: Ken Morgan
- Oregon/Washington: Jan Hodder
- Non-Pacific US: Malcolm Coulter

Ballance, Hodder, and Coulter are newly elected, and PSG welcomes them to the Exco. All except the Chair-elect will serve for two years; the Chair-elect will become Chair next year and Past Chair the year after.

Continuing members of the Exco include chair Bill Sydeman, past chair Julia Parrish, secretary Lora Leschner, student representative Louise Blight, Alaska and Russia representative Rob Suryan, Northern California representative Kyra Mills, Pacific Rim representative Beth Flint, and Old World representative Mark Tasker.

ANOTHER ODDBALL ELECTION

Forty ballots were returned. Although turnout was better than last year (24 votes), the Executive Council would very much like to see more members voting. (The officers are supposed to be representing your concerns for PSG and seabirds. Maybe the members trust everyone who runs!)

One Northern Californian voter wrote "Northern California" in the blank for the "Oregon/Washington" representative, then voted for that candidate. Was the person advocating a new state of NoCaOrWa?

EXECUTIVE COUNCIL CANDIDATES NEEDED

The following positions will be up for election in fall 2001:

- Chair-elect
- Secretary
- Alaska and Russia representative
- Northern California representative
- Pacific Rim representative
- Old World representative
- Student representative

PSG needs more candidates for these positions. Pat Baird, the Elections Chair, always finds at least one candidate for each position—but usually only one. Some officers get tired after a few years and need a change; others are happy to serve for years, but it would be good to give PSG members a choice of candidates. Exco members help determine PSG policy and activities, and they provide a great service to PSG and seabirds. Being a member of the Executive Council is extremely interesting. You keep up to date on all the current conservation issues surrounding seabirds, not to mention PSG politics (yes, we occasionally have those).

Students are invited to become candidates for any position on the Executive Council. Only one position is restricted by academic or professional standing: that of Student Representative, to which only a student can be elected.

Please contact Pat Baird if you or anyone else you know would like to run for PSG office. She can be reached at (562) 985-1780 or patbaird@sculb.edu.

AWARDS AT THE 2001 PSG ANNUAL MEETING

At its 28th Annual Meeting in Lihue Kauai, 7-11 February 2001 PSG presented its Special Achievement Award for 2001 to Dr. Hiroshi Hasegawa. The award honored his unflagging efforts to protect the endangered Short-tailed Albatross (*Phoebastria albatrus*) (see article elsewhere in this issue).

A special fund for student travel awards was established for the 2001 meeting because of the high cost of travelling to Hawaii. The PSG Awards Committee received 22 applications for Student Travel Awards and made 12 awards totaling \$5000. Awardees were: Ben Becker, Russ Bradley, Carina Gjerdum, David Hyrenbach, Deborah Lacroix, Kyung Gyu Lee (Korea), Suzann Speckman, Ignatio Vilchis, Kerry Woo, Peggy Yen, Stephani Zador, and Carlos Zavalaga (Peru).

Twenty-two students made oral presentations at the meeting, and 6 presented posters. Deborah Lise Lacroix received the Best Student Paper Award for her talk "Dine and Dash: The Foraging Patterns of Wintering Surf Scoters (*Melanitta perspicillata*) Feeding on Bay Mussels (*Mytilus trossulus*) in Coastal British Columbia." Benjamin H. Becker received the Best Student Poster Award for his poster "Oceanography and Foraging Ecology of the Marbled Murrelet in Central California during Variable Upwelling and Prey Availability."

PSG NEWS

WOULD YOU LIKE TO HONOR SOMEONE WITH AN AWARD?

In 1993, PSG instituted two awards to recognize individuals who have made significant contributions to seabirds. PSG's Awards Committee is now soliciting nominations for Lifetime and Special Achievement Awards.

The Lifetime Achievement Award recognizes a seabird researcher, educator, or conservationist who has made significant, long-term contributions to seabird science, conservation and education in the Pacific Ocean or in the world. Past recipients of the Lifetime Achievement Award include James C. Bartonek, W.R.P. Bourne, Richard G.B. Brown, Charles Guignet, Thomas R. Howell, Karl W. Kenyon, James G. King, Miklos D.F. Udvardy, and John Warham. The most recent Lifetime Achievement Award went to Dick Brown for his contributions to research on pelagic seabirds of the North Atlantic (see *Pacific Seabirds* 27[1]:18-20, 2000).

The Special Achievement Award recognizes an individual who has performed outstanding, long-term service for the Pacific Seabird Group, or who has made outstanding contributions to the betterment of seabird research, education, or conservation. The Special Achievement Award was awarded in February 2001 to Hiroshi Hasegawa. Past recipients include George Divoky, Craig Harrison, Art SOWls, Steve Speich, and Malcolm Coulter for their years of exemplary service to PSG.

The procedure for nominating a candidate for a PSG award is as follows:

- Contact the Awards Committee to make sure your nomination is in the appropriate category
- Contact the candidate and receive permission to proceed with the nomination process
- Submit a 1-2 page nomination statement to PSG to the Awards Committee giving the candidate's

accomplishments and contributions to seabird research, education, or conservation, or service.

The Awards Committee gives their recommendations to the full Executive Council, which makes the final selection. There is no official deadline for nominations, but they should reach the Awards Committee several months before the next annual meeting.

The Awards Committee consists of the Past Chair (chair of the Awards Committee), current Chair, and Chair-elect. Committee members for 2001 are Julia Parrish, Bill Sydeman, and Lisa Balance. Julia's address is: Zoology Department, University of Washington, Box 351800, Seattle, WA 98194, USA; telephone (206) 616-2958; E-mail: jparrish@u.washington.edu. Each year the committee may decide to give one or both awards, to honor several people in one category, or not to give any award.

Awards are presented at the annual PSG banquet. A short (15-20 minute) speech is made, usually by the person who submitted the nomination, to honor the recipient of the award and explain his or her accomplishments. An engraved plaque is presented.

The final duty of the person who made the nomination is to write a 1-2 page article for *Pacific Seabirds*. Articles are similar to nomination statements but may contain more detail. Recent examples can be found in *Pacific Seabirds* 23(1):9-10 (1996), 24(2):51-53 (1997), 25(2):71-72 (1998), 26(1):13-14 (1999), 27(1):18-20 (2000), 27(2):60-61 (2000), and this issue.

PSG INCREASES MEMBERSHIP DUES

The Executive Council voted at the 2001 annual meeting to increase membership dues, to take effect at the start of 2002. Dues will be \$25 for regular members, \$15 for students, and \$750 for a life membership. The in-

crease is necessary because PSG's costs have been increasing. The most expensive activity supported by dues is publication of *Pacific Seabirds*, and we also have undertaken joint publication (on a three-year trial basis) of *Marine Ornithology*. Other costs include insurance, tax preparation, and other publications.

PSG 2002 MEETING TO BE HELD IN SANTA BARBARA

The Pacific Seabird Group's 29th Annual Meeting will be held on 20-24 February 2002, at the Santa Barbara Museum of Natural History in Santa Barbara, California. There will be a full scientific program on 21-23 February, featuring symposia on "Oil and California's Seabirds" and "Status and conservation of the White Pelican." Committees will meet on 20 February. Field trips to the Channel Islands will be offered before the meeting (19-20 February) and after it (24 February).

For general information, contact Harry Carter, U.S. Geological Survey, 6924 Tremont Road, Dixon, CA 95620, (707) 678-0682, extension 625, e-mail Harry_Carter@usgs.gov; or Sarah Fangman, Channel Islands National Marine Sanctuary, 113 Harbor Way, Santa Barbara, CA 93109, (805) 884-1473, e-mail sarah.fangman@cinms.nos.noaa.gov. For information about the scientific program, contact Lisa Ballance, NMFS, Southwest Fisheries Science Center, 8604 La Jolla Shores Drive, La Jolla, CA 92037, (858) 546-7173, e-mail lisa.ballance@noaa.gov. Announcements and the call for papers will be mailed in fall 2001. Also check the PSG web page for updates on the meeting.

SECRETARY'S REPORT

SUMMARY OF PROPOSED MINUTES OF THE 2001 PACIFIC SEABIRD GROUP EXECUTIVE COUNCIL MEETING Kauai Beach Resort, Lihue, Kauai, Hawai'i, 7 and 8 February 2001

[The full text of the proposed minutes is available from the Secretary, Lora Leschner (leschlll@dfw.wa.gov). The minutes will be come official when they are approved at the 2002 Executive Council meeting.]

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Present were Julia Parrish, Vivian Mendenhall, Bill Sydeman, Louise Blight, Ken Morgan, Rob Suryan, Roy Lowe, George Divoky for Craig Harrison, Ed Murphy, Breck Tyler, Lora Leschner, Patrick Mock and Beth Flint. Bill Sydeman had the proxy for Kyra Mills, Roy Lowe for Jim Lovvorn.

Minutes

Minutes from the 2000 meeting were approved.

Report from the Chair

There was no Chair report

Treasurer's report

Breck Tyler reviewed the Treasurer's report (see preliminary report in *Pacific Seabirds* 27[2]:90-91). A discussion followed on some of the issues. The increased cost of business and possibility of a dues increase was discussed. Life membership cost has not increased for a long time and the student dues are very low. The bylaws state that life membership should be 30 times the regular dues. It was proposed that the rate be increased to \$25 for regular members, \$15 for students, and \$750 for life members. The fixed cost on insurance can be spread if membership goes up. Further discussion on dues was delayed until

after all the expenses and projects were discussed.

Problems with the different calendar for PSG's fiscal year (October through September) and membership (January through December) were discussed. Breck advises to have membership and fiscal years on the same calendar. The current system was begun because the Executive Council needs a full year's financial statements at each annual meeting. However, the result is that 2 reports must be produced. The question of change in fiscal versus calendar year will be delegated to Treasurer and past Treasurer and discussed in a conference call.

The contract on seabird monitoring database was discussed. The Treasurer will prepare a report on expenses and Scott Hatch will prepare a report on products. The Executive Council and membership needs a report from the monitoring committee.

Two of the major costs for PSG are the annual meeting and publication of *Pacific Seabirds*. Vivian Mendenhall reported on costs of *Pacific Seabirds*. 386 copies of spring issue were mailed, plus requests for others mailed later. The fall issue ran to 519 copies. *Pacific Seabirds* production and mailing cost about \$7500. for an accountant familiar with non-profit tax law. Breck Tyler presented information on the expenses and income of the 2000 PSG meeting and the preliminary financial report for the Hawai'i meeting. Members discussed annual meeting expenses and ways to help the Chair-Elect and the local committee get funding for special speakers or symposia.

Breck presented the Treasurer's perspective on the costs and mechanics of the pilot electronic journal, *Marine Ornithology*. A membership dues increase would help subsidize *Marine Ornithology* and help PSG with Ornithological Society dues increases. PSG is committed to 3 years' involvement in *Marine Ornithology*; the Council will then evaluate our position and decide whether PSG should continue. The Treasurer was concerned about management of two memberships, but the Chair explained that the intention was to keep the *Marine Ornithology* membership separate. The Chair referred the discussion on *Marine Ornithology* to the Publications Committee.

Ken Morgan has opened a Canadian bank account so that Canadian members can pay in Canadian funds. Breck said that the reason for this was that foreign checks cost too much to process. Breck changed banks, which also helped. 12 individuals paid dues via the Canadian bank.

OLD BUSINESS

Conservation Committee

Craig Harrison was not present, so Mark Rauzon gave the report.

A letter has been sent to Kauai Power requesting that they put a power line underground. A letter was sent to the UN Food and Agriculture Organization (FAO) supporting an ecosystem management plan for fisheries.

PSG needs to send a letter to the National Marine Fisheries Service (NMFS) asking for observers on California squid boat fisheries. NMFS may already plan to put observers on

SECRETARY'S REPORT

boats; PSG should send a letter to request that bird data be collected in addition to the marine mammal information.

Mark will draft a letter and give it to Craig Harrison for action.

American bird conservancy

There was no report.

Elections Committee

Pat Baird was not present, so Parrish gave the elections report.

Lisa Ballance is the incoming Chair. Malcolm Coulter is the new representative for the non-Pacific US. Jan Hodder replaces Roy Lowe as Washington/Oregon representative. Rob Suryan is leaving Alaska; he will continue to represent Alaska and Russia and will help find a replacement for next election.

Sending the election ballot along with the meeting announcement was not successful. Many downloaded the meeting announcement from the web site; these members did not open their mailed meeting announcement and thus did not get the ballot. The Council discussed methods to increase participation. It was suggested that PSG could distribute ballots via e-mail, but this may not be an option under the law for non-profit organizations in California, where PSG is incorporated. Bill Sydeman will look into voting online or by e-mail. The Council discussed having 2 or more candidates for positions on the ballot, which provides the membership with real choice, versus our usual single-candidate ballot, which makes it look as if new officers are selected by the Council. The Secretary, Lora Leschner, will discuss elections with Pat Baird, the Elections Committee chair, and report back to the Council. The Secretary will work with the Editor to get an announcement about nominations in *Pacific Seabirds*.

Publications Committee

Vivian Mendenhall gave the report on *Pacific Seabirds*. Members are submitting articles for *Pacific Seabirds*. The goal is to have peer-

reviewed short articles and an outlet for conservation or taxonomic notes. PSG would like to continue to use *Pacific Seabirds* for conservation topics. However, if *Pacific Seabirds* and *Marine Ornithology* are both weighty, then costs increase. will be an electronic journal, but the original members receive a printed version. The African Seabird Group has been printing *Marine Ornithology*; the printed version needs to continue for both members and libraries. There are currently 250 subscribers to *Marine Ornithology*. PSG will have to charge its members extra to receive a hard copy of *Marine Ornithology*. The Council discussed the distinction between *Pacific Seabirds* and *Marine Ornithology*. *Pacific Seabirds* is a good outlet for minor articles. PSG will provide *Marine Ornithology* journal free on web, mainly because the mechanics of collecting money on the web are difficult. Concerns were expressed that the publication cost of *Marine Ornithology* could be high due to higher labor and mailing costs in the US and Canada versus South Africa. The Council referred the issue to the publications committee for further development.

Vivian Mendenhall shared an idea for a color guide to dead seabirds that could be printed in Russian and English. Julia Parrish explained that she had just produced a beached bird guide in color and perhaps it could be used instead of the Russian version.

Breck Tyler brought up the exchange of journals with other groups. This exchange agreement needs to be reviewed. PSG exchanges with some groups. What is the benefit? Journals are currently housed at the Western Foundation. The PSG journal exchange compensates that organization because their staff does the work of distributing past PSG journals for free. Western Foundation is doing a good job of housing journals. The membership needs to know about the journal exchange. Julia referred discussion to the publications committee.

Awards Committee

No proposals have been received for the 2002 awards. The Council needs to decide whether SG is willing to pay a recipient to come to a meeting to receive an award. If so, then the potential cost of getting people to meetings should be built into the cost of the meeting, rather than being supported by the general PSG membership.

The Awards committee needs to get names and information to local committee at least 9 months before the meeting. The awards committee needs advanced preparation.

Bill Sydeman said that awards are for different things. Lifetime Achievement Awards should be few and not every year. The guiding principal of the Special Achievement Award is to recognize local achievement.

Student travel awards for the Hawaii meeting totaled \$5000. PSG selected several foreign students for awards in order to encourage seabird research in other countries. The Council was pleased at the result of the student travel award. However, the Committee was clear that the award was only made because of the higher cost of travel to Hawaii. The student representative, Louise Blight, urged the Council to make a commitment to assist student travel. Council members responded that PSG already subsidizes students on membership, awards, and reduced fees. This was intended as a one-time travel award. However, the Council is dedicated to student involvement in the group.

Marbled Murrelet Technical Committee

The Committee chair was not present, but Julia Parrish provided a brief report. The PSG Executive Council must approve the Marbled Murrelet survey protocol before it is released. Last year, the Technical Committee asked the chair to write a letter approving the changes. The Chair approved one final year of changes in 2000, but the committee must bring future changes to the entire Council.

SECRETARY'S REPORT

The Committee is waiting for some statistical analysis before any additional protocol changes are made.

Xantus Murrelet committee

The committee prepared a petition for listing the Xantus Murrelet as an Endangered Species. There was a long discussion of the pros and cons of listing the species and the data available. The committee members explained that they had tried the previous steps of writing to the National Park Service and the Navy, but received unsatisfactory responses. There are threats that jeopardize the existence of the Xantus Murrelet. It was the consensus of committee to submit the petition. U.S. Fish and Wildlife Service may not accept additional petitions, but it is important to submit information on species with such a small population.

The Executive Council voted to submit the Xantus Murrelet petition to the federal and state governments, after revisions.

NEW BUSINESS

Dues increase

The Executive Council voted to increase membership dues, considering the anticipated expenses of PSG, especially the increased costs of insurance, tax preparation, and publications. The new dues will be \$25 for regular members and \$15 for students.

Future meetings

The 2002 will be in Santa Barbara, California. Harry Carter is the local committee chair. Dates were not established, but the local committee plans to have the meeting in late February. The proposed conference site is the Santa Barbara Museum of Natural History. Accommodations are available 1 mile away, but there may be a shuttle. The local committee will get the meeting announcement out in September.

Two symposia are proposed, both on local topics. The Chair-Elect will research symposium ideas. Plenary speakers are a big asset to a meeting.

The local committee should plan on inviting plenary speakers and budget at least \$500 for them.

The meeting in 2003 will be in British Columbia, Canada. No local chair has volunteered yet. Dr. Fred Cooke is retiring from Simon Fraser, but he thinks that Ron Ydenberg, the incoming chair at Simon Fraser, may host the meeting in Vancouver. If not, then Alan Burger, Doug Bertram, and Ken Morgan could host the meeting in Victoria. The desired location for 2004 is Mexico. No specific location or local chair have been identified yet. Lisa Ballance and Lora Leschner will look for a possible Mexican location. The out-going chair, Julia Parrish, has the task of identifying meeting sites for the next 5 years.

8 FEBRUARY 2001

Present were Ed Murphy, George Divoky, Breck Tyler, Louise Blight, Ken Morgan, Rob Suryan, Vivian Mendenhall, Pat Mock, Roy Lowe, Bill Sydeman, Julia Parrish, Beth Flint, and Lora Leschner.

NEW BUSINESS

Dues increase

The dues increase that was approved yesterday should mean a change in Life Membership dues, since under the Bylaws, these are 30 times regular membership dues. The Executive Council approved an increase in life membership dues to \$750.

Disposition of Life Membership dues

Now that the Endowment Fund has reached its goal of \$100,000, should the by-laws be changed so that future life membership money could go to other activities? The Council discussed a proposed by-laws change to redirect the life membership fund. A by-laws change requires a vote of the membership. Julia will explain to members at the Business Meeting why the Executive Council wants a change in the bylaws so the funds can be used with more flexibility. The Council

could still add to the endowment or could use the funds in other ways.

Additional Regional Representatives?

Ken Morgan and Louise Blight discussed a proposal for an additional Canadian Representative. They feel that Canada is the second largest block in PSG. The west coast is well represented by the current Canadian representative, but the East Coast interests are less well covered. Louise suggested that the by-laws be amended to include an eastern and western Canadian representative. Beth Flint said that if the by-laws are changed, then PSG should consider an Asian representative, also.

It was suggested that the biogeography of PSG members be studied so that representation can be examined objectively. The Secretary and Treasurer will prepare a report for the next council meeting.

New members

Recruitment of new members was discussed. Regional representatives are charged with recruiting new members. Pat Mock agreed to draft a new brochure on recruitment.

Student awards and mentoring

Students provided feedback that they liked both the awards and mentoring. The Handbook says that the Past chair is in charge of awards. It was suggested that name tags identify Executive Council members at meetings and that they serve as mentors. Julia will contact Jim Lovvorn and will see if he will continue to facilitate mentoring. One way to provide support to students is to make sure that job information is posted.

Restoration Committee

There was a proposal to restart the restoration committee. Craig Harrison needs to be part of the discussion, since the duties of the Conservation Committee and the restored Restoration Committee would overlap. Bill Sydeman will get a proposal from

SECRETARY'S REPORT

the group that wants to revive the committee. The Council will discuss the proposal via e-mail and phone and may reach a decision.

PSG website

PSG needs to find a new person to manage the website. In the short term, PSG may need to pay a web development firm. It was suggested

that recruitment for webmaster be included in the next *Pacific Seabirds*. Perhaps there should be an advertisement box on the cover, "Webmaster needed." Bill Sydeman agreed to see if the webmaster for PRBO would help in the short term.

Santa Barbara meeting

The Executive Council needs to approve potential symposia. The by-laws do not require this approval, but the handbook does. The Chair-Elect needs to work with the local committee and others and develop proposed symposia, if any. Bill Sydeman will discuss this by e-mail or conference call.

LETTERS

PETREL CLASSICS UPDATED

Errata and corrigenda for *The Petrels: their Ecology and Breeding systems* (1990) and *The Behaviour, Population Biology, and Physiology of the Petrels* (1996), together with details of

publications listed therein as in press or now published, are available from my home page at <http://www.zool.canterbury.ac/jw..htm>. Or, printed for "tipping in," from me at: Dr. John

Warham, Zoology Department, University of Caterbury, P.B. 4800, Christchurch, New Zealand.

--John Warham

ABSTRACTS

ABSTRACTS OF PAPERS AND POSTERS PRESENTED AT THE 28th ANNUAL PSG MEETING

Radisson Kauai Beach Resort, Lihue, Hawaii, 7-11 February 2001

Abstracts are arranged alphabetically by name of first author. An asterisk indicates person who presented the paper, if not the first author. Affiliations are given for all authors, full addresses for first authors and all private individuals.

At-sea distribution of radio-marked Cassin's Auklets (*Ptychoramphus aleuticus*) breeding in the northern Channel Islands

Josh Adam,^{1,2,3} John Y. Takekawa,¹ and Harry R. Carter.¹
¹U.S. Geological Survey, Western Ecological Research Center, San Francisco Bay Estuary Field Station, P.O. Box 2012, Vallejo, California 94592, USA; cerorhinca@hotmail.com. ²Department of Wildlife, Humboldt State University, Arcata, CA, USA; ³Moss Landing Marine Laboratories, Moss Landing, CA, USA.

