II. Seabird Species Accounts

Leach's Storm-Petrel *Oceanodroma leucorhoa* Vieillot

Description

Leach's Storm-Petrel is a small seabird averaging 8" long with a 20" wingspan and weighing 40g (Sibley 2000). It is overall deep smoky-brown with long pointed wings, pale carpal bars on the upperwing, a notched tail, and a tubed bill. While members of some populations have dark rumps, most of those breeding in California have white rumps with a narrow dark division down the center (Ainley and Boekelheide 1990). Two dark-rumped birds among 125 Leach's Storm-Petrels over the San Juan Seamount opposite Santa Barbara Co. 22 August 1985 were exceptionally far north (McCaskie 1986).

Nest

Leach's Storm-Petrels nest colonially in banks, on grassy slopes, or in fields among stumps or rocks. The nest is in an enlarged chamber at the end of a burrow (or, less frequently, in rock crevices (Palmer 1962 in Sowls et al. 1980) of from 1-3 ft. (occasionally 6 ft.) in length. Any actual nest within the chamber consists of a loose, flat, thin pad of dry vegetation (Ehrlich et al. 1980). Orientation to the nest site is based partly on olfactory cues (Ehrlich et al. 1988, Sowls et al. 1980). Mate retention between years is dependent on site tenacity to specific burrow; most mate switches occur with neighbors (Ehrlich et al. 1988). The female has a sperm-storage gland in the oviduct, permitting separation of a breeding pair for several weeks preceding egg-laying. Leach's Storm-Petrels first nest at the age of four or five years (Kaufman 1996).

Eggs

1, cream/white. The peak period of egg-laying noted during a long-term study of this species on Southeast Farallon I. was in the two weeks from 20 May-3 June (Ainley and Boekelheide 1990). One brood is raised per year.

Incubation, Feeding, and Fledging

The single egg is incubated by both adults for 38-42 or, exceptionally, 68 days (Ainley and Boekelheide 1990). An exchange of incubation duties occurs about every three days; the sitting bird loses 11% of body weight during each stint. The nestling is classified as semialtricial 2. It is fed oily regurgitant independently by both male and female every 2-3 nights, less frequently as it matures (Kaufman 1996), and fledges at 63-70 days (Ehrlich et al.1988, Sowls et al. 1980).

Feeding Behavior and Diet

Leach's Storm-Petrels skim the ocean surface for fish, squid, crustaceans, and floating oil from large dead mammals. They seldom sit on the water to feed; they may feed by day or night (Kaufman 1996). As do some other storm-petrels, Leach's are known to follow wounded marine mammals. They occasionally forage for prey at the edge of potentially dangerous gull feeding-flocks (Ehrlich et al. 1988). The flight of Leach's Storm-Petrel is more buoyant and bounding than that of other storm-petrels.

World Distribution

Leach's Storm-Petrels are found in both the North Pacific and North Atlantic oceans. In the Pacific Ocean basin, they breed from Japan and the Russian coastal islands through the Aleutians and southward to Baja California, Mexico. They are highly pelagic, feeding as far as 100 miles off the

California coast during the breeding season and rarely occurring over the continental shelf or in nearshore waters by day (Ainley and Boekelheide 1990).

These storm-petrels winter far out to sea over deep abyssal water. This species has been reported to be among the most abundant ocean birds between Hawaii and the Americas from September to May and uncommon, but present, during other months (Ainley and Boekelheide 1983, Crossin 1974, King 1970; Wahl, Benedict, Ainley, and DeGange, unpubl. data, all in Ainley and Boekelheide 1990). Wintering birds range south to tropical waters in the Pacific (to the Galapagos Is.) and Atlantic (to Brazil) oceans (Erlich et al. 1988).

California Distribution

This species is the most abundant storm-petrel nesting in California. It is known or suspected to breed at 13 sites along the coastline. The total population nesting in the state was estimated at 18,300 in 1980 (Sowls et al. 1980). Ninety-one percent of the population is believed to breed in Humboldt and Del Norte counties, 8% on the Farallon Is., and 1% at Fish Rocks, Mendocino Co. Evidence suggests the small numbers of Leach's Storm-Petrels may also nest on the Channel Islands (Hunt et al. 1979).

The largest colony is on Little River Rock, where a population of 10,000 birds has been estimated (Harris 1974). Other major colonies are Castle Rock with 5000 birds (Sowls et al. 1980), the Farallon Is. with 1400-1600 birds (Ainley and Boekelheide 1990), Trinidad Bay Rocks with 1640 birds, and Prisoner Rock with 160 birds (Sowls et al. 1980).

Colonies are suspected to exist at Fish Rocks, on Prince I., and on Tolowa Rocks. Although nests of this species have not been found at Fish Rocks nor on Prince I., Sowls et al. (1980) mist-netted and banded Leach's Storm-Petrels with clearly visible incubation patches. Further supporting the suspicion that this species breeds at Fish Rocks has been the recapture of banded Leach's there, along with the isolation of that site from other known colonies of the species (Sowls et al. 1980). No recaptures of banded birds were made at Prince I.; Sowls et al. (1980) believe it is possible that the birds captured there originated at nearby colonies at Castle Rock or at Goat I., Curry Co., Oregon. During survey of Tolowa Rocks, many unexamined burrows were noted, and it was stated that it 'seems likely' that Leach's Storm-Petrels nest there in association with Fork-tailed Storm-Petrels (Sowls et al. 1980).

Population Status and Dynamics

Limited historic information as well as differences in survey technique cause the population dynamics of California's breeding Leach's Storm-Petrels to be poorly known. Reports suggest that numbers have locally decreased within the past 100 years. Human activity has clearly been responsible for the loss of the colony at Whaler I. This site was quarried and incorporated into the south Crescent City breakwater in the 1930s (Osborne 1972), thus allowing ready access by rats and therefore the eventual extirpation of the colony.

These storm-petrels were recorded present on Blank Rock in 1916 by Clay and on Flatiron Rock in 1934, but survey at these sites in 1979-80 failed to detect any birds (Osborne 1972). Soil loss and, possibly, overcollecting has been implicated as the apparent cause of the disappearance of colonies at both sites (Sowls et al. 1980). Only one dead storm-petrel was found at nearby Green Rock during a 1970 survey, whereas the species had also been present there as late as the 1930s (Talmadge, unpubl. notes, in Osborne 1972). The effects of nesting cormorants and Common Murres were suggested as an agent of soil loss at these three sites by Sowls et al. (1980).

The population on the Farallon Is. appears relatively stable in size (Ainley and Lewis 1974, in Sowls et al. 1980). It is worth noting that Leach's Storm-Petrels concentrate nesting efforts on Southeast

Farallon I. in substrate not occupied by breeding Western Gulls until 1976, a strategy Ainley and Boekelheide (1990) postulated was a positive response to proximate absence of gulls. These authors also related that storm-petrels there fledge later in the season than any other locally-nesting seabird, and that few Western Gulls remain about the islands by that time.

Threats and Management Implications

Like all surface-feeding, surface-resting seabirds, Leach's Storm-Petrels are at risk from the effects of oil pollution. While a large spill might kill or weaken numbers of these storm-petrels at places where they may concentrate, this scenario is unlikely to be played out. They are generally the most pelagic seabirds breeding in California, spending daylight hours dozens of miles offshore, especially so in the period from November through January when island visitations are infrequent. The chances for a dramatic oil spill occurring far out beyond the continental shelf in surface waters inhabited by these birds would appear small.

Predation by mammals, specifically mustelids, can be detrimental to storm-petrel colonies which are accessible to these predators at low water. Osborne (1972) found about 90 dead Leach's Storm-Petrels on Prisoner Rock during surveys in 1969, 1970, and 1972 and attributed these losses to mink (*Mustela vison*). Sowls et al. encountered 45 Leach's carcasses on Prisoner Rock and suspected a river otter (*Lutra canadensis*) was the predator. A population of river otters studied in the Trinidad Bay area in the 1980s by S. Shannon were found to pursue a distinctly intertidal lifestyle. Since many small sea stacks in the Trinidad-to-Little River stretch of coast stand within the lowest tidal range, the foraging endeavors of otters would appear to pose a distinct risk to accessible seabird colonies.

Harris (1996) believes that the well-established breeding colony of Double-crested Cormorants on Little River Rock may be preempting and destroying storm-petrel nesting substrate. This cormorant colony increased from two pairs in 1974 (Yocom and Harris 1975) to about 50 pairs at the time Sowls et al. published their Catalog Of California Seabird Colonies in 1980. Sowls et al. believed it possible that nearby rocks in Trinidad Bay may have received the storm-petrels displaced from Little River Rock. Button Rock had no nesting storm-petrels in 1970 (Osborne 1972), but in 1980 approximately 1000 Leach's Storm-Petrels were actively breeding there (Sowls et al. 1980). However, the loss of nesting habitat through soil erosion, outright usurpation by force of numbers, or both factors---each attributable to Double-crested Cormorant colonization---may prove to have significant impacts on storm-petrels in this region of California.

Ashy Storm-Petrel *Oceanodroma homochroa* Coues

Description

The Ashy Storm-Petrel is a small seabird averaging 8" in length with an 18" wingspan and weighing 37g (Sibley 2000). It is an overall ashy-brown bird with a tubed bill, notched tail which is often held slightly up-curled in flight, paler secondary coverts, and paler gray edges to uppertail coverts. It is closely related to several species of similar 'dark-rumped' *Oceanodroma* storm-petrels found in the northeastern Pacific.

Nest

Ashy Storm-Petrels prefer to nest in natural cavities; also under loosely piled rocks, stone walls, building foundations, driftwood, turf (Ehrlich et al. 1988, Ainley et al. 1974). The species breeds colonially. Nests are attended by adults only in the dark.

Eggs

1, dull creamy white, unmarked or wreathed with faint reddish-brown dots. One brood is raised per year (Ehrlich et al. 1988).

Incubation, Feeding, and Fledging

The single egg is incubated 44 (?) days. The nestling is classified as semialtricial 2. It is fed a regurgitant oil of marine invertebrates, providing a concentrated energy source and allowing adults to carry more food than if they were to return to the nest with whole prey. Adults may only return to nest with food every few nights (Sowls et al. 1980). Foraging trips lasting several days probably allow adult storm-petrels undertaking provisioning of young to feed over a larger range to optimize effort. Nestlings fledge at about 84 days of age (Kaufman 1996).

Nocturnal nest visitations by adults may serve to reduce predation by Western Gulls. Ainley et al. (1974) reported that only one percent of Ashy Storm-Petrels present on the Farallon Is. were taken by gulls each year. Ashy Storm-Petrels fledge late in the year after many of the Western Gulls have left the Farallon Islands, and by this strategy may avoid a serious post-fledging mortality (Sowls et al. 1980).

Feeding Behavior and Diet

Ashy Storm-Petrels forage by cruising low over the ocean with quick, shallow wingbeats, procuring food items by shallow dips to the surface. They will sit on the water to feed (Kaufman 1996). The diet is little known, but is thought to include small fish, crustaceans, marine algae, euphausiids, and possibly naturally-occurring oils such as those originating from dead marine mammals (Ehrlich et al. 1988, Sowls et al. 1980, Kaufman 1996).

World Distribution

The Ashy Storm-Petrel is a fairly rare seabird of restricted range, limited to the waters of the California Current just off the continental shelf of w. North America. It breeds on islands along the c. and s. California coast, with a very small colony known from Los Coronados Is., Mexico, 8 km south of U.S. border (about six birds; Jehl, pers. comm. in Sowls et al. 1980). It ranges during the non-breeding season from offshore Humboldt Co., California (infrequent; Harris 1996) south along the California coast and off the west coast of Baja California and the San Benito Is., Mexico (Ehrlich et al. 1988). A few birds are occasionally detected well inside San Francisco Bay during the warmer months. Truly remarkable were two Ashy Storm-Petrels seen by a skilled observer on the California side of Lake Tahoe 15 Sep 2000, furnishing the only truly inland report known for the species (Roberson et al. 2001).

At least small numbers of Ashy Storm-Petrels are known to occur in California waters at all seasons, but at the northern end of the species' range it is least common in mid-winter. Apparently some move a short distance south to waters off western Mexico (Kaufman 1996). Ashy Storm-Petrels are not known to undertake a long-distance migration.

California Distribution

An estimated 75% of the world's breeding Ashy Storm-Petrels---some 4000 birds---nest on Southeast Farallon Island (Sowls et al. 1980). With the exception of a small colony at Bird Rock (38*13'49''N, 122*59'35''W) which contained an estimated 14 breeding birds in 1979 and 10 in 1972 (Sowls et al. 1980) and a recently-detected population breeding within the Castle/Hurricane complex of rocks, Monterey Co., thought to number some 10-30 pairs (McChesney et al. 2000), the remainder of the breeding population nests on the Channel Islands. Major colonies there (as detailed in Sowls et al. 1980) are located on:

Prince I. (34*03’29’’N, 120*20’00’’W) where 600 birds were estimated in 1976-77;
Castle Rock (34*03’17’’N, 120*26’17’’W) where 200 birds were estimated in 1976-77;
Santa Barbara I. (33*28’37’’N, 119*02’03’’W) where 250 birds were estimated in 1976-77;
Harris Point to Cuyler Harbor (34*04’N, 120*22’W) where the species was present 25 June 1976;
Scorpion Rock (34*02’50’’N, 119*32’47’’W) where 40 birds were estimated in 1976-77;
‘Sppit Rock’ (34*02’45’’N, 119*43’30’’W), where 16+ birds were estimated 15 July 1976;
Santa Cruz I. from Kinton Point (34*0’30’’N, 119*53’W) to Diablo Point (34*3’N, 119*45’W), where 20 birds were estimated 15 July 1976;
Gull I. (33*57’01’’N, 119*49’28’’W), where 2 birds were estimated 12 April 1977, and
Sutil I. (33*28’50’’N, 119*02’50’’W), where 40-50 birds were estimated in 1976-77.
Sowls et al. (1980) state that, while additional small undiscovered colonies of Ashy Storm-Petrels may exist in the Channel Islands or elsewhere along the California coast, the largest colonies have probably been identified.
Eleven Ashy Storm-Petrels mist-netted on San Miguel I. during the night of 7 Jan 1991 (McCaskie 1991) strongly suggested nesting at this location.
An Ashy Storm-Petrel was mist-netted at night at Año Nuevo Reserve in late May 1998, suggesting that it was prospecting for a nesting site (Roberson et al. 1998)

Population Status and Dynamics

With a restricted world range, localized center of abundance (Farallon Is.), limited number of large colonies, and a population (including non-breeders) believed to total fewer than 10,000 birds (Sowls et al. 1980), Ashy Storm-Petrels are inherently a species of special interest and concern to seabird biologists and wildlife managers. Each known site of concentrated occurrence is valuable to them.

Ainley and Lewis (1974) discuss the history of Ashy Storm-Petrel on the Farallon Is., where observations of storm-petrels were made as early as 1862. Relevant historical material for the Channel Is. is summarized by Hunt et al. (1979). Sowls et al.(1980) stated that populations of this species have probably changed little in size over the years, although little information on their historical status exists. During the 1990s, however, regular counts of birds concentrated on Monterey Bay declined; experts on the species believe that listing under the Endangered Species Act is warranted (Ainley, pers. comm. in Roberson et al. 2001).

Threats and Management Implications

As colonial breeders, Ashy Storm-Petrels can be affected by disturbance by humans and terrestrial predators. Adults are vulnerable to surface oil slicks. Sowls et al. (1980) infer that the species may evade the effects of an oil slick through wide disperal along the coast, thereby reducing the chances that a large proportion of the population will contact a particular pollutant. However, Stallcup (1990) points out that, during the fall large numbers of Ashy Storm-Petrels---clearly comprising a large proportion of the world population---concentrate in tight flocks during the day on Monterey Bay (Ainley 1976), specifically 3-12 miles west of Moss Landing above the Monterey Submarine Canyon. He believes that an oil spill there ‘could all but terminate the species’ (Stallcup 1990).

Black Storm-Petrel *Oceanodroma melania* Bonaparte

Description

The Black Storm-Petrel is a small seabird averaging 9” in length with a 22” wingspan and weighing about 60g (Sibley 2000). It is a remarkably blackish bird with a tubed bill, comparatively long notched tail, and contrasting paler carpal bars. It is closely related to several species of similar ‘dark-

rumped' *Oceanodroma* storm-petrels found in the northeastern Pacific. This storm-petrel prefers generally warm water (Sowls et al. 1980).

Nest

Black Storm-Petrels nest colonially in crevices, amid boulders, or in disused Cassin's Auklet burrows (Ehrlich et al. 1988). The egg is laid on bare ground or a few twigs. Both members of a pair may spend part of their time resting in the nesting burrow for nearly three months prior to egg-laying (Kaufman 1996).

Eggs

1, dull white, somewhat nest-stained, occasionally marked with lavender/reddish; wreathed. (Ehrlich et al. 1988).

Incubation, Feeding, and Fledging

The single egg is incubated more than 18 days. The nestling is classified as semialtricial 2. Little is known of the breeding chronology of this species; precise incubation period and days to fledging remain undetermined (Ehrlich et al. 1988).

Feeding Behavior and Diet

Black Storm-Petrels forage by flying slowly, low over the ocean with plunging, tern-like wingstrokes and a fairly direct flight. The diet includes small fish and invertebrates taken by dips to the surface, natural fats or oils associated with dead marine animals, garbage scavenged from passing ships, and possibly plankton (Sowls et al. 1980). Food is taken by dips to the surface following hovering or fluttering to isolate on items in low flight.

World Distribution

The Black Storm-Petrel breeds on islands off both coasts of Baja California, Mexico, ranging northward following nesting. In California, it is found in coastal and offshore waters north to Monterey Bay (rarely to the vicinity of the Farallon Is. and the Cordell Bank, Stallcup 1990). The period of peak occurrence is typically August to October. Single birds on Monterey Bay 6 May and 17 May 1990 were anomalously early so far north. Black Storm-Petrels are generally found well offshore, but may occur within a few miles of the mainland off southern California and Mexico; this is the storm-petrel most likely to be detected from land in southern California. The species is present in distinctly greater numbers during warm-water years associated with ENSO events.

Most disperse into more southerly waters during the nonbreeding season, disappearing after October (Kaufman 1996) and ranging to Ecuador (Sowls et al. 1980, Stallcup 1990). Unusually northerly occurrences in early fall have been documented off Humboldt Co., California (Harris 1996) and, exceptionally, to Clatsop Co., Oregon (Gilligan 1994). These storm-petrels are usually absent from southern California after December (McCaskie 1984), but wintering birds have been seen in offshore waters as far north as San Francisco (Sowls et al. 1980). Exceptionally late were 600 birds on Monterey Bay 29 December 1983; however, only ten were encountered in the same area 8 Jan 1984 (LeValley and Rosenberg 1984).

Sustained high winds associated with tropical storms may transport storm-petrels from the Sea of Cortez well inland into the desert Southwest, as happened during hurricane *Kathleen* in 1976 and again with hurricane *Nora* in 1997. In the latter event, 36 Black Storm-Petrels were found along the west side of L. Havasu and another 3-4 were seen at the south end of the Salton Sea 27 Sep 1997. These birds survived for some weeks in the area, as evidenced by a high count of 17+ on 11 Oct and the last observation 9 Nov 1997 (McCaskie 1998). The ultimate fate of such storm-translocated waifs is unknown.

California Distribution

The Black Storm-Petrel is the rarest breeding seabird on the California coast. It is known to nest only at two sites in the Channel Islands, which together contained approximately 150 birds when surveyed in 1976-77 (Hunt et al. 1979). This species was unknown as a nesting bird in U.S. waters until the discovery of a colony on Sutil I. (33*28’50’’N, 119*02’50’’W) in 1976 (Pitman and Speich 1976). It has been documented as breeding both on Sutil I. and on Santa Barbara I. (33*28’37’’N, 199*02’03’’W). The estimated population of 150 breeding birds was deduced primarily by mist-net banding and recapture during several nights in 1977 (Hunt et al. 1979).

Additional nesting locations may exist in southern California. Nesting Black Storm-Petrels have been known to occur since 1898 (Anthony 1898) only 8 km south of the U.S.-Mexican border on Los Coronados Islands, Baja California. Jehl (pers. comm. in Sowls et al. 1980) is stated to have estimated that population at approximately 200 birds and noted that it appeared stable.

A single Black Storm-Petrel at the north end of the Salton Sea 28 September 1986 was the first one to be detected inland in California (McCaskie 1987).

