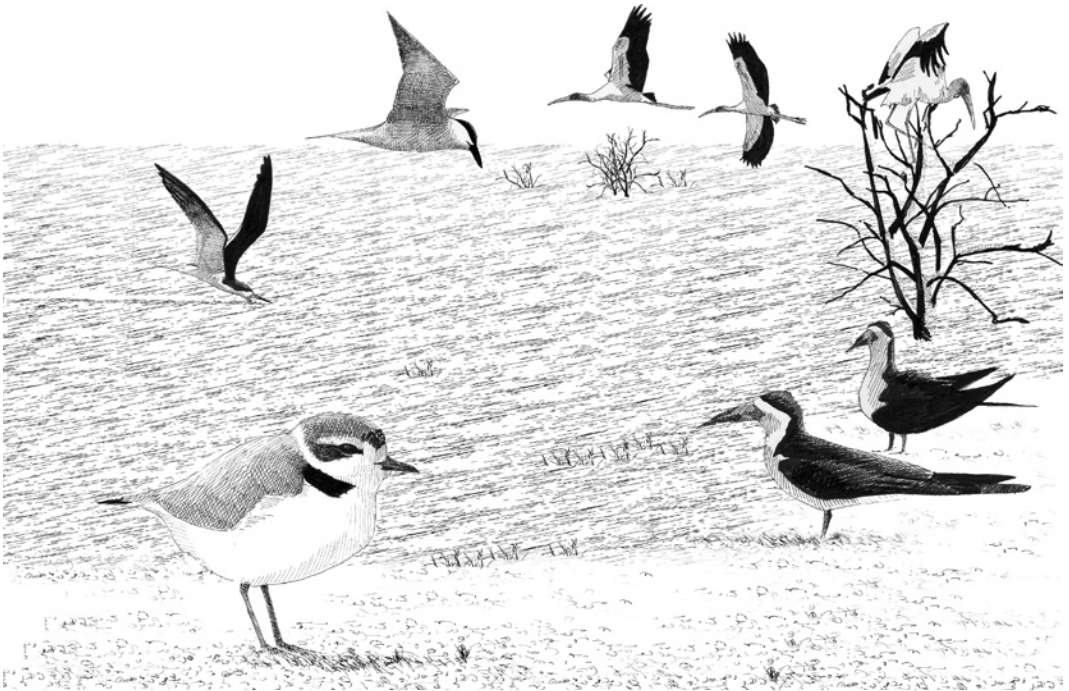


II

SPECIES ACCOUNTS



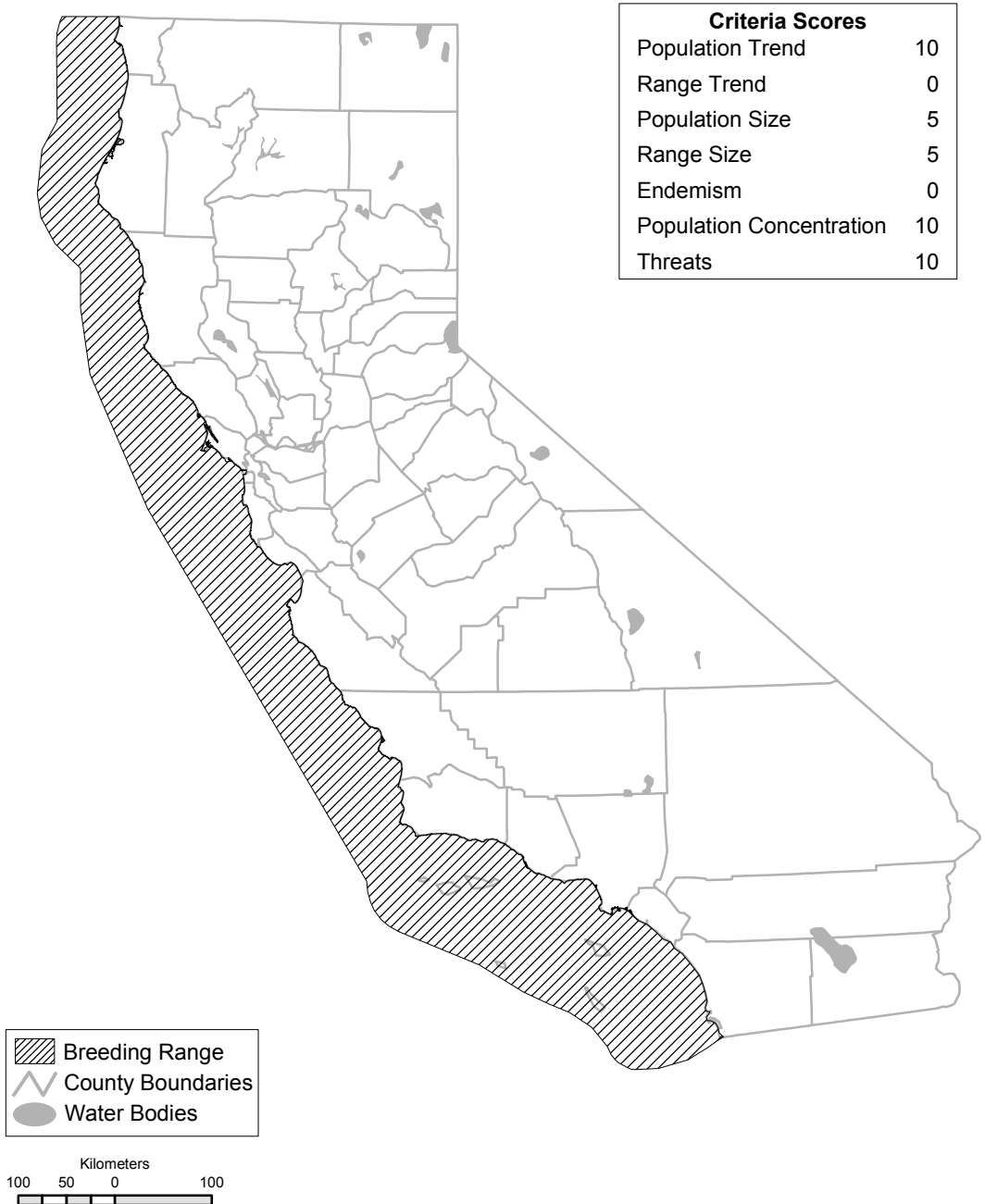
Andy Birch

PDF of Cassin's Auklet account from:

Shuford, W. D., and Gardali, T., editors. 2008. California Bird Species of Special Concern: A ranked assessment of species, subspecies, and distinct populations of birds of immediate conservation concern in California. Studies of Western Birds 1. Western Field Ornithologists, Camarillo, California, and California Department of Fish and Game, Sacramento.

CASSIN'S AUKLET (*Ptychoramphus aleuticus*)

JOSH ADAMS



Breeding-season range of the Cassin's Auklet in California. Nests locally on islands the length of the state, with the largest colonies at Southeast Farallon Island, Prince Island, and Castle Rock (Del Norte Co.); range stable but numbers of breeders have declined at least moderately. Occurs in offshore waters year round, with abundance increasing in the nonbreeding season. Breeding birds concentrate primarily within 50 km of colonies. At sea, associated with the subarctic waters of the inner California Current, particularly upwelling areas such as the continental shelf break, the vicinity of coastal promontories, and predictable oceanographic fronts over the continental shelf.

SPECIAL CONCERN PRIORITY

Currently considered a Bird Species of Special Concern (breeding), priority 3. Not included on prior lists (Remsen 1978, CDFG 1992).

BREEDING BIRD SURVEY STATISTICS FOR CALIFORNIA

Not sampled by the BBS.

GENERAL RANGE AND ABUNDANCE

Mostly confined to the northeastern Pacific Ocean, and rare west to the Kuril Islands, Russia (Manuwal and Thoresen 1993). Two subspecies: *P. aleuticus* occurs from the Bering Sea, Alaska, south through the California Channel Islands; *P. a. australis* occurs in northern Baja California, Mexico (Manuwal and Thoresen 1993). The world breeding population was roughly estimated at 3.57 million birds from information collected since the mid-1970s (Manuwal and Thoresen 1993). Greatest breeding abundance occurs in the Scott Island group off British Columbia (approx. 2 million birds; Rodway et al. 1992), with the largest colony at Triangle Island (approx. 