We examined the distribution of radio-marked Cassin's Auklets in 1999 and 2000 to study their foraging ecology and at-sea threats in the northern Channel Islands. Auklets were radio-marked at nest sites on Prince Island and Scorpion Rock in the northern Channel Islands and monitored by aircraft from March through July. We documented 71 of 78 (91%) of the radio-marked auklets attending their colonies. The auklets foraged within 32-36 km of their breeding colonies with little overlap between individuals from different colonies. The minimum convex polygon foraging areas were similar in both 1999 (478 km²) and 2000 (632 km²) for birds at Prince Island. La Niña conditions occurred during both years, and abundant and persistent prey was available near the colonies. Breeding was early, protracted, and highly successful in both years, and some birds attempted second clutches. In 2000, auklets from both colonies dispersed up to 200 km north

of Point Conception, coincident with changing oceanographic conditions after breeding.

What do seabirds eat?

Beverly Agler,¹ Gabrielle Nevitt,² Lisa Holsinger² and Kate Clark.²
¹Alaska Department of Fish and Game, Juneau, AK 99801, USA; skuas@yahoo.com. ²Department of Neurophysiology and Behavior, University of California at Davis, CA, USA.

What do seabirds eat, or more precisely, what do the seabirds around South Georgia eat, was a question posed when Nevitt began her work on olfaction in Antarctic seabirds. To examine the role of olfaction in these birds, one must know what they eat to be able to hypothesize what odors those prey items might excrete. To examine this question, a thorough literature search was conducted and compiled in a large table. This proved difficult to use. Consequently, we developed an interactive relational database using Microsoft Access 97. The database includes information on 30 species of Antarctic seabirds and their prey items gleaned from over 138 references. Because this is a relational database, it can be expanded to include other seabird species. The data includes forms we developed to enter data. Structured queries created by us allow the user access to the data in a simplified manner. We are in the process of developing additional queries to allow expanded access to the data. We will make this database available to other

researchers, so we would appreciate on system improvements and types questions other researchers may ask such a database.

Geographic structure of colonies and respective foraging areas of Black-legged Kittiwakes in Prince William Sound, Alaska

David G. Ainley,¹ R. Glenn Ford,² Evelyn D. Brown,³ Robert M. Suryan,⁴ and David B. Irons⁴. ¹H. T. Harvey & Associates, 3150 Almaden Expressway, Suite 145, San Jose, CA 95118, USA; dainley@harveyecology.com. ²R.G. Ford Consulting Portland OR, USA; ³Institute of Marine Science, University of Alaska, Fairbanks, AK, USA; ⁴Migratory Bird Management, U.S. Fish and Wildlife Service, Anchorage, AK, USA.

We investigated the size and degree of overlap among colony-specific foraging areas of Black-legged Kittiwakes (*Rissa tridactyla*) in Prince William Sound, Alaska, relative to the size and distribution of colonies, 1995-1999. Large colonies occurred as far apart as physically possible and not within foraging range (ca. 40 km) of one another; only small colonies occurred within respective ranges of large colonies. The at-sea distribution of kittiwakes was related significantly to where prey schools were likely to occur. Foraging grounds tended to abut one another rather than overlap. Foraging range was directly and significantly related to colony size. Area of foraging grounds was significantly related to colony size in a curvilinear

ABSTRACTS

fashion, indicating random sizes of foraging ground among colonies of <2000 pairs but increasingly larger foraging grounds with increase in colony size thereafter. Prey school density (herring [*Clupea pallasii*] and sand lance [*Ammodytes hexapterus*]) did not alter the relationship to size of foraging grounds. We conclude that the density of foraging kittiwakes within Prince William Sound has reached an asymptote; additional birds would compromise access to prey, perhaps by foraging interference. This may explain in part why some colonies of kittiwakes have increased in size and others have decreased or disappeared during the past few decades, while overall numbers breeding in the Sound have not changed.

Parental provisioning patterns in Wedge-tailed Shearwaters (*Puffinus pacificus*) and their comparison to foraging strategies of other Procellariiform seabirds

Cheryl L. Baduini. Department of Ecology and Evolutionary Biology, University of California, Irvine, CA, USA; present address: Joint Science Department, The Claremont Colleges, Claremont, CA 91711, USA. cbaduini@jdsd.claremont.edu.

Procellariiform seabirds exhibit exceptional life-history traits with extended periods of parental care (often 100 days). In many cases, provisioning for chicks is constrained by long foraging trips (2-17 days) to distant and unpredictable feeding areas. The objectives of this study were to determine the provisioning patterns of a northern hemisphere subtropical Procellariiform, the Wedge-tailed Shearwater, and to determine how parents partition food resources between themselves and offspring. Foraging trip length, meal size, and change in adult and chick body mass between foraging trips were measured during 1996 and 1997. Wedge-tailed shearwaters had a unimodal foraging strategy with 1.5 to 2 day foraging trips. The rate of food delivery (g of food per day spent foraging) decreased with increasing trip

duration. Chicks in superior body condition were fed smaller meals than chicks in poor body condition in both years. Parents returning to the colony in better body condition fed their young larger meals. Trip length was generally greater for adults returning with squid and fish combined than for adults returning with squid only. Adults also returned with relatively larger prey items after longer foraging trips. Although foraging strategies may differ, rates of food delivery to chicks (40-60 g/day) were similar to those of other subpolar and temperate shearwater species that feed in highly productive areas and undergo bimodal length foraging trips. Distribution and abundance of prey resources in the foraging environment may influence foraging strategies and decisions made by parents about the timing and amount to feed offspring and the duration of parental care.

Oceanography and foraging ecology of the Marbled Murrelet in central California during variable upwelling and prey availability

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Recent studies have suggested that Marbled Murrelets (*Brachyramphus marmoratus*) in upwelling environments select marine habitat that is anomalously cool, near breeding habitat, and in areas of high prey density. We performed at-sea surveys for murrelets in central California while also measuring oceanographic variables and prey availability to test the hypotheses that murrelets (1) select habitat near potential breeding area, (2) select high productivity habitat, (3) select habitat where potential prey is likely to be found, and (4) find and select prey patches directly. Each of these hypotheses was investigated nested within replicates of high and low upwelling and variable prey availability interactions and at small (400 m) and

medium (2000 m) scales. Classification trees and logistic regression indicated that murrelet habitat selection varied with oceanographic conditions (upwelling intensity) and prey availability. Selection generally consisted of complex and nested interactions between distance to nesting habitat, upwelled waters, fronts, well-mixed waters, and prey patches. Results give insight into murrelet foraging ecology in response to oceanographic variability and may help predict the potential impact of oil spills.

Variation in Marbled Murrelet diet: role of breeding status, SST, upwelling, ENSO, and PDO on trophic level

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Variability in oceanography and subsequent prey availability affects the reproductive success of many seabirds in eastern boundary (upwelling) marine ecosystems. We used stable isotope analysis of modern and historical (1895-2000) Marbled Murrelet (*Brachyramphus marmoratus*) feathers and potential prey from central California to infer trophic level in relation to breeding indicators (brood patches and flying inland) and oceanographic variability during the pre-breeding season. Murrelets' pre-breeding diets were at a lower trophic level in 1999 and 2000, than in 1998, which was an ENSO year that showed low reproductive success. Murrelets that had lower trophic level diets were more likely to possess brood patches when captured in 1999 and 2000, and to fly inland in 2000. Likewise, murrelets showed higher reproductive success during years when diets were at a lower trophic level. The pre-breeding diets of historical murrelets were correlated with oceanographic variability, showing an increase in trophic level with positive SST anomalies, PDO events, and ENSO. Likewise, trophic level also

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increased with decreased spring upwelling. Long-term climate change may interact with these natural oceanographic oscillations to negatively affect reproductive success.

Integrating inland and radar surveys to estimate Marbled Murrelet abundance

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A key management objective of The Pacific Lumber Company Habitat Conservation Plan is to protect the best quality Marbled Murrelet (*Brachyramphus marmoratus*) occupied habitat in reserves, and to minimize the effects of management on populations within the reserves. To monitor the progress of this objective, assessments of habitat occupancy and local population trends are necessary. Unfortunately, traditional methods for assessing Marbled Murrelet population trends and habitat may be difficult. Currently, the utility of audio-visual surveys for monitoring murrelet population trends remains difficult. Further, the at-sea estimates of Marbled Murrelet populations are difficult to relate to inland breeding population size and distribution. However, recent technological advances in the use of radar for identifying and tracking Marbled Murrelets flying over land makes it possible to produce reliable estimates of inland murrelet population sizes by linking data from audio-visual surveys and radar surveys. Results from an exploratory field study suggest that audio-visual detections were positively correlated with radar counts of Marbled Murrelets traveling to and around forest stands. Based on the results from last season's fieldwork, we developed a systematic approach that will estimate the probability that an audio-visual observer can detect murrelets. Further, we discuss how habitat features and weather conditions may be used to estimate the detectability of murrelets

at different survey stations. We also discuss how detectability may be used to predict current murrelet abundance and distribution, as well as from recent years using past audio-visual surveys, in an expanded study of the region.

A Review of the final Restoration Plan and Environmental Assessment for seabirds injured in the American Trader oil spill

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On February 7, 1990, the tanker *American Trader* spilled approximately 400,000 gallons of oil into the Pacific Ocean offshore of Huntington Beach, CA. The Trustees estimated that a minimum of 3,400 birds died and as many as 9,500 chicks were not born as a result of the spill. Species in the area at the time of the spill include the Brown Pelican (*Pelecanus occidentalis*), Xantus's Murrelet (*Synthliboramphus hypoleucus*), Ashy Storm-Petrel (*Oceanodroma homochroa*), and Western Grebe (*Aechmophorus occidentalis*). The United States and the State of California reached a settlement with three of the defendants (BP America, Inc., BP Oil Supply Company and BP Oil Shipping Company, USA) in 1994. The Restoration Plan and Environmental Assessment for seabirds injured by this oil spill was prepared jointly by the US Fish and Wildlife Service., National Oceanographic and Atmospheric Administration, and the California Department of Fish and Game. The draft Restoration Plan was subject to a 45-day public

review period during which additional restoration projects could be submitted. This paper presents an overview of the restoration projects contained in the final plan which fall within five general categories: Brown Pelican roost improvement; seabird nesting habitat restoration on Anacapa Island; public education and awareness; Western and Clark's (*A. clarkii*) Grebe restoration; and international efforts. Project implementation will begin in 2001. The intent of these restoration projects is to compensate the public for injuries incurred during the spill and for any interim losses during the period of recovery through restoring the injured natural resources to their baseline condition.

Sex differences in provisioning rate in chick rearing Marbled Murrelets

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We report a significant male bias in dawn and dusk nest visitations of breeding radio marked Marbled Murrelets (*Brachyramphus marmoratus*) during the chick rearing period in Desolation Sound, BC, from 1998-2000. Overall nest visitation rates of male chick-rearing birds were 1.28 x greater than those of females. Dusk rates of nest visits by males with active nests were 1.69 x greater than those of females. Male visitation rates in early chick rearing were not significantly different from early rearing rates of females or late rearing rates of males. However, female visitation rates during late chick rearing were significantly lower than female rates early in chick rearing and male rates late in chick rearing. These results suggest that chicks are provisioned more by males than females in our study population, especially during the last half of chick rearing. These findings offer a potential behavioral explanation for the annual male bias of non-egg producing birds flying inland during the chick rearing

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period at Theodosia Inlet in Desolation Sound from 1994-1999. While male biased provisioning has not been widely reported in other Alcids, it has been documented in Larids and Procellariids.

Aspects of second inner primary molt in Caspian Terns

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Like most terns, Caspian Terns (*Sterna caspia*) replace all of their primaries once, and a variable number of inner primaries a second time each year. Second inner primary molt (SIPM) may have evolved to contend with the consequences of worn inner primaries, which may be 6-8 months older than the outer primaries. Alternatively, SIPM may have been favored by sexual selection in that the number of inner primaries replaced may be an honest signal of body condition. Analyses of nearly 400 Caspian Terns collected along the Columbia River in Washington and Oregon in 1999 and 2000 indicate a significant positive correlation between the number of inner primaries molted twice and the length of the tenth primary, an index of body condition. This correlation suggests that the extent of SIPM may be an indication body condition during the roughly 9-month-long molting period and, therefore, may act as an honest status signal during mate selection. In turn, we suggest that the mean extent of SIPM may be used to monitor the (1) mean "health" (body condition) of individual tern colonies and, potentially, (2) the habitat quality of their immediate breeding and or wintering grounds. In addition, data from carcasses and field observations of breeding and non-breeding Caspian Terns indicate that the number of inner primaries molted twice was greater in males than in females, and that the

onset of primary molt was later in breeders than apparent non-breeders. Thus, extent of SIPM appears to be influenced by sex and breeding.

Habitat assessment of Marbled Murrelets in Clayoquot Sound, British Columbia, using radar counts and GIS

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High-frequency radar was used to count Marbled Murrelets (*Brachyramphus marmoratus*) in Clayoquot Sound, Vancouver Island, in 1996-1998. Diurnal and seasonal variations were minimized by considering only pre-dawn counts of inland-bound murrelets made between mid-May and mid-July. Counts were often higher during cloudy weather, but weather did not affect three-year averages. Since murrelets sometimes crossed ridges into adjacent watersheds, adjustments were made to the inland catchment area for each radar station, based on topography and flight paths. Mean counts at 18 watersheds, totaling 4,282 birds, were compared with macro-habitat features derived from GIS databases. Counts per watershed were positively correlated to areas of mature forest, and certain biogeographic forest types, but negatively correlated with areas of logged and immature forest (multiple $r^2 = 0.91$). The area of mature forest below 600 m was the strongest predictor ($r^2 = 0.70$) and provided a simple measure of habitat quality readily estimated from GIS, aerial photographs or timber inventories. Counts were not affected by distances to known foraging areas (range 1-28 km). Impacts of logging were evident: when murrelet counts were plotted against areas of original forest, three of five heavily logged valleys had murrelet densities lower than expected, but when plotted against areas of remaining low elevation forest, these differences disappeared. These data suggest that murrelets did not pack into declining habitat in greater densi-

ties but moved away from heavily logged valleys to nest elsewhere. Radar is thus a powerful tool to census this threatened species and study its macro-habitat associations.

Power analysis: an important tool for designing and evaluating seabird monitoring programs

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As part of the planning process for the Gulf (of Alaska) Ecosystem Monitoring Program (GEM) proposed by the Exxon Valdez Oil Spill Trustee Council (EVOSTC), we used power analysis to estimate the number of samples needed to detect specified differences between years in 15 different seabird breeding parameters (e.g., measures of breeding success, behavior, and physiology). Data collected during EVOSTC-sponsored studies of Black-legged Kittiwakes (*Rissa tridactyla*) and Common Murres (*Uria aalge*) at three breeding colonies in Lower Cook Inlet, Alaska, 1995-1999, were used to estimate expected values for means and standard deviations. The computer application "PASS-2000" (Jerry Hintze, NCSS Statistical Software, Kaysville, UT) was used for calculations. The results provide a basis for evaluating the costs of detecting various effect sizes, and the process is an important tool for designing seabird components of the proposed GEM program and for other similar seabird monitoring programs.

Breeding status and conservation of the Japanese Murrelet in the Izu Islands, Japan

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We collated evidence of breeding and conservation problems for the Japanese Murrelet (*Synthliboramphus wumizusume*) in the Izu Islands, Japan. After species description (1835), it was first collected in the Izu Islands in 1877, with breeding first noted in 1901. During the 20th century, murrelets were found breeding at 11 Izu islands (Udonejima, Nijijima, Shikinejima, Hanshima, Kozushima, Onbasejima, Tadanajima, Sanbondake, Motone, Kojine, and Torishima) and were not thought to breed at 7 Izu islands (Oshima, Toshima, Jinajima, Miyakejima, Mikurajima, Hachijojima and Hachijokojima). Surveys have never been conducted at 7 other Izu islands (Zenisu, Inanbajima, Aogashima, Sumisujima, Beyoneizu-Retsugan, Myojinsho and Sofugan). A large decline apparently occurred in the mid-to-late 20th century: a) breeding no longer occurs at Shikinejima and Kozushima; b) breeding habitat has been lost at Sanbondake; and c) large numbers of nests were reported by egg harvesters at Udonejima, Hanshima, Kozushima, and Sanbondake in early century. Current breeding population size appears to range between 350-750 breeding pairs (~10-40% of the global population). Major colonies occur at Tadanajima (100-300 nests), Onbasejima

(75-150 nests), and Sanbondake (75-100 nests); another 100-200 nests may exist at other islands without recent estimates (Udonejima, Nijijima, Hanshima, Torishima). Conservation issues include: human settlement, egg consumption and disturbance; rat predation; habitat loss (bombing of Sanbondake); habitat destruction; high predation levels by crows, snakes and falcons; and mortality in gill nets. Additional surveys, monitoring, and assessment of conservation issues are urgently needed for this rarest member of the Alcidae.

Survival and fecundity estimates of the Desolation Sound Marbled Murrelet (*Brachyramphus marmoratus*) population

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A marked population of Marbled Murrelets has been studied intensively at Desolation Sound, British Columbia since 1994, with some banding prior to that date. Recent new techniques using radio telemetry have allowed us to locate nest sites, assess nest success and the proportion of non-breeders. The banding sample allows us to estimate survival rates using CMR approaches, and the nesting sample allows us to estimate fecundity rates of this population.

85 active nests were monitored over a three year period with an average nesting success of 46%. This is higher than previously published estimates. Moreover, our estimate of hatching success was considerably higher than earlier estimates (82%), suggesting the egg predation may be less of a problem for the birds than earlier studies have suggested. Non-breeding is relatively high in this and other radio-telemetry studies; possible reasons for this are discussed. Fecundity estimates are difficult to estimate accurately because of the uncertainty of how to interpret the non-breeding data, but we suggest that from 0.135 to

0.22 fledging females are produced annually per breeding-age female.

Our best estimate of annual adult survival was 0.83 (estimated SE = 0.05), but this value was obtained by combining data collected by two capture techniques. Several indirect approaches suggest that this is legitimate but rigorous statistical justification for merging the data has yet to be developed.

Investigating methods to reduce the incidental catch of Albatrosses in the Hawaii longline fishery

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We measured the various methods of reducing albatross mortality and recorded the behaviors that lead to albatross mortality on commercial longline fishing vessels. Methods tested while the longline was being set were: using blue-dyed bait; towing a bird-scaring line (i.e., tori line) or buoy; and, strategically discarding offal. Methods tested while the longline was being hauled back were the same with the exception that "no offal discards" replaced strategic offal discards. In addition, the effect of darkness at mitigating against mortality was also tested. Seabird behaviors were partitioned into two categories: "attempts," which included seabird dives, landings and chases; and "interactions," which included seabird contacts or entanglements with fishing gear and hookings. Seabird abundance was also recorded during all observation periods. All behavior and mortality observations were made by the same observer during five separate longline fishing trips. Behavior and mortality data for each device were compared to a general linear model (S-Plus software from Statsci),

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assuming a Poisson distribution. The number of mortalities per seabird per 1,000 hooks were: 0.12 for blue-dyed bait, 0.26 for towed buoy, 0.32 for strategic offal discards, 0.47 for tori line, 0.60 for night setting and 2.23 for the control. If we express the effectiveness of the mitigation methods in relative terms, blue-dyed bait, the towed buoy, strategic offal discards, tori line and night setting each reduce mortality by a minimum of 73%. Blue-dyed bait reduced the albatross mortality by 95%. It is clear from this study that the employment of mitigation methods on swordfish longline fishing vessels could greatly reduce the level of albatross mortality now experienced in this fishery. This research demonstrates the various mitigation methods tested are highly effective on swordfish longline fishing vessels at mitigating the incidental catch of albatrosses and the behaviors that lead to the incidental catch.

Red-footed Booby (*Sula sula*) Colony attendance patterns and population status in the Mariana Archipelago

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Red-footed Boobies (*Sula sula*) (RFBO) in the Marianas appear to be at least as numerous as in 1991 when the last status report was published. In the Saguagaga seabird colony on the island of Rota, RFBO nest and roost below a steep cliff in at least 22 species of trees. Birds used five species most frequently: *Pisonia grandis*, *Intsia bijuga*, *Neisosperma oppisitifolia*, *Mammea odorata*, and *Pouteria obovata*. The 1992-2000 data from this colony indicated a consistent annual breeding pattern commencing in December. Average numbers of birds at the colony ranged between 1200-1400 during the most active part of the year (December-July) and then dropped below 1000 during the latter third (August-

November), possibly as juveniles dispersed from the colony. The data also revealed an apparent shift in the number of nesting birds away from areas directly below an observation walkway constructed in 1992. The shift could have been due to increased disturbance of the area resulting from changes in ease of access. Conservation recommendations that limit further recreational development of the sanctuary were presented to the community during a conference in February 2000.

The Guguan RFBO colony appears to have declined slightly since the last count a decade ago but estimates of colony size on Farallon de Medinilla (FDM) have increased, despite its regular use as a military range. Seabird numbers on FDM show no significant changes between 1997 and 1999, but do exhibit an intra-annual pattern very similar to that of RFBO on Rota. We estimate an archipelago-wide population of 3,500-4,500.

Sooty Tern decline noted on Guguan, Commonwealth of the Northern Mariana Islands

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Guguan is one of the premier seabird islands of the Northern Marianas archipelago. Colonies of Sooty Terns (*Sterna fuscata*) totaling 20,000-35,000 birds have been consistently documented there and mapped by prior workers over the last three decades. In 2000, we found these colonies much reduced in area and only 5,000 birds on land during the count period. No eggs, chicks or juveniles were observed in the colonies, although the early June count should have coincided with their nesting peak. Counts of other resident seabirds were within the ranges previously reported including Grey-backed Tern (*S. lunata*), Black Noddy (*Anous minutus*), and Brown Noddy (*A. stolidus*). However, numbers of Red-

footed Booby (*Sula sula*) were lower than anticipated.

Because no *Varanus* lizards, cats, or rats, other than *Rattus exulans*, exist on the island, predation is probably not an issue here. Neither were there signs of recent volcanism or typhoons to help account for the declines. Rats, however, may continually disturb the tern colony thereby causing indirect losses as birds temporarily, but frequently, desert breeding areas in large numbers. A failure of the food supply might be another reason that these terns were neither nesting nor numerous. We also find it likely that with the past several years of favorable growing conditions, successional vegetation changes have made some areas unsuitable for Sooty Tern nests and may have caused them to shift to other colonies farther north in the chain.