Population Status and Dynamics

The post-breeding dispersal of Black Storm-Petrels which occurs each year results in variable numbers of these birds in ocean waters opposite the southern and central California coast. They may occur nearly anywhere from the international border north to Sonoma County. In typical years they are noted in greatest abundance off the southern California coast and, in some years, over the Monterey Bay submarine canyon. Abundance appears to fluctuate yearly. As an essentially subtropical breeder, this species’ numbers is likely directly tied to effects of El Nino/Southern Oscillation events, during which time upwelling of cooler water abates, resulting in warmer-than-normal temperatures over the continental shelf and a more pronounced northward element to the dispersal exhibited by Black Storm-Petrels, among other seabird species.

Threats and Management Implications

With a restricted presence as a breeding species in the U.S., Black Storm-Petrels are of special interest to seabird biologists and wildlife managers. Although existing in some abundance in waters south of the international border, threats to the California nesting population assume greater magnitude owing to the small numbers breeding in the state.

Population declines at the more populous Mexican colonies may exert a negative effect on the California sites through reducing population outpressure and concomitant recruitment of colonizing birds. The inherently unstable dynamic of small or peripheral colonies of seabirds exhibiting low reproductive potential attends Black Storm-Petrels nesting in the U.S. Any oil pollution event taking place at or near breeding sites, or in ocean waters frequented by post-breeding foraging or roosting flocks, could threaten the welfare of the California component of the species’ population. Human access to sites supporting breeding colonies should continue to be restricted, depredation by mammalian predators such as rats or cats should be prevented or mitigated, and further ‘groundwork’ undertaken in conducting intensive censusing of these birds should be carried out with care not to disturb them.

Fork-tailed Storm-Petrel *Oceanodroma furcata* Gmelin

Description

The Fork-tailed Storm-Petrel is a small seabird averaging 8.5” in length with a 19” wingspan and weighing 54g (Sibley 2000). It is pearly-gray, deeper in coloration above and paler below. Darker

wing coverts contrast with the balance of the wing color both above and below. A dusky cheek patch contrasts with the paler face. The tail is notched. The bill is short, stubby, and tubed.

Nest

Fork-tailed Storm-Petrels nest in burrows 8 in. to 3 ft. deep in soft soil on slopes or at the base of a cliff. An enlarged chamber scantily lined with grass lies at the end of the burrow. They also nest in crevices. Two or more pairs may have nest cavities at the ends of side tunnels branching off from main entrances (Kaufman 1996). The nest is probably perennial (Ehrlich et al. 1988). The species is a colonial breeder.

Eggs

1, dull white, wreathed by dark purple/black specks. One brood is raised per year (Ehrlich et al. 1988).

Incubation, Feeding, and Fledging

The single egg is incubated 46-51 days by male and female. Adults assist emergence of the nestling from the shell. The single nestling is classified as semialtricial 2; it is brooded 1-8 (usually 3-5 days, and begins to explore outside of the nest burrow several days before fledging. It is fed a regurgitant oil by both adults (see Ashy Storm-Petrel) during nocturnal visitations, and fledges at 51-61 days (Ehrlich et al. 1988). Adults will readily desert nests if disturbed by humans during incubation (Sowls et al. 1980).

Evidence from studies of an Alaskan population show that extremely unfavorable weather conditions or insufficient food supply will cause parents to temporarily abandon eggs and chicks (Boersma et al. 1980 in Sowls et al. 1980). Such temporary abandonment of nests reduces viability of eggs, death among chicks, and lengthens the breeding season (Boersma and Wheelwright 1979, Boersma et al. 1980 in Sowls et al. 1980).

Feeding Behavior and Diet

Fork-tailed Storm-Petrels forage by cruising low over the ocean with quick, shallow wingbeats, procuring food items by shallow dips to the surface. Food may be taken while hovering and picking, by dropping into the water and then resuming flight, or by picking at items while swimming (Kaufman 1996). The flight style is similar to that of Ashy Storm-Petrel. Diet includes oil and animal detritus picked from the ocean surface and oils from wounded marine mammals; known to follow large floating carcasses; will follow ships to scavenge garbage (Ehrlich et al. 1980). At sea, this species is not as gregarious as some other species of storm-petrels, but will loosely associate with others of its kind.

World Distribution

The Fork-tailed Storm-Petrel is found in colder North Pacific waters, breeding from the Kurile Is., Komandorskiye Is., Sea of Okhotsk, and Kamchatka Peninsula in Russia, and in the Aleutian Is., on other Alaskan islands, and southward to northern California (Wahl, Ainley, Benedict, and DeGange, all unpubl. data in Ainley and Boekelheide 1990).

California Distribution

The center of abundance of Fork-tailed Storm-Petrels appears to be the Aleutian Is. and the Gulf of Alaska (Sowls et al. 1980). This is a species distinctly partial to colder ocean waters and, as such, it is only sparingly represented as a breeding bird in California. Only a tiny minority of the overall world population of Fork-tailed Storm-Petrels nests within the state. During the non-breeding season these birds disperse more widely over offshore waters, sparingly and irregularly to southern

California. The species was not recorded in summer opposite the southern California coast until a single bird was seen one-half mile off Goleta 10 July 1981 (McCaskie 1981).

Colonies have been identified at six sites in California, all on offshore rocks and islands in Del Norte and Humboldt counties (Sowls et al. 1980). The largest of these is Little River Rock, which supported ca. 200 birds in 1970 (Sowls et al. 1980). The colony on Castle Rock was estimated to contain 100 birds in 1970 (Osborne 1972). There are four smaller colonies, which together contain probably fewer than 100 birds (Harris 1974, Sowls et al. 1980). All major colonies in California are believed to have been located (Sowls et al. 1980).

Published data indicate that, since the 1930s, Fork-tailed Storm-Petrels have disappeared from three California sites and have been found at an additional four sites. A major colony at Whaler I. was extirpated after construction of a breakwater to the island in the 1930s (Osborne 1972). Clay and Dawson found Fork-tailed Storm-Petrels nesting on Blank Rock in 1916 (Dawson 1923, in Sowls et al. 1980), but Osborne (1972) reported that this species no longer bred there. It is thought that soil erosion probably led to their disappearance from this site. Fork-tailed Storm-Petrels were found on Little River Rock, Prisoner Rock, and Tolowa Rocks in the early 1970s (Osborne 1972, Harris 1974, Sowls et al. 1980). These 'recent' discoveries probably reflect a more thorough search for nests rather than an increase in population and colonization of new sites.

This species is regular in small numbers in May and June around Cordell Bank and w. of the Farallon Is. As many as 50 were estimated beyond Cordell Bank, n.w. of the Farallon Is., 23 June 1985 (Campbell et al. 1985). A bird mist-netted on Southeast Farallon I. in 27-28 May 1990 had a brood patch, "strengthening suspicions that they may breed here in very low numbers" (Yee et al. 1990, Stallcup 1990).

Population Status and Dynamics

Nocturnal habits of this and other storm-petrel species makes colony detection difficult, renders estimates of populations imprecise, and causes comparison of survey method and intensity to be difficult (Sowls et al. 1980). For this reason, along with the small size and scattered nature of the California population, knowledge of the status and dynamics of Fork-tailed Storm-Petrels which use offshore rocks in California is limited.

Stallcup (1990) notes that during the 1950s and early 1960s (years of generally cooler water), Fork-tailed Storm-Petrels were considered routine sightings in fall and winter from boats at Monterey Bay, and even on windless days were often the first 'true seabird' to be encountered. However, Fork-tailed Storm-Petrels were only infrequently found on boat trips off California during the period 1965-1990 (Stallcup 1990).

In some years, adults within the California nesting range are seen over shallow nearshore marine waters during the breeding season by day, occasionally entering harbors (Harris 1996). These nearshore occurrences appear to be strongly coincident with sea productivity changes attendant to El Nino/Southern Oscillation events.

During the intense 1983 ENSO, a "massive invasion" of Fork-tailed Storm-Petrels occurred along the entire northern California coast in the second half of August. As many as 35 were seen in Crescent City harbor, 30 at Trinidad Harbor, and up to 100 along the Monterey Bay shoreline (LeValley et al. 1984). Interestingly, this incursion brought only one bird to the coast of southern California (McCaskie 1984). However, the infrequent appearance of this northern storm-petrel in May on Monterey Bay has also been demonstrated to correlate with strong northwest winds (A. Baldridge, in Evens and LeValley 1982). A northwest gale in late winter was responsible for displacing 400 Fork-tailed Storm-Petrels into inner Monterey Bay 23 February 1987. Only two birds were found the

following day, after the gale had abated (Morlan et al. 1987). Such occurrences suggest that, during winter, these storm-petrels may remain in waters sufficiently near the West Coast to be blown ashore.

During early March 1985, a daytime/nearshore appearance resulted in a count of 100 Fork-tailed Storm-Petrels in Monterey harbor 2 March, but the following day 1000 were concentrated from there along the shore to Pt. Joe. A survey of one mile of Monterey Beach 7 March revealed 129 dead. All 57 specimens salvaged for the California Academy of Sciences were emaciated; based on this uniformly poor physical condition and the extent of known mortality, it seemed likely that most of the storm-petrels involved in this nearshore incursion died. During this event, five birds were inside Bodega Harbor 8 March, and up to 20+ were seen in Crescent City harbor 7-28 March (Campbell and Bailey 1985).

'Wrecks' of Fork-tailed Storm-Petrels have also been documented along the California coast during poor food winters in 1976-77 and 1989-90 (Stallcup 1990).

Threats and Management Implications

A representative of more northerly breeding seabird communities, Fork-tailed Storm-Petrels are in a sense marginal in California. They are known from comparatively few sites relative to most other seabirds nesting in the state. The total population in the state is small. Colony sites lie remote from any casual human intrusion. However, the consequences of people moving on foot atop sod-capped islets might prove deleterious. Highly aerial and foraging well offshore, Fork-tailed Storm-Petrels would appear unlikely to run afoul of industrial activity or run special risk of mortality in an oil spill.

Perhaps the greatest proximate threat to Fork-tailed Storm-Petrels within their California breeding range is loss of soil cover on nesting islands. Storm-petrels are strongly dependent on a soil or turf cap to facilitate burrowing on the rocks on which they nest. Soil loss was noted by Osborne (1972) at Blank Rock. The dramatic continent-wide increase of Double-crested Cormorants evident in the thirty years since domestic use of DDT and other chlorinated hydrocarbons was banned was resulted in increased use of offshore rocks for nesting by these cormorants in Humboldt County. As Double-crested Cormorant guano is incompatible with terrestrial plant life, soil depth is diminished through loss of root mass and consequent erosion.

This phenomenon was noted by Harris (1996), who stated concern for welfare of storm-petrels in relating that Little River Rock, a known Fork-tailed Storm-Petrel colony, had been colonized by 200+ pairs of Double-crested Cormorants since 1972 (Smith 1986, in Harris 1996). Harris (1974) stated that the habitat at this site 'certainly has deteriorated' since the late 1960s through not only cormorant impacts, but also the trampling caused by increased numbers of Brown Pelicans using the island as a loafing site. As both Double-crested Cormorants and Brown Pelicans are protected migratory waterbirds, harrassing or removing these birds from sensitive seabird nesting islands would not appear to be a management option.

Brown Pelican *Pelecanus occidentalis* Linnaeus

Description

The Brown Pelican is a large waterbird of temperate and subtropical North American marine and estuarine waters. It has a long bill with an extensible pouch beneath the mandible. Adults average slightly more than four feet in length, have a six-and-a-half-foot wingspan and weigh about eight pounds (Sibley 2000). Brown Pelicans are overall grayish-brown. During the breeding season, adults on the West Coast have a reddish bill and pouch, deep brown hindneck, and buffy-yellowish crown feathering; the head and neck are whitish in winter, and the bill and pouch colors are duller. Juveniles are duller still, with dusky head and neck, dull olive bill and pouch, and whitish underparts.

These pelicans fly ponderously yet buoyantly, moving through the air with an alternation of slow, sweeping wingstrokes and glides. They are social birds throughout the year, though lone individuals are regularly encountered. Truly inland occurrences in California (away from the vicinity of the Salton Sea) are unusual, particularly so in the northern portion of the state. Brown Pelicans may live up to 25-30 years (Ehrlich et al. 1988).

Nest

These pelicans nest in colonies on islands without mammalian predators. While Brown Pelicans breeding on the Gulf Coast are known for tree-nesting, those in California and Baja California build large stick nests on the ground (Gress 1970). Nest material is gathered by the male, and the structure is built by both adults. The nest site may be used in successive years. Females do not breed before their third year, males even later (Ehrlich et al. 1988).

Eggs

3 (range 2-4) white, lusterless, often nest-stained eggs (Kaufman 1996). One brood is raised per year.

Incubation, Feeding, and Fledging

Eggs are incubated 28-30 days by both adults by using their webbed feet, characteristic of many pelecaniform waterbirds. Nestlings are altricial, and are fed regurgitant by male and female. They fledge at 71-88 days (Kaufman 1996).

Feeding Behavior and Diet

Brown Pelicans forage by spotting prey fishes from the air and plunge-diving to capture them. Their capture attempts may result in the bird entirely submerging, if only briefly. The pelican's pouch serves as a fishnet during plunge-dives; upon surfacing, the bird points the bill downward to drain water from the pouch, then raises it to swallow fish.

Throughout the species' range, fish are the chief food (Palmer 1962). Small schooling fishes are especially preferred. Northern Anchovy (*Engraulis mordax*) makes up nearly the entire diet of breeding Brown Pelicans in California (Anderson et al. 1975, 1980, in Sowls et al. 1980).

World Distribution

Brown Pelicans breed along the Atlantic Coast from Chesapeake Bay (recently) south through the Gulf of Mexico and into coastal South America, and on the Pacific Coast from southern California southward along the west Mexican coast into South America (Galapagos Is.). Along temperate North American coasts, birds annually move northward in numbers following the breeding season. Along the West coast, large numbers occur from mid-summer through fall northward to southwestern Washington and sparingly to Puget Sound and southwestern British Columbia. A southward passage in late fall leaves very few Brown Pelicans north of central California.

California Distribution

Brown Pelicans breed regularly in California only on West Anacapa I. In recent years they have also nested intermittently on Santa Barbara I. and at Scorpion Rock. The breeding range formerly extended as far north as Bird Island near Monterey. Pelicans have bred only sporadically on this island since the colony was discovered in 1927 (Sowls et al. 1980). The last successful nesting attempt was in 1959 (Williams 1927, Baldridge 1973). Following several decades of increasing appearance at the Salton Sea and the establishment of a regular presence throughout much of the year, attempts at nesting were first noted in 1997 (K. Molina, pers. comm.) but not subsequently.

Historically, West Anacapa I. has been the site most consistently used for nesting by Brown Pelicans in California. Before 1929, birds nested primarily on East Anacapa I., but the establishment of a

lighthouse there likely caused the breeding population to shift to West Anacapa I. Population estimates for pelicans on Anacapa I. have fluctuated considerably over the years. They are summarized by Anderson and Anderson (1976) and Hunt et al. (1979).

Brown Pelicans have also nested elsewhere in the Channel Islands, specifically on Prince I, Santa Cruz I., and Santa Barbara Island. Brown Pelicans were last recorded nesting on Prince I. in 1939 (Sumner 1939). The only record of nesting on Santa Cruz I. was made by Wright in 1909 (Willett 1912), although up to 160 birds nested on nearby Scorpion Rock in 1972, 1974, and 1975 (Anderson and Anderson 1976, in Sowls et al. 1980). They were first observed breeding on Santa Barbara I. in 1911 (Willett 1912) and nested intermittently there at least through the time of publication of Catalog of California Seabird Colonies in 1980.

Adding evidence to the case for continued resurgence were hundreds of Brown Pelicans which initiated nesting at Pt. Lobos State Reserve, Monterey Co., during April and May 2000 (Terrill et al. 2000). The previous successful nesting there was in 1959 and the most recent attempt was in 1966.

The possibility that Brown Pelicans may re-establish small breeding colonies along the central California coast—or colonize previously unutilized sites—should be borne in mind.

Population Status and Dynamics

Brown Pelicans reach the northern limit of their breeding range on the Pacific Coast along the southern half of the California coast. Historically, breeding populations of these birds in southern California have fluctuated in response to environmental conditions. Current thought suggests that these populations increase during periods of ocean warming (Baldridge 1973, Anderson and Anderson 1976).

In the late 1960s and early 1970s, the reproductive success of Brown Pelicans declined considerably in California and northern Mexico. From 1969 to 1971 only 12 chicks fledged out of 2368 nesting attempts (Gress et al. 1973, Anderson and Anderon 1976). The breeding failures of pelicans during this period were related to the high levels of DDE, the principal metabolite of DDT, in the marine environment (Schreiber and Delong 1969, Schreiber and Riseborough 1972, Riseborough et al. 1971, Jehl 1973, Anderson and Anderson 1976).

Reproductive success of Brown Pelicans can vary markedly from year to year. Changes in oceanographic conditions and in the distribution and abundance of forage fish are two interrelated factors that may account for this fluctuation.

Large numbers in California during summer, fall, and early winter belie the actually small breeding population within the state. As noted above, many birds migrate northward after breeding in spring. It is assumed that the great majority of these are birds of Mexican origin. As many as 20,000 pelicans now pass into, as well as beyond, California at present (D. Jacques, pers. comm.). These birds feed and molt in California, Oregon, and Washington before returning to Mexico by early winter. In some winters, small numbers persist in and about the larger estuaries into January.

Threats and Management Implications

Brown Pelicans feed at the top of a food chain that also includes plankton and anchovies. In the period of years during which increasing amounts of persistent pesticides accumulated in the environment, concentrations in apex predators such as pelicans rose to levels interfering with reproduction. Concentrations of pesticides were magnified at each higher level of the food chain until metabolism and deposition of calcium in eggs were impaired, and egg shell thicknesses were reduced as much as 50% from normal (Anderson et al. 1975). Breaking of thin-shelled eggs under the weight of incubating adults reduced hatching success to almost zero (Gress et al. 1973).

In the three decades since the ban on domestic use of DDT and similar pesticides was enacted in 1972, Brown Pelicans have rebounded. Numbers reaching the California coast from Mexico are now at a high level, and breeding within the state has become strongly re-established. Owing to the birds' habit of roosting en masse on offshore rocks, concern has been raised over the potential effects of trampling of soil and excessive guano at sites supporting burrow-nesting species such as storm-petrels, auklets, and Tufted Puffins.

Although some foraging and migration occurs well out over the continental shelf, the great bulk of pelican activity is concentrated within several miles of the coast throughout the year. This places them at distinct risk of oil pollution. Since they plunge-dive entirely, or nearly entirely, beneath the surface; spend considerable time swimming; routinely occur in large flocks, and are not averse to foraging in 'industrialized' waterways, Brown Pelicans can be impacted by localized oil spills.

Brown Pelicans in southern California feed almost exclusively on anchovies, a fish also in great demand by humans. A sustained high commercial catch could deplete the fish stocks necessary for successful pelican nesting. Any changes in anchovy management must take into account the requirements of an expanding population of pelicans.

Finally, it should be noted that nesting Brown Pelicans are highly susceptible to the consequences of disturbance. Reproductive success is lower in colonies that have been disturbed by man than in those that are undisturbed (Anderson and Keith 1980).

Double-crested Cormorant *Phalacrocorax auritus* Lesson

Description

The Double-crested Cormorant is a large, heavy-bodied dark cormorant widespread in North America. It averages 33" long with a 52" wingspan. This species averages 1.7 kg in weight (Sibley 2000), although members of the subspecies *P. a. albociliatus* breeding along the California coast weigh up to 2.7 kg (Palmer 1962, in Ainley and Boekelheide 1990). Adults are brownish-black or blackish, with bright orange-yellow throat pouches and ephemeral head plumes which are most highly developed during the breeding season. The head plumes of *albociliatus* may be all-white, all-black, or (commonly) black with white tips (K. Garrett, pers. comm.).

In flight this species is distinguished from Brandt's and Pelagic cormorants by its kinked neck and by its habit of often, though not always, flying high above the water. Much unlike either of those species, the Double-crested Cormorant makes extensive use of freshwater environments.

Nest

Double-crested Cormorants usually nest colonially. They prefer to nest on the ground on islands (Lewis 1929, in Ainley and Boekelheide 1990). If no such sites are available they will nest in trees (Vermeer 1973, in Ainley and Boekelheide 1990). Nests are constructed of annual terrestrial vegetation, sticks, marine algae, bones, and large feathers. Within colonies, the earliest breeders are usually the older, experienced nesters. They usually begin to breed at the age of three years (Kaufman 1996).