1.1 million birds in 1989, Rodway 1991). Recent evidence indicates the species has declined both at sea and at several colonies throughout its range (Bertram et al. 2000, references below). Reasons for the apparent decline likely are related to low subadult and adult survival or reduced reproductive output among breeding adults resulting from changes in the abundance and/or availability of suitable prey (Pyle 2001, Bertram et al. 2000, Lee et al. 2007).

SEASONAL STATUS IN CALIFORNIA

Occurs in offshore California waters in all months (Briggs et al. 1987). Greatest numbers occur in the nonbreeding season (Sep through Feb), when birds off California apparently include many migrants from British Columbia and Alaska (Briggs et al. 1987) and probably Washington. The breeding season is variable from year to year and can extend from January through August statewide, but generally is earlier in southern California (Ainley et al. 1990, Adams et al. 2004b). Breeding can be protracted, especially during productive years, when sufficient prey allows pairs to rear two broods successfully (unique to breeding Cassin's Auklets in California and Mexico; Ainley et al. 1990, Manuwal and Thoresen 1993, Adams et al. 2004b).

HISTORIC RANGE AND ABUNDANCE IN CALIFORNIA

Grinnell and Miller (1944) described the Cassin's Auklet as a "common" resident the length of the state coastwise but knew of "surprisingly few" breeding sites for "so numerous a sea-fowl." Known colonies included "'Off-shore rock' [= Off Trinidad Rock?], Humboldt County"; Farallon Islands, San Francisco County; and Prince Island off San Miguel Island, "islet at Scorpion Harbor, Santa Cruz Island," and Santa Barbara Island, Santa Barbara County. Anecdotal accounts of historic status (see Grinnell and Miller 1944, Ainley and Lewis 1974, Hunt et al. 1981) include few quantitative estimates of abundance. Dawson (1911) provided the first numerical estimate for the Farallon Islands of 100,000 to 200,000 birds in 1911. Grinnell (1897) and Robertson (1903) documented a "large" colony of Cassin's Auklets on Santa Barbara Island in 1897 and 1899, but with the introduction of cats ca. 1900 the colony was virtually destroyed by 1908 (Howell 1917).