Using radar to census Marbled Murrelets entering watersheds in southwestern British Columbia

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We used high-frequency marine radar to count marbled murrelets (*Brachyramphus marmoratus*) entering watersheds within 16 Landscape Units of the Sunshine Coast Forest District (SCFD). This provincial Forest District extends along the mainland coast of southwestern British Columbia from Howe Sound to Bute Inlet. Narrow fjords and steep entrances to watersheds provided ideal topography for radar surveys. This topography funneled birds through inlets and estuaries on route to inland nest sites. During the 2000 breeding season we conducted 58 radar surveys at 27 watershed entrances from mid-May through mid-July.

The primary goal of this project is to collect distribution data of marbled murrelet population numbers within the SCFD. This information is to guide habitat management activities within key areas of the District as well as to

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establish a baseline population estimate that can be used to evaluate the effectiveness of management regimes.

The highest numbers of marbled murrelets were detected in the Toba, Brem and Homfray Landscape Units. At watersheds within the Howe and Chapman Landscape Units we detected the lowest number of marbled murrelets. At eleven watersheds, we counted more than 100 marbled murrelets, and 81% of the total 2678 incoming murrelets counted (maximum predawn incoming) occurred within these 11 sites. These radar surveys have, for the first time, established the presence of marbled murrelets in the more remote Landscape Units, specifically Bute East, Bute West, Homathko and Southgate. The census counts are examined with respect to watershed areas and the distribution of habitat types.

Decline of Newell's Shearwaters on Kauai, Hawaii

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We compared trends in the number of Newell's Shearwaters (*Puffinus auricularis newelli*) seen visiting Kauai, Hawaii, on ornithological radar in June 1993 and 1999–2000 and trends in the number of young Newell's Shearwaters recovered in the "Save Our Shearwaters" (SOS) Program on Kauai, 1979–2000. After pairing sampling dates at each site to remove temporal effects, the radar data indicated that the number of Newell's Shearwaters visiting Kauai declined significantly between 1993 and 1999–2000. The mean change from 1993 numbers across 13 sites was $-60 \pm (SE = 7\%)$ in 1999, and $-62 \pm 6\%$ in 2000, with all sites except one showing decreases of 38–93% in 1999 and all sites showing decreases of 31–96% in 2000. The SOS fallout data exhibited two trends, with a pattern of fairly stable numbers

(but no overall trend) between 1979 and 1991 and a ~58% decline from 1993 to 2000. The greatest decline in fallout occurred on the eastern side of the island. Because both the radar and SOS data sets indicated that a decline had occurred, with annual rates of decline of ~13% for the radar and ~12% for the SOS fallout data, we conclude that there has been a significant decrease in the number of Newell's Shearwaters visiting Kauai to breed since 1993. Exact causes of the decline are unknown at present, but we suggest that the most probable cause is associated with either direct or indirect effects of Hurricane Iniki, which hit the island in September 1992.

Trends in reproductive success of Hawaiian seabirds: is guild membership a good criterion for choosing indicator species?

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Because it is rarely possible to monitor all species that occur in sensitive or threatened ecosystems, much theoretical consideration has been given to the process of choosing indicator species. We evaluated whether foraging guild classification or nest site might be an adequate means to select indicator species for monitoring the reproductive success of a suite of Hawaiian seabird species. We examined the reproductive success of six species representing three foraging guilds and two types of nest sites over an 18-year period. For two of the three foraging guilds, there was a strong correlation between the reproductive success of birds from the same guild, and there was a weaker correlation for the third guild. In contrast, there were no significant reproductive success correlations for pairs of species from different foraging guilds but with the same nest

sites. Thus, the within-guild correlations are likely to be driven by guild-specific food availability rather than by similarity in nest site. Because of the weak nature of one of the within-guild correlations, and because there is little detailed information on the causes of nest failure in this system, we recommend continuing to monitor multiple indicator species per foraging guild.

Influence of the Tsushima Warm Current on the breeding performance of piscivorous seabirds

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Diet, chick growth and fledging success of piscivorous rhinoceros auklets and black-tailed gulls breeding on the Teuri Island in northern Hokkaido varied largely among years. We hypothesized that the flow rate of the Tsushima Warm Current, forming major inflowing transport to the Japan Sea, affected their breeding performance through timing and magnitude of migrations of Japanese Anchovy, main diet of these two seabirds species. We analyzed the variation of this current system during 1999 and 2000 using satellite data based sea-surface temperature (SST), topography and chl-a concentration. The rhinoceros auklets hatched 5 days earlier on average in 2000 than 1999. The SST of April was 3° C higher and the chl-a concentration was peaked two weeks earlier in 2000 than 1999. While chick growth rate and fledging success of auklets were lower in 2000 (5.7g/day, 42%) than 1999 (10.9g/day, 85%). The Tsushima Warm Current expanded slowly northward during chick rearing period in 2000. Although we did not know distribution pattern and stock levels of anchovy, weak front formation in 2000

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implies that anchovy might make dispersed patches or migrate northern areas out of the auklets foraging range. Effects of this current system on 9-year variation of the breeding performance of the rhinoceros auklets black-tailed gulls will be discussed.

An anomalous wind and snow storm reduces fledging success at an arctic Black Guillemot colony

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In the summer of 2000 a Black Guillemot (*Cepphus grylle*) colony in northern Alaska had 60% of its nestlings die when an anomalous arctic storm restricted foraging by adults and provisioning of chicks. On 10 August a low pressure system moving eastward in the Beaufort Sea caused sustained winds of >50 mph with gusts >70 mph. Winds abated slightly on 11 August (sustained winds 40 mph and gusts >50 mph) but a major cold front produced almost 1.5 inches of snow on 12-13 August with substantially higher drifts. At the beginning of the storm there were 170 nestlings in the colony, averaging 16 days old. The high winds and snow-blocked entrances to the man-made nest-sites impeded chick provisioning for one to four days. Apparent starvation caused the death of 80 nestlings while an additional 23 chicks were lost when nest sites blew away. Nestling weight loss averaged 27% of pre-storm weight with older chicks more able to survive the period of starvation. Abandonment of the nesting effort by some pairs was indicated by post-storm chick mortality. The 67 surviving nestlings grew rapidly after the storm, fledging at near normal weights.

An increase in the frequency and intensity of extreme weather events has been associated with past periods of rapid climate change. While assessments of contemporary global warming typically emphasize the response of biota to long-term elevations in atmospheric and oceanic temperatures, epi-

sodic perturbations, as described here, have the potential for causing more immediate impacts on animal populations.

What Crested Auklets (*Aethia cristatella*) and stinkbugs (Order Heteroptera) have in common—evolutionary convergence in chemical ecology?

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Two species of *Aethia* auklets (*A. cristatella* and *A. pygmaea*), small planktivorous seabirds of the Subarctic Pacific and Bering Sea, emit a pungent, citrus-like odor. We analyzed six Crested Auklets by three methods (solid phase microextraction SPME, SuperQ, and solvent extraction). Mass spectra obtained from a Shimadzu QP-5000 GC/MS indicate that saturated and mono-unsaturated short-chained aldehydes (n-hexanal, n-octanal, n-decanal, Z-4-decenal, and a 12-carbon unsaturated aldehyde) comprise the auklet odorant. Octanal and hexanal are also secreted in the repugnant metasternal gland emissions of heteropteran insects and are known to be potent invertebrate repellents. We suggest that the auklet odorant's primary function is ectoparasite repellency. This would be highly adaptive for colonial nesting *Aethia* auklets. Increased parasitism is an expected cost of sociality, and parasites are thought to limit group size in their hosts. Ectoparasite infestations can increase the cost of reproduction, introduce disease, reduce fecundity and growth rates, and increase mortality. The courtship behavior of Crested and Whiskered auklets (*A. pygmaea*) appears to promote mutual odor assessment, which could insure ectoparasite resistant mates. These auklets may use

the aquatic phase of courtship, away from the dense aggregation and odor saturation of the colony, to more accurately assess a potential mate's chemical production. The advertisement of chemical potency and related ectoparasite resistance may be a basis for other extravagant traits (e.g., ornaments and facial plumes) in Crested and Whiskered auklets.

Feral cat (*Felis catus*) predation on low elevation native seabird colonies on Maui Island

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Feral house cats (*Felis catus*), introduced to many areas of the world, have been implicated in many cases of predation on native mammalian and avian wildlife, often leading to extinctions of unique island species. Native seabirds, such as the common Wedge-tailed Shearwater (*Puffinus pacificus*) and more rare Bulwer's Petrel (*Bulweria bulweri*), which nest in coastal colonies at low elevations on Maui, were negatively impacted by predation by feral cats. Cat predation on the seabirds was investigated at several locations on the main island of Maui to determine overall predation scope and predation efficiency, to characterize temporal patterns to predation, and to provide an assessment key for identifying cats as predators. Peaks in predation at colonies of sufficient size was found to be diphasic and tied to the bird's biology. Small colonies were vulnerable to total failure and larger colonies to losses of returning adults and late-stage chicks and adults. Cat predation has a sustained negative impact on established native seabird colonies, expansion of colonies, and colonization of new areas by native seabirds.

Selection and application of predictive models of Marbled Murrelet forest habitat relationships

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As part of its Habitat Conservation Plan, the Washington Department of Natural Resources (DNR) is implementing Marbled Murrelet (*Brachyramphus marmoratus*) forest habitat relationships studies to determine the relative importance of geography, topography, and forest structure on murrelet occupancy. Application of models built from the above studies identifies forest stands expected to contain 95% of murrelet occupancy on DNR-managed lands.

Research sites are surveyed for 2 years to determine their status as occupied or unoccupied by murrelets. Habitat information collected at each research site characterizes forest conditions and nesting opportunities. Multiple logistic regression is used to select 2 probability models. The first model includes murrelet nesting variables, such as numbers of platforms, and is built to examine the relationships of these variables to occupancy. The second model includes only variables present in DNR's forest inventory, and is built for application to DNR-managed lands. It assigns each stand a probability of occupancy which is multiplied by the stand's size to predict the amount of murrelet occupancy. The stands are sorted on probability to determine the probability threshold that includes 95% of the occupancy.

Important variables in southwest Washington include distance to marine waters (negative), number of large western hemlock trees (*Tsuga heterophylla*), number of large western red cedar trees (*Thuja plicata*), and basal area of Douglas-fir trees (*Pseudotsuga menziesii*) (negative). Important variables on the Olympic Peninsula include elevation, density of streams and rivers, and number of large conifer trees. Important variables in the North Cascades include number of large western cedar trees and basal area of silver fir trees (*Abies amabilis*).

Lead poisoning in Laysan Albatross (*Phoebastria immutabilis*) chicks: evaluation of contaminant sources on Midway Atoll using stable lead isotopic composition

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OBJECTIVE: To assess the magnitude and sources of lead (Pb) poisoning to Laysan Albatross (*Phoebastria immutabilis*) chicks on Midway Atoll, Pb concentrations and isotopic compositions were measured in chick's blood and in environmental samples adjacent to the chick's nests. **BACKGROUND:** Severe lead poisoning continues to occur in Laysan Albatross chicks on Midway Atoll, despite past remediation efforts. Prior studies have indicated lead-based paint as a predominant exposure source, however this source and the pathway(s) of exposure have not been clearly established. **METHODS:** Sampling site #1 was an open field with no known source of contamination; Site #2 was adjacent to a building believed to contain Pb-based paint. Blood (1mL) and environmental (nest soil, paint, debris) samples were collected using trace metal clean techniques, and analyzed using a Finnigan Element magnetic sector ICP-MS. **RESULTS:** Average blood Pb of chicks from the field site (#1) was 6.0 µg/dL (±1.09 SE, range 1.2 - 12.7 µg/dL, n = 15). In contrast, the blood Pb levels in chicks from the theater site (contaminated) averaged 197 µg/dL (±68.7 SE, range 11.2 - 710 µg/dL, n = 10). Notably, six of the ten birds sampled from site #2 had blood Pb levels >100 µg/dL, three of which also exhibited lethal "droop-wing" syndrome. The Pb isotopic composition measured demonstrated that Pb-based paint was responsible for the highly elevated blood Pb levels in these animals. **CONCLUSIONS:**

In spite of previous attempts to remediate contaminants on Midway Atoll, Pb contamination from Pb-based paint remains a significant threat to seabirds nesting near buildings.

Do predators read the literature? interactions between Bald Eagles and Common Murres

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In W. D. Hamilton's classic paper "Geometry for the selfish herd," the driving force of predation acts as the selective agent of gregariousness because individuals in groups sustain lower risk than loners. Corollaries to this thesis are: the larger the group, the lower the risk; and edge locations are risky, center is safe. Do these relationships work in the real world? On the coast of Oregon, Common Murre (*Uria aalge*) colonies are under increasing pressure from Bald Eagle (*Haliaeetus leucocephalus*) predation. We examined the escalating interaction between murre and eagles at one colony - Yaquina Head. At Yaquina, murre nest in geographically distinct groups from hundreds to over ten thousand. All groups are within sight of each other, and can simultaneously see and respond to approaching eagles. From 1998-2000, we recorded behavioral variables: eagle visitation, attack, and success, the location of victims, and the response of the murre as a function of group size; and demographic variables: reproductive success and attendance of all nesting groups. Murre in smaller groups appeared to perceive a greater risk from eagles, often evacuating their nesting area in response to eagle flyovers. This cycle of chronic evacuation led to significantly lower reproductive success. However, eagles preferred to attack murre in larger groups, so that the actual risk of death, while absolutely low, was significantly higher than that in smaller groups. Victims were often taken from the center. Despite the risk, these murre remained

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on the nesting area more frequently, a response which translated into significantly higher reproductive success.

Monitoring seabird Populations in Japan: the government's role

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Recent developments are moving Japan toward an enhanced system for seabird monitoring: increased interest in seabird conservation after the 1997 Nakhodka oil spill, formation of the Japan Seabird Group in 2000, and initiatives to increase joint seabird research under the US-Japan Migratory Bird Treaty. Compilation of the first Japan-wide seabird colony catalog database is in progress and should help guide future work. I review legal authority for seabird surveys in Japan and government implementation to suggest what role can be expected of the government and where private efforts are most needed. Legal authority for seabird surveys in Japan is generally vague and allows the government broad interpretive discretion. There is a conspicuous absence of legal requirements for wildlife surveys within protected areas, in which are found most of the important seabird colonies. In most cases, government surveys of these areas lean heavily toward qualitative evaluation of colony status; quantitative results rarely exceed a measure of relative abundance. Coverage of seabird populations has been poor within government surveys attempting broad species and geographical coverage, and inadequate funding often leads to heavy reliance on previously existing data and questionnaire surveys. There has been a nearly complete absence of exploratory surveys to discover new nesting sites, and periodic, comprehensive sweeps of known sites do not occur. More careful monitoring of population trends and other demographic parameters over time has

been a predominantly private effort. Except for some land-based surveys of birds near shore, systematic surveys of at-sea distribution and abundance have been rare and of limited geographical coverage.

Reproductive investment in seabirds

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R.A. Fisher: *The Genetical Theory of Natural Selection* (1930) was the first to point out the potential trade-off between reproduction and survival. This insight has led to the field of "Life History Adaptation." Seabirds, with high survival and low reproduction, have been proposed as a good example of extreme survival-oriented life-history adaptation. However, the evolutionary causes of this adaptive syndrome have been only partially explored. We describe the different theories that have been proposed to account for the life history adaptations of seabirds and test them against currently available data. We also examine the evidence for life-history trade-offs at the level of individuals, concentrating on the experimental evidence for such trade-offs. We conclude by proposing a general framework against which both individual- and population-level life history trade-offs can be tested.

Five years and 10 tons later: lessons from a large-scale food supplementation experiment at a Kittiwake colony

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Since 1996 we have provided herring and capelin to Black-legged Kittiwakes (*Rissa tridactyla*) nesting on an abandoned radar tower on Middleton Island, Gulf of Alaska. We present some of the

trends observed over the last 5 years of the study. From 1996-1998 we offered supplemental fish en masse at each nest site. However, by 1998 "stealing" by non-site holders reached epidemic proportions and threatened the integrity of the study. So in 1999 we began hand-feeding individuals. This allowed us to tabulate the exact amount of fish consumed by males, females and chicks at specific sites. We discovered that during egg development female intake was half that of males, suggesting that females may be meeting their nutritional needs via courtship feeding—lending weight to the argument this behavior serves as a pair bonding mechanism. Throughout the remainder of the season males and females ate equal amounts of food. Overall, consumption was highest prior to laying. Our data indicate adults continue to forage naturally even if they are provided all the food they need at the nest site. A strong, negative correlation between the quantity of food consumed and fledging success in unfed pairs suggests fed birds rely on supplementation the most when natural foraging conditions are poor. Although our supplementation study indicated that food is primarily limiting the productivity of North Pacific kittiwakes, predation and social facilitation play a role. We found a gradient of reproductive success depending on whether pairs have access to supplemental food, breed in a thriving colony, nest in gull vulnerable habitat, or a combination of these factors.

Regulation of parental provisioning and nestling departure decisions: a supplementary feeding experiment in Tufted Puffins (*Fratercula cirrhata*)

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In 1999 and 2000, a supplementary feeding experiment was used to examine the regulation of provisioning

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effort and nestling departure behavior in Tufted Puffins (*Fratercula cirrhata*) on Triangle Island, BC. From the parents' perspective, life history theory predicts regulation of parental effort in order to balance current investment with future expectation of survival and reproduction. I test the hypothesis that nestling nutritional demand regulates provisioning behavior and predict that parents of supplementary fed nestlings will decrease provisioning effort. Supplementary feeding significantly increased nestling mass, culmen, and tarsus length but had no statistically detectable effect on wing length. I could not detect differences in the number of fish delivered per bill load, bill load mass, or prey composition. However, parents of supplementary-fed nestlings provisioned significantly less frequently than parents of control nestlings. Results support the hypothesis that parents adjust provisioning effort in accordance with nestling demands in the years of this study. From the nestling's perspective, remaining in the nest as the nestling approaches independence might depend on the provisioning behavior of the parents. Morbey *et al.* (Anim.Behav. 57:873, 1999) hypothesized that nestlings use the intensity (rate) of pre-fledging mass recession to gauge parental reluctance to provision and are more likely to fledge when the expectation of another feed is low. The supplementary feeding experiment tested the prediction that the expectation of provisioning influences the fledging behavior of Tufted Puffins. As predicted, supplementary fed nestlings experienced reduced rates of mass recession and remained in the nest significantly longer than control nestlings.

A tale of two species: temporal and spatial patterns in breeding populations of New England Herring and Great Black-backed Gulls

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Following decades of increases in breeding populations in the northeastern U.S. ("the best of times"), the Herring Gull (*Larus argentatus*) has been declining recently ("the worst of times"). Reduced persecution and increased food from anthropogenic sources are commonly cited for the increase; however, few data exist on causes of the ongoing decline. Since 1928, the Great Black-backed Gull (*Larus marinus*) populations have generally increased in the northeastern U.S., resulting in coastal breeding distributions similar to that of the Herring Gull. However, breeding populations for this species have yet to show a similar decline. Trends for both species along coastal Maine may or may not be reflections of colony-specific trends. To investigate the potential influence of intraspecific and interspecific interactions between these gull species, I conducted research on nest habitat, density, and site characteristics, diet, behavioral interactions, and breeding success on Appledore Island, ME. On Appledore, patterns of nesting behavior, aggression and breeding success of the two species differ markedly, resulting in Herring Gulls being relegated to rocky habitats at the periphery of the island and areas of dense vegetation and/or human habitation in the island's interior. Colony position-specific levels of aggression and breeding success also favor Great Black-backed Gulls over Herring Gulls as areas of overlap (interface nests) increase on the island. Predation on Herring Gull post-fledglings by Great Black-backed Gulls also is extensive. These asymmetric interactions favoring the more recent "invader" are likely contributing significantly to the regional decline for Herring Gulls and the lack thereof for Great Black-backed Gulls.

Status of Brown Pelicans nesting in the Southern California Bight

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Reproductive failure and population decline of brown pelicans (*Pelecanus occidentalis californicus*) nesting in the Southern California Bight (SCB) in the 1960s were associated with high levels of DDE. Because of the possibility of extirpation, the subspecies was accorded federal and state endangered status in 1970-71. Beginning in the mid-1970s, as DDE levels greatly declined and mean eggshell thickness increased, reproductive success improved substantially and the population began recovering. DDE levels in the SCB have declined steadily and (since the mid-1980s) appear to have stabilized at low levels (about 2.0 µg/g [ppm], wet-weight in eggs). PCBs are the second most common contaminant found in pelicans; like DDE, PCBs also show a trend of declining levels, but the decrease has been more gradual. Highly toxic non-ortho PCB congeners were detected, but at levels not likely to be associated with reproductive problems. Dibenzo-*p*-dioxins and dibenzofurans were below detection limits (<1.2 ng/kg-18 ng/kg) in all samples. None of the aryl hydrocarbon hydroxylase (AHH)-active PCBs were at levels likely to cause reproductive impairment. While some eggshell thinning still occurs (about 5%), reproductive rates are now largely determined by food availability. The number of pairs nesting on the Channel Islands (Anacapa and Santa Barbara islands) has increased to historically high levels (about 5,200 pairs on average) since the mid-1980s; however, long-term reproductive rates are about 35% lower than those from central areas of the subspecies' range where they were not known to have been affected by contaminants. A subjective criterion previously established for downgrading to threatened or delisting as endangered has been met for breeding population size but not for productivity. It is possible that the SCB population (at the northern periphery of the range) is stable at current reproductive rates, but unfortunately there are no detailed

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historical data for comparison. Without complimentary data on specific survival rates, long-term viability of the breeding population seems to be the most realistic criterion for assessing its endangered status.

Effect of land management strategies on Marbled Murrelets on the Olympic Peninsula, WA

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The Endangered Species Act places the onus for conservation and recovery of listed species on federal land managers. Olympic National Park contains the largest contiguous area of marbled murrelet (*Brachyramphus marmoratus*) nesting habitat remaining in the lower 48 states and is surrounded by more fragmented habitat. Results of a two-year study to examine murrelet use of the park will be presented. Is there a difference in murrelet use of developed and pristine areas? No difference in use within the park could be discerned. Does murrelet use of the park differ from use of surrounding lands? The rate of occupancy in the park is significantly greater than that in adjacent areas that are more intensively managed. Implications of these findings for the conservation and recovery of this threatened seabird under provisions of the Endangered Species Act will be discussed.

On the trail of Common Murres in Puget Sound: heading for safe or troubled waters?