On offshore islands of California, Double-crested Cormorants may nest alongside Brandt's Cormorants, but prefer the shoulders of hillsides, higher slopes, and the summits of islands (Michael 1935, Drent et al. 1964, Siegel-Causey and Hunt 1981, 1986; Ainley and Boekelheide 1990). Birds breeding in the 1990s on Teal I., a fragmented earthen levee on South Humboldt Bay, variably nest from 1-4 ft. above ground in live coyote-brush (*Baccharis pilularis*) when available; use dead coyote-brush until it no longer can support an elevated nest structure; make extensive use of dead

coyote-brush twigs in construction; or, ultimately, nest on almost entirely bare ground formerly supporting stands of the shrub (D. Fix, pers. obs.).

Eggs

3-4, light blue/bluish-white, usually nest-stained. One brood is raised per year (Ehrlich et al. 1988).

Incubation, Feeding, and Fledging

Eggs are incubated 25-29 days by both adults. They hatch asynchronously. Nestlings are altricial. They are fed regurgitant by each parent; are brooded almost continuously for 12 days, and can maintain body temperature at 14-15 days. Nestlings may leave the nest site and begin to wander through the colony at 3-4 weeks of age, but they return to the nest to be fed. They usually first fly at about 5-6 weeks after hatching, and are thought to be independent at 9-10 weeks (Kaufman 1996). Adults energetically defend eggs and young from avian predators (Ehrlich et al. 1988). One-two young were fledged per nest in studies of interior and Atlantic seaboard populations, and pairs fledged about two young per nest on the Farallon Is. in the 1970s and 1980s (Ainley and Boekelheide 1990).

Feeding Behavior and Diet

Double-crested Cormorants feed by diving from the surface, and prey upon shallow-water fishes (Robertson 1974). Foraging by birds frequenting the c. and n. California coast is almost entirely in mainland coastline, estuarine, or coastal lagoon waters (Ainley and Boekelheide 1990). Indigestible material is regurgitated in pellets. These cormorants are gregarious and, although solitary foraging is common, group feeding is frequently observed and takes place throughout the year.

World Distribution

Double-crested Cormorants are confined to North America. They occur along the Pacific coast from southern Alaska to Baja California, on the Atlantic coast from the Canadian maritime provinces to Florida and Cuba, locally inland in the West, on the Great Plains in both Canada and the U.S., in the Missouri-Mississippi drainage, around the Great Lakes, and in the southeastern U.S. They are abundant in subtropical habitats of the Sea of Cortez and in Florida. This cormorant is quite migratory, moving north in spring both through the interior of the continent and coastwise. They vacate most interior regions in winter, particularly those prone to ice cover.

California Distribution

Double-crested Cormorants breed locally inland on lakes in California from Clear Lake to the Salton Sea. The coastal distribution includes colonies on the Channel Is., on the Farallon Is., and on nearshore rocks and islands north of San Francisco. Sowls et al. (1980) detailed coastal colonies at 17 sites, the largest of which was Prince I. (s. California) with 450 birds. Other large coastal colonies at the time of publication of Sowls' et al. Catalog Of California Seabird Colonies (1980) were the old Arcata Wharf in North Humboldt Bay with 340 birds and the Farallon Is. with 180 birds. The remaining 14 coastal sites listed by Sowls et al. supported 150 or fewer cormorants. The total coastal California breeding population in 1980 was stated to be about 1900 birds.

As this species continues to rebound from depressed numbers range-wide in past decades, the California population can be expected to grow and to colonize new nesting sites. Thus, Sowls' et al. 1980 summary of statewide coastal population cannot now be considered current. During the early 1990s, a colony ranging from 200-700+ pairs of Double-crested Cormorants bred (successfully, in all but one year) at Teal I. in southeast South Humboldt Bay. Populations nesting in the San Francisco Bay system have been noted to have expanded within the past ten years (T. McKee, pers. comm.).

Population Status and Dynamics

Historically, this species has been affected by human disturbance in the form of disruption at colonies, persecution, and other less direct human factors. Ainley and Lewis (1974) attribute failure to recover in numbers on the Farallon Is. to decimation of the Pacific Sardine *Sardinops caerulea* throughout that fish's California range in the 1940s and 1950s. Human disturbance through most of the twentieth century 'undoubtedly contributed' to the decline in cormorant numbers on the Farallon Is. (Ainley and Boekelheide 1990).

Double-crested Cormorants were among the piscivorous birds most affected by eggshell thinning caused by persistent pesticides up to the time of the ban on domestic use of DDT and other persistent organochlorine environmental contaminants in the early 1970s. Eggshell thinning in Double-crested Cormorants was documented by Gress et al. (1973, in Sowls et al. 1980) on the Channel Is. and by Ayers (1975, in Sowls et al. 1980) at the old Arcata Wharf colony.

Since that time, their numbers have dramatically increased. This is indirectly referenced by their inclusion on the National Audubon Society 'Blue List' from 1972 to 1981 followed by demotion to the 'Special Concern' list in 1982, thence to Local Concern by 1986. During the late 1970s, Sowls et al. (1980) compared the numbers of Double-crested Cormorants breeding north of Cape Mendocino with numbers reported by Osborne (1972) and found that abundance had increased at three sites. Nests were absent at two other sites, but they found six additional colonies unreported by Osborne. The total number of breeding birds in that region apparently increased from 530 in 1970 to 1200 in 1980.

Threats and Management Implications

Double-crested Cormorants are vulnerable to direct persecution, harassment, and disturbance at colonies and roosting sites. Human disturbance during the breeding season can be very disruptive (Ayers 1975, in Sowls et al. 1980). Vandalized colonies are abandoned. Continentally, they suffered a long-term decline due to persecution up until the 1920s, then gradually increased into the 1950s. Persistent organochlorine contaminants induced another declining trend in the 1960s, but the population overall has rebounded dramatically since the domestic ban on DDT and similar chemicals was enacted in 1972 (Kaufman 1996). They remain vulnerable to gull predation (Kury and Gochfeld 1975).

As Double-crested Cormorants are highly mobile birds which spend considerable time out of the water both day and night, they may be more able than some other coastal-nesting birds avoid effects of oil pollution; few oiled birds have been found after spills (Smail et al. 1972 and Berkner pers. comm., in Sowls et al. 1980). However, their nearshore distribution may put them at generally greater risk than more pelagic species for contact with industrial activities.

Pelagic Cormorant *Phalacrocorax pelagicus* Pallas

Description

The Pelagic Cormorant is a small, slender, blackish cormorant highly glossed with greenish and purplish iridescence in adulthood. In contrast to the other two species of cormorant resident in California, Pelagics have thin bills and comparatively long tails. Breeding adults have conspicuous white flank patches, engorged red gular skin, and ephemeral whitish filoplumes on the neck. They average 28" long with a 39" wingspan. Sibley (2000) gives average weight as 1.8 kg; however, Ainley and Boekelheide (1990) state that the weight of birds breeding on the Farallon Is. varies from 0.8-2.2 kg. Members of this species breeding in California are of the smaller, southerly subspecies *P. p. resplendens*.

Pelagic Cormorants are notable for their habit of feeding and flying solitarily or in pairs; flocks of this species are seldom encountered on the water or in flight.

Nest

Pelagic Cormorants are not colonial in a strict sense, but rather assemble in loose aggregations commensurate with the extent and quality of appropriate habitat. They invariably place their nests on precipitous ledges, outcrops, and nooks on rock faces from just above the spray zone to hundreds of feet above the water. Nests are made of marine algae, grass, debris, or only moss, and firmly cemented to the ledge with the excrement of attending adults (Ehrlich et al. 1988, Ainley and Boekelheide 1990). Ehrlich et al. (1988) state that both sexes build. Nests may be used in successive years, and are added to yearly. The small size of the nest, its delicate constituent components, and its often-severe exposure to the elements precludes the accretion of an imposing structure.

Eggs

This species lays 3-5 (exceptionally, 7) eggs which are light blue/bluish-white and usually nest-stained. One brood is raised per year (Ehrlich et al. 1988).

Incubation, Feeding, and Fledging

Eggs are incubated 26-31 days; a long-term study on the Farallon Is. found that the mean incubation period was 29.5 days (Ainley and Boekelheide 1990). Young hatch asynchronously and are altricial. Nestlings are fed regurgitant by both adults. They grow rapidly, reaching adult size and attaining a complete set of juvenal feathers less than two months after hatching (Ainley and Boekelheide 1990). On the Farallons, most nestlings first departed their nest sites when between 45-50 days old. Ainley and Boekelheide (1990) noted that some chicks between 30-40 days of age which fell from or otherwise departed their nests were able to regain the nest and ultimately fledged successfully. Adults may attend and feed semidependent young for a few weeks after they leave the nest (Kaufman 1996).

Unlike some other seabirds, mostly-grown-but-dependent young Pelagic Cormorants are unable to wander from their nests and develop further in the company of others of their species (e.g., in a creche) owing to the physical constraints of their small and precarious nest sites.

Foraging Behavior and Diet

Despite their name, Pelagic Cormorants are tied to generally shallow nearshore waters over the inner continental shelf. They are seldom encountered more than several miles from mainland coasts or seaward of breeding sites. However, they are able to dive at least as deep as 120 ft., evidenced by entanglement in commercial fishing nets (Ehrlich et al. 1988). They capture fish by diving from the surface and pursuing them underwater, using webbed feet for propulsion.

Their diet is generally comprised of fishes characteristic of submerged rocky reefs and organisms that hide within the substrate. A study of Pelagic Cormorant diet conducted on the Farallon Is. during 1975-1977 revealed that several species of sculpin, juvenile rockfish and a mysid shrimp (*Spirontocaris*) predominated. W. Hoffman (pers. comm. to D. Fix) stated that gunnels and greenlings are important components of the diet for birds occurring along the Oregon coast. Herring, sand lance, marine worms and marine algae are also taken (Kaufman 1996).

It is of interest to note that Ainley and Boekelheide (1990) point out that juvenile rockfish (*Sebastes* spp.), a critically important food source during the breeding season at the Farallons, are not bottom-dwelling fishes at that life stage but, instead, shoal in mid-water. Thus, Pelagic Cormorants at that time of year are open-ocean feeding birds, pursuing and capturing prey items in mid-water column, rather than bottom feeders.

World Distribution

Pelagic Cormorants are in a broad sense northern birds, characteristic of cold, foggy, windswept coastlines of the northern North Pacific basin. They range from n. Japan and e. Siberia through the Aleutians and the Bering and Chukchi Seas through the Gulf of Alaska and southward into waters of the California Current. The great bulk of the population occurs to the north of California. In winter they may be found as far south as southern Baja California.

California Distribution

This species nests in suitable habitat along the entire length of the California coastline, south to Pt. Arguello. The sweeping 1979-1980 study conducted by Sowls et al. (1980) revealed that 56% of the state breeding population nested on cliffs of the mainland shore, while 44% nested on offshore islands. Those authors noted that scattered continuous bands of loosely-colonial nesting pairs occur in some areas, such as at Triplett Gulch, which encompasses two km of coastline and numerous offshore rocks. Areas immediately north of San Francisco were highlighted as having a disproportionately large percentage of nesting birds, as do the Farallon Is. (Sowls et al. 1980).

In keeping with the biophysical needs of an essentially cold-water seabird, Pelagic Cormorants occur in decreasing numbers with respect to distance south of San Francisco until the southern terminus of their nesting range—in n. Baja California--is reached. This distribution may reflect available nesting habitat, or perhaps oceanographic or biological factors as yet imperfectly understood.

Population Status and Dynamics

Detailed information on the historical status of Pelagic Cormorant in California is limited. Nesting aggregations are not highly colonial and occur at irregular density along most of the state's coast, often at sites difficult to access. In the Channel Is. there has been little change in either the total numbers of distribution of the birds over the past century (Hunt et al. 1979). In contrast to this seeming stability, breeding populations on the Farallon Is. declined greatly in size during the last half of the nineteenth century, a period marked by unrestricted egg collecting for the San Francisco market (Ainley and Lewis 1974, in Sowls et al. 1980). Historical population estimates for the northern California coast are available from Osborne and Reynolds (1971), though differences in time of survey and survey technique limit comparisons (Sowls et al. 1980).

The tendency of Pelagic Cormorants to move nest sites in succeeding years (Benz and Garrett 1978, Nysewander and Barbour 1979, in Sowls et al. 1980) makes surveys of large areas desirable for this species.

Ainley and Boekelheide (1990) relate that studies of Pelagic Cormorants on the Farallon Is. indicate that the size of the breeding population exhibited great annual variation. They hypothesized that this variability was due chiefly to the size of the juvenile rockfish population. Breeding success at the Farallon Is. is strongly tied to the availability of juvenile rockfish; large-scale or even complete nest desertion occurs early in the breeding season during warm-water years in which this food source is not present in sufficient quantity to sustain reproductive attempts (Ainley and Boekelheide 1990). This happened as recently as during the ENSO event of 1998 at Pt. Lobos, Monterey Co. (Roberson et al. 1998). They further note that an apparent inability by Pelagic Cormorants to exploit alternative sources of food during warm-water years--when young rockfish are not sufficiently numerous to sustain breeding attempts--contributes to reproductive failure. High rates of desertion and nest failure caused Ainley and Boekelheide to wonder how the species is able to maintain itself under conditions of pronounced prey irregularity.

Limited data from birds banded on the Farallons suggest that young of the year apparently disperse only short distances, in contrast to the strong northward movement exhibited by young Brandt's Cormorants.

Threats and Management Implications

Because of their widespread low- to moderate-density breeding distribution, Pelagic Cormorants are less prone than many other seabirds to be impacted in large numbers by oil pollution. However, as a resident nearshore species, they are at risk from localized slicks. Oil spills have resulted in known Pelagic Cormorant deaths, although to date these have been comparatively few (Aldrich 1938, Moffitt and Orr 1938, Smail et al. 1972, and Berkner pers. comm., all in Sowls et al. 1980). Since nearly all of their foraging is done close to shore and targets prey fishes living, in many cases, in proximity to outfalls of larger streams bearing agricultural runoff, it is conceivable that they may be exposed to deleterious chemicals such as pesticides. At the time of publication of Catalog of California Seabird Colonies (Sowls et al. 1980), there had been no documentation of significant eggshell thinning attributable to pesticide loading, in contrast to the case with Brandt's Cormorant and Brown Pelican. Shoreline use and steady development of the mainland coastline poses a threat to the species. Some nest sites may be subject to regular disturbance from human activities.

Brandt's Cormorant *Phalacrocorax penicillatus* Brandt

Description

Brandt's Cormorant is a large dark waterbird with a slender neck, short tail, heavy hooked bill, and a blue gular pouch bordered behind by buffy-yellow feathering. It is 34" long with a four-foot wingspan and weighs 2.1 kg (Sibley 2001). Breeding adults have long, ephemeral white plumes trailing down their backs.

Nest

Brandt's Cormorants are highly colonial. They nest on flat ground or on gentle slopes, preferring northwesterly or northeasterly exposures (Farallon Is., Ainley and Boekelheide 1990; Channel Is., Hunt et al. 1981 in Ainley and Boekelheide 1990). They avoid perpendicular cliffs used by Pelagic Cormorants. The nest is a mound composed of annual terrestrial vegetation, marine algae, and guano. It is perennial, used in successive years. Fresh material is added to guano-coated, rotted debris. Male gathers and piles nest material before pair formation, displaying to attract females; after pair formation, male continues to bring material to nest site while female builds.

Eggs

This species usually lays four (range 3-6) light blue/bluish-white eggs which become nest-stained. Replacement clutches may be laid if initial clutches are lost, but fledging success from replacement clutches is lower than for initial clutches. One brood is raised per year (Ainley and Boekelheide 1990).

Incubation, Feeding, and Fledging

Both sexes incubate for about 29 days (Ainley and Boekelheide 1990). Hatching is asynchronous and follows patterns of brood reduction strategy (Ainley and Boekelheide 1990). Nestlings are continually brooded during the first 5-10 days of life until they are able to thermoregulate. They begin to develop rapidly at about twenty days of age. The young are fed regurgitant by both adults.

Fledging is the termination of a gradient of decreasing dependence on parental provisioning, during which time chicks move from the immediate nest site, wander about the colony, take to the water and begin to forage on their own, and ultimately cease being fed by adults. Adults have been known to

continue feeding young as late as October (Ainley and Boekelheide 1990). During study of this species on the Farallon Is. from 1971-1982, the period of time adults spent at the nest site with chicks varied widely from year to year. The mean duration was 37 days (Ainley and Boekelheide 1990).

Feeding Behavior and Diet

Brandt's Cormorants obtain food by surface dives in marine or estuarine waters. Most foraging is done in the open ocean. Varied marine fishes are captured. Examination of pellets recovered on the Farallon Is. during the five years 1973-1977 (Ainley and Boekelheide 1990) indicated that prey items were caught at or near flat, sandy or muddy seafloor. Adults were found to rely heavily on juvenile rockfishes, bothid and pleuronectid flatfishes, Pacific Tomcod, Plainfin Midshipman, and Spotted Cusk-Eel. Flatfishes comprised a great proportion of the Farallon birds' diet by weight. During years of near-normal water temperature, species diversity in the diet was low, owing to reliance on rockfishes. As numbers of juvenile rockfish were very low in 1976, a warm-water year, diet diversity spiked. Brandt's Cormorants are also known to take shrimp and crabs (Kaufman 1996).

Breeding adults may range many miles from their nest sites in the course of daily feeding. Nearly all of the foraging commute performed by mainland/nearshore nesters involves strictly coastwise movement opposite shore (D. Fix, pers. obs.), with few appearing to venture more than several miles from land. In this sense, they are restricted to waters over the inner continental shelf.

World Distribution

Brandt's Cormorant is a coastal species chiefly confined to nearshore upwelling areas of the California Current System. It breeds from extreme southeastern Alaska (a few pairs) south along the coasts of British Columbia, Washington, Oregon, California, and Baja California. Seventy-five percent of the world population nests in central and northern California. Foraging within larger estuaries is frequent, but occurrences anywhere on waters outside direct tidal influence are exceptional. By and large, this is an exclusively marine species highly dependent on prey productivity originating through cold-water upwelling.

California Distribution

Brandt's is the most abundant cormorant species along the outer California coast. Although locations of nesting colonies occur irregularly owing to constraints of substrate requirements, birds involved in nesting range miles from their colonies, such that the species is present along the entire length of the coastline in summer. The largest breeding aggregation is on the Farallon Is., where 28,000 birds nested in 1979 (Ainley pers. comm. in Sowls et al. 1980). Sowls et al. noted that, during their late 1970s survey period, at least 13 colonies in California contained more than 1000 birds. Brandt's Cormorants are among the California nesting seabirds which nest in large colonies rather than in loose, dispersed colonies or as discrete pairs.

Population Status and Dynamics

In the manner of some other seabirds given to nesting in large assemblages, Brandt's Cormorants are known to shift their colonies from one site to another over the years (Hunt et al. 1979, Sowls et al. 1980). Several examples serve to illustrate this phenomenon. Two hundred birds nested on Casket Rock in Mendocino County in 1969; no nests were observed there in 1979, but 330 birds nested in 1980 (Sowls et al. 1980). Sowls et al. (1980) noted that similar fluctuations occurred at White Rock, '333 Point', and Arched Rock; they also stated that cormorants may have abandoned Prince I. (Del Norte Co.) in 1977 because of a heavy flea infestation, attributing this speculation to Hunt et al. (1979). While Sowls et al. estimated only 200 Brandt's Cormorants in the Pinnacle Pt. survey segment (#007, Catalog of California Seabird Colonies, 1980) in the course of their 1979-1980 census effort, 1100 birds were counted from shore within that segment at Pt. Lobos in June 1981

(LeValley and Evens 1981). At well-watched Año Nuevo I., San Mateo Co., Brandt's Cormorants bred for the first time in 1993, with 37 nests constructed (Yee et al. 1993).

These birds leave sites of breeding concentrations on the north coast and at the Farallon Is. in early winter, dispersing along the central and southern coast (Osborne 1972, DeSante and Ainley 1980). Band returns indicate that young birds disperse northward following the breeding season; most recoveries were from north of Cape Mendocino, primarily in Humboldt Bay and along the Oregon coast (Ainley and Boekelheide 1990). Observers along the Oregon coast annually witness considerable northward flight within two miles of shore by flocks of Brandt's Cormorants. Such flocks often contain scores of cormorants, flying in unwavering formation. This evident northward movement is generally first noted in August and continues well into early fall. Some return flight is noted by observers later in fall (D. Fix, pers. obs.). Brandt's Cormorants are much less numerous on the Humboldt and Del Norte County coasts in late fall and winter than during the warmer months (Harris 1996). A count of 130+ at Pt. St. George 3 December 1980 was exceptional; it is conceivable these birds may have been late-lingering fall migrants (LeValley and Evens 1981).