RECENT RANGE AND ABUNDANCE IN CALIFORNIA

The current breeding range of the Cassin's Auklet in California remains essentially the same as in 1944 (see map), though additional work, particularly intensive focused surveys, has located many more colonies. Statewide surveys of breeding seabirds have been conducted only twice in California. New sites for Cassin's Auklets discovered on these surveys do not necessarily reflect range or habitat expansions, but simply may represent sites overlooked previously. Surveys from 1975 to 1980 estimated 161,160 breeding birds at 12 sites (Hunt et al. 1981, SOWLS et al. 1980; Farallon numbers adjusted from Ainley et al. 1990 [see Carter et al. 1992]). The next statewide survey, from 1989 to 1991, estimated 53,572 Cassin's Auklets breeding at 16 locations in 1991 (Carter et al. 1992). The latter authors concluded that most of the apparent change in numbers between the two statewide surveys probably reflected differences in census techniques at the South Farallon Islands and Prince Island, though they acknowledged that a decline had probably occurred at the former site. The vast majority of the statewide population in 1991 occurred at three colonies: Farallon NWR, San Francisco County (68%); Prince Island and Castle Rock, near San Miguel Island, Santa Barbara County (16%); and Castle Rock NWR, Del Norte County (10%). Cassin's Auklet population abun-

dance is believed to fluctuate both annually and on decadal time scales from climate-driven changes in the California Current system that cause changes in plankton communities and alter auklet prey abundance or availability (Ainley and Lewis 1974, Ainley et al. 1990, McGowan et al. 1998, Lee et al. 2007). In recent decades, studies in California at colonies and at sea indicate parallel declines in abundance, though early colony data used for comparison are of uncertain reliability and at-sea work for southern California shows mixed results. Manuwal (1972) estimated the Southeast Farallon Island (SEFI) population at 105,000 breeding birds in 1971. Carter et al. (1992), however, judged this number was an overestimate reflecting extrapolation error. Lee et al. (2007) estimated auklets on SEFI declined by about 50% from 1991 to 2002. However, if Manuwal's (1972) estimate is correct, there may have been a $\geq 75\%$ reduction in abundance at California's primary colony from 1971 to 2002 (Lee et al. 2007). This population decline has occurred during a period of ocean warming and generally decreasing zooplankton biovolume measured off southern California (references in Lee et al. 2007).

Annual spring and summer surveys at sea from Monterey Bay to Bodega Bay (i.e., covering the foraging area of auklets nesting on the Farallon Islands) indicate a $>80\%$ decline in abundance (densities) from 1985 to 1994 (Allen 1994; fig. 3 in Oedekoven et al. 2001). Similarly, at-sea surveys off southern California during spring revealed a 75% decline in abundance between 1987–1990 and 1995–1998 (Hyrenbach and Veit 2003). However, preliminary comparisons between 1975–1983 (Briggs et al. 1987) and 1999–2001 surveys off southern California revealed approximately equivalent estimated total numbers of auklets during January (approx. 100,000 birds), and a 100% increase in density at sea during May (Mason et al. 2004). If auklet abundances indeed fluctuate on a decadal or greater time scale, continuous monitoring will be required to understand population fluctuations.

Northern California. The largest colony in northern California is at Castle Rock, Del Norte County (5638 birds in 1989, Carter et al. 1992). This colony may have increased in numbers since 1959, when Thoreson (1964) estimated 100 birds. Small numbers of birds (84 estimated in 1989) also occur on Green Rock, Humboldt County, and probably on Fish Rocks, Mendocino County (Carter et al. 1992).

Central California. As indicated above, the largest colony in California occurs on the Farallon

NWR. From 1991 to 2002, densities of occupied auklet burrows in study plots on SEFI decreased significantly (6.0% per year, Lee et al. 2007). Recently, population abundance estimated with index plots indicates that numbers of breeding auklets on SEFI fluctuate annually and have increased from a nadir of 10,458 in 1998 to 29,229 in 2004 (Warzybok et al. 2004), a value similar to the 29,880 estimated in 1989 (Carter et al. 1992). At SEFI, auklets' demographic parameters, including survival, breeding propensity, breeding success, and recruitment, are synchronously affected by annual variation in ocean climate (Lee et al. 2007).

Southern California. The largest colonies in this region occur on Prince Island (8922 birds in 1991) and Castle Rock (2614 birds in 1991), both off San Miguel Island (Carter et al. 1992). Cassin's Auklets nest on other small islands scattered throughout the northern Channel Islands (unless noted otherwise, numbers of birds from Carter et al. 1992, Table 35): Point Bennett (20) and Harris Point to Cuyler Harbor ("Hare Rock," 28) in San Miguel Island area; Diablo Rocks (28), Spitt Rock (10 estimated by Hunt et al. 1979 in Jun 1977, 0 found in May 1991 by Carter et al. 1992), Scorpion Rocks (546), Willows Anchorage Rocks (10), and Gull Island (132) in Santa Cruz Island area; and Santa Barbara Island (132), Shag Rock (2), and Sutil Island (122) in Santa Barbara Island area. A maximum estimate of 120 (probably fewer) birds nested on Scorpion Rocks in 2000 (J. Adams unpubl. data).