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In Washington State, Common Murres (*Uria aalge*) experienced a precipitous population decline in the early 1980s. Currently, the population

remains at 30% of pre-1980 levels. The cumulative effects of predation, oil spills, dwindling food resources and fishery bycatch may prevent population growth, although the relative importance of each factor is unknown. We conducted aerial radio-tracking surveys of 22 Common Murres from Tatoosh Island, WA, in 1999 and 2000, to determine whether murres interact with a gillnet fishery active in Northern Puget Sound. As a first step, we describe the patterns of murre migration at the time of the fishery. After murres depart the Tatoosh colony, which lies at the confluence of the Strait of Juan de Fuca (SJF) and the Pacific Ocean, their initial movement is not random but rather is directed and at a large scale. They head east through the SJF, into Puget Sound (PS). After reaching the eastern SJF, directed movement ceases and becomes localized, two successive murre locations being no more than 20km apart. Of the murres effectively tracked, 82% were consistently located in the SJF and PS. Fourteen murres reached the eastern SJF and PS, and 71% resided within the confines of the same geographical area. Less than half (43%) of murres were located at least once within the boundaries of non-treaty commercial fishing zones. Murres may use SJF and PS because of the availability of predictable food resources and the apparently increased safety of calmer waters relative to the outer coast.

Use of radar to monitor Xantus's Murrelets at Anacapa Island, California, in 2000

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The Xantus's Murrelet (*Synthliboramphus hypoleucus*) is one of the rarest seabirds in the world. Introduced predators, especially cats and rats, have

extirpated or reduced many murrelet colonies throughout its breeding range. Eradication of introduced Black Rats (*Rattus rattus*) at Anacapa Island is planned by federal and state trustee agencies. As part of the program, it was recognized that additional effort was needed to develop a baseline monitoring program for Xantus's Murrelets at Anacapa Island. A pilot radar monitoring program in April and May 2000 determined that radar surveillance offshore of breeding sites was an effective way to collect Xantus's population data and determine nocturnal activity patterns. Five nights of radar surveys were conducted at Anacapa and one survey at each of two control sites. Surveys were conducted from 20:00 to 05:00. Eighty hours of sampling were conducted and 1,838 Xantus's Murrelet targets were recorded. The maximum radar detection distance for murrelets was 990m. Murrelet flight speeds averaged 36.3 mph (range = 27-61). Detection rates increased rapidly after 21:00, 90 minutes after sunset, and peaked between 00:00 and 01:00. Detection rates dropped after 02:00 and stayed low until 05:30. All three islands exhibited significant differences in hourly detection rates. Sampling hours with the lowest variation occurred from 23:00 to 03:00 with a Coefficient of Variation of 0.15. For a long term monitoring effort, these sampling hours would yield the lowest variation in counts and have the greatest power to detect a change in the trend of this population. To achieve ≥ 0.90 power and detect a -5 percent change in the population, 6 years of surveys with at least 8 radar surveys per year to each site would be required. Complementary data on at-sea congregations (spotlight transects, vocal detection surveys, and nightlighting captures) and breeding phenology and success also are being gathered.

Monitoring Common Murre populations: a preliminary analysis of three years of replicate aerial surveys on three Central California colonies

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In 1996, 1997, and 1998, aerial surveys were conducted on three central California Common Murre (*Uria aalge*) colony complexes: Point Reyes Colony Complex, Drake's Bay Colony Complex, and Castle/ Hurricane Colony Complex. Two replicate surveys were conducted at each colony complex during early to mid-May (week 1), during late May/early June (week 2), and during mid-June (week 3). Our objectives were to determine if timing of aerial surveys (week 1 vs. week 2 vs. week 3) had a significant effect on our colony attendance estimates, and to determine if conducting replicates reduced our estimation error substantially. Colony attendance at each colony complex was found to vary by week, and week differences varied across years. We found that the margin of error for one survey was within 16% of our survey estimate using a 95% confidence interval. Conducting a second (replicate) survey reduced the margin of error to 10%, and we estimate that a third survey in a one-week period would reduce the margin of error to 7%. Further analysis of the data will be conducted as part of a more comprehensive study on Common Murre population trends in central California.

Revival of the Short-tailed Albatross population on Torishima, Japan

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The Short-tailed Albatross (*Phoebastria albatrus*) was once believed to be extinct, but about 10 birds were rediscovered surviving on Torishima, Japan, in January 1951. Since then, the species has been protected, and the

Japanese government has carried out active conservation programs for saving the species, along the lines of my proposal of the 1980s. First, we improved nesting habitats by grass transplants and succeeded in increasing the breeding success up to 67%, producing more than 50 fledglings after 1985. Suddenly in 1987, however, a landslide took place on the nesting slope, and subsequent mudflows reduced the breeding success to less than 50%. To cope with this problem, we have conducted erosion control as well as habitat management from 1993, and we have recovered the former level of breeding success, resulting in more than 130 fledglings after 1998. At the same time, we started artificial creation of a new colony by use of decoys and sound playbacks at a safe site on Torishima, and we already have had 4 fledglings from the new colony. In 2001, half a century since the rediscovery, the Torishima population is estimated to be about 1150 birds in total with 238 nesting pairs. A simple population model predicts that the breeding population size would continue to increase at 7% per year, if both marine and terrestrial environments do not change seriously, reaching 450 to 500 pairs in 2010.

Adult and subadult survival rates of Cassin's Auklets at Frederick Island, British Columbia.

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We estimated adult and sub-adult annual survival rates of Cassin's Auklets (*Ptychoramphus aleuticus*) at Frederick Island, British Columbia from 1994-2000 using Program MARK. Estimates were from recaptures of 2481 birds banded at knock-down nets at two sites. Birds were grouped by site and according to three progressive stages of iris-color at first capture. The best model (based on QAICc) assumed

brown-eyed birds became mixed-eyed, and mixed-eyed birds became white-eyed, after one year. Apparent survival increased markedly with stage, and thus age. There is an indication that permanent emigration or transient behavior might be a feature for birds of all ages since adults had lower apparent survival during their first year after capture than in later years. Alternatively, these rate differences could indicate learning or a detrimental effect of handling. Apparent survival rates varied markedly among years, with white-eyed birds (at least age 2 and older and >1 year after capture) surviving annually from 0.926 (SE = 0.012) to 0.535 (SE = 0.028). For the generally younger mixed-eyed birds (>1 year after capture) the rates varied from 0.863 (SE = 0.035) to 0.616 (SE = 0.064). The rates for the youngest (brown-eyed) birds (1 year after capture) were very low at 0.449 (SE = 0.046) to 0.088 (SE = 0.017). Slight differences in the patterns of survivorship between sites might be explainable by changes to the nesting habitat behind one of the nets. We suggest that the measurable decline in survivorship of white-eyed birds during 1997-98 is related to the El Niño event of that year.

Duration of foraging trips and chick feeding rates for Common Murres at three colonies in central California

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In 1999 and 2000, the duration of foraging trips and chick feeding rates of Common Murres (*Uria aalge*) were examined at three colonies along the mainland coast of central California: Point Reyes Headlands, Castle Rocks and Mainland, and Devils Slide Rock.

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Feeding and foraging data have received more attention in recent years and may potentially provide information on feeding distances, prey abundance, and productivity of Common Murres. In this study, all-day and two-hour observations were used to measure trip duration and chick feedings. Data were analyzed to compare both of these parameters between sites, as well as between years. All-day feeding rates were compared with rates from two-hour subsamples, in order to determine the differences in magnitude between the two observation techniques. This poster shows some preliminary results of the aforementioned parameters and discusses the significance of these findings.

Should we be conducting inland protocol surveys for Marbled Murrelets in August? A discussion based on findings from the Olympic Experimental State Forest, Washington, U.S.A.

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The Marbled Murrelet Technical Committee of the Pacific Seabird Group has produced and updated a protocol of methods for surveying Marbled Murrelets (*Brachyramphus marmoratus*) in forests since 1994. Objectives of this protocol include providing scientifically-based methods for distinguishing murrelet "occupancy", indicating a site has some importance for breeding, from "presence" or "probable absence", indicating a site is probably not important for breeding. These findings frequently are important in regulatory or land-management decisions as well as in drawing conclusions from research, all of which are likely important in the long-term conservation of Marbled Murrelets. In Washington, Oregon, and California, surveys are distributed across the survey season (1 May–5 August) according to a schedule described in the protocol. We examined seasonal patterns

of murrelet activity from over 4,400 inland surveys conducted from 1994–2000 in old-growth forests managed by the Washington State Department of Natural Resources on the western Olympic Peninsula of Washington. Murrelet activity was consistently reduced during August. Average numbers of detections per survey were lowest (0.39 ± 0.14 [mean \pm standard error], = 223 surveys) in August, while the average from all surveys was 1.67 ± 0.07 ($N = 4472$). Average numbers of detections during August consistently ranked lowest compared to the other 13 (7-day) weeks of the survey season. As much as 25% of the survey effort can occur in August, depending on scheduling and findings during the two-year survey. If our observations reflect a consistent, region-wide pattern of murrelet behavior, surveys conducted during August could lead to false-negative conclusions and less effective murrelet conservation.

Providence and persistence: making sense of beached bird surveys

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Although estimates of seabird beaching rates have been calculated for several regions within the Pacific Northwest, few studies have examined the differences between regions. Furthermore, most published information has only summarized total deposition rates (combining all species), leaving the specific patterns for many taxa in doubt. Long-term studies by Bob Loeffel and Greg Lippert, on the Oregon and Washington coasts, respectively, are among the few that have collected data across all seasons for a number of years (25 and 5, respectively). Because neither study marked and recaptured carcasses, though, regional persistence patterns (i.e. duration of a carcass's stay on the beach) remain unknown. Their data, combined with those of the Coastal Observation and Seabird Survey Team (COASST), in which car-

cases are marked individually and left in place, reveal several striking and curious trends. The most commonly beached alcids, Common Murres (*Uria aalge*), Rhinoceros Auklet (*Cerorhinca monocerata*), and Cassin's Auklet (*Ptychoramphus aleuticus*) show marked differences in their abundance across sub-regions. Common Murres show remarkable annual consistency in high deposition rates from Grays Harbor south to the Long Beach Peninsula before tapering off in Oregon, while Rhinoceros and Cassin's Auklets are 5–10x more abundant on the Long Beach Peninsula than in similar coastal areas to the immediate north and south. This talk will relate these and additional patterns to those of other West Coast studies, and give the first year-round assessment of regional beach bird persistence rates as noted by COASST observers in 2000.

Statistical power for detecting trends with applications to seabird monitoring

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Methods for estimating power in population monitoring include both analytical models and Monte Carlo simulations. TRENDS (software by T. Gerrodette) uses the first approach, while MONITOR (software by J.P. Gibbs) takes the latter. Using either program, it is essential to enter an appropriate measure of variability for a given population index. Generally, that measure will be the component of interannual variation in a time series that is unexplained by any trend in numbers (i.e. standard error of estimation from a regression analysis of mean count versus year). Other important decisions include a choice of assumptions about variance structure and selection of an exponential or linear model of population change. Using seabird monitoring data from Alaska, I computed the power to detect trends of -1.4% per year (draft goal of the North American

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Waterbird Conservation Plan) and -2.7% per year (goal established for land birds by Partners In Flight). At an alpha level of 0.05 and desired power of 0.9, the estimated study duration (with annual censusing) required to detect such changes varied from 16 to 69 years depending on species, software, trend, and study design. Power estimates from MONITOR appear slightly conservative for linear trends, and the model of exponential change provided in MONITOR is incorrect and unusable. TRENDS gives reliable results for single-plot designs but is unable to handle potentially powerful multi-plot designs available in MONITOR. Neither program supports "what if" analyses of sampling effort within years, because neither models the within- and between-season components of variance adequately.

History of seabird populations on Johnston Atoll

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Johnston Atoll has been subjected to numerous environmental insults since its discovery in 1796. Guano was mined here from the late 1850s to the early 1900s. Although it was designated a "refuge and breeding ground for native birds" in 1926 by Executive Order, a succession of military missions began in 1934 and has continued to this day. Beginning in 1939, numerous dredging operations enlarged the two original islands and also created two new ones, increasing the land area from 56 to 696 acres. In spite of the large human population and infrastructure, 15 species of seabirds breed here today. Laysan and Black-footed albatrosses formerly bred here but no longer do. The addition of new land to the atoll has allowed for the expansion of the populations of some species, but the Wedge-tailed Shearwaters (*Puffinus pacificus*) are limited mostly to the original land areas, where the

substrate is suitable for burrowing. Most of the seabirds breed on the three small, uninhabited islands. White Terns (*Gygis alba*) and Black Noddies (*Anous tenuirostris*) have benefited from introduced trees and breed almost exclusively on the main island. Red-tailed Tropicbirds (*Phaethon rubricauda*) also breed mostly on the main island, where the bushes and trees provide adequate shade. The ending military mission, continuing involvement of U.S. Fish and Wildlife Service, and absence of introduced predators make Johnston Atoll National Wildlife Refuge one of few areas in the central Pacific where seabird populations can be expected to thrive in the new millennium.

Does water clarity affect the at-sea distribution of nearshore marine birds?

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Water clarity has been proposed as a factor affecting the at-sea distribution of seabirds. Pursuit diving birds may prefer turbid water, in which their prey are less likely to see them, and plunge divers may prefer clear water, in which prey are visible below the surface. During at-sea surveys of nearshore marine birds in Monterey Bay, California, I measured surface water clarity using a transmissometer. This is the first study to continuously record both seabird distribution and an index of water clarity. Using randomization analyses, I tested for patterns of distribution of seven species of marine bird relative to water clarity at two scales: 100 m and 1000 m. Species distributions that I analyzed included four pursuit divers: Pacific Loon (*Gavia pacifica*), Western Grebe (*Aechmophorus occidentalis*), Brandt's Cormorant (*Phalacrocorax penicillatus*) and Marbled Murrelet (*Brachyramphus marmoratus*); two plunge divers: Brown Pelican (*Pelecanus occidentalis*) and Forster's Tern (*Sterna forsteri*); and one benthic foraging sea-duck: Surf

Scoter (*Melanitta perspicillata*). Bird distributions for all species were not strongly related to water clarity.

Correlates of Marbled Murrelet activity in old-growth Forests: Olympic Experimental State Forest, Washington, U.S.A.

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Inland activity of Marbled Murrelets (*Brachyramphus marmoratus*) is hypothesized to reflect characteristics of the species' behavior and ecology, including behavioral responses to weather conditions and breeding season phenology. We examined aspects of these hypotheses at two time scales, daily and weekly, using findings from over 4,400 inland Marbled Murrelet surveys conducted 1994-2000 in old-growth forests managed by the Washington State Department of Natural Resources on the western Olympic Peninsula of Washington. Daily (numbers of detections/survey, and time from first to last detections) and weekly (detections/survey, and proportion of surveys with detections) indices of murrelet activity were correlated—we used detections/survey for all analyses reported here. Activity levels were highly variable within days throughout the 14-week season, coefficients of variation (averaged within weeks) were 165-266% for 199 dates with 10 surveys. Correlations of summarized weather conditions with numbers of detections were generally not statistically significant ($P > 0.05$), however comparisons of conditions at the time detections were made with available conditions throughout the surveys found more detections than expected occurred during cloudy and/or foggy periods and fewer than expected during rainy periods ($P < 0.01$). Detections occurred later in the morning during cloudy or foggy weather ($P < 0.01$). We observed seasonal patterns in activity. Levels were over twice as high during the five

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weeks that approximate the peak activity period identified by the Pacific Seabird Group survey protocol than those recorded earlier or later in the season ($P < 0.01$). Additional understanding of inland activity of murrelets is needed for more effective development and monitoring of conservation strategies.

Effects of diet and crude oil ingestion on captive pre-fledging Pigeon Guillemots

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We performed studies on captive-reared Pigeon Guillemots (*Cephus columba*) at the Alaska SeaLife Center. In 2000, 77.4% of collected eggs ($N = 93$), from multiple locations in south-east and south-central Alaska, successfully hatched. Of the 21 eggs that failed to hatch, 52% came from a single site that required extensive boat transportation, suggesting that embryo survival is sensitive to handling. Different groups of guillemot chicks were fed either high-lipid (56.5% of calories as lipid, 910 kJ/day) or low-lipid isobiomass diets (37.2% of calories as lipid, 630 kJ/day). We found differences in pre-fledging growth between high-lipid and low-lipid diet groups. On day 30 post-hatch, both body mass and wing chord length were greater for chicks on the high-lipid diet (431.9 ± 9.8 g and 131.2 ± 1.4 mm, respectively) than those on the low-lipid diet (368.5 ± 4.3 g and 127.7 ± 0.7 mm, respectively). Chicks fed the low-lipid diet were also subjects in a 10-day crude oil ingestion experiment consisting of the following groups: low crude oil dosing (125 μ l/kg), high crude oil dosing (500 μ l/kg), and control. We detected no differences in growth parameters or hematocrits among the crude oil dosing groups. Stress series were performed 3 days after the end of the dosing period and corticosterone levels were approximately two-fold higher in chicks

fed crude oil (30 min stress, 16.4 ± 2.7 ng/ml plasma) compared with controls (30 min stress, 8.7 ± 1.9 ng/ml plasma). Studies are ongoing to characterize differences in blood chemistries due to crude oil ingestion.

Nesting habitat preferences in Marbled Murrelets: GIS and telemetry approaches combined

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We used 85 nests from Marbled Murrelets (*Brachyramphus marmoratus*) located by radio-telemetry during the field seasons 1998 ($N = 23$), 1999 ($N = 34$) and 2000 ($N = 28$) in Desolation Sound, southern British Columbia, and 9 additional nest locations in 2000 from a second study area, Clayoquot Sound, on western Vancouver Island. All nest locations were characterized for the following landscape characteristics: slope, aspect, elevation, edge and patch size for "old forests." Findings were related to a larger landscape context of habitat availability using a 50 km circle around the center of the suspected foraging activity, as determined by "dipnetting." Our approach allows us to investigate habitat preferences of nesting Marbled Murrelets, by comparing habitat use to habitat availability. Using several provincial and international GIS data sets, we examine the relationship of nests to the landscape features described above. We then develop a multivariate nesting habitat model to predict the occurrence of this bird within the two study areas using a Generalized Linear Model (GLM), Classification and Regression Tree (Cart) and other advanced modeling algorithms. Results indicate a very good model fit, even beyond the study area; findings are compared with existing models and knowledge for this bird.

Albatross response to survey vessels: implications for studies of distribu-

tion, abundance, and prey consumption

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The study of seabird ecology at sea is complicated by the tendency of many species to follow and otherwise attend vessels. Seabird vessel-attendance biases abundance estimates, blurs the correlation between seabird distributions and habitat features over small scales, and inhibits the statistical analysis of marine bird dispersion patterns. These biases have important implications when estimating the size of rare and endangered populations and the prey consumption by abundant species. This study illustrates how observations of recognizable ship-following albatrosses can be used to mitigate the biases of vessel-attendance. I surveyed albatross distributions off southern California between August 1996 and April 1999 from CalCOFI cruises. I quantified the degree of albatross attraction to survey vessels, and estimated that standard 300 m strip transects overestimated their abundance by at least a factor of 3.57. Additionally, I modeled albatross ship-following behavior and determined that 95% of recognizable Black-footed (*Phoebastria nigripes*) and Laysan (*P. immutabilis*) Albatrosses ceased to follow the survey vessel after 60 and 38 minutes respectively. Using these models, I calculated that standard survey methods overestimated Black-footed Albatross abundance by an additional factor of 1.17 due to their ship-following behavior. When these two biases were combined, standard survey techniques overestimated albatross abundance and squid consumption by a factor of 4. Determining the degree of vessel-attraction and the temporal scale of ship-following will enhance our ability to monitor the abundance, and prey consumption of albatross populations. This information is essential to incorporate accurate estimates of seabird resource consumption into multi-

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species fisheries models and ecosystem-level management plans.

Long-term changes in marine bird communities of the California Current (1987-98): importance of prey patchiness and energetic constraint

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The productivity of the California Current has decreased in response to a long-term ocean warming trend since the mid 1980's. We surveyed seabird and macrozooplankton abundance off southern California, using seasonal CalCOFI cruises as vessels of opportunity. Our objective was to determine if marine bird communities have shifted in response to changes in the abundance and patchiness of their zooplankton prey. Our analyses revealed that onshore and offshore seabird assemblages have responded to declining ocean productivity differently. Onshore, we detected a decrease in overall seabird abundance and a long-term shift in community composition, concurrent with a decline in the abundance and aggregation of macrozooplankton biomass. We detected no such changes offshore. Additionally, we found that onshore and offshore seabird assemblages have become progressively more similar through time. Analyses of individual species responses revealed that marine birds with different energetic flight costs, determined on the basis of wing morphology measurements (wing loading = body mass / wing surface area), responded differently to declining zooplankton biomass and aggregation. We detected a concurrent long-term increase in the abundance of a pelagic, low-cost species with disproportionately large wings (Cook's Petrel,

Pterodroma cooki), and declines in the abundance of four coastal species with high flight costs: Common Murre (*Uria aalge*), Sooty Shearwater (*Puffinus griseus*), Rhinoceros Auklet (*Cerorhinca monocerata*), and Cassin's Auklet (*Ptychoramphus aleuticus*). We hypothesize that energetic requirements and prey patchiness modulate the response of bird species to decreasing ocean productivity. These results suggest that species-specific characteristics influence community-level responses to changing ocean climate.

Oceanographic habitats of two sympatric North Pacific albatrosses: scale-dependent patterns

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We characterized the habitats exploited by Black-footed (*Phoebastria nigripes*) and Laysan (*P. immutabilis*) Albatrosses breeding sympatrically at Tern Island, Hawaii. Analyses of ARGOS telemetry data in conjunction with satellite-derived sea surface temperature and chlorophyll concentrations suggest that albatross habitat selection is scale-dependent. Over macro-mega scales (1000's of km) albatross dispersion is influenced by water mass distributions and constrained by breeding duties at the colony. During the brooding period (< 18 days after chicks hatched), Black-footed Albatrosses restricted their movements to tropical waters (> 20° C), while Laysan Albatrosses ventured into the cooler waters of the Transition Domain (15-12° C) and the Subarctic Frontal Zone (12-10° C). Albatross foraging ranges expanded during the rearing period (19-140 days post-hatching), when both species foraged in cooler and more productive water masses. Black-footed Albatrosses commuted to the California Current,

and Laysan Albatrosses ventured into subarctic waters (< 10° C) in the Gulf of Alaska, the Aleutians, and the Northwest Pacific. Within these large-scale water masses, albatrosses focused their foraging activities along smaller coarse-meso scale (10's-100's of km) features characterized by elevated productivity and prey concentrations. Foraging birds engaged in area-restricted searching behaviors along continental shelves (California-British Columbia, Aleutians), and water mass boundaries (North Pacific Transition Domain, California Current). Conversely, albatrosses commuted rapidly over tropical and subtropical waters between highly-productive foraging areas and Tern Island. An understanding of the physical processes that stimulate ocean productivity and prey aggregation is essential to delineate important foraging grounds exploited by highly-mobile, pelagic species.