Sensitivity to human disturbance during the period of egging on the Farallon Is. from the 1850s to the 1890s impacted Brandt's Cormorant population size at that site. Fewer than 5000 birds nested there in the early twentieth century (Ainley and Lewis 1974, in Ainley and Boekelheide 1990), but the population had increased to 18,000-20,000 birds by 1959, to 22,000 by 1972, and to 28,000 at the time of publication of Catalog of California Seabird Colonies (Sowls et al. 1980).

Conversely, populations in the Channel Is. have declined in size since first recorded in the late 1800s. Hunt et al. (1979) speculated that they were affected first by human disturbance and later by the accumulation of pesticide residues. Thin eggshells were seen in Brandt's Cormorant eggs on San Nicolas I. and Lion Rock (Frame 1972, Hunt et al. 1979).

Sowls et al. (1980) noted that their population estimates (1979) for the remainder of the California coast exclusive of the Farallons were nearly double the figures from 1969 and 1970 (Osborne and Reynolds 1971). They surmised that the difference may have been due in part to more accurate censusing rather than any real population change, or, conceivably, to an unusually high nesting effort in 1979.

It has been shown that reproduction in Brandt's Cormorant is reduced during warm-water years, in which cold upwelling is curtailed (Ainley and Boekelheide 1990). Only 16,000 birds nested at the Farallon Is. in 1980 (Ainley pers. comm. to Sowls et al.). More dramatically, a crash in fish populations caused widespread abandonment of nesting efforts there in 1983, with only ten chicks raised to fledging; typically, 7500-10,000 young are fledged (LeValley and Evens 1983). Similarly, the ENSO event of 1998 "crushed the breeding of marine cormorants" in Monterey Co., where Brandt's completely failed at Pt. Lobos and only 8+ nestlings survived at Bird Rock off Pebble Beach by 28 June. These two colonies combined for 4677 nesting pairs in the 1989 colony survey conducted by the U.S. Fish and Wildlife Service (Roberson et al. 1998). Evidence suggests, furthermore, that elevated levels of mortality occur in warm-water years (Ainley and Boekelheide 1990). This was especially true in 1983, a dramatic El Nino/Southern Oscillation year in the North Pacific (Stenzel et al. 1988, in Ainley and Boekelheide 1990).

Threats and Management Implications

As it is closely tied to nearshore ocean and estuarine waters, Brandt's Cormorant is susceptible to oil pollution. This threat is greatest in the vicinity of breeding colonies, where large numbers of birds assemble for extended periods. This species may be the most vulnerable of all cormorants to localized oil spills because of its tendency to concentrate both at nest colonies and while foraging. Reported deaths from oil spills are infrequent, and this species made up only one percent of the

recovered birds in the 1971 San Francisco oil spill (Smail et al. 1972 in Sowls et al. 1980); this may reflect a greater tendency to sink than in other seabird species (Harris pers. comm. to Sowls et al. 1980, Wahl 2002).

Entanglement in fishing nets poses a continual threat to all diving seabirds which forage in proximity to fishing operations. Brandt's Cormorants have been reported caught in nets at depths as great as 70m (Clay 1911).

They are vulnerable to disturbance during the breeding season. Adults flush from nests readily when approached by boats, low-flying aircraft, or humans on foot; this temporary desertion allows Western Gulls to prey upon eggs and helpless nestlings (Sowls et al. 1980).

Snowy Egret *Egretta thula* Molina

Description

The Snowy Egret is a small, slender, graceful heron which is entirely white but for its legs, feet, bill, and loral skin (adults). They are 24" long with a 41" wingspan and weigh 13 ounces (Sibley 2000). They are found widely in the temperate and tropical New World, inhabiting shorelines, marshes, swamps, and other wetland habitats. Breeding birds have bright reddish or yellow-orange loral skin and decorative plumes or 'aigrettes'. Throughout the year, adults ordinarily have black legs and highly-contrasting deep-yellow feet, long back plumes, and a black bill. Young birds have greenish legs and feet and indistinctly bicolored bills, the proximal one-half pale than the distal half. They are sociable, and nest colonially.

Nest

Nests are usually placed in shrubs or trees, rarely in cactus or on the ground. The structure is flat, flimsy, and constructed of sticks, twigs, or rushes. Colonies sometimes occur in expanses of marsh vegetation over water. The male collects nest material and brings it to the female, who builds.

Eggs

3-5 (range 3-6) light bluish-green eggs are laid. One brood is raised per year (Ehrlich et al. 1988).

Incubation, Feeding, and Fledging

Eggs are incubated by both male and female for 20-24 days. Young hatch asynchronously and are classified as semialtricial 1. They are fed regurgitant by both adults and fledge at about 30 days.

Foraging Behavior and Diet

Snowy Egrets are active hunters, walking or even running along shorelines or in shallow water in pursuit of fishes, crustaceans, amphibians, insects, and similar prey, which are taken by a quick lunge with bill extended. Open mudflats and tidal sloughs, exposed rocky or sandy ocean coast (locally), salt- and freshwater marshes, wet meadows, lakeshores, and (to a limited extent) upland pasture provide foraging venues.

World Distribution

These egrets are found in the temperate United States (occasionally in southern Canada) southward to Argentina and the Galapagos Islands.

California Distribution

Snowy Egrets breed locally along the California coast, in southern California, in the Central Valley, and east of the Cascade-Sierra divide. Concentrations tend to occur most frequently in the vicinity of

nesting colonies and the outlying wetlands used by birds associated with them. Withdrawal from the northern interior takes place in fall and winter.

Population Status and Dynamics

Snowy Egrets are not typically thought of as offshore nesters. It is worth noting that a small breeding population became established in the early 1990s on Prince I., opposite the mouth of the Smith R., Del Norte Co. (A. Barron, in Harris [1996]). This colony is thought to number some ten to twenty pairs. This island also supports Black-crowned Night-Herons, as well as many species of nesting seabirds.

Threats and Management Implications

The Snowy Egrets breeding on Prince I. presently appear at little risk from human disturbance, nor are their favored foraging and loafing sites in the nearby Smith R. estuary under direct threat.

Black-crowned Night-Heron *Nycticorax nycticorax* Linnaeus

Description

The Black-crowned Night-Heron is a stout, short-billed heron of crepuscular and nocturnal habits. They are characteristic of swamps, sloughs, marshes, estuarine and lakeshores, harbors, and other wetland settings. The adult has a lustrous black cap and back, pale gray underparts, red eyes, and thin white plumes arising at the crown and trailing down the back. Immatures in their first year of life are dingy gray-brown overall, with streaked underparts, conspicuously white-tipped coverts and dark eyes. Subadults resemble older birds, but retain some breast-streaking, fine white stipplings on the coverts, and lack as distinct a pattern overall. These herons are 25” long with a 44” wingspan and weigh 1.9 lbs (Sibley 2000).

Nest

Nests are placed inidividually or (most commonly) in colonies numbering up to several hundred pairs in trees, shrubs, or marsh vegetation; they are occasionally concealed in dense undergrowth. Night-heron nests are often fragile and loose, but sometimes substantial. They are built of sticks, twigs, or reeds, scantily lined with finer materials. Nests may be used in successive years. They first breed at 1-3 (usually 2-3) years of age (Ehrlich et al. 1988).

Eggs

3-5 (range 1-7) light bluish/greenish eggs are laid. Clutch size is larger in the northern part of the range (Ehrlich et al. 1988). One brood per year is raised.

Incubation, Feeding, and Fledging

Eggs are incubated by both male and female for 24-26 days. Nestlings hatch asynchronously and are classified as semialtricial 1. They are fed regurgitant by male and female and, nearer fledging, unpredigested fish. Young fledge at 42-49 days. One brood per year is raised (Ehrlich et al. 1988).

Foraging Behavior and Diet

Black-crowned Night-Herons are sometimes abroad during the day, but specialize in hunting at night. At that time they occupy a great many foraging venues in wetlands, along shores, or otherwise in proximity to water. Prey is obtained by patient scanning-and-lunging with the bill. They eat a wide variety of smaller vertebrate and invertebrate prey, including small birds and their eggs, nestlings, and fledglings (locally significant predator of both ducklings and rail adults and young); fishes, crustaceans, amphibians, reptiles, snails, and similar prey.

World Distribution

Black-crowned Night-Herons have a nearly cosmopolitan distribution, occurring in the form of one subspecies or another over much of the world. In North America, they breed from southern Canada south locally through the U.S. and into Mexico. Most of the population retreats well to the south during the colder months, wintering from the Pacific Coastal and southern states into tropical America.

California Distribution

These herons are resident over much of lowland California in appropriate habitat, both coastally and inland. Some interior summering sites are vacated during the winter, while other locations are visited by night-herons outside the breeding season but not extensively in spring and summer. The extent to which migration occurs, and hence the state of seasonal flux of the population, is poorly perceived.

Population Status and Dynamics

This species is not usually considered in any discussion of breeding seabirds. However, a small population consisting of perhaps 10-20 pairs colonized Prince I. opposite the mouth of the Smith R., Del Norte Co., in the early 1990s (A. Barron, in Harris [1996]). This colony coexists with nesting Snowy Egrets. Prince I. supports many species of breeding seabirds in addition to hosting this small mixed-species heronry.

Threats and Management Implications

The small population nesting on Prince I. would appear to be at little risk from human disturbance. The birds' preferred hunting and loafing areas in the adjacent Smith R. estuary are free from threat of development and human use, while occurring daily, is light.

Peregrine Falcon *Falco peregrinus* Tunstall

Description

Peregrine Falcons are variably-sized larger falcons characterized by long pointed wings, a commanding disposition, and surpassing abilities of flight. They average 16 inches long with a forty-one-inch wingspan and weigh about 1.6 pounds (Sibley 2000). The species is polytypic. *F. p. anatum* is the most widespread New World form, occurring from boreal Alaska and Canada southward locally in Canada and the United States, wintering southward. *F. p. tundrius* breeds across the Holarctic and winters chiefly in middle and tropical America. *F. p. pealei* is largely resident in coastal southeast Alaska and British Columbia; some authorities attribute breeding birds on the Washington coast to this race. Introduction of non-native subspecies of peregrines during the era of captive propagation and reintroduction in the 1970s and 1980s resulted in some crossing involving members of exotic forms. Sexual dimorphism in size is universal irrespective of subspecies.

Adult Peregrine Falcons have a dark 'hood' and sideburn, pale gray to deep blue-gray upperparts, variable patterning on the underparts, and yellow feet, legs, cere, and orbital ring. Young birds have dark brown upperparts, a facial pattern similar to that of the adult but sometimes muted or, in *tundrius*, a prominent white or pale-buff forecrown and supercilium. Peregrines fly rapidly with fluid yet flickering wingbeats. They also soar high in the sky for long periods, particularly in the vicinity of nesting sites in spring and summer.

Nest

No nest is built. The female lays in a simple scrape in a protected cliff pothole, on a ledge, on massive undisturbed human structures such as large buildings or bridges, and (rarely) in large cavities in the main trunk of overstory trees. Lining is absent or scant and, if present, is scraped into nest

hollow by the female. Vertical protection beneath the site appears important to nest situation. Command of open air space from placement at midslope, upper slopes, or along ridgetops is preferred. Urban peregrines nest on tall buildings and other structures in southern California, A very few pairs of peregrines nest in old-growth coast redwoods in Humboldt County and perhaps elsewhere. Pairs of Peregrine Falcons are monogamous, though mate replacement is regular.

Peregrine eyries are commonly occupied by the same pair in successive years, or may be alternated at irregular intervals with use of nearby alternate nest sites within the territory.

Eggs

3-4 (range 2-6) eggs are laid. One brood per year is raised.

Incubation, Feeding, and Fledging

Eggs are incubated for 29-32 days. Nestlings are classified as semialtricial 2 (Ehrlich et al. 1988).

During incubation, the male brings food to the female, who accepts it near or at the nest. Both adults provisioning nestlings to fledging. The young generally fledge at 41-44 days (Sherrod 1983). Family groups of adults and semidependent young remain together for some weeks following fledging.

Foraging Behavior and Diet

Peregrine Falcons eat mostly birds, which are captured through aerial stoops, tail-chases, or while gliding among treetops of the upper forest canopy searching for unsuspecting prey. Some hunting is done from exposed perches. A great variety of birds are taken, ranging in size from swallows and warblers through a wide range of shorebirds and songbirds to the larger waterfowl. Males tend to prey upon smaller birds, females larger birds. They hunt opportunistically with respect to type of prey pursued. Prey may be transported miles from the point of capture. Items may be plucked at the site of a kill or else taken to a plucking site some distance away.

World Distribution

Peregrines and several species of peregrine-like falcons are distributed widely around the world. The Peregrine Falcon in a restricted sense (though occurring as many subspecies) inhabits portions of all continents except Antarctica. Members of Holarctic populations retreat broadly southward in fall, returning in spring to higher latitudes and elevations. In North America, Peregrine Falcons breed in Alaska, Arctic and boreal Canada (particularly west of the Rockies), locally across much of the interior Western states, and locally in unmanaged and urban areas alike in the central and eastern United States, and southward locally into Middle America (where it is more common as a transient and wintering bird).

California Distribution

Peregrine Falcons in California originally occurred patchily across much of the state, inhabiting seacoast, foothills, and mountains. Following several decades of increasing—and, ultimately, great—diminishment in the several decades following World War II, the population in the state has rebounded. Today, numerous eyries are located throughout most of the state in appropriate habitat. Northbound or southbound transients, as well as wintering birds from farther north, swell their numbers from September to April.

A minority of California's breeding population occupies select seastacks and coastal mainland cliffs from northern Del Norte Co. to the Channel Islands. During the extreme period of decline in the late 1960s, all but one known coastal eyrie in California was unoccupied or suffered nest failure. Initial reintroduction and reestablishment through propagation and hacking at mainland sites in the 1970s and 1980s was followed by reappearance of pairs on offshore rocks. During the 1990s, the total of known pairs in California increased significantly (D. Fenske, pers. comm.).

Population Status and Dynamics

California's nesting peregrines suffered a serious decline during at least the late 1940s until the ban on domestic use of DDT and similar chlorinated hydrocarbons was enacted in 1972. Occupying an energetic niche at a high trophic level, these birds experienced eggshell thinning and consequent reproductive failure during this time. Many historical sites were abandoned after years of declining fledging rates and population recruitment. A vigorous reintroduction program undertaken by The Peregrine Fund, Inc., and cooperating governmental and non-governmental agencies has been successful in returning breeding birds to most ancestral eyries, as well as to sites previously not known to have been inhabited.

Threats and Management Implications

Although not especially susceptible to human disturbance owing to typically protected nest placement, peregrines are nevertheless highly sensitive to it; they may abandon clutches or even nestlings if repeated loud noises or close approaches by untutored persons occur. However, some degree of clutch recycle ability exists early in the breeding cycle.

The Peregrine Falcon is to be afforded fullest protection within accepted Federal and state guidelines wherever human activities may conflict with the needs of the bird.

Black Oystercatcher *Haematopus bachmani* Audubon

Description

The Black Oystercatcher is a large, robust, brownish-black shorebird of the intertidal zone, 17.5" in length with a 32" wingspan and averaging 1.4 lbs. (Sibley 2000). Birds of all ages have a long, bilaterally flattened bill, red in adults and pinkish-red with a dark tip in juveniles. The legs and feet are pale flesh; the eye is pale yellow. There is no distinguishing flight pattern (other than uniform darkness). Females have longer, narrower bills and heavier bodies (Andres and Falxa 1995). Their loud, far-carrying call-notes are often heard before the bird is seen.

Nest

The nest built by both adults, usually above high tide line in weedy turf, beach gravel, or a rock depression, generally with an unobstructed view; it is usually lined with rock shards or shell bits (Ehrlich et al. 1988). Intermittent nest construction begins 2-3 weeks before eggs are laid; most preparation is accomplished by the male of the pair. Use of the same nest site in successive years appears common. Copulatory behavior begins in early February (Helbing 1977, Andres and Falxa 1995). Adults establish breeding territories. Birds on the Farallon Is. begin nesting at five years of age (W. Sydeman pers. comm., Andres and Falxa 1995).

Eggs

1-3 (rarely 4, exceptionally 5), cream buff/olive buff, variably spotted, blotched, or scrawled with brownish-black or purplish-gray; smooth to slightly rough. Egg-laying takes place chiefly in May and early June. The peak laying period in northern California is in the third week of May (Andres and Falxa 1995). Eggs are laid at 24-hour intervals but hatch at four-hour intervals; thus, eggs laid earlier have a longer lay-to-hatch period (Drent et al. 1964 in Andres and Falxa 1995). One brood is raised per year (Ehrlich et al 1988).

Incubation, Feeding, and Fledging

Eggs begin to be incubated by both sexes as soon as the clutch is complete, and incubation continues for 26-28 (range 26-32) days. Incubation changes are frequent throughout the day (Helbing 1977 in Andres and Falxa 1995).

Nestlings are classified as Precocial 3 and hatch at a weight of 32-36g (Webster 1942, Nysewander 1977 in Andres and Falxa 1995). They may leave the nest within hours of hatching; within a few days, they follow adults to feeding areas (Sowls et al. 1980). Larger siblings interfere with food delivery to smaller siblings by reaching a food-bearing parent first, by chasing siblings en route to a parent, or by stealing from them after they receive a food item (Groves 1984 in Andres and Falxa 1995). Chicks are believed capable of thermoregulation by 21 days of age (Andres and Falxa 1995).

Flight is attained at about 35 days, at which point they are considered to have fledged; however, fledglings continue to depend on adults for an extended period. A study in British Columbia revealed that chicks developed 'searching and handling'skills comparable to those of adults within one year (Groves 1982 in Andres and Falxa 1995); however, immature birds are thought to require more than three years to develop a complete repertoire of efficient foraging skills (Falxa 1992).

Feeding Behavior and Diet

Although their diet is varied, Black Oystercatchers specialize in preying upon mollusks by inserting their sharp, flattened bills between the shells, severing the adductor muscle, and exposing the animal within for consumption. They sometimes manipulate blades of marine algae with the bill to reveal prey (Andres and Falxa 1995).

They forage almost exclusively in intertidal habitats, on rocky shores exposed to surf action and on sheltered gravel, cobble, or sandy shores and mudflats of bays and sounds. In California, 93% of foraging is in areas washed intermittently by waves; wave-splashed mussels gape more often, and hence are more vulnerable to the birds' predation (Hartwick 1976, Falxa 1992, in Andres and Falxa 1995).

The ubiquitous California Mussel (*Mytilus californianus*) is important locally, and is known to be the chief food of oystercatchers both in the Channel Is. (Hunt et al. 1979 in Sowls et al. 1980) and in northern California (Helbing 1977 in Sowls et al. 1980). Chicks at the nest are frequently fed crabs (Hartwick 1976, Helbing 1977 in Sowls et al. 1980).

They are also known to take other mollusks such as limpets, whelks, and chitons; various marine invertebrates, especially worms, isopods, echinoderms, barnacles, crabs, and other crustaceans; and fish. Ephemeral food sources such as beached by-the-wind sailors (*Vellela vellela*) and herring spawn are also exploited (Andres and Falxa 1995, Ehrlich et al. 1988). On Southeast Farallon I., adults were observed feeding chicks tenebrionid beetle larvae captured in the soil of a nearby seabird colony (Morrell et al. 1979 in Andres and Falxa 1995).

World Distribution

Black Oystercatchers are found throughout the year from the outer Aleutian Is. (from Kiska eastward; not Near Is. group) and south from Bristol Bay, Alaska in appropriate habitat along the Pacific coast to southern California and, locally, on the mainland coast and islands of the west side of the Baja California peninsula (Jehl 1985, in Andres and Falxa 1995). They are strongly associated with rocky coasts and islands. Though believed largely resident, small numbers visit jetties, breakwaters, and other coastal and outer-estuarine rockworks; birds occasionally visit sand beaches to bathe or forage. They are almost never seen anywhere away from outer coastal environments, although they have been increasingly found inside n. San Franciso Bay.

California Distribution

Oystercatchers are present along the California coast throughout suitable habitat from the Oregon border to Pt. Arguello and the Channel Islands (except San Nicolas I.). They are resident and breed on both offshore islands and rocks and mainland rocky shores. This species is a scarce visitor to the mainland southern California coast. Considering the somewhat irregular distribution of habitat

within the state, the population estimates by Sowls et al. (1980) for each of nine survey subregions are rather uniform. However, concentrations of 242 breeding birds in the Channel Is. and 40 in the Farallon Is. together represented half of the catalog breeding total.