Although no historical estimates exist for Anacapa Island (Hunt et al. 1979), numbers of breeding birds likely were reduced or eliminated by large numbers of introduced Black Rats (*Rattus rattus*, now extirpated; McChesney et al. 2000). Several nests have been documented on Rat Rock, a rocky peninsula on the west end of West Anacapa Island (D. Whitworth pers. comm.), but it is unclear whether auklets have recolonized the main Anacapa Islands. Scattered aggregations of auklets (numbering in the tens) were observed at sea to the north of Anacapa Island in May 2005 (J. Adams pers. obs.). Cassin's Auklets formerly nested in a "large" colony on Santa Barbara Island (Grinnell 1897, Robertson 1903), but were decimated by introduced cats (*Felis catus*, now extirpated; Hunt et al. 1981). Small numbers of auklets appear to have persisted there and on nearby Sutil Island (Hunt et al. 1981, Carter et al. 1992). Although recent surveys are lacking, it is possible that Cassin's Auklets no longer breed at Santa Barbara Island (P. Martin pers. comm. in

MSRP 2005). Reasons for lack of recovery (and subsequent possible extirpation) since cats were removed from Santa Barbara Island are not known but may reflect low recruitment to the population during warm ocean climate conditions off southern California (McGowan et al. 1998). Additional mortality is likely associated with past oil spills in southern California (e.g., 1969 *Platform A* oil spill, Sept 1997 *Torch* oil spill) and, on the basis of recent evidence for northward postbreeding dispersal (Adams et al. 2004a), spills in northern California (i.e., Nov 1984 *Puerto Rican* oil spill, Ford et al. 1987; the Feb 1986 *Apex Houston* oil spill, Page et al. 1990; and the recently identified *S.S. Jacob Luckenbach* spills).

ECOLOGICAL REQUIREMENTS

During nesting, Cassin's Auklets require islands free from non-native predators (cats and rats) and large domestic mammals (cattle, sheep, pigs, goats, rabbits) that could trample fragile burrows and destroy vegetation essential for stabilizing soil required for burrowing. Depending on local conditions, auklets nest in earthen burrows excavated by adults, rocky crevices, debris piles, cracks under buildings, and large caves (Thoresen 1964, Manuwal and Thoresen 1993). Highest burrow densities on Castle Rock, Del Norte County, appear to be associated with areas with vegetation dominated by the grass *Leymus (Elymus) mollis* (Osborne 1972); on SEFI with soil protected by native vegetation, especially Maritime Goldfields (*aka* Farallon Weed, *Lasthenia maritima*; Ainley et al. 1990); and on Prince Island with *Opuntia* cactus (Hunt et al. 1981). Auklets readily nest in artificial nest boxes (SEFI, Ainley et al. 1990; Prince Island, Lewis and Gress 1988; Año Nuevo Island, M. Hester pers. comm.) and in artificial burrows (Prince Island and Scorpion Rock; Adams et al. 2000).

At sea, auklets are associated with the subarctic waters of the inner California Current, influenced by seasonal upwelling and, specifically, areas of bathymetric relief—such as the continental shelf break (200-m isobath; Allen 1994, Oedekoven et al. 2001, Adams et al. 2004a); in the vicinity of coastal promontories (Pt. Reyes, Pt. Sur, Pt. Conception); and over the continental shelf—where prey may be concentrated along recurring and predictable oceanographic fronts. Within total available foraging area off the Channel Islands, radio-marked adult auklets from Prince Island were associated with cooler (11–13°C), more chlorophyll-rich waters near the shelf break

(200-m isobath; Adams et al. unpubl. data). Radiotelemetry and at-sea surveys also detected greater concentrations of auklets in areas with greater zooplankton concentrations in the upper 15 m of surface waters (Adams et al. unpubl. data).

Adult and chick diets are thought to be similar and consist of a diverse variety of crustaceans (primarily Euphausiacea—*Thysanoessa spinifera* and *Euphausia pacifica*—and hyperiid amphipods), larval–early juvenile fishes (*Sebastes* spp., Pleuronectidae, Bothidae, Clupeiidae, and several others), and squid (Hunt et al. 1993, Sydeman et al. 2001, Adams et al. 2004b). Fish apparently are more important in the Channel Islands (Hunt et al. 1993, Adams et al. 2004b) than at SEFI (Ainley et al. 1990, 1996; Sydeman et al. 2001).

California breeders are thought to reside near colonies during the nonbreeding season (Briggs et al. 1987, Manuwal and Thoresen 1993), and individuals can attend colonies during any month of the year (SEFI; Ainley et al. 1990). However, recent colony-specific information from adults radio-marked at Prince Island and Scorpion Rock (Adams et al. 2004a) and increased abundances off Oregon during late summer (Ainley et al. 2005) indicate northward postbreeding dispersal to areas off central and northern California and Oregon. Dispersion at sea becomes increasingly more aggregated near colonies during early spring as birds attend colonies more regularly; breeding birds are concentrated primarily within 50 km of colonies during incubation and chick-rearing (Hunt et al. 1981, Briggs et al. 1987, Allen 1994, Adams et al. 2004a). From March through June, auklets breeding in the northern Channel Islands are aggregated in greatest densities within the western Santa Barbara Channel (Adams et al. 2004a, Mason et al. 2004).