Overlap between satellite-tracked female Black-footed Albatrosses and the Japanese eastern Pacific longline fishery

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In the central North Pacific, Black-footed Albatrosses (*Phoebastria nigripes*) sustain substantial mortality in the Hawaiian longline fishery, where an estimated 1-2% of the world population (58,500 breeding pairs) is taken yearly (Skillman and Flint, 1997). Pelagic longline fleets not currently monitored by observer programs are a likely source of additional mortality in the central and eastern North Pacific. Determining the overlap between longline fishing effort and albatross foraging zones is an important first step to identify potential sources of additional bycatch. We tracked four female albatrosses for a total of 99 days during their summer dispersal

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(July–September, 1997–99), and compared their movements to seasonal summaries of fishing effort from the Japanese Eastern Pacific Ocean longline fishery. The tracked birds ranged across international borders and spent 22%, 26% and 52% of their time in U.S., Mexican and international waters respectively. Determining the overlap between the fishery and albatross distributions was hindered by the inherent spatial and temporal variability of fishing effort. While the analysis of summertime longline effort between 1981 and 1987 revealed potential overlap with the satellite-tracked albatrosses, the pattern was not as clear when data from 1991–97 were analyzed. At present, this research cannot directly evaluate whether Black-footed Albatross bycatch occurs at the Japanese eastern Pacific longline fishery. However, the available data suggest there is potential for albatross interactions with this fishery, especially because fishing effort is likely to increase in the coming years. These results underscore the need for “exploratory” observer coverage in fisheries that overlap albatross foraging ranges.

Extensive variation in feeding flock use by individual seabirds linked to prey type

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We examined the use of feeding flocks by breeding Black-legged Kittiwakes (*Rissa tridactyla*) in Prince William Sound, Alaska, by tracking 116 birds over seven years during foraging trips. We tested to see if variation in feeding flock use was related to prey abundance or prey type. Prey abundance was assessed by aerial surveys of fish schools. Prey type was assessed by comparing diets at the colonies. We found extreme variation in feeding flock use by birds, ranging from only 7% to 90% of feeding occurring in flocks. This variation was not related to

prey abundance, but was highly correlated with prey type. Generally, when kittiwakes fed on young of year Pacific herring and young of year sand lance, they fed in feeding flocks, but when they fed on age one herring, they fed singly. The reasons for these differences are likely related to three factors: 1) an increased foraging efficiency while searching for prey, 2) an increased foraging efficiency while capturing prey, and 3) differences in the behavior of the prey types.

Waved Albatrosses off the coast of Peru during El Niño, 1998

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In this paper we investigate the responses of Waved Albatrosses (*Phoebastria irrorata*) to El Niño 1998, and discuss these responses in relation to oceanographic conditions and prey distribution off the coast of Peru. A total of 3,853 and 989 Waved Albatrosses were observed off Peru during the early fall and late winter cruises, respectively. The average density of Waved Albatrosses was 1.72 birds·km⁻² in April and 0.30 birds·km⁻² in August–September. During early fall, these albatrosses aggregated over the continental shelf between 9° S and 11° S. In late winter, scattered birds were found along the edge of the shelf. More Waved Albatrosses were observed in areas where fish backscatter was registered by the echosounder than expected by chance. Of the birds observed during April and August–September, 72% and 77%, respectively, were aggregated in areas where—in spite of El Niño—potential prey was available for foraging birds. Earlier studies suggested that Waved Albatrosses forage on small squids at the Galapagos Islands and shoaling fish, such as Peruvian Pacific Sardine

(*Sardinops sagax*) and Peruvian Anchovies (*Engraulis ringens*) off the coast of Peru. Oceanographic conditions observed during early fall 1998 suggest that birds were distributed in an area of local upwelling that contained over 50% of the total prey available in the coastal system at that time. Locally available prey included epipelagic species such as Chub Mackerel (*Scomber japonicus*) as well as sardines and anchovies. Waved Albatrosses during late winter were distributed at the edge of the shelf, where the mesopelagic species Panama Lightfish (*Vinciguerria lucetia*) was particularly common.

Variation in survival rates of Crested, Least, and Whiskered Auklets at Buldir Island, Alaska 1990–2000.

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No previous study has investigated whether seabird adult survival varies with large scale variability in oceanographic conditions. We estimated annual adult survival for three auklet species over a ten year period at Buldir Island, Aleutian Islands, Alaska, USA. Crested (*Aethia cristatella*, $N = 650$) and Least Auklets (*A. pusilla*, $N = 340$) were captured by day using noose carpets, marked with plastic color bands, and survival estimates were based on color band resightings during 1990–2000. Whiskered Auklets (*A. pygmaea*, $N = 499$) were mist netted at night, marked with stainless steel bands, and survival was estimated from recaptures during 1992–2000. Survival estimates and relationships between survival and the covariates Pacific Decadal Oscillation (PDO), Aleutian Low Pressure Index, and North Pacific Index (NPI) were evaluated using program MARK.

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For Crested Auklets, the best fit was a two-age model incorporating the covariate NPI, indicating survival rates varying from 0.93 ± 0.04 (SE) to 0.73 ± 0.06 over the study period years ((age1,age2*NPI), $p(g)$). For Least Auklets, the best fit was also the two-age model incorporating the covariate NPI, with survival varying annually from 0.96 ± 0.07 to 0.79 ± 0.09 ((age1,age2*NPI), $p(g)$). For Least and Crested Auklets, the best model included two groups of birds based on ease of resighting. For Whiskered Auklets, the best fit was a two-age model incorporating the covariate PDO and indicating survival rates varying annually from 0.99 to 0.82 ± 0.09 ((age1,age2*PDO), $p(\text{constant except for 1999})$). Our results indicate that at Buldir, varying auklet survival correlated strongly with, and is thus likely determined by, large-scale oceanographic variation.

California Least Tern population: status and trends

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The California least tern (*Sterna antillarum browni*) breeds from April through August at nesting areas along the coast from the San Francisco Bay, California to lower Baja California, Mexico. Prior to its listing as endangered under both the federal and California Endangered Species Act in the early 1970's, the progressive conversion of suitable nesting habitat to human uses had resulted in a severe reduction in both nesting sites and numbers of nesting pairs. Thereafter, the number of nesting pairs in California escalated from an estimated 664 in 1976 to over 4,000 in year 2000. Up to 38 nesting sites are now used, up from 23 in 1976, when statewide censuses were initiated. However, over 80% of the nesting population is concentrated in 10 sites. In addition, poor production years such as 1999 still threaten the

population, as does predation by a variety of both native and non-native predators. Thus, continued management will be required to ensure long-term survival. Population and productivity fluctuations, existing management and monitoring methods and recommendations for future monitoring and management will be discussed.

Nocturnal activity as predator avoidance in Black-vented Shearwaters

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Many seabirds are nocturnal at their colonies and it has been theorized that this is a result of predator-prey relationships. We examined nocturnal behavior in the Black-vented Shearwater (*Puffinus opisthomelas*) on Natividad Island, Mexico, to test the hypotheses that nocturnal attendance patterns are a result of prey availability and shearwater foraging patterns or predation pressure by diurnal Western Gulls (*Larus occidentalis*). We looked at shearwater attendance and activity patterns throughout the breeding season, including activity on the colony surface, vocalizations of shearwaters and gulls, and percent of shearwater burrows entered per night in relation to moon phase. We used direct observations and radio telemetry to examine the behavior patterns of shearwaters in flocks formed on the water adjacent to the breeding colony at dusk. We found that shearwater activity was mostly restricted to moonless nights. Fewer burrows were entered on nights with a full moon than on other nights. Activity patterns of birds in the near-shore flocks were not consistent with the foraging limitation hypothesis. Predation rate by Western Gulls on shearwater live-mounts was highest during daytime, intermediate during moonlight, and lowest at complete dark. Our results support the hypothe-

sis that pressure from diurnal predators causes nocturnal colony attendance patterns in the Black-vented Shearwater.

Correlated patterns of kittiwake chick growth and productivity on St. George Island, AK.

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Although seabird breeding success should be influenced by the same factors that affect the ability of parents to provision young (food supply and weather for example), past research on kittiwakes suggests that productivity is not related to nestling growth. On St. George Island, in the south-eastern Bering Sea, kittiwakes displayed marked inter-annual variability in reproductive performance over the past 20 years. For Red-legged Kittiwakes (*Rissa brevirostris*) I found that nestling growth was poorly related to laying success ($r^2 = 0.01$), but was well correlated with hatching success ($r^2 = 0.76$), fledging success ($r^2 = 0.50$), and overall productivity ($r^2 = 0.67$). These results indicate that factors shaping laying success are independent of those important during incubation and brood rearing period, and that resource conditions are somewhat stable and potentially predictable over the course of the breeding season. In addition, both Red-legged and Black-legged (*R. tridactyla*) Kittiwakes on St. George Island have historically exhibited greater reproductive success at the High Bluffs area of the colony where nestling growth is greater. Moreover, although within-colony correlations between productivity and chick growth corroborate results from inter-annual comparisons, they cannot be explained by differences in resource abundance because kittiwakes forage some distance from the colony and, in principle, have equal access to common food resources. I suggest that within-colony patterns are a consequence of either a local advantage of breeding at High Bluffs (where ticks are less abundant, for example) or

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a difference in "bird quality" (intrinsic foraging and provisioning abilities) between High Bluffs and lower-elevation areas.

What's going on at Devil's Slide Rock anyway? The timing, number, and breeding success of Common Murres at three Central California colonies from 1996 to 2000

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Restoring breeding Common Murres (*Uria aalge*) to Devil's Slide Rock (DSR) using social attraction equipment has been very successful. Every year since the project's inception in 1996, numbers of breeding pairs and fledged chicks has increased. To determine if the murres recolonizing DSR behave in a manner similar to that of established nearshore breeding colonies two central California murre colonies (Point Reyes Headland [PRH] and Castle/Hurricane Colony Complex [CHCC]) have been monitored in addition to DSR since 1996. Here we present data on the number of breeding pairs, the timing of laying, and the reproductive success at these three colonies from 1996 to 2000. Upwelling indices indicate that environmental conditions were worst in the El Niño year of 1998 and best in the La Niña year of 1999. In 1998 reproductive success was reduced at all three colonies. Although murres at PRH and CHCC responded to El Niño by laying late and laying fewer eggs, at DSR the number of breeding murres increased slightly from 1997 and the mean laying date was almost two weeks earlier than at PRH and CHCC. In 1999 murres at all three colonies responded favorably

to La Niña; breeding was early and reproductive success was high. Numbers of breeding murres increased at DSR from 14 in 1998 to 70 during the La Niña conditions of 1999. Chicks fledged per pair has been high at DSR and PRH in the last two years, but lower at CHCC. Possible reasons for these patterns are discussed.

Attraction of Dark-Rumped Petrels to artificial burrows in the Galapagos Islands

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We excavated a total of 160 artificial burrows for endangered Dark-rumped Petrel (*Pterodroma phaeopygia*) into the interior rim of the dormant caldera of the Mirador Volcano on Santa Cruz Island, Galapagos in 1988 and 1989. In these years and in 1990, we broadcast petrel flight calls near the burrows on alternate nights from mid June to mid August. We measured the use of the burrows daily by placing upright toothpicks in the entranceways and powdery soil in front of the burrows to record tracks. We recorded petrel visits within 64, 38 and 16% of the burrows respectively from 1988 to 1990. These data suggest that petrels visit multiple burrows when first prospecting and eventually concentrate visits to a single burrow. Burrows with the most visits eventually contained breeding pairs in subsequent years. We found no difference in the frequency of visits during nights in which we played recordings vs. nights without recordings, but visited burrows were 0.5 m closer to speakers than was expected if burrow use was random. Eggshell fragments were found in one of the burrows in 1989, providing evidence that nesting occurred in the first year of the project. Four pairs nested in artificial burrows in 1990 and the number of nesting pairs increased to at least 15 by 1994.

Dine and dash: the foraging patterns of wintering Surf Scoters (*Melanitta perspicillata*) feeding on bay mussels (*Mytilus trossulus*) in coastal British Columbia

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Surf Scoters (*Melanitta perspicillata*) winter in abundant numbers along the west coast of British Columbia. They forage in large flocks preferentially feeding on intertidal mussels in rocky habitats. The combination of abundance, density and preferential selection of mussels indicate that Surf Scoters may deplete and impact their prey, the bay mussel (*Mytilus trossulus*). I conducted a two year study to examine the predation impacts of Surf Scoters on mussels by: (1) using monthly photographs to monitor 14 mussel beds to assess scoter predation; (2) conducting bimonthly boat surveys to determine the abundance and distribution of Surf Scoters. In 11 sites, the mussel beds were entirely depleted. Boat survey data demonstrated that 95% of the foraging sites were not re-occupied after initial observation. The foraging and distribution patterns observed suggest that feeding remains profitable throughout the period of mussel depletion. I hypothesized that openings in mussel beds created by Surf Scoter predation increases the overall feeding efficiency of the flock, since mussels around the perimeter are easier to access and remove. Simulation models were used to test the hypothesis that creating openings in mussel beds allow more scoters to feed on a site than would normally be predicted. Surf Scoter flocks benefit from increased feeding efficiency due to reduced handling time of mussels. In conclusion, large numbers of Surf Scoters completely deplete a mussel bed before abandoning the site.

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Are corticosterone levels a good indicator of food stress and reproductive success in a seabird colony?

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To determine if stress hormone levels in adult seabirds are related to local food conditions and indicate the reproductive health of a colony, we contrasted base-line levels of corticosterone in supplementally fed and unfed adult Black-legged Kittiwakes (*Rissa tridactyla*) breeding on a radar tower on Middleton Island, AK in 1999 and 2000. Blood was obtained from adults shortly after returning from the wintering grounds (~1 1/2 months prior to breeding), and during pre-egg laying, incubation and chick-rearing stages of breeding. A variety of reproductive parameters were also measured at fed and unfed sites throughout the colony. Base-line levels of corticosterone were 2-3 times higher in birds sampled shortly after arriving on the island compared to those sampled during the remainder of the breeding season (levels decreased from an average of 8-16 ng/ml to 2-6 ng/ml). Differences were most pronounced in 1999—a season when pre-laying conditions were some of the worst for many years—and were greater for individuals that subsequently failed to breed. During pre-egg laying, incubation, and chick-rearing stages, corticosterone levels were consistently low and not significantly different between sexes, or between fed and unfed kittiwakes (except chick-rearing in 1999). Further, corticosterone levels during these three stages were a poor predictor of reproductive success in the colony. Taken together, these results suggest that base line-levels of corticosterone have a limited ability to predict local food conditions and the reproductive health of a colony. Useful sampling appears to be

limited to when birds first arrive from their wintering grounds.

Breeding population of Streaked Shearwaters (*Calonectris leucomeras*) on the Sasu Islet, Korea

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For study on breeding population of Streaked Shearwaters (*Calonectris leucomelas*), survey quadrats were established on the Sasu islet (approximately 217,000 m²) Chejudo, Korea, during the breeding season. In July 2000 (10 × 10m, N = 41), survey was carried out for about two weeks after egg laying. We regarded adult contained burrows as breeding burrows. Burrow density was 0.15/m² ± 0.02 (mean ± SE). High densities were recorded in old field and rock area. Sixty eight percent of burrows surveyed were breeding ones and the density of breeding burrows was 0.10/m² ± 0.02. The breeding population was estimated to be 8,166 ± 2,340 pairs. But only 36.4% (5 × 6m, N = 31); 19.8% (10 × 10m, N = 18) of burrows surveyed were adult or chick contained burrows during the hatching season in Aug. 1998 and 1999 respectively. Fifty-four breeding burrows were monitored for 23 days in 1999. And breeding failures were recorded in 31 out of 54 burrows (57.5%). Norway Rats (*Rattus norvegicus*) eating a chick in a burrow was observed. Predation by Norway Rats was the probable cause of failure for 26 (82.3%) of these burrows. Above results suggest that Norway Rats predation is the main factor affecting this breeding population of Streaked Shearwaters.

Caspian Tern predation on juvenile Salmonids in the Columbia River estuary

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Rice Island, a dredged material island in the Columbia River estuary, supported the largest breeding colony of Caspian Terns (*Sterna caspia*) in the world (over 8,000 pairs) during the late 1990's. Using bioenergetics modeling, we estimated that terns nesting in the estuary consumed about 11.8 million juvenile salmonids (95% confidence interval = 8.3 – 15.9 million) during the 1999 out-migration. A management plan implemented in 2000 sought to relocate the Rice Island tern colony to a new site on East Sand Island, 21 km closer to the ocean, where it was hoped terns would consume significantly fewer juvenile salmonids. Over 94% of the terns shifted to East Sand Island, where nesting success was nearly four times higher than at the Rice Island colony. Juvenile salmonids comprised 44% of the prey items of terns nesting at East Sand Island, compared to 91% of prey items at Rice Island. The relocation of nearly all the nesting terns from Rice Island to East Sand Island resulted in a sharp drop in consumption of juvenile salmonids. Total smolt consumption by Caspian terns nesting in the Columbia River estuary in 2000 was estimated at 7.3 million (95% confidence interval = 5.7 – 9.3 million). This represents a reduction of about 4.4 million (38%) compared to the 1999 smolt consumption estimate. Regional resource managers are contemplating further reduction in the annual consumption of juvenile salmonids by restoring tern colonies outside the estuary and relocating a portion of the East Sand Island colony to these alternative sites.

Effects of different microhabitats and burrow types on the breeding success of Wedge-tailed Shearwaters (*Puffinus pacificus*)

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The Wedged-tailed Shearwater (*Puffinus pacificus*) is the most common shearwater species in Hawaii. The current study investigated the breeding ecology of this species on Kapapa Island, a small offshore islet in Kaneohe Bay, Oahu. The purpose of the study was to determine the difference in overall breeding success, and egg and chick success between four microhabitats (sand ledge, ironwood, rock flat and mixed low vegetation) and three types of nests (rock burrow, underground burrow, and ground nest) in the breeding colony located on the islet.

Overall breeding success for Kapapa Island was 61%. Results showed a significant difference among the four microhabitats and the three types of nests, the ironwood forest exhibiting the lowest overall breeding success (50.1%), the rock flat the highest (80.4%). Breeding success was 78% for rock burrows, 67% for underground burrows, and 28% for ground nests.

Differences in breeding success could be attributed to several physical and biological factors such as heat stress and predation pressure (for ground nests), and potential for collapse and water inundation (for underground burrows). The highest success was found in the rock burrows, which have a lower susceptibility to temperature changes, and to trampling/collapse due to their inherent construction.

Seasonal movements of seabirds in the Santa Barbara Channel, California

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Shore-based and shipboard data were gathered to examine seasonal movements of seabirds in the Santa Barbara Channel, California. Forty shore-based surveys of seabirds were conducted semi-monthly from Point Mugu, Ventura County, California from June 1999 to December 2000. Of 45 species recorded, Western Gull (*Larus occidentalis*), Brown Pelican (*Pelecanus occidentalis*), and Surf Scoter (*Melanitta perspicillata*) were the most frequently observed birds. Peaks in overall seabird abundance resulted from strong along-shore movements of gulls in late November 1999 and early January 2000 and the occurrence of large numbers of Western Grebes (*Aechmophorus occidentalis*) and Pacific Loons (*Gavia pacifica*) in late April and early May 2000. Eleven shipboard strip transects were conducted semi-monthly from March to October 2000 from Santa Barbara harbor to Santa Rosa Island. More than 10,000 individual seabirds of 30 species were observed. Sooty Shearwater (*Puffinus griseus*), phalaropes, Western Gull, and Brown Pelican were the most abundant species observed. Large influxes of phalaropes occurred in early May 2000 and large influxes of shearwaters occurred in late August 2000. Data collected in the Santa Barbara Channel supplement extensive aerial at-sea transects that examine at-sea distribution of seabirds throughout Southern California in May, September, and January 1999-2000.

At-sea distribution and abundance of seabirds in Southern California

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In 1999-2000, we conducted aerial at-sea transects of seabirds in shelf and slope waters off southern California

from 35° 35' N to the U.S.-Mexican border and as far west as 122° W. Surveys were conducted primarily in May (spring, breeding season), September (fall dispersal and migration), and January (mid-winter). Both offshore and coastal strip transects were conducted from fixed-wing aircraft at 200 feet ASL with a variable transect width of 50 to 100 m. Offshore transects were spaced from 8 to 15 nm apart while all mainland and island coastlines were surveyed about 300 m from shore. As found on University of California/BLM surveys in 1975-1978, Sooty Shearwaters (*Puffinus griseus*), Red-necked Phalaropes (*Phalaropus lobatus*), Western Gulls (*Larus occidentalis*), and California Gulls (*Larus californicus*) were numerically dominant in offshore areas, while Western/Clark's grebes (*Aechmophorus* spp.), Western Gulls, Surf Scoters (*Melanitta perspicillata*), Brown Pelicans (*Pelecanus occidentalis*), and Brandt's Cormorants (*Phalacrocorax penicillatus*) dominated in coastal areas. Transect design and analyses are focused on: (a) measuring spatial variation and relationships with sea surface temperature, upwelling, bathymetry, and breeding and/or roosting locations; and (b) updating baseline data for assessing population changes over time from potential anthropogenic impacts (e.g., oil pollution, military activities, and human disturbance), El Niño/La Niña events, and longer-term environmental change.

Reproductive success of the Ashy Storm-petrel at Santa Cruz Island, California, 1995-1998

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Reproductive success of the Ashy Storm-Petrel (*Oceanodroma homochroa*) was studied at five locations at Santa Cruz Island off southern California in 1995-1998. Nests were marked, mapped, and monitored infrequently with small flashlights; adults were not flushed or handled in order to prevent disturbance by researchers. Egg-laying occurred from early April through late September, peaking in mid-June. In 1995-1997, mean values of hatching, fledging, and breeding success were 61%, 93%, and 54%, respectively. Hatching success was 17% lower and fledging success was 6% higher than at the South Farallon Islands in 1972-1983 (excluding 1977). Breeding success was 15-24% lower than reported for the South Farallon Islands in various periods between 1971-1995. In 1998, a strong El Niño year, hatching success and breeding success were not significantly different from 1995-1997, but a greater proportion of chicks did not fledge. Possible factors affecting breeding success included: contamination of eggs and eggshell thinning due to chlorinated hydrocarbons; predation of adults; and human disturbance at nesting locations.