Population Status and Dynamics

Black Oystercatchers are a non-colonial nesting species. Through the establishment of large nesting and feeding territories, the population is distributed throughout available habitat (Sowls et al. 1980). Feeding territories are defended year-round (Ehrlich et al. 1988). However, they are often found in loose association with other seabirds, and are known to be gregarious in winter (Webster 1941 in Sowls et al. 1980). Nonbreeding birds typically roost communally at sites which lie above the high-tide zone and afford a wide view of nearby coastline (Andres and Falxa 1995).

They are believed to be monogamous, and to maintain a long-term pair bond (Sowls et al. 1980). A small sample of color-banded birds in central California suggests that pairs remain together not only throughout the year, but for successive years—perhaps for the lives of some birds. However, some 'divorce' occurs between breeding seasons (Andres and Falxa 1995). There exists little data on post-fledging or adult survival. Based on resighting of color-banded birds, annual survivorship of birds more than one year old in California (n=26) is estimated at >90% at a minimum (Andres and Falxa 1995).

Sowls et al. (1980) estimated a minimum breeding population of 704 birds for California. However, those authors pointed out that, during field surveys preparatory to compilation of Catalog Of California Seabird Colonies, they used territorial defense as an indication of nesting, therefore likely underrepresenting the actual California population, which they allow 'is probably about 1000 birds'.

It is worth noting that Black Oystercatchers disappeared from the Farallons in the 1860s, possibly as a result of excessive human disturbance (Sowls et al. 1980)---specifically, the intense commercial egg-collecting that occurred there during that period. A few birds were seen there in 1903, but it was not until 1956 that they were once again observed there regularly. The breeding population at the Farallons increased to 16 by 1959 and to 40 in 1972 (Ainley and Lewis 1974). Since that time the population has stabilized and may be at its maximum (Ainley pers. comm. in Sowls et al. 1980).

The ranges of Black Oystercatcher and American Oystercatcher (*H. palliatus*) overlap in Baja California. Hybridization has been known to occur, particularly during periods of low population size. Assortative mating of parent forms is most prevalent (Jehl 1985 in Andres and Falxa 1995). Both phenotypically pure American Oystercatchers (rare) and hybrid and putative backcross American X Black Oystercatchers (uncommon) have been documented as occurring in southern California.

Threats and Management Implications

Black Oystercatchers are highly specialized birds which require clean, undisturbed, untrammeled rocky coastlines for nesting and feeding. With an overall population of some 11,000 birds (Page and Gill 1994 in Andres and Falxa 1995), loss of any significant regional component would have consequences, yet the population is widely distributed over a very long span of Pacific shoreline. Oil spills, which foul intertidal habitats, could seriously affect food supplies, but 'losses of birds from direct oiling would probably be low' (Sowls et al. 1980). Long-term degradation of intertidal habitat would almost certainly cause population declines (Sowls et al. 1980).

Common Ravens are noted as major egg predators by Ehrlich et al. (1988); specifically, oystercatcher productivity in Prince William Sound, Alaska, was inversely correlated with raven abundance (Andres and Falxa 1995). Hartwick (1974 in Sowls et al. 1980) lists gull predation as an important cause of mortality. Mortality among chicks is apparently high. Both chicks and eggs are

frequently wave-washed (Sowls et al. 1980). Kenyon (1949) and Jehl (1985, both in Andres and Falxa 1995) stated that scientific collecting, human disturbance, and mammalian predation have caused extirpation of breeding pairs on small islands off the coast of Baja California. Human disturbance and feral cat predation on the Channel Is. caused breeding pairs to abandon nest sites; the density of breeding birds on disturbed islands was only 3% of the density on undisturbed islands (Warheit et al. 1984 in Andres and Falxa 1995).

Western Gull *Larus occidentalis* Audubon

Description

The Western Gull is a large, heavy-billed 'pink-footed' gull restricted to the temperate West Coast of North America. It averages 25" long with a 58" wingspan and weighs 2.2 lb (Sibley 2000). Adults have dark gray back and wings, restricted white subterminal and apical spots in the outer primaries, slightly-contrasting black wingtips, thick orange-yellow bill with a red distal mandibular spot, and flesh-pink legs and feet. Aside from blackish under-wingtips and a grayish shadow through the undersides of the flight feathers, the balance of the plumage is white.

Juvenile birds are deep sooty-brown with a whitish rump and have dark eyes. Later immature stages are variably marked, with older birds more closely resembling adults in all plumage, iris, and bill features. At all ages, males are slightly larger and flatter-crowned than females. These outward gender-based differences are subtle.

The species is polytypic. The paler-mantled nominate *L. o. occidentalis* occurs n. of Monterey, and the darker-mantled *L. o. wymani* from Monterey southward. In definitive basic plumage, 'pure' *occidentalis* adults entirely lack the streaking about the head exhibited by members of *wymani*. Adult plumage is essentially attained at the close of the third complete prebasic molt.

Somewhat complicating the identification picture, as well as affecting discussion of species-specific life history traits, is the extensive hybridization of Western Gull with Glaucous-winged Gull (*L. glaucescens*) in Oregon and Washington. This thorough regional gene-mixing produces a continuum of phenotypes involving the parent types and crosses.

Nest

Western Gulls nest on offshore islands, rocks, and (locally) mainland coastal cliffs and bluffs. Colonies may be situated on dredge spoil islands; scattered pairs nest on navigation aids and, locally, on rooftops. They are colonial, often associating with other seabirds. Pairs may nest singly, but when they do so, there are ordinarily other pairs scattered in similar situations in the general vicinity. The nest is a bulky, flattened bowl of dried grass, forbs, marine algae and similar material, frequently well out in the open, but occasionally partly sheltered. Both members of a pair build the nest. The nest is generally situated on a grassy or semi-barren slope or flat.

Colonies usually occur at greatest density on the flatter portions of islands and offshore rocks (Sowls et al. 1980), although minor ridgeline niches, hollows, and small ledges are used. Some pairs nest atop navigation aids and other exposed marine or lower-estuarine structures, including sparsely-vegetated earthen levee fragments and rooftops. The nest is often adjacent to water for drinking and cooling (Ehrlich et al. 1988). Nests are typically used by pairs in successive years.

Eggs

3 (range 1-5) eggs comprise a clutch. Eggs are buff/cinnamon-brown/gray, mottled, but variable within and between clutches (Ehrlich et al. 1988). One brood is raised per year.

Incubation, Feeding, and Fledging

Both members of pairs incubate for 26 (range 25-29) days. Prior to beginning an incubation shift, an attending adult may 'belly-soak' to wet the eggs, effecting evaporative cooling. Embryos can survive short exposure to 114F/46C degrees, and are thus unusually heat-tolerant for gulls (Ehrlich et al. 1988). Within clutches, size, weight, and survival is strongly related to the egg-laying sequence. During incubation, one parent guards while the other sits on the nest. The nestlings are classified as semiprecocial. They are fed semi-digested regurgitant by each parent. Nestlings fledge at 42-49 days of age (Ehrlich et al. 1988). Young ultimately disperse from the colony at about 70 days of age; however, parental care typically extends several weeks beyond dispersal (Ehrlich et al. 1988).

Foraging Behavior and Diet

Western Gulls are highly opportunistic feeders. This attribute has abetted their success in an increasingly humanized estuarine/littoral habitat. They behave both as predators and scavengers, taking living food such as clams, crabs, sea urchins, starfish, young birds, seabird eggs, and small estuarine and terrestrial vertebrates; they eat carrion such as beached seabirds, fish, and marine mammals; and garbage, taken in greatest quantity during extended foraging visits to mainland dumps. Fish-processing waste is taken widely. Western Gulls may forage miles at sea, along the coastal littoral zone, in harbors, river mouths, about industrial areas within estuaries, and in flooded pastures in coastal bottomlands.

Important foods around the intensively-studied Southeast Farallon I. colony include anchovies, rockfish (*Sebastes* spp.), Pacific Saury (*Cololabis saira*), midshipmen (*Porichthys*), cephalopods, euphasiids, barnacles, and offal (Ainley and Sanger 1979, Hunt et al. 1979). During the strong 1983 ENSO event, marine food sources plummeted, such that Western Gulls spent much more time than normal commuting daily to and from San Francisco Bay area garbage dumps (Ainley and Boekelheide 1990).

As do some other species of gulls (and corvids), Western Gulls are known to drop shelled prey---even walnuts—from the air to gain ready access to the meal inside. This is believed to be a learned behavior (Ehrlich et al. 1988).

World Distribution

Western Gulls are restricted to the temperate West Coast of North America, breeding from southwestern British Columbia south to northern Baja California. The bulk of the population occurs in Oregon and California. Few are ever found truly inland, but may wander some miles upriver during fish runs. In a general sense, the species is largely resident within the breeding range, although individuals are well-known to make lengthy travels to wintering sites sometimes hundreds of miles removed from nesting colonies (Spear et al. 1986, 1987, in Ehrlich et al. 1988). Some winter as far south as southern Baja California. Many may be found well out to sea, especially during the nonbreeding season. Western Gulls are locally sympatric with Glaucous-winged Gulls and intergrade with them in Washington and Oregon (Hoffman et al. 1978).

California Distribution

Most of the California breeding population is concentrated at a few sites. By far the largest colony in California—indeed, the world's largest—occurs on the Farallon Is. Sowls et al. (1980) published an estimate of 32,000 there. This represents greater than 60% of the entire population nesting in the state. Other large colonies are at Middle Anacapa I. with 5000 gulls, Santa Barbara I. (2300), San Nicolas I. (1800), Castle Rock (1350), and Prince I. (960). Most colonies are much smaller. Sixteen of the remaining sites catalogued by Sowls et al. (1980) supported between 100 and 500 birds, 22

sites had 50-100 birds, and 115 sites have fewer than 50 birds (Sowls et al. 1980), many of these situated on the smaller offshore rocks.

Population Status and Dynamics

A century of decreased persecution and an abundant and varied food supply may be causing the population of Western Gulls in California to be growing. Sowls et al. (1980) believed this to be a likely scenario, but noted that documentation is difficult to obtain, since historical data for much of the California coast are lacking. Those authors cautioned that this increase—should it be occurring—may not be desirable. Population growth in several populations of large gulls has been attributed to the availability of human food wastes and sewage (Drury 1979, Kadlec and Drury 1968, Vermeer 1963, in Sowls et al. 1980). Through force of sheer numbers and aggressive disposition, increased populations of Herring and Great Black-backed gulls have impacted tern and Atlantic Puffin colonies by usurping optimal nest habitat, stealing food, and eating eggs and chicks (Nettleship 1972, Nisbet 1973, in Sowls et al. 1980).

Compared to the slightly different survey effort of Osborne and Reynolds (1971), who censused many of the larger Western Gull colonies in central and northern California, Sowls et al. found more Western Gulls at 20 sites in 1979 and 1980 than in 1970, fewer at four sites, and no change at two others. The apparent net increase in numbers of breeding Western Gulls at these 26 sites was about 1600 birds. Additionally, the 1979-1980 survey effort of Sowls et al. found many previously undiscovered sites.

Other evidence that numbers may have increased comes from the Farallon Is. and Prince I. The number of Western Gulls on the Farallons plummeted in the mid-to-late ninteenth century, owing chiefly to egg collecting and disturbance from domestic animals (Ainley and Lewis 1974, in Sowls et al. 1980). The population recovered in size to about 23,000 birds in 1959 and remained stable until about 1972 (Ainley and Lewis 1974). By 1980, the population had increased to 32,000 birds, and at that time there appeared to be a surplus of adult-plumaged gulls, indicating that availability of nest sites might have become a limiting factor (Sowls et al. 1980).

On Prince I., a population of about 500 birds in 1968 (Huber 1968, in Sowls et al. 1980) increased to about 1000 in 1976 (Hunt et al. 1979). On Santa Barbara I., however, there has been a marked decline in numbers of Western Gulls since 1972 (Sowls et al. 1980). This decrease has been tied to the diminished abundance of anchoves (Hunt and Butler 1980, in Sowls et al. 1980).

Threats and Management Implications

Owing to its remarkably varied diet, opportunism, and belligerent demeanor at competitive foraging venues, the Western Gull would seem to be among the most likely California nesting seabirds to continue to coexist with man in an environment increasingly prone to climatic and hydrographic fluctuations, as well as direct human impacts. Serving as a buffer to any stochastic events diminishing the population is the present existence of an excess of nonbreeding adults, contributing to the species' reasonably high reproductive potential. It is probably one of the marine waterbirds that is least vulnerable to oil spills, as individuals are highly mobile, are not tied by dint of behavior to the ocean surface, and frequently return to land to rest, roost, bathe in freshwater outfalls, and preen.

They are, however, susceptible to disturbance while nesting. Disturbance in particularly dense colonies may result in intraspecific pirating of eggs as well as outright cannibalism. Chicks frightened from their territories may be killed by neighboring gulls or become lost and starve. Increasing numbers of elephant seals on some island habitats may have displaced nesting Western Gulls.

Persistent pesticides have been implicated in eggshell thinning in Western Gulls. Aberrant female-female pairing, often with supranormal clutches of 4-6 eggs, has been documented on Santa Barbara I. (Hunt and Hunt 1977, in Sowls et al.). Such pairings typically result in nonreproduction, as the eggs are usually infertile and do not hatch.

Western Gulls are the most important predators of storm-petrels and Cassin's Auklets on the Farallons (Manuwal 1974, Ainley et al. 1974, in Sowls et al. 1980). It stands to reason that further increases in Western Gulls may increase the incidence of such predation, but any effects would be difficult to assess at unstudied sites where these species occur together. Western Gulls are known to kleptoparasitize cormorants, Rhinoceros Auklets, and probably Tufted Puffins. The present rate of incidence is unknown, but may increase if gull populations continue to expand (Sowls et al. 1980)

Common Murre *Uria aalge* Pontoppidan

Description

The Common Murre is among the most abundant seabirds breeding in the Northern Hemisphere. It is a medium-sized diving bird with a pointed bill, short tail, narrow and stubby wings, and a monochrome color pattern. Common Murres average 17.5" in length with a 26" wingspan and weigh slightly less than 1 kg (Sibley 2000).

Adults in alternate plumage are deep sooty-brown above (appearing blackish in most lights) on the head, breast, back, and upperside of the wings, and unmarked white below except for blurry dark flank streaks. A rare dark morph exists, in which the general coloration of the bird's upperparts extends to encompass much of the underparts. This form has been estimated to occur in perhaps 1:1000 Common Murres in California; interestingly, it has not been recorded elsewhere (Sibley 2000). Seldom recorded, an albino Common Murre was off Monterey 2 March 1986 (Campbell, Barron, and Bailey 1986), and another was seen from Pigeon Pt., San Mateo Co., 18 February 1995 (Yee et al. 1995).

In basic plumage, acquired by most birds August-October, the dark of the breast and head retreats to a dark cap, enclosing the eye, but with much white on the lower face and a dark line extending posterior to the eye. Juveniles at sea are of variable size until fully-grown (September), with the pattern of basic-plumaged adults until their first prealternate molt. Entirely adult plumage is not acquired until the bird is more than one year of age.

The species is polytypic. Eight subspecies of Common Murre have been described throughout various regions of the Northern Hemisphere, with three occurring in North America. Of these, *U. a. californicus* ranges from northern Washington to California and is the only subspecies known to occur in California waters (Ainley and Boekelheide 1990). However, it has been suggested that, given the occasional extreme southward movement of small numbers of Thick-billed Murres (U. lomvia) in some years, the Alaskan-breeding *U. a. inornata* may exhibit a similar dynamic (Scott and Nehls 1973, Roberson 1985, in Manuwal et al. 2001).

Nest

Common Murres nest in densely-packed breeding colonies typically involving many thousands of birds. One study indicated an average of 20 incubating birds per square meter (M.P. Harris and Birkhead 1985, in Ainley and Boekelheide 1990). Murres build no actual nest. The egg is laid on bare ground, generally on the gently sloping upper portion of offshore rocks. Flat ground is also used when available, as well as precipitous slopes or cliffs offering numerous ledges or niches as 'nest' sites. Pairs are monogamous, and exhibit high fidelity to nest sites; the pair bond is likely long-term (Ehrlich et al. 1988).

Eggs

One egg is laid per clutch. Murre eggs are distinctly pyriform, an adaptation increasing the amount of egg surface contacting the brood patch during incubation (Ainley and Boekelheide 1990). They are notable for their wide range in coloration and pattern, with a ground color varying from blue/green/white/brown and variable dark markings. It is believed that the unique color and pattern of each murre egg facilitates recognition by attending adults (Johnson 1941, in Ainley and Boekelheide 1990). Common Murres first breed at 4-6 years of age. Adults appear at nest sites on the Farallon Is. about three weeks prior to the initiation of egg laying (Ainley and Boekelheide 1990).

Incubation, Feeding, and Fledging

Murres incubate a single egg in a semi-upright stance with feet holding the egg in place. Incubation shifts range from 12 –24 hours (Ehrlich et al. 1988) over 32-33 (range 30-35) days. Young are fed small fishes brought to them by both parents during daylight hours. They are semi-nidifugous, leaving the immediate nest site after 23.5 days (ave. in study on Farallon Is., Ainley and Boekelheide 1990) at 20-25% of adult weight (S.R. Johnson and West 1975, Birkhead 1977a, Hunt, Eppley and Schneider 1986, in Ainley and Boekelheide 1990).

Upon reaching the ocean, chicks are accompanied by a single parent, which is almost always the male (Birkhead 1976, Hunt, Eppley and Schneider 1986, PRBO unpubl. data, in Ainley and Boekelheide 1990). The dependent young are then fed frequently by the parent, remaining near the adult bird for several weeks. Fledglings and parents remain in nearly constant visual and/or vocal contact through the first month the young bird is at sea (D. Fix, pers. obs.). They are believed to acquire powers of flight at 50-70 days of age (Kaufman 1996).

Feeding Behavior and Diet

Common Murres feed by diving from the surface, pursuing small fishes by using their wings for underwater propulsion. They are able to sustain dives of more than one minute duration and achieve depths of 100-550 ft. (Ehrlich et al. 1988). They are strong fliers and, by means of rapid and uninterrupted straight-line commutes, they are able to forage many miles from breeding colonies on a daily basis.

Small marine and estuarine fishes such as herring, capelin, sand lance, anchovies, and various smelts comprise the great bulk of the diet, but Common Murres also consume a few crustaceans, mollusks, worms, and cephalopods (Ogi and Tsujita 1973, 1977, in Ehrlich et al. 1988) as well as squid (Kaufman 1996). Juvenile rockfish are a particularly important component of the diet at the Farallon Is. (Ainley and Boekelheide 1990). Examination of stomach contents of gillnet-killed murres from Monterey Bay indicated that the spring, summer, and fall diet was comprised chiefly of rockfish, market squid, Northern Anchovy, Night Smelt (*Spirinchus starksi*), and lingcod (Ophiodon elongatus) (Manuwal et al. 2001).

World Distribution

Common Murres breed on offshore rocks, islands, and mainland cliffs in the northern North Pacific and North Atlantic ocean basins. They winter in open waters, often well south of the breeding range in the North Atlantic. Unlike the closely-related Thick-billed Murre, they avoid areas of pack ice (Kaufman 1996).

California Distribution

Common Murres occupy the southernmost extent of their range in coastal California. They breed from Castle Rock (Del Norte Co.) south to Hurricane Point Rocks at the north end of the Big Sur coast. They are known to have nested at 26 sites in California (Manuwal et al. 2001). The distribution within the state separates into two groups: the northern California group consisting of 15

colonies in Del Norte, Humboldt, and northern Mendocino counties; and the central California group consisting of 10 colonies in Marin, San Francisco, San Mateo, and Monterey counties.

The total nesting population in California was estimated in 1980, 1982, and 1989 (Sowls et al. 1980, Briggs et al. 1983, Carter et al. 1992). The population was calculated to include 467,100, 514,900, and 351,600 breeding birds in 1980, 1982, and 1989 respectively. These estimates were based on summed, whole-colony counts for all colonies, with a *k* correction factor Manuwal et al. 2001). Sowls et al. (1980) reported that two colonies in California exceeded 100,000 birds, ten ranged between 1000-10,000, and one supported fewer than 100 murres. Those authors noted that a few nonbreeders have been seen on three additional rocks: Kibesillah Rock, White Rock, and Gualala Point I. all appear to have suitable nesting habitat and should be watched (Sowls et al. 1980).