THREATS

Cassin's Auklets are at risk from a variety of factors, including oil spills and contaminants, introduced animals and plants, increased predation rates in response to artificial lights, and human disturbance. Flocking behavior, aggregation at sea, small body size, and foraging behavior (wing-propelled diving) predispose auklets to be extremely vulnerable to oil spills or oil platform blowouts (Nisbet 1994, Carter et al. 2000). Assessing mortality associated with spills is problematic for the Cassin's Auklet because there is a low potential for the recovery of small, dead oiled alcids (Carter et al. 2000). Auklet eggs from the Channel Islands

had elevated levels of DDE and evidence indicating eggshell thinning resulting from organic contaminant exposure (Fry 1994, Kiff 1994).

Auklets are extremely vulnerable to mammals introduced on islands that prey on their eggs and chicks (i.e., rats on Anacapa Island, cats formerly on Santa Barbara Island; McChesney and Tershy 1998). The presence of Black Rats on San Miguel Island poses a risk for large colonies located on adjacent Prince Island and Castle Rock. Non-native, invasive plants (i.e., mallow, *Malva* spp.; stinging nettle, *Urtica* spp.; sea fig, *Carpobrotus* spp.; iceplant, *Mesembryanthemum* spp.; Kikuyo Grass, *Pennisetum clandestinum*; and New Zealand Spinach, *Tetragonia tetragonooides* at Farallon NWR) may displace native island flora (e.g., *Lasthenia maritima* on SEFI), increase soil salinity (*Mesembryanthemum*), and enhance erosion rates and ultimately degrade limited nesting habitat. In some cases, however, non-native vegetation may help to stabilize soils and benefit burrowing auklets (Año Nuevo Island; M. Hester pers. comm.).

Increasing recreational use in waters near nesting colonies increases the risk of visitation to sensitive colonies (e.g., Channel Islands; Ainley and Hunt 1991). Direct human disturbance on San Miguel Island and Scorpion Rocks is a potential threat if an increasing number of boats anchor overnight near colonies, especially during the breeding season, when birds attending colonies experience unnaturally enhanced light levels (J. Adams pers. obs.). Auklets are easily disoriented by bright lights at sea, especially near colonies (Dawson 1923, J. Adams pers. obs.). Artificially elevated light levels near colonies, such as from high-intensity lights now used on squid boats fishing near the Channel Islands, may increase this species' vulnerability to native avian predators (gulls, owls, falcons), disrupt breeding activities, and attract auklets to vessels, where they may be injured or killed by collisions.

MANAGEMENT AND RESEARCH RECOMMENDATIONS

- Eradicate non-native Black Rats from the California Channel Islands (San Miguel Island; MSRP 2005); eradicate non-native House Mice (*Mus musculus*) on Southeast Farallon Island (Luckenbach Trustee Council 2006).
- Risk to island populations could be reduced by enhancing preventative measures

through education that decreases the probability of introducing non-native mammals to the islands and providing or requiring "rat-spill" kits and contingency plans that address potential transfer of rats to and from marine vessels that frequent offshore islands (Channel Islands National Park, Island Packers, Inc.).

- Control or eradicate invasive plant species on islands (SEFI, Prince Island, Scorpion Rock) and restore native vegetation to breeding colonies (Año Nuevo Island, Scorpion Rock) to prevent habitat loss and facilitate nesting (MSRP 2005).
- Restrict human access and disturbance to islands with known colonies (especially in southern California; MSRP 2005, Luckenbach Trustee Council 2006).
- Restrict the use of bright lights (i.e., on light boats and seining vessels associated with the California squid fishery, Channel Islands) in the vicinity of colonies, especially during the nesting season (Carter et al. 2000).
- Assessments of contaminants and oil pollution throughout state coastal waters used by Cassin's Auklets during the breeding and nonbreeding seasons would provide information related to anthropogenic risks to populations at sea.
- Ongoing studies to estimate and refine demographic parameters (age at first breeding, adult survival, nesting success, and recruitment rates), particularly for colonies off southern California, would provide more complete population information.
- Detailed investigations of sex-specific behaviors (e.g., diving), daily activity budgets, and energetics will help sort out the role of parental effort in determining reproductive output within the context of a variable marine environment. Such information provides necessary context for interpreting breeding success, demographic parameters, and the potential impacts of climate change.
- Prior to the consideration of translocating or attracting auklets to sites such as Santa Barbara Island (MSRP 2005), at-sea surveys should be implemented to compare foraging environments and prey distributions between established colonies (Prince Island and Castle Rock off San Miguel Island) and new sites.