Seabird bycatch in a North Pacific longline fishery – solutions that work

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Seabird bycatch occurs in longline fisheries as seabirds attempt to feed on sinking baits during gear deployment. In Alaska seabird bycatch in longline fisheries includes Northern Fulmars (*Fulmarus glacialis*), Larids, Shearwaters (*Puffinus* spp.) and 3 spe-

cies of albatross (*Phoebastria* spp.). Although actual bycatch is rare, these fisheries face closure or limitation due to the potential hooking mortality of Short-tailed Albatross (*P. albatrus*), an internationally endangered species, and now operate under regulations borrowed from other nations. In the second year of this study, we compared seabird and fish catch rates among three seabird deterrent treatments in the IFQ sablefish fishery in the Gulf of Alaska and Aleutian Islands. Vessels in this fleet tend to be less than 25 m, have crews of six persons, hand-bait hooks, and deliver iced fish in trips lasting only a week. Deterrents, selected in collaboration with fishers, included: a single streamer (tori) line, paired streamer lines, and paired streamer lines in combination with weight (0.23 kg/10 m) added to the groundline. Seabird abundance and foraging behavior (bait attacks per minute) were also quantified during each set. Preliminary results indicate that compared to a control of no deterrent, paired streamer lines plus weight and paired streamer lines alone were nearly 100% effective at reducing seabird bycatch. These results suggest that cooperative research between fishers and scientists can create effective and practical solutions.

Marbled Murrelet population trends in northern California adjacent to managed and unmanaged forests

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We conducted line transect surveys in the near-shore waters of Northern California for 10 years beginning in 1989. Because of an offshore gradient in Marbled Murrelet (*Brachyramphus marmoratus*) densities, our sampling efforts were stratified to allow definition of the density curve. We used linear regression analysis methods to estimate population size from transects at

two distances from the shoreline. We found densities stable in areas adjacent to the large contiguous forest stands in state and national parks. In areas adjacent to forests managed for timber harvesting, we found a downward trend. However, preliminary analysis of the last two years of data indicates a possible reversal of this trend.

A protocol for archiving seabird plot photos and data

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As data continue to accumulate, filing cabinet needs multiply and biologists who can answer questions about 20-yr-old reports eventually retire. The Alaska Maritime National Wildlife Refuge is in the process of trying to develop electronic archives for various forms of data. Goals are to (1) improve access for more people, (2) allow re-analysis of historical data, (3) take up less physical space, (4) standardize data formats—especially when data are collected by multiple observers, and (5) preserve data for long periods of time. Additionally, storage in a compact and reproducible medium allows placement of data in an off-site location (National Archives and Records Administration) for further protection. This presentation details our new system for scanning and digitally archiving population and productivity photographs. The most difficult decision is which photographs to archive. We estimate our current collection to be about 10,000 photographs and anticipate archiving 2-3,000. A relatively low scanning resolution (2-3 MB file size) is probably sufficient for plot photographs. We developed a Microsoft Access database to store metadata about the original and scanned images. Images are saved as JPEG files on CD's. Because of changing database technology, the collection must be migrated forward in time onto new data management systems, simultaneously with the migration of the individual

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images onto new media. Although long-term storage of such a large quantity of multimedia information is a daunting task, we hope that beginning the process now will preserve our staff's hard work for generations to come.

Murre and kittiwake reproduction at a subarctic colony: links with local climate and oceanography and to oceanographic oscillations in the north temperate and tropical Pacific Ocean

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Numbers of adults, timing of breeding, and breeding success of Black-legged Kittiwakes (*Rissa tridactyla*) and Common Murres (*Uria aalge*) at Bluff, Alaska fluctuated markedly among years during 1975-2000. Numbers and breeding success were highest, and breeding was earliest, in years when local (Nome) spring temperatures were highest and ice break-up in the region was earliest. In turn, spring temperatures in Nome were strongly correlated with the North Pacific Index (*NPI*) during this period (e.g., April temperature in Nome vs. *NPI* for April: $r = -0.571$, $P = 0.003$; May temperature in Nome vs. *NPI* for May: $r = -0.511$, $P = 0.009$). Spring temperatures in Nome also were strongly correlated with the Niño 3.4 Index (*N3.4*) and the newly derived Trans-Niño Index (*TNI*); e.g., May temperatures in Nome were significantly correlated with *N3.4* for January ($r = 0.415$, $P = 0.04$) and *TNI* for February ($r = -0.499$, $P = 0.01$). Examination of the historical climatic record for Nome, which extends back to 1907, indicated that correlations between April and May temperatures and the *NPI* also were highly significant in 1907-1974, as were those between April temperatures (but not May temperatures) and *N3.4*. These results suggest that there may be surprisingly strong couplings between oceanographic variability in the tropical and

temperate Pacific and local conditions influencing murres and kittiwakes at this colony.

Heart rate as a measure of social recognition: do Little Blue Penguin (*Eudyptula minor*) chicks use vocal signatures to distinguish siblings from other chicks?

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Researchers investigating social recognition typically measure only behavioral responses during discrimination tests—physiological changes have been largely ignored. We examined whether Little Blue Penguin (*Eudyptula minor*) chicks could distinguish siblings from other chicks using auditory cues, by measuring behavioral and heart rate changes during playback experiments. Chicks were exposed to five treatments, the begging calls of siblings, neighboring chicks and unfamiliar chicks, and two controls (heterospecific begging calls and music). We also determined if chicks developed distinctive begging calls, by using *F* ratios to quantify inter- versus intra-individual variability in a range of acoustic parameters, and applying a discriminant function analysis. Inter-individual variation was greater in pitch parameters than temporal or amplitude parameters, suggesting that call pitch may be important for individual recognition. The discriminant function analysis showed each chick's calls were distinctive and could act as a vocal signature. Treatments did not instigate different behavioral responses. However, chick heart rates during playback of sibling calls were significantly higher than those recorded during stranger, but not neighbor, playback. A simple recognition system based on familiarity may allow this plesiomorphic and loosely colonial penguin to gain at least some of the benefits associated with more advanced sibling recognition systems (some highly colonial seabirds discriminate

siblings from neighboring chicks). Heart rate can be a useful measure of social recognition abilities, particularly in species where changes in behavior are not always evident or are difficult to observe.

The status and conservation of the Long-billed Murrelet in Japan

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We summarize the past and current status of the Long-billed Murrelet (*Brachyramphus perdix*) in Japan during the breeding season (March-September). Since its discovery and description in 1811 (Pallas), the Long-billed Murrelet (then called the Asian Mottled Murrelet, *Cephus perdix*) has been encountered in northern Japan throughout the year. Recently, however, fewer and fewer observations of this species have been recorded during the breeding season. The Long-billed Murrelet was thought to breed on Hokkaido although no nests have been documented. Based on our recent surveys, we believe this species may no longer breed in Japan, despite its known breeding on nearby Russian islands. We discuss the conservation problems, including gill-net fishing, logging of mature forests in coastal regions, oil pollution, and predation, that may have led to its extirpation from Japan during the breeding season.

Metabolism of cytochrome P450 3A (CYP3A)- mediated compound, quinine, in Adelie Penguin chicks

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Cytochromes P450 (CYP) are a large superfamily of enzymes that catalyze metabolism of a variety of xenobiotics, including environmental pollutants. Our previous study (Wanwimolruk et al. 1999; *Comp. Biochem. Physiol.* 124C: 301-307) has shown that adult Adélie Penguins (*Pygoscelis adeliae*) have much less ability than humans to eliminate xenobiotics having a similar nature to quinine, a specific human CYP3A4 substrate. This study was aimed to determine if the activity of CYP3A subfamily in Adélie Penguin chicks is different from that observed in adults. Liver microsomes prepared from 10 chicks (age 14-28 days) were used for incubation with quinine. The formation of its metabolite, 3-hydroxyquinine, was quantified using HPLC and used as a measure of CYP3A activity. Mean maximum rate of metabolism (V_{max}) and substrate affinity (K_m) in chick livers were 119 ± 35 pmol/mg protein/min and 122 ± 27 μ M, respectively. These seemed less than those reported in adults (160 ± 72 pmol/mg protein/min and 160 ± 73 μ M, respectively), but the differences were not statistically significant (P 's > 0.1). Mean intrinsic clearance (V_{max}/K_m) was 1.0 ± 0.3 ml/min in chicks, which was similar to that previously observed in adults. These results suggest that chick penguins have the ability to metabolize quinine, but the capacity is much less than humans. The metabolite formation in chick livers was inhibited by specific CYP3A inhibitors, midazolam and troleandomycin, but not by other CYP inhibitors, suggesting that the metabolite formation is likely to be catalyzed by a CYP isoform resembling the human CYP3A4.

Historical and present distribution of colonies of Streaked Shearwaters (*Calonectris leucomelas*)

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The Streaked Shearwater (*Calonectris leucomelas*), the most

abundant shearwater in western Pacific, mainly breeds in warmer current regions along Japanese archipelagoes, from Nakanokamishima Is. (24°N north) to Oshima-Ohshima Is. (41°N) and adjacent islands off southern Korean Peninsula. Based on a comprehensive literature survey, Streaked Shearwaters breed on 73 islands in total (17 located in the Sea of Japan, 19 in the Pacific Ocean, 18 in the Yellow Sea and Tsushima Strait, 18 in the East China Sea and one in Taiwan Strait; in other words 56 in Japan, 12 in Korea, two in China, and one each in North Korea, Russian and Taiwan). There might be more in China, Taiwan and North Korea.

These breeding colonies have possibly expanded northwards with the northward movement of the polar front, which was located 32-35°N (north East China Sea—Izu Islands) around 20,000 years ago, when the Sea of Japan was isolated from ocean.

The high concentration in offshore uninhabited islands in Pacific in rather higher latitudes for this species of 38-40°N (150 thousands birds in five islands) may be an outgrowth both of the higher marine production in subarctic boundary with cold and warm currents, and long-term nature conservation originated by local coastal residents. The unwritten law of islanders to protect the shearwaters in Mikura Island of Izu Islands for hundreds years has also supported the present estimated largest population of more than 1.8 million birds.

The fossil record of Hawaiian seabirds

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The fossil record of seabirds in the Hawaiian Islands includes archaeological deposits and extends as far back as the Middle Pleistocene about 500,000 years ago, although most fossil specimens are late Holocene in age (5,000 years or less). There is at least some fossil evidence of seabirds from all the

main Hawaiian Islands, with the most being known about Hawaii, Moloakai, Oahu, and Kauai. Taphonomic bias may greatly affect species composition and relative abundance from site to site, for example on the south coast of Kauai, where the seabird fauna of a Holocene lake deposit is very different from that found in adjacent dunes. Some species, such as terns, are almost never found as fossils. Only two total extinctions have been recorded—a petrel and a gull. Many species were more widely distributed than in historic times, and all species of seabirds were probably much more abundant than at present. Extinctions and reduction in population-sizes of seabirds are all thought to be related to the arrival of humans.

Breeding biology of the Japanese Murrelet

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Breeding biology of the Japanese Murrelet (*Synthliboramphus wumizusume*) was studied from 1993 to 1996 at Biro Island, off Kyushu, Japan. Nesting occurred most commonly in gaps within stone piles (56%). The first egg was laid in mid- to late-March and the second one in late-March to early-April. Only one case of egg replacement was observed, after an adult broke its own egg. The interval between first and second egg averaged 7.6 days, and the clutch was neglected for 3 days. Length of incubation averaged 31.4 days, with daytime incuba-

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tion of 29 days. Time from laying first egg to family departure averaged 42 days. Both parents shared incubation duties equally. Length of incubation shifts in 1993 and 1995 differed significantly from those in 1994 and 1996 (1.8 and 1.4 days, respectively). Family departure occurred in late-April to early-May for all years, and 53-67% of dates were concentrated within one week of the median. Chicks at departure (21.8 g) were 2.5 g lighter than just after hatching. Departure times were distributed relatively evenly from 1 to 8 hours after sunset. Early in June, murrelets could no longer be seen at sea around Biro Island. Specimens suggest that some murrelets move north in summer and spend winter south of breeding range. Differences in external measurements between Japanese Murrelet males and females and between Japanese and Ancient Murrelets (*S. antiquus*) were also examined, based on comparison with measurements of Ancient Murrelet carcasses from the 1997 *Nakhodka* oil spill in the Japan Sea.

Geographic and species differences in the stress response in Leach's Storm-petrels and Wilson's Storm-petrels

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Leach's Storm-Petrels (*Oceanodroma leucorhoa*) breed on islands in both the North Atlantic and the North Pacific Oceans during the boreal summer, while Wilson's Storm-Petrels (*Oceanites oceanicus*) breed in Antarctica and nearby islands during the austral summer. During the boreal summer, a large population of Wilson's Storm-Petrels feeds in the Bay of Fundy in the North Atlantic Ocean. We obtained blood samples for analysis of corticosterone levels immediately after capture and 30 minutes after capture to compare geographic and species differences in the stress response. Leach's Storm-Petrels were sampled during the

breeding season at Tatoosh Island, Washington and at Kent Island, New Brunswick. Wilson's Storm-Petrels were sampled in the Bay of Fundy, Nova Scotia. Wilson's Storm-Petrels had a significantly lower stress response than Leach's Storm-Petrels at either site. Wilson's Storm-Petrels were in heavy molt of their flight feathers during the sampling period (mid July). Other researchers (*i.e.* L. M. Romero) have reported a reduction of the stress response during molt in several sparrow species and European Starlings (*Sturnus vulgaris*).

Biology, status and conservation of seabirds in Hokkaido

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For the purpose of promoting conservation of seabirds in Hokkaido, we will discuss the status of their colonies. By using published and unpublished research data, we summarized information regarding their size, and natural and human-induced disturbances of each colony.

At least 12 species breed in Hokkaido. The present status of the Long-billed Murrelet (*Brachyramphus perdix*) is unknown. For some colonies in which we are able to use trend of their size, we have calculated their annual rate of change by regression analysis. In Teuri Island, colony size of the Common Murre (*Uria aalge*) decreased by 12% annually during 1938-80 and decreased by 27% during 1981-94. In Moyururi Island, colony size of the Common Murre decreased by 25% annually during 1965-83 and no individual has been observed since 1985. We also found out that colony size of Tufted Puffin (*Fratercula cirrhata*) in Moyururi Island and Spectacled Guillemot (*Cephus carbo*) in Teuri

and Yururi Islands decreased during the last 30 years.

Descriptions of disturbances were found in research reports at 14 colonies. Out of 14 colonies, predation by gulls or crows was reported at 12 colonies and death due to being caught by commercial nets was reported at the 6 colonies. Disturbance by introduced rats and cats was reported at 5 colonies.

In Japan, most colony areas are protected by law, such as the Wildlife Protection and Hunting Law. However, there are no guidelines for protection of seabirds at sea (or under the sea). We therefore must understand their threats at sea, for example, the impact of by-catch in commercial nets, and we must seek ways to allow the coexistence of both seabird and human communities.

Adult time budgets of Common Murres at three nearshore colonies in central coastal California

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A temporal (within and between year) and spatial (between colony) investigation of Common Murre (*Uria aalge*) adult time budgets (co-attendance) was conducted in central California in 1999 and 2000. We observed breeding pairs of murres during the incubation and chick-rearing periods at three nearshore colonies in central California to aid in evaluating restoration efforts in this region. Currently, social attraction techniques are being used to restore the extirpated Devil's Slide Rock colony. We found that on average, murres spent more time in co-attendance during the chick-rearing period than during the incubation period. In addition, murres at the restoration colony spent more time in co-attendance during the chick-rearing period when compared to the other colonies. However, adult time budgets at each colony did vary by day, and

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day differences varied between years. We look at the influence of environmental factors on time spent in co-attendance as well as the relationship between time budgets and reproductive success.

Post-breeding survival and behavior of radio-tagged juvenile and adult Marbled Murrelets

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Conservation measures are greatly enhanced by knowledge of demographic parameters within populations. For Marbled Murrelets (*Brachyramphus marmoratus*) almost nothing is known about juvenile survival. In addition, direct measures of fecundity are difficult to determine accurately for this species. Instead juvenile to adult ratios from at sea surveys are commonly used as an index of productivity. Knowledge of juvenile vs. adult behavior is essential for these ratios to be interpreted accurately. From July 31 to August 26 we attached radio transmitters to 14 juvenile and 8 adult Marbled Murrelets captured in Desolation Sound, BC. The movements of radioed birds were tracked by boat and fixed wing aircraft from August 1 to November 12. From the data collected we provide the first estimate of juvenile survival and also document differences in the movements of juveniles and adults during the post breeding period.

Victims or villains? Seabirds in the coastal ecosystem

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Over 50% of the world's human population lives within 20 miles of a coastline, making highly productive coastal ecosystems an intense focus of

human use and interest. However, other predators, such as marine mammals and seabirds, also are concentrated in coastal systems. As human impacts increase and fisheries decline, this leads to conflict between people and seabirds. In this retrospective analysis, we examined the role seabirds have played in the California Current System over the last three decades. Piscivorous seabirds comprise more than 3,600 metric tons of predatory biomass on the shelf and demand 431 billion Kcal of energy there, predominantly in the form of forage fishes. Energy content of forage fish varies by a factor of 2.5, from Pacific cod (0.94 Kcal/gm) to eulachon (2.55 Kcal/gm). Therefore, depending on which prey species are consumed, seabirds eat 220-300 thousand metric tons of fish annually, or roughly double the current California sardine fishery. Seabird impacts on forage fishes depend on the energy content and size of available prey – poorer quality fish must be consumed in greater quantities, as is also the case with smaller fish, to satisfy energetic demands. Impacts can be further intensified around breeding colonies, where demand can be 7-10 times the average regional value. Finally, seabirds can have large impacts on rare prey, as in the case of endangered salmonids, even when the percent of total diet is small. Management of the ecosystem, rather than just the fisheries, will require honest assessments of the spatio-temporally explicit needs of these birds, and the realization that seabird predators are an influential and integral part of the system.

Marbled Murrelet population dynamics in central California

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We used radio-telemetry to determine if poor Marbled Murrelet (*Brachyramphus marmoratus*) reproductive success in central California was due to a low rate of nest initiation or a high rate of nest failure. We also estimated the survival rate for murrelets in this region using mark-recapture techniques. We radio-tagged 24 murrelets in April and May, 2000. Of these, only two attempted to nest and 15 did not attempt to nest. Of thirteen murrelets with brood patches, almost all flew inland during the early morning flight period; only two of 11 non-brood patch birds flew inland. Brood patch birds and birds that flew inland did not spend more time foraging, nor were they in better body condition than non-brood patch birds and birds that did not fly inland, respectively. Low nest initiation could have been due to nest-site limitation, low food availability, predator avoidance, or a combination of these factors. We banded 187 individual Marbled Murrelets from 1997 to 2000 and recaptured 24 of these at least once. The estimated survival rate for this population was lower than the estimate used by Beissinger (1995) to model a declining population. Management recommendations include increasing the number of birds that attempt to nest and reducing adult mortality.

Hawaii East?: the changing marine avifauna of San Benedicto Island, Mexico

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Since we started visiting San Benedicto Island, Mexico (ca. 400 km south of the tip of Baja California) in 1978, two and possibly three species of central Pacific seabirds have colonized the island. Laysan Albatross (*Phoebastria immutabilis*) was first seen

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around the island in 1979, first observed displaying on land in 1987, and first recorded nesting in 1992. The population currently consists of 20 nesting pairs and appears to be growing slowly. We saw a single Black-footed Albatross (*P. nigripes*) roosting on the island for the first time in December 1999 and photographed a bird on an egg in 2000. Mexican military personnel stationed on Guadalupe Island, 1300 km to the north, told us a pair of "black" albatrosses raised a chick on that island in 1998, were absent in 1999, but were attempting to nest again in 2000. These are the first records of Black-footed Albatross breeding east of Hawaii. Male Brown Boobies (*Sula leucogaster*) nesting on San Benedicto are comprised of forms that are light-headed (eastern Pacific) and dark-headed (central Pacific and elsewhere), indicating that Brown Boobies from the central Pacific may also have colonized the island, although when is not clear. A facile explanation that albatrosses may have been "lured" into breeding in the eastern Pacific because of food made available by commercial fishing operations does not explain the presence of central Pacific Brown Boobies at San Benedicto. The reason why these normally philopatric species have begun breeding halfway across the Pacific may have to do with burgeoning central Pacific populations or possibly changing oceanographic conditions.

Attraction and behavior of Laysan Albatross on Kaohikaipu Islet, Oahu

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We report the results of a 7-year study with the shared goals of attempting to artificially stimulate colony formation of Laysan Albatrosses (*Phoebastria immutabilis*) on Kaohikaipu Islet, Oahu, and to study the reaction and behavior of albatrosses to different types of decoys and vocalization playback. In each year of the study we presented adult sky-pointing decoys

and head-forward, loafing model decoys in two circular displays in similar habitat and broadcast a combination of adult courtship calls and chick begging calls. Observers conducted behavior scans from Sea Life Park about 1/4 mile from Kaohikaipu for 80-120 days per year starting in mid December and ending mid May. Conclusions include: 1. Albatrosses were very rare in the vicinity of Kaohikaipu Islet prior to the initiation of this study, but since the project began albatrosses have been seen on and near the island in every year of the study; 2. In all years of the study the behaviors most common were loafing, sleeping, preening and walking; 3. Attraction was not random—prospecting albatrosses consistently favored certain decoy postures and groupings; 4. Of two study plots on the island, albatrosses consistently favored the higher elevation plot, even when chicks, eggs and recordings of chick sounds were switched to the lower plot.