Prince I. in southern California has not been occupied by Common Murres since 1912, although 3-9 birds 'attended' there but did not breed in association with a Brandt's Cormorant colony (H.R. Carter, unpubl. data in Manuwal et al. 2001). This leaves the Hurricane Point Rocks site as presently the southernmost Common Murre breeding colony not only in the state but in the world.

Colony size in California varies greatly, from as few as 50 birds on Sisters Rocks to 126,500 birds on Castle Rock. Other large colonies are at the Farallon Is. (60,000), Green Rock (55,000), False Klamath Rock (26,500) and Flatiron Rock (24,000) (Sowls et al. 1980).

Population Status and Dynamics

Murres are highly gregarious, particularly in spring and summer. Nesting in dense colonies deters attacks by aerial predators. They may forage individually at some removal from others of their kind, but more often assemble in feeding concentrations which typically include many hundreds of birds.

Following the breeding season, Common Murres disperse to sea, spending the nonbreeding months over waters of the continental shelf and slope and perhaps seaward.

They are given to mid- or late-winter nest site 'visitations', in which thousands of murres suddenly appear at their breeding rocks, may remain in the vicinity for a few days, and then disappear again until the onset of the nesting season, though sometimes repeating the visitation. Based upon winter visitations by numbers of murres at the Farallons, it is suspected that most of the breeding population there remains within a half-day flight of the islands year-round (Ainley and Boekelheide 1990).

Higher winter at-sea numbers in northern California after December may indicate some limited movement of murres from Oregon in January and February in certain years, although colony attendance, populations of subadult murres, changes in at-sea distribution, and survey error may be involved (Briggs et al. 1983, 1987; Tyler et al. 1993, in Manuwal et al. 2001).

Historically, the colony on the Farallon Is. was much larger than at present. Direct human impacts were first noted in an 1818 report by the Russian sealing station, at which time seabirds, likely including murres, were killed for meat and feathers (Manuwal et al. 2001). Based on the number of eggs reported removed by commercial egg collectors in one year, this site may have supported 400,000 Common Murres in the 1850s (Ainley and Boekelheide 1990). Fourteen million murre eggs went to the San Francisco market during the last half of the nineteenth century. Later, oil pollution was cited as a limiting factor (Ainley and Lewis 1974, in Ainley and Boekelheide 1990. In the late 1950s, only 6000 nested on the Farallons, but the population increased to 20,500 in 1972, 60,000 in 1980, and a peak of 88,000 in 1982 (Sowls et al. 1980, Ainley and Boekelheide 1990).

The El Nino/Southern Oscillation climate phenomenon has had a dramatic impact on populations of this species as well as that of other seabirds preferring cooler waters. Ainley and Boekelheide (1990) correlated reduced nest attendance and lower reproductive success with the occurrence of ENSO events, and note that years of particular warmer water in the California Current appear to be

coincident with greater nesting failure. For example, in 1982 North Farallon I. was the fourth-largest colony in California, but a census at about the same time in 1983—a pronounced ENSO year--revealed only 1400 birds. This lack of birds was attributed to effects of both ENSO and drownings incidental to the regional halibut gill net fishery.

Vividly underscoring the impact of food scarcity upon reproductive effort is that only one murre chick fledged for every ten nests on the Farallons during the 1983 breeding season (LeValley and Evens 1983).

Sowls et al. (1980) argued that two lines of evidence suggested Common Murres were increasing in California at the time of their 1979-1980 survey of all of California's breeding seabird colonies. First, murres were found breeding at four sites where they were not observed by Osborne and Reynolds (1971). Second, they cite much greater numbers recorded by their survey effort compared to those researchers.

Osborne (1972) found that population in the region from Cape Mendocino to the Oregon line had increased from a few thousand in the 1910s to about 143,000 birds by 1970 (Sowls et al. 1980). Clay (unpubl. notes, in Sowls et al. 1980) made no mention of Common Murres at Flatiron Rock from 1910-1934, but Osborne estimated 10,000 birds nesting there in 1970. Sowls' et al. estimate for this site in 1979 was 24,000. Clay estimated 2,000 birds at Green Rock in 1941, compared to Osborne's (1972) estimate of 40,000 in 1970 and Sowls' et al. estimate of 55,000 in 1979-1980.

Following the era of intense depredation by man, the Common Murre population in northern California seems to have increased markedly from the 1940s to the late 1970s. By 1995, 26 murre colonies had been described in California, including 22 colonies used between 1979 and 1995 and 4 colonies extirpated earlier in the twentieth century (Manuwal et al. 2001). However, murre numbers in central California have declined substantially since the early 1980s; in this region, the birds currently exist well below historical population levels and distribution. Major declines occurred rapidly between 1982-1986, and low numbers have remained over extended periods of time following these declines. Limited increase has occurred in central California in recent years (Manuwal et al. 2001).

Threats and Management Implications

Nesting Common Murres are very sensitive to disturbance by boats, low-flying aircraft, and humans on foot. Adults may flush from colonies en masse when disturbed, knocking eggs and chicks from nest sites. Eggs and chicks which remain in view are subject to increased predation by aerial predators while adults are on the water or in the air; gulls and Common Ravens are the most frequent scavengers at such occurrences.

Incidental capture in gill nets was a serious problem in the mid-1980s along the c. California coast. The California Department of Fish and Game estimated 22,000 seabirds, mostly Common Murres, drowned in gill nets in waters opposite central California during the first nine months of 1983; the total for the entire year may have reached 30,000 (PRBO estimate, in Ainley and Boekelheide 1990). Stallcup (1990) stated that tens or maybe hundreds of thousands of murres were drowned in gill nets between 1983 and 1986. Takekawa et al. (1990) suggested that more than 75,000 murres died from 1979-1987 in central California as a result of gill net fisheries. With a change in fishery regulations, this problem is no longer as severe.

Common Murres are among the coastal North Pacific seabirds most at risk for mass mortality and weakening during oil spills. The *Puerto Rican* spill off San Francisco in November 1984 killed 1500-2000 murres (Ford et al. 1987), and the *Apex Houston* spill of February 1986, which impacted tens of thousands of seabirds between San Francisco and Monterey Bay, was responsible for the death of 6300-7500 murres (Manuwal et al. 2001).

Pigeon Guillemot *Cepphus columba* Pallas

Description

Pigeon Guillemots are medium-sized alcids of the North Pacific Ocean. They average 13.5" long with a 23" wingspan, and weigh 450-490 gm (Ainley and Boekelheide 1990, Sibley 2000). Adults in alternate plumage are all sooty-black except for a white upperwing patch partly bisected by a dark intrusion on the greater coverts. Their feet and gapes are bright vermilion. Basic-plumaged adults are dappled and flecked gray-and-white. Juveniles are a nondescript mix of white and dark markings, and are notable for exhibiting some variation from bird to bird (D. Fix, pers. obs.). They are known by their white wing-patch, blackish head, guillemot shape and bill, and chiefly inshore occurrence.

Nest

Pigeon Guillemots nest in coastal cliffs, caves, crevices, crannies, potholes, and in burrows; also under loose rocks or boulders and on rough talus slopes. They also nest in drain pipes, under wharf timbers, and within chafing gear on docks (Campbell 1977, Ainley and Boekelheide 1990). They are loosely colonial. Burrow excavation is accomplished with beak and claws. Eggs are placed on rock chips, pebbles, or debris gathered at the nest. Guillemots nest in small colonies. In some regions of the California coast, Pigeon Guillemots and Rock Doves may complete for nesting space (Sowls et al. 1980).

Eggs

Eggs: typically 2 (1-2), greenish-, bluish-white/white, marked with browns, blacks. One brood is raised per year (Ehrlich et al. 1988).

Incubation, Feeding, and Fledging

During a study of this species at the Farallon Is. from 1971-1982, the peak of egg-laying occurred in the last week of May (Ainley and Boekelheide 1990). Eggs are incubated for 29-32 days (first egg in clutch) or 26-32 days (second egg; Ainley and Boekelheide 1990). Short incubation shifts of 30 minutes to one hour each (maximum, 17 hours) are alternated by adults (Ehrlich et al. 1988).

Nestlings are semiprecocial; they develop most rapidly at between nine and twelve days of age. While dependent, they are fed whole fish by both adults. They fledge at 35-39 days (Ainley and Boekelheide 1990) at night, scrambling or fluttering down to the water while still without well-developed powers of flight. They swim and dive immediately, but may not be capable of strong flight for another 2-3 weeks (Kaufman 1996). Fledglings seen on inshore ocean waters in mid-summer are often seemingly unattended by adults (D. Fix, pers. obs.).

Feeding Behavior and Diet

Pigeon Guillemots dive from the surface and propel themselves underwater with their wings, pursuing fish, shrimp, crabs and mollusks. Dives times may reach 75 seconds (Ehrlich et al. 1988).

The bulk of their diet is small fish. Juvenile rockfish (*Sebastes* spp.), cottids, and *Citharichthys sordidus* were commonly-taken prey items in the long-term Farallon Is. study (Ainley and Boekelheide 1990). Near Kodiak they are known to eat small crabs (Krasnow et al. 1978, in Sowls et al. 1980). Polychaete worms and small octopi are stated to be taken as well (Kaufman 1996).

World Distribution

The Pigeon Guillemot nests from northern Japan around the Aleutian Is. arc and in the Bering Strait south along the Pacific Coast to southern California. It winters locally in protected nearshore waters (notably on Puget Sound and adjacent waters) and on the open ocean.

California Distribution

Pigeon Guillemots breed along the mainland coast and on offshore rocks and islands from the Oregon border s. to Santa Barbara Island. The population within the state is apparently highly migratory. After the breeding season, dispersal occurs, during which time (Sep-Oct) few or no guillemots are detected along most of the California coastline.

It is worth noting that the whereabouts of California's breeding Pigeon Guillemots in winter is not clearly perceived. Much speculation has been rewarded with few answers. Presently as well as historically, very few Pigeon Guillemots are seen on nearshore ocean waters from November to late February by either shore-based observers or those aboard boats, nor are beached birds routinely found. Twelve birds near the mouth of Tomales Bay, Marin Co., 31 January 1981 (LeValley and Evens 1981) constituted a large winter concentration. A representative report of a 'straggler' which was both late and unusually far south on the California coast was one at Carpentaria, Santa Barbara Co., 5 Nov 1986 (McCaskie 1987). It has been suspected by many seabird biologists that much of the population may shift northward in fall and winter, concentrating in the 'inland marine waters' of Washington and British Columbia (Ainley et al. 1990). Ultimately, Wahl and Tweit (2000) presented quite compelling evidence that guillemots breeding in California do in fact winter well north of the state. Those authors based their argument chiefly upon three related phenomena: near-total absence during late fall and winter during 316 one-day boat trips out of Grays Harbor, Washington from 1971-1999; observation of adults in post-breeding plumage flying north over the continental shelf in August and September along a route that "would be essentially a straight line from northern California and Oregon to the entrance of the Strait of Juan de Fuca"; and winter numbers in inland marine waters that are thought to be approximately twice as large as summer populations.

Following winter absence or near-absence, pairs begin arriving at nesting sites in February and March. They are found breeding in large aggregations up to 3000 birds, in smaller groups of only a few birds, or as isolated pairs scattered along the coast in suitable habitat (Sowls et al. 1980). A pair seen 16 April 1993 at East Marin I., well inside San Francisco Bay, indicates the potential for expansion into lower-estuarine environments (Yee et al. 1993). The situation of colonies is largely dependent upon quality and extent of nesting substrate and--as is true for all seabirds-- security from mammalian predators and human disturbance. Sowls et al. (1980) noted that delimiting 'colonies' per se is often difficult, especially in those regions where birds are spread along the coast.

An estimate of about 12,000 nesting birds is given in the Catalog of California Seabird Colonies (Sowls et al. 1980). The authors stated that they felt their estimate was conservative, dryly noting that "censusing Pigeon Guillemots is at best an inexact science." Sowls et al. (1980) stated that the Farallon Is. supported 3000 guillemots, marking this site as the largest breeding-season concentration in the state.

Sowls et al. (1980) noted that the coastline between Davenport and Pt. Santa Cruz is inhabited by about 1300 Pigeon Guillemots, and that Point Arguello, Fish Rocks, Castle Rock, Sugarloaf I., and Prince I. have large numbers as well. More than half of the sites investigated by those authors in the course of their 1979-1980 surveys had more than 30 birds.

Population Status and Dynamics

Few data pertaining to the historical status of the Pigeon Guillemot in California are available. On the Farallon Is. they escaped early persecution from commercial egg collectors provisioning the Gold Rush egg market in San Francisco, but later fell victim to oil pollution (Ainley and Lewis 1974). Their numbers reached an all-time F.I. low of 200 in 1911. Since then, that population recovered to 1000 birds in 1959, 2000 in 1972, and 3000 by 1980 (Ainley pers. comm. in Sowls et al. 1980).

Ainley and Boekelheide (1990) summarized colony attendance at the Farallon Is. It would seem that the following phenology generated there likely applies, with slight variation in timing, to the balance of the California coast.

Guillemots first appear in waters near prospective breeding sites in March at the Farallon Is. Ainley and Boekelheide noted that large numbers often appeared on the first day of their return. Early-season attendance at the colony site proper is restricted to morning and evening during both early-spring influx and the end of the breeding season; adults are commonly seen throughout the day at other times. Following initial arrival in numbers, population at the Farallons quickly reached a plateau maintained through July, except for a brief peak in June. The authors theorized that this June peak might represent an influx of immature birds. The size of the population present at the islands decreased rapidly following July, with few remaining to September. They noted that only 'the odd fledgling' in nearby waters was noticed in October (Ainley and Boekelheide 1990).

Ainley and Boekelheide (1990) indicated that 1000-1100 pairs occurred at the Farallons during the breeding season in 'normal', non-ENSO-influenced years from 1971-1982. Only 500 pairs were there in the breeding season during the warm-water year of 1978, and fewer than 50 during the pronounced ENSO event of 1983. Guillemots ultimately failed to occupy more than the ten percent of normal nest sites there in 1983 (LeValley and Evens 1983). No eggs were laid at the Farallons that year, pointing to the high bioenergetic costs of cessation of upwelling for populations of guillemots summering in waters of the California Current. The ENSO event of 1998 caused few birds to attend their usual nesting islands at Pt. Lobos, Monterey Co. (Roberson et al. 1998).

After fledging, young Pigeon Guillemots originating at the Farallon Is. move north at least as far as British Columbia. A few move south, but only as far as Monterey Bay (Ainley and Boekelheide 1990). Those authors noted that the northward movement is very rapid, evidenced by the recovery of banded fledglings in Oregon and Washington within weeks of their departure from the islands.

Threats and Management Implications

Pigeon Guillemots are not particularly prone to disturbance at colonies, owing to comparatively low densities and inaccessible nest sites. However, they will readily desert if disturbed during incubation or brooding (Sowls et al. 1980). Cairns (1980, 1984, in Ainley and Boekelheide 1990) felt that the critical periods for disturbance were during egg-laying and the first few days of the nestling period, when chicks are still brooded.

As is true for Common Murres, guillemots are highly vulnerable to oil pollution. They spend large amounts of time on the water and, especially during the breeding season, usually close to land where oil exploration and development are concentrated. Fortunately, as Sowls et al. (1980) noted, the population is widely distributed along the coast, so that any oil spill would most likely affect only local birds. If one surmises that rougher late fall and winter weather predisposes commercial shipping to some increased risk of accident, Pigeon Guillemots would appear to avoid this season of greater risk, as nearly all of the California population appears to move well away from the state's coast at that time of year. However, if (as Wahl and Tweit 2000 argue) many if not most California nesting birds winter in Puget Sound, on the Strait of Juan de Fuca, and associated 'inland marine waters', then the threat of contamination by oil may be much greater. Those waters support heavy ship traffic, four oil refineries, and considerable industrial activity. Each of these pose a distinct risk to such a concentrated wintering population putatively involving large numbers of California breeders.

During the period from October 1980 to August 1981, nearly 20,000 seabirds drowned in nets (set for halibut and other fishes) and washed ashore in central California. Many of these were locally-breeding birds. This dramatic fisheries by-catch resulted in the deaths of more Pigeon Guillemots on

Monterey Bay than were known to comprise the entire local population (Evens et al. 1982). Mortality on such a scale has not been repeated.

As are nearly all other seabirds breeding in waters of the California Current, Pigeon Guillemots are at risk of large-scale or even complete reproductive failure during pronounced warm-water ENSO events.

Xantus's Murrelet *Synthliboramphus hypoleucus* Xantus de Vessey

Description

Xantus's Murrelet is a small eastern North Pacific alcid of restricted distribution. Adults are 9.75" long with a 15-inch wingspan and weigh 6 oz. (Sibley 2000). The upperparts are dark with a grayish sheen; the underparts, including the underwing linings, are white. The bill is short, slender, and black. At sea, Xantus's Murrelets sit low in the water. They are often seen in pairs.

This species is polytypic, comprising two distinct forms, the southern-breeding *S. h. hypoleucus* and the more northern-breeding *S. h. scrippsi*. *Hypoleucus* Xantus's Murrelets are distinguished by a tiny 'breaking wave' of white in front of and above the eye, thus partly isolating the dark eye against the white face. Members of *scrippsi* show but a suggestion of this effect (a less apparent 'ripple'), with the white/dark line of demarcation extending in a cleaner line from gape to nape. Breeding birds in California are all *scrippsi*. Murrelets of the *hypoleucus* race are rare post-breeding visitors to offshore waters of southern California, with scattered records from Monterey Bay. Recent at-sea investigations by skilled observers aboard N.O.A.A. research vessels have found that *hypoleucus* Xantus's Murrelets may occur in significant numbers more than fifty miles off Oregon and Washington, a pelagic region in which they outnumber members of the northern *scrippsi*—suggesting that the two forms exhibit a 'leapfrog' post-breeding-season distribution.

This species and the closely-related Craveri's Murrelet (*S. craveri*) are thought to be reproductively isolated even though a small zone of sympatry exists in the San Benitos Is., Mexico (Jehl and Bond 1975). Further study of *hypoleucus* may shed light on its relationship to, and possible isolation from, the other two members of the southern *Synthliboramphus* superspecies.

Little was known about the life history of Xantus's Murrelet before intensive research was begun on the species in 1975 by Hunt et al. (1979). Much information in this account is taken from that study, as reiterated in Sowls et al. (1980).

Nest

On offshore islands in small colonies; sites are usually on high rugged slopes, often under large rocks or dense vegetation (Ehrlich et al. 1988). They also use rabbit and Burrowing Owl burrows, accumulation of debris, old Brown Pelican nests, and human-built structures (Hunt et al. 1979 in Sowls et al. 1980). Nests are well concealed in crevices, but irregular attendance can result in nearly half of all eggs being lost to deer mice (Kaufman 1996). The birds undertake no nest burrow excavation or nest construction. The eggs are laid on bare rock or in a shallow depression in soft substrate. Nest sites are commonly used by returning pairs in successive years (Kaufman 1996).

Five Xantus's Murrelets at Anacapa I. 24 February 1984, with 20 seen three days later, provides evidence for the arrival 'window' of returning breeders (McCaskie 1984).

Eggs

Two (range 1-2) eggs are laid, usually greenish with brown/lavender marks, occasionally light blue/dark brown with spots. Pattern varies within clutches. Eight days (range 5-12) ordinarily pass between the laying of each egg. One brood is raised per year (Ehrlich et al. 1988).

Incubation, Feeding, and Fledging

Both parents incubate for 34 (range 27-44) days (Sowls et al. 1980). Eggs are incubated beneath the wings, in contact with lateral brood patches on each side of the body (Sowls et al. 1980). Nest relief takes place every 3-4 (range 1-6) days. The nestlings are classified as Precocial 2 (Ehrlich et al. 1988). Parents do not feed young in the nest, as the young are present there for only one or two nights.

The young are extremely precocial for seabirds, fledging in the manner of other *Synthliboramphus* murrelets. Following a period of intense vocalization, the family emerges from the nest and adults lead the young a few feet downslope, then fly to sea. Now alone, chicks move to the cliff edge and jump or are blown off the cliff, with successful attempts ending up in surf as much as 200' below. Chicks waylaid during the night or attempting to leave nests during the day are quickly located and eaten by Western Gulls. Fledglings closely accompany the parents, who lead them well away from the nesting island. (Kaufman 1996).