MONITORING NEEDS

It is important to continue population monitoring at SEFI, the largest colony in California, but, because of contrasting regional oceanographic environments, more complete population assessments would benefit from equivalent effort initiated and maintained at Castle Rock NWR, Del Norte County, and at Prince Island and Scorpion Rock, Santa Barbara County. Because statewide censusing of auklets and other burrow- and crevice-nesting seabirds has not been conducted since 1989–1991, statistically robust censuses are now required to detect and assess population trends. Information derived from telemetry combined with stratified-random, at-sea survey designs (Jolly and Hampton 1990) and new statistical techniques (Clarke et al. 2003) may more accurately estimate population sizes and trends for a species that is inherently difficult to census at breeding colonies (Carter et al. 1992). Annual monitoring of Cassin's Auklet chick diet, if maintained, would continue to provide critical demographic information at SEFI, and a similar effort annually at Channel Islands colonies would help fill data gaps for the population. Regional comparisons will provide better information related to variability in ocean climate affecting key elements of the California Current system food web (i.e., variability and composition of zooplankton and early-life-stage fishes; Adams et al. 2004b). To aid the management of potentially harmful fishing practices, well-designed studies are needed to monitor the effects on seabirds of artificial light at sea near breeding colonies. State and federal agencies and the fishing industry are encouraged to work together to determine the feasibility of initiating an observer program for squid fisheries that use bright lights near breeding colonies.

ACKNOWLEDGMENTS

This account was improved by reviews by K. Mills and W. D. Shuford and additional comments from J. Buffa and L. Jones.

LITERATURE CITED

- Adams, J., Takekawa, J. Y., and Carter, H. R. 2000. Foraging distribution and movement patterns of Cassin's Auklets nesting at Prince Island, California, in 2000, in *At-sea distribution of seabirds and marine mammals in the Southern California Bight* (D. L. Orthmeyer, H. R. Carter, J. Y. Takekawa, and R. T. Golightly, eds.), pp. 88–117. Unpublished progress report of U.S. Geol. Surv., W. Ecol. Res. Ctr., Dixon and Vallejo, CA, and Humboldt State Univ., Dept. of Wildl., Arcata, CA.
- Adams, J., Takekawa, J. Y., and Carter, H. R. 2004a. Foraging distance and home range of Cassin's Auklets nesting at two colonies in the California Channel Islands. *Condor* 106:618–637.
- Adams, J., Takekawa, J. Y., and Carter, H. R. 2004b. Stable foraging areas and variable chick diets: Insight to ocean variability and reproductive success of Cassin's Auklet in the California Channel Islands, 1999–2001. *Can. J. Zool.* 82:1578–1595.
- Ainley, D. G., Boekelheide, R. J., Morrell, S. H., and Strong, C. S. 1990. Cassin's Auklet, in *Seabirds of the Farallon Islands: Ecology, Dynamics, and Structure of an Upwelling-System Community* (D. G. Ainley and R. J. Boekelheide, eds.), pp. 306–338. Stanford Univ. Press, Palo Alto, CA.
- Ainley, D. J., and Hunt, G. L., Jr. 1991. Status and conservation of seabirds in California, in *Seabird status and conservation: A supplement* (J. P. Croxall, ed.), pp. 103–114. Int. Council Bird Preservation Tech. Publ. 11.
- Ainley, D. G., and Lewis, T. J. 1974. The history of Farallon Island marine bird populations, 1854–1972. *Condor* 76:432–446.
- Ainley, D. G., Spear, L. B., and Allen, S. G. 1996. Variation in the diet of Cassin's Auklet reveals spatial, seasonal, and decadal occurrence patterns of euphausiids off California, USA. *Mar. Ecol. Prog. Ser.* 137:1–10.
- Ainley, D. G., Spear, L. B., Tynan, C. T., Barth, J. A., Pierce, S. D., Ford, R. G., and Cowles, T. J. 2005. Physical and biological variables affecting seabird distributions during the upwelling season of the northern California Current. *Deep-Sea Res. II* 52:123–143.
- Allen, S. G. 1994. The distribution and abundance of marine birds and mammals in the Gulf of the Farallones and adjacent waters, 1985–1992. Ph.D. dissertation, Univ. Calif., Berkeley.
- Bertram, D. F., Jones, I. L., Cooch, E. G., Knechtel, H. A., and Cooke, F. 2000. Survival rates of Cassin's and Rhinoceros auklets at Triangle Island, British Columbia. *Condor* 102:155–162.
- Briggs, K. T., Tyler, W. B., Lewis, D. B., and Carlson, D. R. 1987. Bird communities at sea off California: 1975 to 1983. *Studies Avian Biol.* 11.
- California Department of Fish and Game (CDFG). 1992. Bird species of special concern. Unpublished list, July 1992, Calif. Dept. Fish & Game, 1416 Ninth St., Sacramento, CA 95814.
- Carter, H. R., McChesney, G. J., Jaques, D. L., Strong, C. S., Parker, M. W., Takekawa, J. E., Jory, D. L., and Whitworth, D. L. 1992. Breeding populations of seabirds in California, 1989–1991, vol. I—Population Estimates. Unpublished report, U.S. Fish & Wildl. Serv., Dixon, CA. Available from Carter Biol. Consulting, 1015 Hampshire Rd., Victoria, BC V8S 4S8, Canada.
- Carter, H. R., Whitworth, D. L., Takekawa, J. Y., Kee-