The Transition Zone chlorophyll front, a dynamic global feature defining migration and forage habitat for marine resources

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Pelagic ecosystem dynamics on all temporal scales may be driven by the dynamics of specialized oceanic habitat. One such habitat is the basin-wide chlorophyll front located at the boundary between the low chlorophyll subtropical gyres and the high chlorophyll subarctic gyres. Global satellite maps of surface chlorophyll clearly show this feature in all oceans. In the North Pacific, the front is over 8,000 km long and seasonally migrates north and

south about 1,000 km. In the winter this front is located at about 30°-35° N latitude and in the summer at about 40°-45° N. The front represents a zone of surface convergence as cool, vertically mixed, high-chlorophyll surface water on the north side sinks beneath warm, stratified, low-chlorophyll water on the south side. Satellite telemetry data on movements of loggerhead turtles (*Caretta caretta*) and detailed fisheries data for albacore tuna (*Thunnus alalunga*) show that both apex predators travel along this front as they migrate across the North Pacific. The front is easily monitored with ocean color satellite remote sensing. A change in the position of the transition zone chlorophyll front (TZCF) between 1997 and 1998 appears to have altered the spatial distribution of loggerhead turtles. The position and dynamics of the front varied substantially between the 1998 El Niño and the 1999 La Niña. For example, from May to July 1999 the TZCF remained between about 35° N and 40° N latitude showing very little meandering, while in 1998, during the same period, the TZCF exhibited considerable meandering and greater monthly latitudinal movement. Catch rates for albacore were considerably higher in 1998 than in 1999 and we hypothesize that a meandering TZCF creates regions of convergence which enhance foraging habitat at the front for apex predators.

How useful are productivity ratios from at-sea surveys of Marbled Murrelets?

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Productivity ratios from at-sea surveys are being used as indices of fecundity of Marbled Murrelet populations (*Brachyramphus marmoratus*). Although fecundity is a fundamental

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determinant of population trend, we believe the utility of at-sea productivity ratios as indices of murrelet fecundity in support of population monitoring has yet to be demonstrated. We discuss pitfalls in the estimation of productivity ratios in relation to their use as a population-monitoring tool. For example, changes in nesting habitat occur on a decadal scale, whereas at-sea conditions that influence a female's physiological condition vary by year. Asynchronous or unquantified movements into and out of breeding areas, dissimilar habitat selection by hatch year (HY) and after hatch year (AHY) murrelets, and degree to which breeding adults aggregate with their offspring can influence the ratio. Point estimates of ratios vary depending on method of analysis. Simultaneous and density-based ratios from the San Juan Islands, WA, from 1995-2000 ranged from 0.01 to 0.13, whereas the highest staggered ratio from counts of HY to early-season AHY was 0.6, surpassing the theoretical maximum of 0.5 for a population with 100% breeding success. Estimates of error in productivity ratios have rarely been reported, but precision of an estimator is critical in evaluating its usefulness. Estimates of error from our studies in Puget Sound are very large (the ratio in summer 2000 was 0.04, SE = 0.13). Further research will be needed to refine the techniques for at-sea population sampling and data analysis to develop a useful and reliable index in support of population monitoring.

Feral cats as seabird conservationists? A cautionary tale

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The ecological histories of three central Pacific tropical atolls are examined with reference to the introduction of rats and cats, the subsequent elimination of rats by cats and the possible link to a modern epidemic. The effects of Polynesian rats (*Rattus exulans*) on small seabirds can be extremely negative on drier islands, and

less so on others (small rodents and flightless rails co-existed on Wake Atoll). Howland Island was literally overrun with rats, probably introduced by prehistoric navigators as a food source. Small seabirds were seriously affected by rodents. House cats (*Felis catus*) introduced by American colonists around 1935 eliminated the Polynesian rats on Howland.

House cats have also eliminated rats from Jarvis and Baker Islands, but not mice. Cats were in turn extirpated in 1964 by POBSP personnel, but they reappeared in 1966 after a visit to the islands by the US military who were conducting biological warfare tests. Project Magic Sword was designed to test the efficacy of mosquitoes as delivery systems and over one million were released upwind of Baker Island. But why reintroduce cats if rats were already absent? To monitor biotoxin build-up? To test their susceptibility? These questions are answered and the relationships of the biological warfare testing is compared to the 1999 outbreak of West Nile virus.

Population size and breeding success of Double-crested Cormorants (*Phalacrocorax auritus*) on the Richmond-San Raphael Bridge, California, in 2000

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Through a contract with the California Department of Transportation, surveys were conducted on the Richmond-San Rafael Bridge (RSRB), located in San Francisco Bay, to monitor the Double-crested Cormorant (*Phalacrocorax auritus*) population in 2000. The timing of colony occupation and breeding, population change, movement patterns, and overall productivity of Double-crested Cormorants was investigated. Our research was designed to provide guidelines to contractors about the timing of maintenance and earthquake retrofitting ac-

tivities in and around the RSRB cormorant colony without causing harm to the birds. 669 breeding pairs were observed on the RSRB. The hatching success rate was 0.48, and an estimated 881 chicks fledged (~1.32 fledglings per pair). A similar study was conducted by the Point Reyes Bird Observatory on the RSRB colony from 1988-1990 to monitor the effects, if any, on the reproductive success of the cormorants from treated wastewater from the Chevron Richmond Refinery's deep water outfall. These results were compared with the 2000 results; changes in population size, reproductive success, and nest distribution on the RSRB were analyzed. Although hatching success and fledging success have decreased significantly since 1990, the size of the population has increased. The colony has expanded since 1990, and the distribution of the population has changed substantially. The RSRB colony was also compared to other Double-crested Cormorant colonies in the central California meta-population, including a colony utilizing the San Francisco-Oakland Bay Bridge. The RSRB colony was shown to have increased in size, while other central California populations have decreased in size.

Patterns of hematocrit values in Least Auklet (*Aethia pusilla*) on Buldir Island, Alaska

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Hematocrit measures the density of red and white blood cells in whole blood and has been used to indicate immune and general condition, and high levels are linked with social dominance. Since it is cheap and easy to obtain in the field, hematocrit might be an alternative to conventional condition measures. To evaluate the use of hematocrit, we correlated it with morphometrics, body mass, a condition index, plumage score, brood patch score, and ornament expression in

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Least Auklets adults ($N = 112$) and subadults ($N = 41$), breeders and non-breeders. Spearman-rank correlations with all factors were weak. Hematocrit of erythrocytes was most correlated with that of leucocytes ($r = 0.15$) and brood patch score ($r = 0.15$); hematocrit of leucocytes was most correlated with bill depth ($r = -0.17$) and plumage score ($r = 0.18$). Correcting for multiple testing, none of these correlations were statistically significant. Condition (mass/wing) was not correlated with hematocrit ($r^2 < 0.005$). Age groups did not differ significantly in hematocrit values (MANOVA, Wilks Lambda = 0.9846, approx. $F_{2,150} = 1.18$, $P = 0.31$), but breeding birds had significantly higher erythrocyte hematocrits than non-breeders (U-test, $z = 3.46$, $P = 0.0005$). This indicates that hematocrit reflects a different quality of condition than a mass-based condition index.

Seabird bycatch in longline fisheries off Alaska: current estimates and bycatch reduction efforts

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In groundfish fisheries off Alaska, longlines account for most of the seabird bycatch. Longlines catch surface-feeding seabirds that consume prey which resemble bait. During setting of the line, seabirds are hooked as they attempt to capture the bait. Birds that habitually scavenge floating material from the sea surface are also susceptible to being hooked on longlines.

Longline fishing is considered the most recent and, potentially, the most serious global threat faced by albatrosses and other procellariiform taxa. Preliminary estimates of the annual seabird bycatch for the groundfish fisheries of Alaska, based on 1993 to 1999 data, indicate that approximately 17,000 seabirds are taken annually in the combined groundfish fisheries of the Bering Sea/Aleutian Islands (BSAI) and Gulf of Alaska (GOA) regions (14,600 in the BSAI; 2,300 in the GOA) at the average annual rates of 0.10 and 0.06 birds per 1,000 hooks in the BSAI and in the GOA, respectively. Fulmars (*Fulmarus glacialis*) comprise about 60% of the estimated 14,600 seabirds that are incidentally caught in the BSAI. Various gull species (almost 20%) and unidentified seabirds make up most of the remaining bycatch in the BSAI as less than 5% of the bycatch in this area consists of albatrosses, shearwaters, and "all other" species. Northern fulmars are also the most abundant species among the estimated 2,300 seabirds that are incidentally caught in the GOA (almost 50%), followed by albatrosses (almost 40%), gulls, unidentified seabirds, shearwaters, and "all other" species. Collaborative efforts to reduce seabird bycatch in Alaska have included: regulatory measures, research on effectiveness of seabird avoidance measures, numerous outreach items, participation in development of a national plan of action on seabird bycatch reduction, and distribution of free seabird avoidance gear.

Oily fishes, junk foods, and energy shortages: implications for Kittiwake reproduction in the Gulf of Alaska

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The "Junk Food Hypothesis" predicts that the shift in marine trophic structure in the Gulf of Alaska during the late 1970's resulted in lower diet quality and declines in piscivorous seabirds and other top trophic level predators. We tested the hypothesis that quality of forage fishes (lipid content) limits productivity of Black-legged Kittiwakes (*Rissa tridactyla*) by investigating relationships between diet composition, food delivery rates, and energy provisioning to broods at six colonies during the late 1990's. Differences in lipid content and energy density among and within forage fishes were sufficient to potentially limit energy availability to growing nestlings, thereby limiting fledging success. But kittiwakes consistently fed their young mostly (>82%) high-lipid forage fishes: sand lance *Ammodytes hexapterus*, herring *Clupea pallasii*, and capelin *Mallotus villosus*. The proportion of low-lipid gadids (e.g., pollock *Theragra chalcogramma*) in kittiwake diets was <8% in any one colony and year, and averaged <1%. Nevertheless, kittiwake productivity was strongly positively related to energy provisioning rates to broods; variation in energy provisioning rate alone explained nearly 50% of variation in productivity. Differences in energy provisioning to kittiwake broods were, however, influenced more by meal delivery rate and meal size than by quality of the diet. Productivity of kittiwakes at colonies in the northern Gulf of Alaska was primarily dependent on availability of three high-lipid forage fishes: capelin, sand lance, and herring. Switching to alternative low-lipid prey (i.e., gadids) when high-lipid forage fish are scarce does not appear to be adaptive. Thus the Junk Food Hypothesis was not supported.

Beached bird and tarball deposition patterns in the Gulf of the Farallones: the answer is blow'n in the wind

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The Gulf of the Farallones National Marine Sanctuary and the Farallones Marine Sanctuary Association conduct bimonthly shoreline surveys along the northern California coast. Data collected include encounter rates (numbers/km) for live and beached (dead) birds, mammals, tarballs and oiled wildlife, human activity patterns, and relative abundance of wrack vegetation and invertebrates. Data were analyzed for seasonal and geographical deposition patterns of selected species, oiled species and tarballs. The mean monthly encounter rate for all beached birds except murre was highest during the oceanic season of the Davidson Current (Nov-Feb, 0.90/km). Common Murres (year-round resident and most commonly found beached bird) were encountered mostly during the Transition Season (Sep-Oct, 0.67/km). Tarballs were encountered most frequently during the Davidson Current (72.18/km). Peak months for tarballs were November and January. Oiled Common Murre encounter rates were highest during the Davidson Current (0.063/km). Regional differences in deposition were apparent. Beaches north of Point Reyes had higher encounters of beached birds during the Davidson Current (1.77/km) when compared to southern beaches. Beaches south of Point Reyes had higher encounters during the Transition Season. Between Point Reyes and the entrance to San Francisco Bay the encounter rate was 1.52/km and beaches south of the Bay entrance had an encounter rate of 1.29/km. Deposition patterns during the Davidson Current were correlated with oceanographic parameters. Higher deposition periods of murre were correlated with higher sea surface temperatures ($P = 0.0097$, $r^2 = 0.216$), shorter wave periods ($P = 0.0363$, $r^2 = 0.147$), and lower wave heights ($P = 0.0046$, $r^2 = 0.253$).

Foraging dynamics of multi-species flocks in San Francisco Bay

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The San Francisco Bay (SFB) is an extremely productive estuarine environment, harboring a diverse array of marine organisms including many species of seabirds. Multi-species seabird feeding flocks in SFB include Brandt's and Double Crested Cormorants (*Phalacrocorax penicillatus* and *P. auritus*), Western Gulls (*Larus occidentalis*), Common Murres (*Uria aalge*), Brown Pelicans (*Pelecanus occidentalis*), Common Terns (*Sterna hirundo*), Western Grebes (*Aechmophorus occidentalis*), and others. Seabird feeding activity and behavior are indicative of habitat productivity, prey type and availability, and other estuarine conditions. In April through July 2000, we conducted weekly surveys of feeding flock activity in the San Francisco Bay, and recorded time of formation, location, duration, and species composition of flocks within visual distance of our observation point on Alcatraz Island. Data already show extreme variation in foraging patterns inside SFB, with some breeding species disappearing and reappearing throughout the season. Analysis will include GIS mapping of foraging flock locations and examination of patterns with respect to bay floor bathymetry, sea surface temperature, tidal flux characteristics, and other abiotic data. Persistent foraging flock locations indicates consistent aggregations of prey, possibly associated with localized upwelling and other water column characteristics. Subtidal estuarine productivity in this large bay ecosystem may be more consistent spatially and temporally than previously thought.

Observation of Short-tailed Albatross by satellite portable phone

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In 1991, the Yamashina Institute for Ornithology initiated a project on the Short-tailed Albatross at a new site on Torishima, one of the Izu islands. The project involved the initiation of a new nesting colony using decoys and vocal lures. A new observation system using video that transmits live to our office near Tokyo, was established at the site in 1997. The system uses a portable satellite phone developed by NTT DoCoMo Inc. The camera established near the colony can be controlled for zoom and change of view by a personal computer in the office. Two cameras, each at a different location, were used: one beside the nesting spot of the first pair that colonized the site, the other above the decoys where all birds could be observed.

The incubation period was 63-66 days. Just after the egg was laid, the male started incubating. The pairs exchanged incubation duties regularly, with the longest period between nest exchange being 24 days. This type of information was never previously recorded for Short-tailed Albatross parental care. The behavior of juveniles and interactions with decoys were recorded for three breeding seasons.

This system is most useful in the observation of an endangered species on an isolated island where it is difficult for researchers to live and where the nesting colony is readily disturbed by humans.

Rat eradication on Midway Atoll National Wildlife Refuge: a success story with petrels and shearwaters

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The black rat (*Rattus rattus*) was introduced to Midway Atoll in 1943. After its introduction, drastic declines of several ground and burrow-nesting petrel and shearwater populations were observed. The Bonin Petrel (*Pterodroma hypoleuca*) population decreased from approximately 500,000 birds in the early 1940's to an estimated 5,000 nesting pairs in 1979. Dense rat populations lead to the extirpation of petrels from Eastern Island. The Christmas Shearwater (*Puffinus nativitatis*) population on Eastern Island decreased to a low of 50 nesting pairs after rat introduction. Rat eradication efforts were initiated on Midway in 1994. 1998 eradicated rats eradicated from all three islands in the atoll. Increased reproductive success of the Bonin Petrel was observed after rat eradication. Before rat eradication, complete reproductive failure was observed in Bonin Petrel colonies located in high rat density areas. Bonin Petrel reproductive success in these same areas have increased to a high of 83% after rat eradication. Bonin Petrels have also re-colonized Eastern Island with as many as 47 nesting pairs in 2000. Christmas Shearwater numbers have also increased dramatically since rat eradication. As many as 200 nesting pairs have been observed since 1997 with reproductive success as high as 67%.

Previously used and newly established breeding sites at a partly restored colony of Common Murres

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In 1996, Common Murres (*Uria aalge*) recolonized the extirpated colony at Devil's Slide Rock (DSR), San Mateo County, California, when 6

breeding sites were established after social attraction equipment (i.e., decoys, mirrors, and broadcast vocalizations) was deployed. From 1996 to 1998, 27 breeding sites were established among decoys in one localized area on the eastern portion (founder area) of the rock. In 1999, 70 pairs bred at DSR, with 32 additional sites established in the founder area (1996-1998), plus 18 new sites in a satellite area located on the western portion of this colony. By 2000, 98 pairs bred at DSR, with 28 new sites located mostly within or appended to the founder and satellite areas. As a result, the nesting densities have increased in both the founder and satellite areas simultaneously. However, breeding sites do not occur between these two separate nesting groups. Using sites studied in 1999-2000, we compare colony attendance prior to egg laying, laying dates, and breeding success at previously used and newly established breeding sites for the founder and satellite areas. Preliminary results suggest that previously used sites tend to be reused, are attended more frequently, have earlier laying, and have higher breeding success than the newly established sites. In addition, laying dates for newly established sites of 1999 for both the founder and satellite areas differed in 1999 and 2000, whereas newly established sites in 2000 for both areas did not.

Seabird bycatch in Canada's west coast gillnet and longline fisheries

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As a result of the 1999 International Plan of Action of the United Nations Food and Agricultural Organization (FAO), the reduction of seabird mortality in longline fisheries has received considerable international attention. Seabirds are long-lived, with delayed maturity and low reproductive output. Several of the seabird species

caught in fisheries may be declining, and increased mortality from gear entanglement may be deleterious to some populations. Canada has endorsed the principles laid out in the International Plan of Action for longline fisheries. However, there is also a need to assess seabird bycatch in several net fisheries. In British Columbia, the number of seabird species caught and the bycatch rate are virtually unknown. A study began in the fall of 2000 to assess the status of seabird bycatch in BC's net and longline fisheries. The study is being supported by Fisheries and Oceans Canada and Environment Canada. With the inclusion of previously collected fisheries observer data in test and commercial salmon gillnet fisheries, seabird mortality was examined for a period of up to 4 years. Common Murres (*Uria aalge*) and Rhinoceros Auklets (*Cerorhinca monocerata*) were the two most common species caught; Marbled Murrelets (*Brachyramphus marmoratus*) were caught infrequently. Seabird bycatch data in longline fisheries was collected from interviews conducted by the International Pacific Halibut Commission in 1998-99. The interviews indicated that Black-footed Albatross (*Phoebastria nigripes*) was the most common species caught during commercial halibut fishing. Preliminary bycatch rates will be presented at the meeting, as well as a fisheries overview and future research needs.

Can Kiska's auklets survive the rat menace?

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Kiska Island (69,598 acres, 28,166 hectares) is located in the western Aleutian Islands, Alaska. On the lava fields of Kiska volcano Least (*Aethia pusilla*) and Crested Auklets (*Aethia cristatella*) nest in immense num-

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bers—probably millions. Norway rats (*Rattus norvegicus*) were introduced during World War II and persist today. Kiska is one of at least 20 rat-infested Aleutian Islands, and it is unique in that it still has a substantial seabird colony. During a brief visit in May 2000, rats were documented taking adult auklets, eggs, young, and caching large numbers of uneaten birds. In an experiment, quail eggs were set out in plots to test the level of rat predation. Egg loss due to rats occurred on all plots, but on some coastal plots, loss was 33% during the first night. Because of the magnitude of auklets at Kiska and winter rat die-off, we wonder if there are so many birds that rat predation effects are insignificant at the population level; or is this spectacular colony in decline and possibly in danger of elimination? The U.S. Fish and Wildlife Service plans to investigate the auklet/rat relationship further in 2001. The planned approach is to follow the survival of color-banded auklets and marked eggs through the breeding season. Research results from Kiska will be compared with the nearby and rat-free auklet colony on Buldir Island. If auklet populations are threatened, the Service will consider rat control options. Thoughts and suggestions are welcome.

Interannual and intercolony variation in seabird densities across oceanographic regimes

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Seabird distribution patterns at sea often reflect fluctuations in prey availability, as birds switch foraging areas to follow prey movements or to forage

in areas of higher prey abundance. To examine how variability in food supply affects the distribution of seabirds, we conducted at-sea surveys for seabirds and contemporaneous acoustic surveys for small schooling fishes in Lower Cook Inlet from 1996-1999. Effort was focused around 3 seabird colonies, the Barren Islands (well-mixed oceanic waters), Gull Island (oceanic and estuarine waters), and Chisik and Duck islands (estuarine waters). At the regional scale (>100 km), average annual estimates of prey abundance (acoustic backscatter) were significantly higher around the Barrens and Gull Island than around Chisik. Densities of Black-legged Kittiwakes (*Rissa tridactyla*) and murre (*Uria* spp.) followed the same pattern, with average densities around both the Barrens (6.2 kittiwakes and 10.4 murre/km², respectively) and Gull Island (5.8 and 6.0/km²) significantly higher than densities around Chisik (1.1 and 1.5/km²), a pattern not necessarily reflective of colony size. At the patch scale (1-10 km), birds consistently aggregated in areas of higher prey abundance, and those hot spots persisted from year to year. However, at the colony scale (20-40 km), annual estimates of kittiwake and murre densities were not significantly correlated with annual estimates of acoustic backscatter within any colony region. We suggest that the unique oceanographic regimes surrounding each colony have such strong influences on prey abundance that interannual variability within the colony scale is slight in comparison.

Conserving waterbirds in North America: the North American Waterbird Conservation Plan—a continental waterbird conservation strategy

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Within North America, a unique opportunity to coordinate bird conservation planning across species guilds

and geographic scales has emerged. Neotropical migrants have a network of bird conservationists within the Partners in Flight planning effort, waterfowl have the North American Waterfowl and Wetland Plan, and shorebirds have the United States and Canadian Shorebird Conservation Plans. To make certain waterbirds are not overlooked, a North American Waterbird Conservation Plan is being developed. For the past two years, a unique partnership of waterbird biologists have assembled to identify waterbird research, monitoring, management, and outreach needs at the continental scale. The result is a draft continental strategy for waterbirds. This strategy, in addition to the other three bird plans, make up the North American Bird Conservation Initiative, a tri-lateral initiative between Canada, Mexico and the United States, focused on integrating bird conservation across species and landscapes.

While the continental waterbird strategy is near completion, its usefulness for on-the-ground implementation of projects is limited. Over the next year, fourteen regional working groups will meet to develop regional waterbird conservation plans. The purpose of the regional plans is to identify species priorities, establish habitat goals, and identify local projects which, once implemented, will contribute to waterbird conservation at both the regional and continental scale.