Foraging Behavior and Diet

Xantus's Murrelets feed in the open ocean by diving from the surface and pursuing small fishes while using their wings for propulsion. They often forage in the immediate vicinity of their colonies during the breeding season, but disperse widely thereafter. Their diet is poorly known. In some areas in the breeding season, they eat mostly very small fishes (larval anchovies and others); small crustaceans are also taken (Kaufman 1996). Northern Anchovies, Pacific Saury and rockfish (family Scorpaenidae) are the most important prey species taken by these murrelets in the Channel Is. (Hunt et al. 1979 in Sowls et al. 1980). Of these, anchovies are the most important Their availability may dramatically influence the birds' breeding success (Hunt and Butler 1980).

World Distribution

The breeding range of Xantus's Murrelet is restricted to the Channel Islands and the west coast of Baja California, Mexico. A distinct northward movement is apparent beginning during the latter stages of the general breeding season. The scope and apparent intensity of this dispersal varies annually. Pairs or single birds are regularly seen on Monterey Bay and less frequently, but annually, well out to sea from the southern and central California coast. Historically, they had been recorded infrequently off the Oregon coast and occasionally in Washington and British Columbia; sightings in the two states have increased in recent years, likely the result of greater observer effort. They winter offshore as far south as southern Baja California (Ehrlich et al. 1988).

California Distribution

All colonies of Xantus's Murrelets known to exist in California are in the Channel Islands. Of greatest importance to the birds is Santa Barbara I., where 2000-4000 birds were estimated to breed (Sowls et al. 1980). G. L. Hunt, Jr. and others have conducted studies of this species' breeding biology and at-sea distribution at this site.

The remaining colonies of Xantus's Murrelet in California are small. Of these, Prince I. and Sutil Rock are the largest, each with 150 birds, followed by East Anacapa I. with fewer than 40 birds, Snag Rock with 30 birds, and Gull Rock with two birds (Sowls et al. 1980). This species probably also breeds at Scorpion Rock and Castle Rock. Small numbers may occasionally breed at other locations in the Channel Islands (Hunt et al. 1979).

Most intriguing is the possibility that 'stealth' breeding may have occurred—or may yet be occurring--opposite the central California coast. Xantus's Murrelets were recorded on all five birding boat trips to beyond the Cordell Bank, northwest of the Farallon Is.,1 June-13 July 1986, and a pair was seen near the islands 2 June 1986. In this light, the observation of an adult Xantus's

accompanying a fledgling 4 miles west of Pt. Joe, Monterey Co., 8 August 1986 (Bailey et al. 1987) furnished reasonably compelling evidence that at least one pair bred somewhere in the area. Five sightings of the species near the Farallons and offshore Monterey Bay during the period 7 March-19 May 1990 (Yee et al. 1990) provided additional data for speculation. An adult mist-netted at night at Año Nuevo Reserve, San Mateo Co., in late May 1998, was strongly suggestive of breeding activity (Roberson et al. 1998).

Population Status and Dynamics

Xantus's Murrelets spend much of the year well offshore, returning to land to nest. They are active at night during the breeding season, spend daylight hours either in the nest or foraging at sea. Other colony activities such as nest-site selection, incubation shift changes, and fledging all occur at night (Hunt et al. 1979). Numbers present at the colonies drop sharply in midsummer, with many of these birds evidently going north at least to the central California coast. A few are present off southern California all year, but they are commonly seen mainly from March through July. Their whereabouts in winter are poorly known.

During late summer and into the fall, variable numbers of Xantus's Murrelets visit Monterey Bay and waters to seaward. Occurrence and abundance at Monterey Bay is thought to be correlated with fluctuating water temperature. They are most numerous there from August through October (Zimmer 1985). However, Xantus's Murrelets clearly can appear north of the southern California coast earlier in the year. Fifteen were north to the Cordell Banks area 23 June 1985, and smaller numbers persisted off Monterey and Marin counties during the same period (Campbell et al. 1985).

Suggesting that some numbers were apparently present in May 1983 in central California coastal waters were six observations of 1-2 birds at Cordell Bank, about the Farallon Is., at Bodega Harbor, and at Pt. Lobos (Evens et al. 1983). Two Xantus's Murrelets were 18-20 miles off Monterey Bay 17 May 1987 (Campbell et al. 1987). A few are sometimes seen in central California offshore waters in winter. For example, six were seen 6 December 1986-24 January 1987 inshore and offshore Monterey Bay, and another was at the Farallon Is. 18 Jan 1987 (Morlan et al. 1987).

At-sea observations by biologists and birders have revealed that a few pairs of Xantus's Murrelets may be expected well offshore in late summer—generally no closer than the outer continental shelf, generally 15-40 miles out, and sometimes 100 or even 200 miles from land. Unlike most alcids breeding in California, they are rarely seen from mainland points along the coast (Kaufman 1996).

The population of these birds on Santa Barbara I. is apparently recovering from a drastic decline. Between 1897 and 1908, feral cats (*Felis catus*) were introduced onto the island. Few data on the size of the murrelet population prior to the cats' introduction exist, but Sumner (1939) states, "at one time large colonies of auklets and murrelets were present on the island, but none have been recorded in recent years and it is supposed that they have been exterminated by these feral cats." Through targeted control measures, by 1975 the cats were reduced to perhaps a single animal and Xantus's Murrelets are now some of the most abundant breeding seabirds on the island (Hunt et al.1979). This colony at least partially recovered during the mid to late 20th centry (Hunt et al. 1980 and McCheney and Tersy 1998 in PSG 2002).

The worldwide population is currently estimated between 5,000-11,500 breeding birds, 2,500-2,800 of which breed off the California coast (PSG 2002). In 1991 population estimates were 51.4% lower than1975-1978 estimates (Carter et al 1992 in PSG 2002). Models derived from these estimates indicate a 2.5-5.3% decline per year from 1977 to 1991 (Hunt et al. 1981, Carter et al. 1992 and Sydeman et al 1998 in PSG 2002). Furthermore, the Channel Islands National Park seabird monitoring program has recorded declining annual use of moitored nest sites since the early 1990's (Wolf et al. 2000 in PSG 2002). In April 2002 the PSG (Pacific Seabird Group) submitted petitions to

the federal and California state governments for the listing of the Xantus's Murrelet under the Endangered Species Act.

Threats and Management Implications

Major threats identified by the PSG include non-native predators, oil pollution, native predators and artificial light pollution (Drost and lewis 1995, Carter et al. 2000 and Roth and Sydeman 2000 in PSG 2002). Artificial light pollution includes bright lights attached to on shore and offshore oil platforms; fishing, diving and pleasure boats; and commercial fishing vessels (Carter et al. in PSG 2002). Many nocturnal seabirds, including murrelets, are attracted to bright lights at night and are known to land on the decks of boats. This behavior causes them to become disoriented and can lead to injury or death. Other threats include human disturbance at colonies, oceanographic and prey changes, military operations, bycatch in fisheries (PSG 2002).

An insular subspecies of Deer Mouse (*Peromiscus maniculatus*) resides on each of the eight large Channel Islands (Nelson and Goldman 1931). They are known to prey on eggs and possibly the chicks of Xantus's Murrelet, but their presence is not a deterrent to successful reproduction (Hunt et al. 79, Winnet et al. 1979). The Island Fox (*Urocyon littoralis*) is present on all large Channel Is. except Anacapa and Santa Barbara I., the only two islands with large seabird colonies. The presence of foxes on the other large islands may account for small populations of seabirds there (Sowls et al. 1980).

Because Xantus's Murrelets spend much time on the water and dive for food, they are at risk from effects of oil spills. Because adults and recently-hatched chicks are concentrated for a period of time during the nesting season, a localized spill around any of their breeding sites might result in a significant population loss.

Cassin's Auklet *Ptychoramphus aleuticus* Pallas

Description

Cassin's Auklet is a small, compact and abundant small alcid of cooler North Pacific waters. It averages 8.5" in length with a 15" wingspan and weighs 160-170 gm as an adult (Ainley and Boekelheide 1990). Adults and juveniles are similar in having dark gray plumage relieved only by a whitish belly, a brief strip of paler gray under the wing, and a tiny whitish arc immediately above each eye. Sexes are not dimorphic and are essentially identical, though males have larger bills (Nelson 1981, Knudsen 1976 in Ainley and Boekelheide 1990). Juveniles have a somewhat paler throat (Sibley 2000).

Nest

Cassin's Auklets nest on rocky or turf-capped offshore islands, in isolated cliffs, and occasionally in caves (Ehrlich et al. 1988). The nest site is in a burrow or crevice on a slope or in a relatively flat area. The entrance is often obscured. Burrows are excavated by both adults, using bill and claws; males have been found to take the most active role (Ainley and Boekelheide 1990). Excavation may be interrupted by bowing, calling, and fighting with neighbors (Ehrlich et al. 1988). Burrows may reach two meters in length. In talus and rock, pairs use any suitable cavity (Ainley and Boekelheide 1990).

A study on the Farallon Is. revealed that 40% of Cassin's Auklets breeding there used natural crevices, with the balance of pairs occupying burrows (Manuwal 1974a, b in Ainley and Boekelheide 1990). At the Farallons, highest nest density involved burrows in sites where a layer of deep soil is protected by thick annual vegetation, reaching one burrow entrance per square meter of surface area

(Ainley and Boekelheide 1990). Eggs are laid on twigs and nest remnants. These auklets exhibit strong nest site tenacity and long-term pair bonds (Ehrlich et al. 1988).

Eggs

1 egg, creamy white, unmarked, often nest-stained. One brood is raised per year, occasionally two (Ehrlich et al. 1988).

Incubation, Feeding, and Fledging

The egg is incubated for an average of 39 days (Ainley and Boekelheide 1990). Male and female share incubation duties about equally (Ainley and Boekelheide 1990), with 24-hour shifts by each (Ehrlich et al. 1988). Pairs will readily replace a lost egg, and will, under certain circumstances, lay a second egg after fledging the first chick—a behavior unique among auklets (Ainley and Boekelheide 1990). Survival of second-egg fledglings was found to be significantly lower than for first-egg fledglings (Ainley and Boekelheide 1990).

The young is semiprecocial, covered in down, and is able to thermoregulate within a few days. The chick avoids light and is alone in the burrow after hatching, but is guarded alternately by each adult for the first to five days of life (Ainley and Boekelheide 1990). It is fed by both male and female. Cassin's have throat pouches that they fill with food before returning to the colony to feed chicks (Ainley and Bokelheide 1990). The nestling is fed pigeon-milklike regurgitant, small marine invertebrates and larval fish until fully fledged.

As fledging approaches, the chick often visits the nest entrance, occasionally takes short walks, and flaps its wings (Ehrlich et al. 1988). The nestling fledges at 80%-90% of adult weight at an age of 41 days (Ehrlich et al. 1988), a period longer than that of other auklets. Ainley and Boekelheide (1990) surmise that the longer incubation and nestling period for Cassin's Auklet are likely the result of a slower rate of chick growth and food demand; one nocturnal visit by a provisioning adult each night is a limiting factor. Fledglings are independent of adults at fledging, and must learn to find food and forage efficiently on their own (Ainley and Boekelheide 1990).

Feeding Behavior and Diet

These auklets dive from the surface of the ocean, pursuing small marine creatures by using their wings for propulsion. Euphausiids (chiefly *Thysanoessa spinifera*) were found to be targeted by Cassin's nesting at the Farallon Is. (Ainley and Boekelheide 1990), contributing a major share both by number of prey items consumed and as a percentage of total weight in the diet. Small fish, while offering an outsize return on calories relative to euphausiids, were consumed less frequently, comprising about 5% of diet by capture number at the Farallons (Ainley and Boekelheide 1990). Ehrlich et al. (1988) state that other zooplankton, squid, and marine insects are dietary components, and Kaufman (1996) notes that amphipods and copepods are also taken. Diet indicates that foraging is performed in mid-water column.

As are auklets in general, Cassin's are considered offshore feeders (Sealy 1972, in Ainley and Boekelheide 1990). They may commute a considerable distance to and from favored foraging sites during the nesting season. A foraging flock of 2000 auklets over the west slope of the Cordell Bank in mid-breeding season was thought to consist of 'local' Farallon I. breeders (Campbell et al. 1985).

World Distribution

Cassin's Auklets are among the most widespread alcids of the North Pacific Ocean. They breed from the Aleutian Is. through the Gulf of Alaska and southward to Baja California, frequenting primarily offshore waters, but occur to varying extent in nearshore waters (D. H. S. Wehle, in Farrand 1983). They are characterized by Ainley and Boekelheide (1990) as largely confined to the 'upwelling

domain' of the eastern North Pacific (Favorite, Dodimead, and Nasu 1976, in Ainley and Boekelheide 1990). A southward movement of northern birds from Oct-Dec has been noted along the Oregon and California coasts (D. Fix, pers. obs.). Southern breeders may remain near the colony site throughout the year (Kaufman 1996). Alone among the world's six auklet species, Cassin's frequents waters that are not covered or influenced by winter pack ice (Ainley and Boekelheide 1990).

California Distribution

Along the California coast, Cassin's Auklets breed from Castle Rock, Del Norte Co., south to the Channel Islands. An estimated 237,170 birds occupied ten sites at the time of the fieldwork summarized in Sowls' et al. Catalog of California Seabird Colonies (1980).

Of the known colonies in the state, that present on the Farallon Is. is by far the largest, involving a population generally estimated at 135,000 (Ainley and Boekelheide 1990). However, this does not include a population of 'special nonbreeders' or 'floaters' hypothesized to exist by Manuwal (1972, 1974b, in Ainley and Boekelheide 1990); this segment of the overall population is described as consisting of potential breeders unable to nest owing to a bird-satured substrate ashore. This additional *ca*. 36,000 auklets would bring the total population, excluding nestlings, to some 171,000 during the breeding season (Ainley and Boekelheide 1990).

Of the estimated 23,000 Cassin's nesting in the Channel Is., 20,000 are found on Prince Island. Castle Rock, Del Norte Co., supports a nesting population estimated at 3600 birds (Sowls et al. 1980).

The only known breeding Cassin's Auklets between South Farallon I. and the Channel Is. are located at Ano Nuevo I., San Mateo Co. (Thayer et al. 1999), and in the Castle/Hurricane complex of rocks in Monterey Co. (McChesney et al. 2000). Both of these populations are very small, and each was discovered only recently. While the Ano Nuevo I. colony is known to have been initiated during the period of time that island's seabirds have been intensively studied, auklets nesting at the Castle/Hurricane complex may have done so prior to investigations undertaken by McChesney et al. (2000).

Population Status and Dynamics

Cassin's Auklets are likely the most pelagic of all California alcids (Hunt et al. 1979). They spend a great deal of their lives on the open ocean, returning to land only to breed. They feed during the day, but--aside from hidden incubating birds and nestlings--are active in the nest colony only at night. Their nocturnal behavior at and near breeding colonies minimizes the threat of gull predation. For these reasons the species is difficult to census, causing perception of any subtle shift or trend in population distribution and numbers to become masked by vagaries of observer effort.

Seasonal movements of California birds are not well understood, although the distribution of banding returns (*n*=thousands) have firmly indicated that the Farallon Is. auklets are localized and sedentary (Ainley and Boelkelheide 1990). Whether this dynamic applies to other colonies in California is an area open for investigation. Wintering birds of the northern California coast are found within ten and fifty miles offshore (Manuwal 1974a, Yocom and Harris 1975, in Sowls et al. 1980). Most begin breeding when two to four years old. They are thought to live ten to twenty years (PRBO unpubl. data, in Ainley and Boekelheide 1990).

Most auklets are diurnal but the exception is Cassin's Auklet, which is strictly nocturnal. Sealy (1972, in Ainley and Boekelheide 1990) argued that colony visitation patterns evolved largely in response to daily cycles in the availability of suitable prey, and secondarily in response to the habits of predators.

Cassin's Auklets were rare on the Farallon Is. during the mid-nineteenth century. Ainley and Lewis (1974, in Sowls et al. 1980) relate this scarcity to a period of more than two decades when warm, tropical water moved north along the California coast. They hypothesized that populations of Cassin's increased when cold water returned to the region. Cassin's Auklets are now the most abundant birds on the Farallons.

Ainley and Boekelheide (1990) note that, through its distinct preference for colder waters, Cassin's is a 'subarctic' alcid, *contra* the characterization of Ashmole (1971) and Manuwal (1984), who stated that the species nests from subarctic to subtropical waters. The former authors point to the concentration of activity throughout the year which takes place in the coastal side of the California Current, particularly in waters affected by strong colder upwelling, and to the dense concentrations regularly encountered in waters above the continental slope.

Osborne (1972, in Sowls et al. 1980) estimated that the number of Cassin's Auklets on Castle Rock increased from 100 seen in 1959 by Thoresen (1964) to 3600 in 1970. Cassin's formerly bred on Flatiron Rock, Humboldt Co., as late as 1934 (Clay, unpubl. field notes in Sowls et al., 1980). Osborne (1972, in Sowls et al. 1980) believed that soil erosion was the principal reason for their extirpation from this island.

Threats and Management Implications

Western Gulls prey heavily on Cassin's Auklet at Castle Rock and at the Farallon Is. (Thoresen 1964). Young are pulled by gulls from shallow burrows. Adults are killed at night when they unfortunately land at the feet of roosting gulls (Thoresen 1964) or in early morning if they have lingered at the colony too late (R. LeValley, pers. obs.). Cassin's Auklets are vulnerable to disturbance from humans and to the effects of introduced predators such as rats. They may desert their nests if disturbed during incubation, and their burrows can easily be caved in by unwary visitors to their colonies.

These auklets feed from the ocean surface in large social flocks where they are highly vulnerable to oil contamination (Hunt et al. 1979). An oil spill near the Farallon Is., where 80% of the state's population breeds, would be particularly damaging to this species.

It is apparent that, as burrow nesters, Cassin's Auklets need a sufficient mantle of soil in order to sustain viable populations. Increasing numbers of Double-crested Cormorants breeding and loafing on offshore rocks and islands may degrade soil through the impact of phosphorus-rich guano on vegetation. The recent surge in Brown Pelican numbers on the California coast during the nonbreeding season may also pose the threat of trampling and soil compaction.

Rhinoceros Auklet *Cerorhinca monocerata* Pallas

Description

The Rhinoceros Auklet is a medium-large alcid of colder North Pacific waters. Although called an auklet, it shares morphological characteristics and life history adaptations typical of puffins as a group (Ainley and Boekelheide 1990); for these reasons, it has been described as a misnamed puffin. An alternative name for the species is Horn-billed Puffin (American Ornithologists' Union 1983).

These birds average 15 inches in length with a 22" wingspan and weigh 1.1 lb (Sibley 2000). Overall, the plumage is dull gray with a paler belly. No contrasting wing pattern is evident in flight. Its dusky plainness and unwavering flight, body held consistently parallel to the water, have earned the Rhino the nickname 'flying football' among shore-based observers watching the birds at a distance.

Breeding adults acquire two thin, wispy white plumes which trail from behind the eye and from the base of the bill. The bill in breeding season is yellowish, adorned above with a short, projecting nubbin, giving the species its name. The plumes and the 'horn' are shed during the prebasic molt in early fall; until the following prealternate molt, adults are unadorned and quite plain. The irises of adults are pale whitish throughout the year. Juveniles have dusky eyes and distinctly smaller bills than adults, and lack the facial plumes and 'horn'.

Nest

Rhinoceros Auklets nest on offshore rocks and islands and, locally, on mainland cliffs. They prefer rocky, shrub- or grass-covered slopes, nesting on a wide range of slope gradients. Ocean-facing or wooded, turf-covered banks are used when available (Sowls et al. 1980). Throughout most of the species' range, nests are chiefly situated in burrows dug into the ground on both forested and unforested islands. Burrows are dug by both adults (Sowls et al. 1980). On wooded islands, the burrow entrance is usually near a stump, tree, or beneath a log (Ehrlich et al. 1988). The tunnel is up to 6m in length; it often forks two or three times before ending in a nesting cavity (Heath 1915, Willett 1915, in Sowls et al. 1988). The actual nest is of minimal twigs, moss, or ferns, formed into a shallow saucer (Ehrlich et al. 1988). Well-studied birds on the Farallon Is. are not known to dig their own burrows (Ainley and Boekelheide 1990); many pairs there occupy natural cavities.

An Oregon nesting colony is situated within a large mainland marine grotto, Sea Lion Caves (Scott et al. 1974, Varoujean and Pitman 1980, in Sowls et al. 1980). Occupation of conglomerate cliffs at Point Arguello indicates that this species also nests in rocky mainland habitats.

Mutual billing maintains the pair bond among breeding adults. Burrow defense and ownership are proclaimed by standing upright, often with wings partly spread, bill open and pointing up while hissing (Ehrlich et al. 1988).