- ney, T. W., and Kelly, P. R. 2000. At-sea threats to Xantus's Murrelets (*Synthliboramphus hypoleucus*) in the Southern California Bight, in Proceedings of the fifth California Islands Symposium, 29 March to 1 April 1999 (D. R. Browne, K. L. Mitchell, and H. W. Chaney, eds.), pp. 435–447. U.S. Minerals Mgmt. Serv., Pacific Outer Continental Shelf Region, Camarillo, CA.
- Clarke, E. D., Spear, L. B., McCracken, M. L., Marques, F. F. C., Borchers, D. L., Buckland, S. T., and Ainley, D. G. 2003. Validating the use of generalized additive models and at-sea surveys to estimate size and temporal trends of seabird populations. *J. Applied Ecol.* 40:278–292.
- Dawson, W. L. 1911. Another fortnight on the Farallones. *Condor* 13:171–183.
- Dawson, W. L. 1923. *The Birds of California*. South Moulton Co., San Diego.
- Ford, R. G., Page, G. W., and Carter, H. R. 1987. Estimating mortality of seabirds from oil spills, in Proceedings of the 1987 Oil Spill Conference, pp. 547–551. Am. Petroleum Inst., Washington, DC.
- Fry, D. M. 1994. Injury of seabirds from DDT and PCB residues in the Southern California Bight ecosystem. Unpublished report to U.S. Fish & Wildl. Serv., Ecol. Serv., 2800 Cottage Way, Sacramento, CA 95825.
- Grinnell, J. 1897. Report on the seabirds recorded during a visit to the islands of Santa Barbara, San Nicolas and San Clemente, in the spring of 1897. *Pasadena Acad. Sci. Publ.* 1.
- Grinnell, J., and Miller, A. H. 1944. The distribution of the birds of California. *Pac. Coast Avifauna* 27.
- Howell, A. B. 1917. Birds of the islands off the coast of southern California. *Pac. Coast Avifauna* 12.
- Hunt, G. L., Jr., Harrison, N. M., and Piatt, J. F. 1993. Foraging ecology as related to the distribution of planktivorous auklets in the Bering Sea, in *The status, ecology, and conservation of marine birds of the North Pacific* (K. Vermeer, K. T. Briggs, K. H. Morgan, and D. Siegel-Causey, eds.), pp. 18–26. *Can. Wildl. Serv. Special Publ.*, Ottawa.
- Hunt, G. L., Jr., Pitman, R. L., Naughton, M., Winnett, K., Newman, A., Kelly, P. R., and Briggs, K. T. 1981. Reproductive ecology and foraging habits of breeding seabirds, in Summary of marine mammal and seabird surveys of the Southern California Bight area 1975–1978, vol. 3—Investigators' reports, part 3—Seabirds, book 2. Publ. PB-81-248-05, U.S. Dept. Commerce, Natl. Tech. Information Serv., Springfield, VA.
- Hyrenbach, K. D., and Veit, R. R. 2003. Ocean warming and seabird communities of the southern California Current system (1987–98): Response at multiple temporal scales. *Deep-Sea Res. II* 50(14–16): 2537.
- Jolly, G. M., and Hampton, I. 1990. A stratified random transect design for acoustic surveys of fish stocks. *Can. J. Fish. & Aquatic Sci.* 47:1281–1291.
- Kiff, L. F. 1994. Eggshell thinning in birds of the California Channel Islands. Unpublished report to U.S. Fish & Wildl. Serv., Ecol. Serv., 2800 Cottage Way, Sacramento, CA 95825.
- Lee, D. E., Nur, N., and Sydeman, W. J. 2007. Climate and demography of the planktivorous Cassin's Auklet *Ptychoramphus aleuticus* off northern California: Implications for population change. *J. Animal Ecol.* 76:337–347.
- Lewis, D. B., and Gress, F. 1988. Seabird monitoring in the Channel Islands National Park, 1986. *Natural Science Rep.* 88–002, U.S. Natl. Park Service, Channel Islands Natl. Park.
- Luckenbach Trustee Council. 2006. *S.S. Jacob Luckenbach* and associated mystery oil spills. Final damage assessment and restoration plan/environmental assessment. Prepared by Calif. Dept. Fish & Game, Natl. Oceanic and Atmospheric Admin., U.S. Fish & Wildl. Serv., and Natl. Park Serv.
- Manuwal, D. A. 1972. The population ecology of the Cassin's Auklet on Southeast Farallon Island, California. Ph.D. dissertation, Univ. Calif., Los Angeles.
- Manuwal, D. A., and Thoresen, A. C. 1993. Cassin's Auklet (*Ptychoramphus aleuticus*), in *The Birds of North America* (A. Poole and F. Gill, eds.), no. 50. *Acad. Nat. Sci.*, Philadelphia.
- Mason, J. W., McChesney, G. J., McIver, W. R., Carter, H. R., Takekawa, J. Y., Golightly, R. T., Ackerman, J. T., Orthmeyer, D. L., Peerey, W. M., Yee, J. L., Pierson, M. O., and McCrary, M. D. 2004. At-sea aerial surveys of seabirds in the Southern California Bight: 1999–2002, in *At-sea distribution and abundance of seabirds and marine mammals in the Southern California Bight: 1999–2003* (J. Y. Takekawa, H. R. Carter, D. L. Orthmeyer, R. T. Golightly, J. T. Ackerman, G. J. McChesney, J. W. Mason, J. Adams, W. R. McIver, M. O. Pierson, and C. D. Hamilton, eds.), pp. 11–109. Unpublished summary report, U.S. Geol. Surv., W. Ecol. Res. Ctr., Vallejo, CA, and Humboldt State Univ., Dept. of Wildl., Arcata, CA.
- McChesney, G. J., Gress, F., Carter, H. R., and Whitworth, D. L. 2000. Nesting habitat assessment for Xantus' Murrelets and other crevice-nesting seabirds at Anacapa Island, California, in 1997. Unpublished report, U.S. Geol. Surv., W. Ecol. Res. Ctr., Dixon, CA, and Humboldt State Univ., Dept. of Wildl., Arcata, CA.
- McChesney, G. J., and Tershy, B. R. 1998. History and status of introduced mammals and impacts to breeding seabirds on the California Channel and northwestern Baja California islands. *Colonial Waterbirds* 21:335–347.
- McGowan, J. A., Cayan, D. R., and Dorman, L. M. 1998. Climate-ocean variability and ecosystem response in the northeast Pacific. *Science* 281:210–217.
- Montrose Settlements Restoration Program (MSRP). 2005. Draft restoration plan and programmatic environmental impact statement/environmental impact