Use of stable isotopes to identify nutrient sources for a breeding seabird in a complex hydrographic environment

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Prince William Sound (PWS) is connected to the Gulf of Alaska (GOA)

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by hydrographic processes that are dynamic in nature and thereby strongly influence biological productivity in the Sound. This biophysical coupling between PWS and the GOA has been recently investigated using natural stable isotopes of carbon and nitrogen. Investigators have demonstrated that biological production of lower trophic levels in PWS can be greatly supplemented by advected carbon from the GOA, which is highly variable among years. We investigated whether the inter-annual and possibly regional differences in nutrient sources (PWS vs. GOA) could explain the respective differences in reproductive success of a piscivorous seabird, the Black-legged Kittiwake (*Rissa tridactyla*). For isotope analysis, we collected feather samples from kittiwake nestlings at nine colonies throughout PWS in 1997, juvenile herring samples from three bays widely distributed within PWS in 1997, and zooplankton samples from stations within PWS and adjacent GOA waters in 1995-1997. Preliminary results do support a regional gradient with colonies in central and southern PWS exhibiting a greater reliance on GOA carbon compared to northern colonies. Additionally, the current year's energy source for breeding kittiwakes may most reflect residual energy from the previous year's primary production. Reliance on residual energy in the system may be indicative of poor energy input during the current year, which, in turn, may affect year-class strength of the kittiwake's primary prey.

Temporal variability in prey consumption by breeding seabirds in the California marine ecosystem

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Seabirds are highly visible secondary and tertiary predators in marine ecosystems. Models of seabird prey consumption indicate that seabirds

consume a large proportion of the available biomass of lower trophic-level organisms, particularly large zooplankton and the younger age classes of many pelagic fishes, and at rates comparable to marine mammals and human fisheries. However, empirical studies of interannual and longer-term variability of prey harvest are extremely rare. We have been studying prey consumption by locally breeding seabirds (families Laridae, Phalacrocoracidae, and Alcidae) in the California eastern boundary current system for 3 decades (1971-2000). Intraannual, interannual, and interdecadal variability in prey consumption for 4 alcid species (1 planktivorous and 3 piscivorous species) are described and related to changes in local oceanographic conditions and apparent prey availability. Long-term trends (declines and increases) in the consumption of certain prey species and size-classes of prey, and an apparent "regime-shift" in prey consumption in the late 1980s, have been revealed. Prey consumption varied with changes in population size and productivity (number of offspring to feed). Estimates of trophic impact by seabirds on mid trophic-level prey organisms will be significantly improved by determining seasonal, interannual, and decadal scale patterns of prey consumption by both resident and migratory birds.

Island conservation in northwest Mexico

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The 230+ islands of northwestern Mexico have 29 species of breeding seabirds and over 210 species and subspecies of endemic vertebrates. Isolation and aridity have protected these islands from many human impacts, and they have relatively intact biotas. Nev-

ertheless, they have a higher apparent extinction rate than the adjacent mainland (12% vs. 2% for bird species, 20% vs. 1% for mammal species and subspecies). Introduced mammals are responsible for 93% of these extinctions. Most of the islands are managed by the Natural Protected Areas Department and fall under >8 jurisdictions, resulting in dramatically different levels of actual protection. Islands in the Gulf of California are well protected, but others including the biodiverse Guadalupe, Revillagigedo, and Tres Marias islands are not. The Island Conservation & Ecology Group (ICEG) developed a regional database of native species, introduced species, and extinctions to prioritize conservation action. ICEG, the National Autonomous University of Mexico, Center for Biological Investigations, and National Protected Areas Department collaborated with local people and nongovernmental organizations to remove one or more introduced mammals from each of 18 islands. They will soon complete eradication on five more. This work has protected habitat for 20 seabirds and >48 endemic vertebrates. Our method of science-based, collaborative conservation action has resulted in the removal of introduced mammals from most islands less than 4,000 ha in this biologically important region. This experience will make eradications possible on larger islands. Once introduced mammals are removed, long-term protection of these islands depends on active management by Mexico's Natural Protected Areas Department.

Tufted Puffin flight feather molt and effects of food availability

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Thirteen Tufted Puffins (*Fratr-cula cirrhata*) were reared in the labo-

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ratory from eggs through completion of most of their first flight feather molt. Birds were fed 50g or 110g capelin per day from 10 days post-hatch until fledging (44-59 days of age), and *ad libitum* after fledging. Birds fed 50g per day began primary molt an average of 26d earlier (225.0 ± 3.5 d of age, mean \pm SE) than birds fed 110g per day (251.0 ± 6.4 d). Within each food treatment group, young birds began and completed molt earlier than older birds. Rate and duration of primary and secondary molt did not differ between food treatment groups, requiring 53.6 ± 3.1 d. Secondary molt began 13.2 \pm 0.9d after onset of primary molt, but completed simultaneously with primary molt. Eleven birds replaced primaries in order from the innermost primary (P1) distally to P10; however, in two birds molt began in the middle of their primaries (P4-P6) and progressed distally to P10 and proximally to P1, a sequence also exhibited by many captive subadult and adult Tufted Puffins in Alaska. This is the first documentation of the long-term effects of food stress during early development on molt in alcids, and the first record of polymorphism in flight feather molt sequence in any species of bird.

Examining the stress response in Marbled Murrelets in Desolation Sound, British Columbia

Laura McFarlane Tranquilla,*
Centre for Wildlife Ecology, Department of Biological Sciences, Simon Fraser University, Burnaby, BC, V5A 1S6, Canada; lat@sfu.ca.

The Marbled Murrelet (*Brachyramphus marmoratus*) has been the subject of intense research, due to concern about its status as a threatened species in both Canada and the U.S. Efforts to describe demography should include descriptions of nonbreeding propensity; if this propensity is high, causes should be addressed. Physiological analysis of corticosterone can

help address this issue. Corticosterone is a hormone released when birds experience stress. Factors affecting perceived "stress" include body condition, energy expenditure, and environmental factors. The release of corticosterone is regulated in individual birds according to input from natural stressors, and to the life stage event under way at the time. It is this regulation of corticosterone that is particularly relevant to describing the biological status of the bird. By understanding what causes regulation of the stress response under natural conditions, it is then possible to address possible capture effects. This study addresses some of the ways corticosterone release is modified in Marbled Murrelets. The ability to determine reproductive status using radiotelemetry allows alternative comparison of corticosterone levels with subsequent reproductive success, and in particular, assessment of nonbreeders. So far, results from my study suggest that males and females regulate corticosterone differently, and that females may be more susceptible to stressors than males. Successful breeding may depend on the ability to reduce sensitivity to unpredictable disturbances. I found a complex interaction exists between biological status of the bird and the effect of capture: some birds are impacted by capture, while some are not.

Using multiple techniques to describe breeding phenology in Marbled Murrelets

Laura McFarlane Tranquilla,*
Russell Bradley, Fred Cooke, and Falk Huettmann. Centre for Wildlife Ecology, Department of Biological Sciences, Simon Fraser University, Burnaby, BC, V5A 1S6, Canada; lat@sfu.ca.

Due to its elusive breeding habits, the reproductive phenology of the Marbled Murrelet (*Brachyramphus marmoratus*) has not been thoroughly described. The research project in Desolation Sound, BC, Canada, has employed a number of techniques to describe aspects of the breeding phe-

nology of the Marbled Murrelet. These include traditional at-sea surveys to describe the abundance of adults and juveniles in the study area; use of radio transmitters, which monitor daily activity patterns and determine reproductive success; and physiological analysis of plasma, which allows identification of egg-producing females caught in the study area. These three methods allow independent and comparable estimates of the timing of egg production, incubation, chick-rearing, and fledging stages. Physiological analysis of plasma allows description of these stages for a larger sample of the population than other methods. Once a few years of data have been collected, it is possible to address inter-annual variation in this phenology, including influential environmental factors. In addition, studying breeding phenology helps to outline the best times to catch birds or target activities to specific times during the breeding season, (e.g. when is it best to do at-sea surveys), and may influence decision-making by industry, if there is need to restrict activities to certain breeding stages. Recent results suggest that the timing of initiation and duration of reproductive stages in 1999 and 2000 have been fairly consistent. Also, an approximate score of breeding stage by brood patch score may be more meaningful than previously thought.

Patterns of variation of tail streamers and other morphological traits in relation to age, sex and sexual selection in the Red-tailed Tropicbird

Allison Veit and Ian L. Jones. Department of Biology, Memorial University of Newfoundland, St. John's, NF, A1B 3X9, Canada; p99av@mun.ca.

We investigated patterns of variation of tail streamer length and other morphological traits of Red-tailed Tropicbirds (*Phaethon rubricauda*), a monogamous seabird, based on 251 individuals, including 145 known-age birds, measured in the year 2000 at Tern Island, French Frigate Shoals in the Northwestern Hawaiian Islands.

ABSTRACT

One prominent ornament was displayed: an elongated red tail streamer, composed of two central rectrices which are filamentous with a black rachis and narrow red vane averaging 395 mm in length. Rectrix molt has been described as a continuous stepwise molt, with central rectrices constantly being replaced, so individuals almost always had one full grown rectrix and the other absent or partly grown. Male and female Red-tailed Tropicbirds are morphologically indistinguishable externally so we used a combination of cloacal appearance near laying and a genetic sexing technique to identify males and females. Among the traits measured there was evidence for slight sexual dimorphism for the tail streamer and for culmen length, wing length and tarsus (males were slightly larger than females). There was no correlation between individuals' full-grown streamer length and wing length or body size, consistent with the hypothesis that streamers have an ornamental rather than aerodynamic function. As in other putative sexually selected traits, the tail streamers were more variable across individuals than non-ornamental traits. Based on adults of known age (four to sixteen years), the length of individuals' tail streamers does not appear to increase with age and tail streamer length was not correlated with body condition.

Oceanic habitat of tropical seabirds: exploring relationships between abundance and oceanography with a Generalized Additive Model

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We used generalized additive models to investigate habitat relationships of pelagic seabirds in the eastern tropical Pacific. Seabird distribution

and abundance were recorded from two NOAA research vessels using 300-meter strip transect methods during 386 days at sea, in the boreal summer and fall of 1989 and 1990. Habitat was quantified using latitude, longitude, and the following oceanographic variables, recorded from the same vessels: sea surface temperature, salinity, water density, and chlorophyll, thermocline depth and strength. We chose six seabird species representing a diverse group, phylogenetically and ecologically. The models were fitted using a forwards and backwards stepwise selection process, based on the Akaike Information Criterion. Fitted models selected as important from three to eight habitat variables for each species, with Leach's Storm-Petrel (*Oceanodroma leucorhoa*) exhibiting the most generalized pattern (all 8 variables selected) and Red-footed Booby (*Sula sula*) exhibiting the most specialized (only 3 variables selected). For the remaining species the number of habitat variables selected varied: Wedge-tailed Shearwater (*Puffinus pacificus*) with 7, Red-tailed Tropicbird (*Phaethon rubricauda*) with 6, Juan Fernandez Petrel (*Pterodroma externa*) with 5, and Wedge-rumped Storm-Petrel (*O. tethys*) with 4. Phylogenetic comparisons indicated that habitat generalists and specialists can be found among Oceanitidae (Leach's and Wedge-rumped Storm-Petrels, respectively), Procellariidae (Wedge-tailed Shearwater and Juan Fernandez Petrel, respectively), and Pelecaniformes (Red-tailed Tropicbird and Red-footed Booby, respectively). Micronekton feeders (both Storm-Petrels) included a specialist and generalist, as did species which feed in association with tunas and dolphins (Wedge-tailed Shearwater, Juan Fernandez Petrel, Red-footed Booby). Generalized additive models are a valuable tool in identifying habitat relationships for pelagic seabirds.

Feeding site specialization of chick-rearing Adelie Penguins in a fast sea ice area

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Parents of coastal feeding seabird species (kittiwakes and shags) show individual feeding site specialization. By visiting the same feeding site repeatedly they are expected to improve foraging efficiency and meal delivery. To examine individual feeding site specialization and its effects on meal delivery, we radio-tracked both members of 20 pairs of Adelie Penguins (*Pygoscelis adeliae*) breeding at Hukuro Cove colony in 1999/2000 summer where fast sea-ice limited their feeding opportunity. Their meal frequency was recorded and the meal delivery rate was estimated by weighing chicks at regular interval. The parents fed in small pools in ice cracks along the coasts and icebergs, and they showed individual site fidelity. Mean distance to feeding sites varied among individuals (0.3-2.2 km) and males fed in sites closer to the colony than females. The male and female members of pairs selected feeding sites independently. Feeding site specialization did not affect trip duration, hence meal frequency. Although there was clear individual feeding site specialization, high prey availability and presumably small variation in feeding efficiency among sites in the study season might make the effects of this specialization ambiguous.

Organochlorines and Eggshell Thinning in Ashy Storm Petrels at Santa Cruz Island, California, 1995-1997

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ABSTRACT

ratory from eggs through completion of most of their first flight feather molt. Birds were fed 50g or 110g capelin per day from 10 days post-hatch until fledging (44-59 days of age), and *ad libitum* after fledging. Birds fed 50g per day began primary molt an average of 26d earlier (225.0 ± 3.5 d of age, mean \pm SE) than birds fed 110g per day (251.0 ± 6.4 d). Within each food treatment group, young birds began and completed molt earlier than older birds. Rate and duration of primary and secondary molt did not differ between food treatment groups, requiring 53.6 ± 3.1 d. Secondary molt began 13.2 \pm 0.9d after onset of primary molt, but completed simultaneously with primary molt. Eleven birds replaced primaries in order from the innermost primary (P1) distally to P10; however, in two birds molt began in the middle of their primaries (P4-P6) and progressed distally to P10 and proximally to P1, a sequence also exhibited by many captive subadult and adult Tufted Puffins in Alaska. This is the first documentation of the long-term effects of food stress during early development on molt in alcids, and the first record of polymorphism in flight feather molt sequence in any species of bird.

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ABSTRACT

cover in Hudson Bay has approximately halved. We suggest that the observed changes in diet composition reflect changes in the relative abundance of the species involved and that the decline in arctic cod and increase in capelin are associated with a general warming of Hudson Bay waters, as a result of ongoing climate change in the area.

A large-scale model for the at-sea distribution of Marbled Murrelets (*Brachyramphus marmoratus*) in coastal British Columbia, Canada

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It is not fully understood what role the marine environment plays in the summer distribution and rate of occurrence of Marbled Murrelet (*Brachyramphus marmoratus*). Consistent information on the distribution of Marbled Murrelets does not exist in British Columbia, Canada. In order to improve our knowledge on this topic, we compiled and investigated (1) murrelet surveys (count and density), (2) environmental factors, and (3) prey distribution. We then overlaid these data in a Geographic Information System (GIS, Arc View) and identified the significant predictors by evaluating their shortest distances from survey locations to the predictors. In this multivariate scenario, we used Generalized Linear Models (GLM), Multivariate Adaptive Regression Splines (MARS, Salford Systems) and Classification and Regression Trees (CART from both S-PLUS and Salford Systems). It is shown that there is a strong correlation between Marbled Murrelet abundance and several environmental and prey predictors. We present a spatially explicit large-scale distribution model to predict Marbled Murrelet abundance in coastal British Columbia. Model predictions are evaluated by several methods (e.g. Bootstrapping, model

comparison, and distance to old-growth forest), allowing for discernible results.

Are there consequences for Glaucous-winged Gulls that re-lay a clutch?

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As part of a larger study of the effects of harvesting eggs at a glaucous winged gull (*Larus glaucescens*) colony, we investigated the physiological cost of increased reproductive investment during the egg-laying and incubation stages. We found that the total number of eggs laid did not affect hatching success. We tested the hypothesis that gulls that laid (females) and incubated (males and females) a second clutch would show different levels of corticosterone in their blood from gulls that kept their original clutch. Birds under physiological stress exhibit high baseline levels of corticosterone, a hormone that regulates behavior in response to stressors. However, birds can modify their behavior by suppressing their stress response, thus decreasing the amount of corticosterone released during a standardized capture period without increasing their baseline levels. In our experiment, we removed the entire clutch on the day the third egg was laid in 32 nests, forcing the breeding pairs to re-lay a clutch. We captured birds from surviving control nests and manipulated nests at the end of their incubation period. We found no differences in the baseline levels of corticosterone, indicating conditions were favorable for the gulls. However, females from manipulated nests had suppressed stress responses, which may have resulted from a combination of poor body condition experienced by all of the females at the end of incubation

and the laying of extra eggs. These results suggest that gulls are adapted to variable incubation investments, but the implications of these costs as mediated through adult and chick survivorship should be investigated.

The Peruvian Tern: nesting and breeding strategies to reduce predator detection

Carlos Zavalaga, Albert Bertolero and Manuel Plenge. Av. Guardia Chalaca 1333, Callao1-Callao, Peru, czav@terra.com.pe.

Nest predation has been recognized as one of the main selective pressures in shaping the nesting strategies of birds. Among seabirds, the need for security from predators has led to the location of their breeding grounds on remote islands, in inaccessible places on the mainland, or in harsh climates. In this study, we described the nesting habits and breeding biology of Peruvian Terns (*Sterna lorata*) at three localities off the coast of Peru in 1969-74 and 1995-98. Unlike all other open-nesting seabirds in Peru, Peruvian Terns built their nests mainly 2-3 km inland, only in loose aggregations (colony size = 6-10 nests), and with a high inter-nest distance (about 21 m). Nests were small depressions without any nest material and were located close to stone aggregations, sand marks or colorful broken glass. Egg laying was asynchronous, spreading from October to late January. Eggs were incubated from 23 to 29 days and chicks weighed about 8 g at hatching. Body mass growth fitted the logistic equation with the following parameters: $k = 0.193 \text{ days}^{-1}$, asymptote = 51 days, $t_1 = 10$ days. Chicks fledged about 27 days after hatching. High breeding asynchrony, low nest density, cryptic nests, camouflaged eggs and chicks, and high mobility of chicks seem to be breeding adaptations to avoid massive mortality occasioned by ground predators.

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The Pacific Seabird Group holds occasional symposia at its annual meetings. Published symposia are listed below. They are available for purchase (unless out of print). To order, see the membership application/publication order form.

SHOREBIRDS IN MARINE ENVIRONMENTS. Frank A. Pitelka (Editor). Proceedings of an International Symposium of the Pacific Seabird Group, Asilomar, California, January 1977. Published June 1979 in *Studies in Avian Biology*, Number 2. Out of print.

TROPICAL SEABIRD BIOLOGY. Ralph W. Schreiber (Editor). Proceedings of an International Symposium of the Pacific Seabird Group, Honolulu, Hawaii, December 1982. Published February 1984 in *Studies in Avian Biology*, Number 8. Out of print.

MARINE BIRDS: THEIR FEEDING ECOLOGY AND COMMERCIAL FISHERIES RELATIONSHIPS. David N. Nettleship, Gerald A. Sanger, and Paul F. Springer (Editors). Proceedings of an International Symposium of the Pacific Seabird Group, Seattle, Washington, January 1982. Published 1984 as Canadian Wildlife Service, Special Publication. Out of print.

THE USE OF NATURAL VS. MAN-MODIFIED WETLANDS BY SHOREBIRDS AND WATERBIRDS. R. Michael Erwin, Malcolm C. Coulter, and Howard L. Cogswell (Editors). Proceedings of an International Symposium at the first joint meeting of the Colonial Waterbird Society and the Pacific Seabird Group, San Francisco, California, December 1985. *Colonial Waterbirds* 9(2).

ECOLOGY AND BEHAVIOR OF GULLS. Judith L. Hand, William E. Southern, and Kees Vermeer (Editors). Proceedings of an International Symposium of the Colonial Waterbird Society and the Pacific Seabird Group, San Francisco, California, December 1985. Published June 1987 in *Studies in Avian Biology*, Number 10. \$18.50.

AUKS AT SEA. Spencer G. Sealy (Editor). Proceedings of an International Symposium of the Pacific Seabird Group, Pacific Grove, California, December 1987. Published December 1990 in *Studies in Avian Biology*, Number 14. \$16.00.

STATUS AND CONSERVATION OF THE MARBLED MURRELET IN NORTH AMERICA. Harry C. Carter, and Michael L. Morrison (Editors). Proceedings of a Symposium of the Pacific Seabird Group, Pacific Grove, California, December 1987. Published October 1992 in *Proceedings of the Western Foundation of Vertebrate Zoology*, Volume 5, Number 1. \$20.00.

THE STATUS, ECOLOGY, AND CONSERVATION OF MARINE BIRDS OF THE NORTH PACIFIC. Kees Vermeer, Kenneth T. Briggs, Ken H. Morgan, and Douglas Siegel-Causey (editors). Proceedings of a Symposium of the Pacific Seabird Group, Canadian Wildlife Service, and the British Columbia Ministry of Environment, Lands and Parks, Victoria, British Columbia, February 1990. Published 1993 as a Canadian Wildlife Service Special Publication, Catalog Number CW66-124-1993E. *Free of charge from:* Publications Division, Canadian Wildlife Service, Ottawa, Ontario, K1A 0H3, Canada.

BIOLOGY OF MARBLED MURRELETS—INLAND AND AT SEA. S. Kim Nelson and Spencer G. Sealy (Editors). Proceedings of a Symposium of the Pacific Seabird Group, Seattle, Washington, February 1993. Published 1995 in *Northwestern Naturalist*, Volume 76, Number 1. \$12.00.

BEHAVIOUR AND ECOLOGY OF THE SEA DUCKS. Ian Goudie, Margaret R. Peterseen and Gregory J. Robertson (editors). Proceedings of the Pacific Seabird Group Symposium, Victoria, British Columbia, 8-12 November 1995. A special publication compiled by the Canadian Wildlife Service for the Pacific Seabird Group. Published 1999 as Canadian Wildlife Service Occasional Paper number 100, catalog number CW69-1/100E. *Free of charge from:* Publications Division, Canadian Wildlife Service, Ottawa, Ontario, K1A 0H3, Canada.

SEABIRD BYCATCH: TRENDS, ROADBLOCKS AND SOLUTIONS. Edward F. Melvin and Julia K. Parrish (Editors). Proceedings of an International Symposium of the Pacific Seabird Group, Semi-Ah-Moo, Washington, February 1999. To be published by University of Alaska Sea Grant, Fairbanks, Alaska. In preparation.

Information on presenting symposia: Pacific Seabird Group Symposia are initiated by one or more persons with interest in a particular topic. The goal is to present a collection of papers that explore and review the chosen topic, usually at an annual meeting of the Pacific Seabird Group. In some cases the papers are then edited and published as a Symposium of the Pacific Seabird Group. Individuals interested in organizing a symposium must first contact both the Coordinator of the Publications Committee and the Scientific Program Coordinator for an annual meeting. Important guidelines will be provided for obtaining approval, organizing, presenting, and publishing Pacific Seabird Group Symposia, including the responsibilities involved. Organizers can then proceed to put the symposium session together. This opportunity is available to all members of the Pacific Seabird Group.

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