Eggs

These alcids lay one egg, weighing 15% of adult body weight (Ainley and Boekelheide 1990), which is dull white, unmarked or marked with lavender/gray/browns, and occasionally wreathed (Ehrlich et al. 1988). One brood is raised per year.

Foraging Behavior and Diet

Rhinoceros Auklets pursue prey below the ocean surface by diving and propelling themselves underwater with their wings. They eat fish, especially schooling species such as sardines and anchovies. Sand lance, herring, rockfish, smelt, and saury are also taken (Kaufman 1996). They also consume marine inverebrates such as crustaceans (Sowls et al. 1980, Erlich et al. 1988) and cephalopods (Heath 1915, Richardson 1961, Leschner 1976, in Sowls et al. 1980). Pursuit-diving elicits tight schooling of prey, concentrating them toward the surface. Sharpe (1995) presented evidence indicating that Rhinoceros Auklets may create 'bubble nets' to concentrate prey fishes.

These auklets commonly forage in mixed-species flocks (Ehrlich et al. 1988), and are quick to notice and take advantage of 'feeding frenzies' (Heath 1915, Richardson 1961, Leschner 1976, in Sowls et al. 1980). Once present at the scene of a frenzy, an individual aggressively repositions itself over the surfacing masses of small fish with short flights characterized by frequent takeoffs and adroit landings, repeatedly placing itself in the midst of shifting prey concentrations (D. Fix, pers. obs.).

Incubation, Feeding, and Fledging

Male and female incubate the single egg for 42 days (Ainley and Boekelheide 1990) (range 39-52 days, Ehrlich et al. 1988). Each adult usually incubates for 24 hours before relief (Ehrlich et al. 1988). The nestling is semiprecocial, and is brooded for about four days (range 0-9), whereafter it is

able to thermoregulate (Sowls et al. 1980). It is fed whole fish by both adults. Fish are carried in the bill, and are typically brought to the colony in the evening, although some food items are delivered during the day (Ehrlich et al. 1988, Ainley and Boekelheide 1990), and adults may move about burrow entrances by day (Scott et al. 1974, Thoresen 1983, in Sowls et al. 1980). Nestlings fledge at 48-55 days (Ainley and Boekelheide 1990) at 64%-68% of adult weight (Sealy 1972, in Ainley and Bookelheide 1990).

World Distribution

Rhinoceros Auklets breed from northern Japan through the Aleutian Is. and the Gulf of Alaska southward along the Pacific Coast to central California. In California, the species is present throughout the year; however, these birds are more commonly seen from shore or in nearshore marine waters during spring and summer. Despite the occasional occurrence of thousands on Monterey Bay and many elsewhere along the open coast, only a very small proportion of the world population of this species is found in California.

California Distribution

Rhinoceros Auklet colonies are difficult to find and census. Adults almost always enter and leave colonies at night when feeding chicks. This predominantly nocturnal behavior may have evolved as a means to reduce kleptoparasitism by gulls. In California and Oregon, Rhinoceros Auklets can often be observed on or near colonies by day, but farther north they appear to be strictly nocturnal. This regional difference remains unexplained, but may be related to the availability of food and its proximity to colonies (Sowls et al. 1980). Difficulty in censusing these birds, along with an apparent expansion into unoccupied habitat in the late 1980s, causes an overview of its California distribution to require comparison to the Catalog of California Seabird Colonies (Sowls et al. 1980).

During those authors' 1979-1980 surveys, Rhinoceros Auklets were known from eight sites in the state, but breeding had been confirmed at only three: Prince I. and Castle Rock in Del Norte Co., and at the Farallon Islands. Those investigators estimated a statewide breeding population of 362 birds. At the remaining five sites at which breeding was not confirmed, they observed auklets in breeding plumage on or near the colony and suspected that nesting was occurring. These sightings involved up to five birds on Green Rock, Humboldt Co., at one time, with birds observed entering burrows on several occasions, and as many as 38 auklets on the water next to or flying in the vicinity of the rock. Apparent occupation there continued until at least as recently as 26 April 1997, when one bird was noted at a burrow entrance (Roberson et al. 1997).

Forty-one percent of the California population of Rhinoceros Auklets was believed to nest at the Farallon Is. at the close of the 1980s (Ainley and Boekelheide 1990). About 100 auklets were suspected to breed there and the population was thought to be expanding (Ainley pers. comm.; see Population Status and Dynamics, below). The percentage of the state population nesting on the Farallons has since likely changed, as noted below.

Sowls et al. (1980) reported that at Gualala Point I., Fish Rock and Arched Rock, the presence of birds on the water immediately adjacent to the rock, 'fly-bys', and the presence of suitable burrows strongly suggested breeding at those sites. Those investigators also suspected Rhinoceros Auklets of breeding at Little River Rock, citing Harris (pers. comm. to Sowls et al.).

Additionally, they felt that Point Arguello may support a mainland colony of nesting Rhinoceros Auklets in California, as they observed a maximum of 24 birds there on 11 June 1980. A minimum of 13 birds were discovered entering and leaving small caves in the cliffs on 17 and 18 July 1980. An examination of these caves was inconclusive (Sowls et al. 1980). However, the presence of at least seven alternate-plumaged auklets there all summer in 1981, with four seen to enter and/or leave burrow entrances, was interpreted as 'strong evidence' of breeding by McCaskie (1981).

Rhinoceros Auklets were first detected breeding at Castle Rock upon discovery of one nest in 1917 (Sowls et al. 1980). Osborne (1972) surveyed Castle Rock in 1969-1970 and estimated a population of between 100-150 auklets at that site (in Sowls et al. 1980). He revisited the island in 1977 and felt that the population had increased to 200 birds (Osborne, pers comm., in Sowls et al. 1980).

Sowls et al. surmised that small numbers of these birds likely occurred at several more sites, particularly in northern California. Those authors' suspicions were borne out in subsequent years. Rhinoceros Auklets were seen carrying fish near Año Nuevo I. in June and July 1982 (LeValley and Evens 1982) and throughout the summer of 1983 (LeValley and Evens 1983), strongly suggesting local nesting. Twenty-three active burrows were discovered in 1986 (G. Strachan), marking this as the southernmost colony at which breeding had been confirmed with physiological evidence.

In an attempt to overcome the limitations of existing substrate at Año Nuevo, artifical burrows were installed in spring 1987; one-half of these were promptly occupied, with an estimated 20 pairs total breeding there in both natural and artificial burrows that year (Campbell et al. 1987). This 'new' population has enjoyed success, judging from the 97 nests found by researchers during the 1993 breeding season (Yee et al. 1993).

Also in 1986, as many as 11 Rhinoceros Auklets were suspected of nesting on the mainland at Point Reyes. In 1987, nesting was attempted on two mainland cliffs in Santa Cruz County. One site had two pairs copulating, with one carrying fish by 29 May; three other probable nesting pairs were noted there as well. Four miles north of that site, two pairs were displaying and landing on a cliff (Campbell et al. 1987).

Population Status and Dynamics

Rhinoceros Auklet populations in California are within the southernmost portion of the species' range in the eastern Pacific. This case is closely mirrored by several other alcid species characteristic of colder North Pacific waters. The cool California Current and nearshore cold-water upwelling associated with the continental slope allows such northern seabirds to inhabit lower-temperate latitudes. Both this species and the closely-related Tufted Puffin occur in far smaller numbers in California than in Alaska.

In a broad sense, Rhinoceros Auklets are resident in California, but the population is thought to be shifted generally offshore over waters of the continental slope and westward--and possibly southward--in winter. During fall, variable numbers are routinely encountered over the mid- and outer continental shelf and slope by birders observing aboard boats originating from most California ports. These birds can be numerous in fall on Monterey Bay and in some years, following fledging of young, in and about the harbor at Crescent City.

The attraction of this auklet to food-rich waters resulting from upwelling within the Monterey Submarine Canyon causes large numbers to linger in some winters; 2500 were seen flying seaward from Monterey Bay at dawn on 27 February 1984 (LeValley and Rosenberg 1984). During January 1986, at least 9500 auklets were concentrated with Common Murres and other seabirds on Monterey Bay, the largest number seen there in about ten years (Campbell et al. 1986). Some birds are known to occur as far south as southern Baja California in winter (Ehrlich et al. 1988). Small flocks of Rhinoceros Auklets moving in migration, both in spring and fall, can frequently be seen from shore points with telescopes (m.ob., *fide* D. Fix). Such flocks are reported by boat observers from waters of the continental shelf and beyond.

Sowls et al. (1980) noted that significant increases in numbers had been observed at the two largest colonies (at Castle Rock and on the Farallon Is.), and that auklets had been found breeding or were suspected to breed at six additional sites. They stated that those increases, together with the discovery in the 1970s of 'new'nesting sites in Oregon (Scott et al. 1974, Varoujean and Pitman

1979) and in British Columbia (Hatler et al. 1978), indicated that this population increase might be widespread along the west coast of North America.

The historical picture at the Farallons is intriguing. Following the collection of several scientific specimens during 1860s, none was detected possibly breeding there for more than a century. The species' reappearance in 1972—two pairs, which may have bred (Ainley and Lewis 1974 in Ainley and Boekelheide 1990)—was followed by steady increase. Aside from increased mortality during the ENSO event of 1982-1983, population growth at the Farallons has been steady. Ainley and Boekelheide (1990) note that, while extermination of rabbits has caused potential nesting cavities to become available, the growth rate in the Rhinoceros Auklet population at the Farallons is such that augmentation through recruitment of birds from elsewhere--most likely to the north of California--is suggested.

Threats and Management Implications

Rhinoceros Auklets are very sensitive to disturbance during the nesting period. Adults will readily desert their nests if disturbed during incubation or brooding. Their burrows are often near the surface of the ground and are easily collapsed.

Like all alcids, Rhinoceros Auklets are vulnerable to the effects of oil spills. Sites at which they concentrate during the breeding season lie near- or on-shore, with foraging occurring within the route traveled by commercial shipping. Oil slicks or other pollution in the vicinity of colonies could affect a large portion of California's breeding population. During winter, California waters support large numbers of these auklets, many from colonies farther north (Briggs 1980, in Sowls et al. 1980). The *Apex Houston* spill event of February 1986 killed hundreds of Rhinoceros Auklets on Monterey Bay (Campbell et al. 1986). Oil pollution has been reduced significantly in the Gulf of the Farallones, and in 1974 rabbits were eliminated from Southeast Farallon Island. Rabbits had occupied all but the most precipitously situated cavities suitable for Rhinoceros Auklet (as well as Tufted Puffin) nesting (Ainley and Boekelheide 1990).

Tufted Puffin *Fratercula cirrhata* Pallas

Description

The Tufted Puffin is among the most striking North American birds. It is one of the larger auks, 15" long with a 25" wingspan and weighing about 1.7 lb (Sibley 2000). Adults in the breeding season are black with a white face; staring yellow eyes; a large, deep, laterally-compressed orange bill; and wispy yellowish 'flaxen' plumes trailing from above each eye, decurving at the nape in a loose curl. In late fall, winter, and early spring (when seldom seen) they lack the white face, brilliant bill sheaths, and head plumes. Juveniles are essentially similar to basic-plumaged adults, but have smaller bills.

Nest

Tufted Puffins usually nest in burrows at the edges of cliffs or on the grassy slopes of islands. Those nesting in California also use crevices, cavities, or small caves found in loose sandstone or unconsolidated conglomerate rock (Sowls et al. 1980). They prefer some slope or altitude to their sites, perhaps to aid their takeoffs (Ainley and Boekelheide 1990). Burrows (when used) are excavated by each member of a pair (Ehrlich et al.1988). They tend to be shallow, from 2 ft. to 9.5 ft. in length, and the tunnel ends in a chamber. They occasionally lay the egg on a simple pile of grass and feathers, in rock piles, or rarely under matted vegetation, forming a saucer-shaped nest with a rim of marine vegetation (Sowls et al. 1980). Straw for nest-lining is often stolen from the nests of gulls.

Tufted Puffins are active at the colony during the day and at dusk; unlike the auklets, they do not rely upon cover of night to arrive at or depart from the nest site. As fish feeders, they nest somewhat later in the season than plankton feeders (Ainley and Boekelheide 1990).

Eggs

One egg is laid, which is bluish-white/off-white, marked with gray/light brown, and occasionally wreathed. One brood is raised per year (Ehrlich et al. 1988).

Incubation, Feeding, and Fledging

The Tufted Puffin has the longest incubation period of any alcid, about 45 days. The nestling is semiprecocial, but develops slowly. The slow rate of chick development is presumed to be an evolutionary response to the parents' far-ranging foraging sorties and consequent reduced provisioning capabilities (Ainley and Boekelheide 1990). Both parents feed the nestling, carrying fishes in their bills and dropping them on the ground in the nest or near the entrance. One-two days may pass between feeding visits to the nest (Kaufman 1996). The young bird fledges at about 43 days of age (Ainley and Boekelheide 1990) at 64%-68% of adult weight (Sealy 1972, in Ainley and Boekelheide 1990). Fledglings appear to leave their burrows and go to sea only under cover of darkness (Sowls et al. 1980).

Shortly after the young have fledged, both fledglings and adults head far out to sea. The annual late-summer exodus is quite abrupt. Ainley and Boekelheide (1990) related that none had been seen at the Farallon Is. after September. The few persisting along the extreme northern California coast are seldom seen as late as late August (D. Fix, pers. obs.). With the exception of Xantus's Murrelet, this wholesale dispersal scenario is in contrast to that of other alcids breeding in California.

Foraging Behavior and Diet

Tufted Puffins forage by diving from the surface, pursuing small fishes by using their wings for propulsion. Fish taken include saury, sand lance, capelin, rockfish, and smelt. They have been reported to eat some crustaceans, mollusks, sea urchins, small squids, and small amounts of algae (Kaufman 1996). Following capture, prey fish are carried crosswise in the bill. As many as a dozen small fish—often nearly alternating head-and-tail orientation—may be carried to the nest by each parent following an individual foraging bout.

World Distribution

Breeds from Hokkaido, the Sea of Okhotsk, and Chukotka through the Bering Strait, the Aleutian Is., and southward on coastal islands, rocks, and locally on the mainland coast south to central (formerly southern) California. The general center of abundance appears to be the Gulf of Alaska and the Aleutian Is.(Sowls et al. 1978). Most of the population is suspected to winter chiefly over deep water far out to sea in the temperate North Pacific Ocean.

California Distribution

Tufted Puffin is the least common alcid nesting in California. An alcid of cold northern waters, it is a distinctly less prevalent component of the California breeding seabird avifauna than it is in Alaska. In a general sense, this species has suffered significant declines in California within historic times. However, localized increases have been noted in recent decades.

In their Catalog of California Seabird Colonies, (1980), Sowls et al. list 14 sites at which Tufted Puffins have been recorded. Their 1979-1980 survey effort detected puffins from Prince I., Del Norte Co., south to Hurricane Pt. Rocks at the northern tip of the Big Sur coast. They note, however, that confirmation of breeding was recorded for only five of these locations: Prince Island, Castle Rock, Green Rock, Puffin Rock, and the Farallon Is. With the exception of Little River Rock, Tufted

Puffins were observed near burrows at the remaining sites: Sugarloaf I. off Cape Mendocino, Goat I. opposite (town of) Mendocino, Van Damme Cove, Fish Rocks, Arched Rock, Pt. Reyes, and Hurricane Pt. Rocks. At least one pair of puffins continued to nest at Goat I. in 2000 (Roberson et al. 2001). Although Harris (1974) listed Tufted Puffin as a possible breeder on Little River Rock, where the habitat appears suitable, Sowls et al. did not observe birds there. Tufted Puffins were regularly observed at Piedras Blancas Rock in 1979 (M. Rauzon, pers. comm. in Sowls et al. 1980) but not in 1980 (R. Jameson pers. comm. in Sowls et al. 1980); however, one was seen from Pt. Piedras Blancas 30 May 2000 (McCaskie and Garrett 2000).

The largest puffin colonies in California are on Castle Rock and at Southeast Farallon I. Surveys of 1979-1980 revealed that each site supported about 100 birds (Sowls et al. 1980). All remaining locations contains ten or fewer birds. It is believed that most puffin colonies in California have been identified, but Sowls et al. suggest that a few undocumented pairs may be present at scattered locations, primarily in northern California.

By all accounts, the Tufted Puffin's range in California contracted north during the twentieth century, and, not surprisingly, its population declined in size. Notably, the Farallon I. population was once much larger than it is today. The several thousand birds present in the early 1900s decreased to a low of 26 in 1959 (Ainley and Lewis 1974). They were formerly found breeding in the northern Channel Is. (Willett 1910, in Sowls et al. 1980) but they no longer do so, having mysteriously disappeared by the 1940s (Hunt et al. 1979, in Sowls et al. 1980; Stallcup 1990). The southernmost suspected breeding site today is Hurricane Pt. Rocks in central California. Of interest were four puffins seen two miles off San Simeon, San Luis Obispo Co., 3 May 1990 (McCaskie 1990). Might these birds have been prospecting for nest sites in the vicinity?

There is little information on the historical status of this species elsewhere in California. Puffins once nested on Blank Rock off Trinidad, Humboldt Co., during the earlier part of the twentieth century (Clay, unpubl. field notes) but they have not been known to occur there in decades. Soil erosion has been suggested as the most likely cause of abandonment. Clay also reported Tufted Puffins on Flatiron Rock, terming them 'numerous' in 1911, but since then their nesting habitat has apparently deteriorated greatly. Osborne (1972) found only two puffins breeding on Flatiron Rock in 1970 and Sowls et al. (1980) list only two at this site during the 1979 and 1980 breeding seasons. Green Rock, also off Trinidad, where Osborne (1972) estimated ten birds breeding, appeared based on annual spring telescoping to support only 1-2 pairs during the 1990s (G. Lester et al., unpubl. notes).

During winter, Tufted Puffins are very rarely seen near land in California and are not expected in waters over the continental shelf. It is clear that the great bulk of the regional population does not regularly occur anywhere near land at the latitude of California in the colder months. One to two birds in Monterey Bay 6-7 December 1986 and three offshore Pillar Pt., San Mateo Co., 18 January 1987, with none detected in southern California, was the most ever reported during a single winter season (Morlan et al. 1987). Exceptionally, birds have been seen in winter as far as San Diego (Stallcup 1990).

Population Status and Dynamics

Much of what is known about the life history of the Tufted Puffin specifically as a California seabird has been revealed during long-term study by Point Reyes Bird Observatory researchers at Southeast Farallon Island. Forty percent of the California population of breeding Tufted Puffins occurs at the Farallons (Ainley and Boekelheide 1990). As was noted above, they were much more numerous at the Farallons during the nineteenth century than at present. Ainley and Boekelheide (1990) stated that oil pollution, the introduction of the European hare, and, possibly, the disappearance of sardines in the mid-twentieth century played important roles in diminishing the population. The species was not present from the 1860s, when several were collected for scientific specimens, until 1972.

Estimates of the puffin population on Southeast Farallon I. made in the period 1972-1982 revealed an increase from about 27 pairs in 1972 to about 50 pairs in 1982 (PRBO data), thus indicating average growth of about 7% per year. The greatest increase occurred from 1973-1977, during which period the population doubled each year. Diminished food resources resulting from the pronounced ENSO warm-water event of 1982-1983 caused few birds to appear during the 1983 nesting season and, following that event, fewer puffins appeared than previously (Ainley and Boekelheide 1990).

Ainley and Boekelheide (1990) summarized this history by characterizing population growth at the Farallons as "slow but steady", with the exception of curtailed breeding and apparent increased mortality due to El Nino.

In California, extensive areas of ideal nesting habitat exist on only a few islands. Consequently, many colonies are small, and undoubtedly will remain so (Sowls et al. 1980). Except on the Farallon Is., lack of appropriate substrate may ultimately be one of the major factors limiting expansion of the Tufted Puffin colony along the state's coastline.

Threats and Management Implications

Tufted Puffins in California are concentrated around two major breeding colonies, Castle Rock and Southeast Farallon I. Repeated human disturbance or an oil spill could severely impact these small but critical core populations. Both islands are protected.

Ainley and Boekelheide (1990) state that oil pollution 'has been reduced significantly' in the Gulf of the Farallones, and further note that in 1974 the long-established introduced rabbits were eliminated, potentially reducing competitive pressure for burrows.

Ainley and Lewis (1974) state that oil pollution was the major cause of the decline at the Farallons and suggested that, subsequently, the crash of the overfished Pacific Sardine stock has been the major factor keeping this population depressed.

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