- report. Report of the Montrose Settlements Restoration Program, Natl. Oceanic and Atmospheric Admin., U.S. Fish & Wildl. Serv., Natl. Park Serv., Calif. Dept. Fish & Game, Calif. Dept. Parks & Recreation, and Calif. State Lands Commission.
- Nisbet, I. C. T. 1994. Effects of pollution on marine birds, in *Seabirds on islands: Threats, case studies and action plans* (D. N. Nettleship, J. Burger, and M. Gochfeld, eds.), pp. 8–25. Proceedings of the Seabird Specialist Group Workshop, XX World Conference of the International Council for Bird Preservation, Univ. Waikato, Hamilton, New Zealand, 1990. BirdLife Conserv. Ser. 1.
- Oedekoven, C. S., Ainley, D. G., and Spear, L. B. 2001. Variable responses of seabirds to change in marine climate: California Current, 1985–1994. *Mar. Ecol. Prog. Ser.* 212:265–281.
- Osborne, T. O. 1972. Ecology and avian use of the coastal rocks in northern California. M.A. thesis, Humboldt State Univ., Arcata, CA.
- Page, G. W., Carter, H. R., and Ford, R. G. 1990. Numbers of seabirds killed or debilitated in the 1986 *Apex Houston* oil spill in central California. *Studies Avian Biol.* 14:164–174.
- Pyle, P. 2001. Age at first breeding and natal dispersal in a declining population of Cassin's Auklet. *Auk* 118:996–1007.
- Remsen, J. V., Jr. 1978. Bird species of special concern in California: An annotated list of declining or vulnerable bird species. Nongame Wildl. Invest., Wildl. Mgmt. Branch Admin. Rep. 78-1, Calif. Dept. Fish & Game, 1416 Ninth St., Sacramento, CA 95814.
- Robertson, H. 1903. Cassin's Auklet, *Ptychoramphus aleuticus*. *Condor* 5:96–97.
- Rodway, M. S. 1991. Status and conservation of breeding seabirds in British Columbia, in *Seabird status and conservation: A supplement* (J. P. Croxall, ed.), pp. 43–102. Int. Council Bird Preservation Tech. Publ. 11.
- Rodway, M. S., Lemon, M. J. F., and Summers, K. R. 1992. Seabird breeding populations in the Scott Islands on the west coast of Vancouver Island, 1982–89, in *The ecology, status, and conservation of marine and shoreline birds on the west coast of Vancouver Island* (K. Vermeer, R. W. Butler, and K. H. Morgan, eds.), pp. 52–59. Occ. Paper 75, Canadian Wildl. Serv., Ottawa.
- Sowls, A. L., DeGange, A. R., Nelson, J. W., and Lester, G. S. 1980. Catalog of California seabird colonies. U.S. Fish & Wildl. Serv., Biol. Serv. Program. FWS/OBS-80/37.
- Sydeman, W. J., Hester, M. M., Thayer, J. A., Gress, E., Martin, P., and Buffa, J. 2001. Climate change, reproductive performance and diet composition of marine birds in the southern California Current system, 1969–1997. *Progress Oceanogr.* 49:309–329.
- Thoresen, A. C. 1964. The breeding behavior of the Cassin Auklet. *Condor* 66:456–476.
- Warzybok, P. M., Bradley, R. W., and Sydeman, W. J. 2004. Population size and reproductive performance of seabirds on Southeast Farallon Island, 2004. Unpublished report to the U.S. Fish & Wildl. Serv., Farallon NWR. Available from PRBO Conserv. Science, 3820 Cypress Dr., #11, Petaluma, CA 94954.