Supporting Information

Newsome et al. 10.1073/pnas.0913011107

SI Text

Historic Sheep, Seabird, and Marine Mammal Population Estimates. Historic estimates of sheep (*Ovis aries*) populations on each of the northern Channel Islands were compiled from a variety of sources: (*i*) publications about the history of the islands; (*ii*) newspaper articles that mentioned feral herbivore numbers on an island; (*iii*) field notes kept by archaeologists, biologists, and antiquarians; (*iv*) U. S. and local District Court Proceedings; (*v*) oral histories of island ranchers and inhabitants; (*vi*) court depositions and local assessments for deed transfers or for probate settlements upon sale of an island; (*vii*) ranch stocking records and correspondence in local archives and libraries and at Channel Islands National Park; and (*viii*) published articles summarizing feral herbivore eradication programs on each island.

Sheep were first introduced onto the northern Channel Islands in the mid- to late-1840s (San Rosa Island) ad early 1850s (San Miguel and Santa Cruz Islands). From an initial introduction of 45 sheep to San Miguel Island in A.D. 1851 (1), the population grew to a high of 6,000 by 1862 and hovered between 2,000 and 4,000 during the 1880s and 1890s (Fig. 2*A*). On Santa Rosa Island the number of sheep went from an initial introduction of 53 animals in 1844 (2) to more than 60,000 in the early 1870s (3, 4) and more than 80,000 in the 1880s (figure 2 of ref. 5). At their peak in the late 1880s, it was estimated that more than 125,000 sheep were present on Santa Rosa (6). On Santa Cruz Island sheep went from an initial introduction of 200 animals in 1852 (7) to 30,000–40,000 in the 1860s, nearly 70,000 during the 1870s and 1880s, and to a peak of almost 100,000 by 1890 (figure 2 of ref. 8).

Sheep grazing on the northern Channel Islands declined during the first half of the 20th century when island grazing operations were transitioning from sheep grazing to cattle grazing. During the first half of the 20th century, 1,100–2,500 sheep were being grazed on San Miguel Island. Following the termination of the grazing lease for the island in 1948, however, all but 500 sheep were removed from the island immediately (1). The last sheep on San Miguel were eliminated in 1966, thus ending more than 100 years of sheep grazing on this island. Today no feral herbivores occur on San Miguel. Sheep grazing was largely eliminated from Santa Rosa Island in the early 1900s. Between 1901 and 1904 the number of sheep on Santa Rosa declined from ~10,000 to ~700 ,with the last sheep being eradicated from the island in the early 1950s. Despite the transition from sheep grazing to cattle grazing in the early 1900s, a significant number of feral sheep remained on Santa Cruz Island until nearly the end of the 20th century when they finally were eradicated from the island (9, 10).

The Channel Islands support a diverse and abundant seabird breeding avifauna with 24,000 pairs of 16 species known to nest on the islands in the late 1970s (11). The largest concentration of nesting seabirds on the Channel Islands was on San Miguel Island and its two islets, Prince Island and Castle Rock, where at least 14,000–15,000 pairs of nine species nested in late 1970s (11). Other large concentrations of nesting seabirds have been recorded on Santa Barbara (3,400 pairs, 10 species) and Anacapa islands (3,000 pairs, seven species) (11). The other Channel Islands supported a much lower diversity and abundance of nesting seabirds, with 950 pairs on Santa Cruz Island and 900 pairs on Santa Rosa Island (11). Until the late1970s, there were no accurate island-specific standardized population counts for seabirds nesting on each of the Channel Islands. Systematic surveys undertaken in the late 1970s (11, 12), in the late 1980s (13), and from the mid-1990s to 2007 (14) provide estimates for more recent seabird populations (Fig. 2*B*). By the late 1980s the seabird fauna at San Miguel Island and islets was estimated to be 33,250 birds of at least 12 species (13). By 2007 this avifauna was at ~20,780 birds of 13 species (14). Population estimates for most species have not varied greatly between each of these survey efforts (Fig. 2*B*). Double-crested cormorants (*Phalacrocorax auritus*) declined between the late 1970s and the late 1980s, Brandt's cormorants (*Phalacrocorax penicillatus*) increased during the late 1980s but returned to late-1970s numbers by 2005–2007, and Western gulls (*Larus occidentalis*) increased between the late 1970s and 2007 (Fig. 2*B*). Some of the changes observed in seabird numbers at San Miguel Island and its off lying islets are the result of the intensity of species-specific survey efforts, possible increased predation from avian predators such as peregrine falcon (*Falco peregrinus*) and barn owl (*Tyto alba*), or environmental factors such as El Niño (14). A few species, such as tufted puffin (*Fratercula cirrhata*), rhinoceros auklet (*Cerorhinca monocerata*), common murre (*Uria aalge*), and brown pelican (*Pelecanus occidentalis*), have recolonized Prince Island after multidecade absences (14). These recolonizations are the result of either substantial population recovery of a species (brown pelican and common murre) or range expansions (tufted puffin and rhinoceros auklet) (14).

Pinniped and sea otter (*Enhydra lutris*) populations have fluctuated dramatically through time at the Channel Islands. Prehistoric abundances and breeding ranges of pinnipeds on the Channel Islands are unknown. Archaeological data from San Miguel Island indicate that the Chumash and their predecessors hunted sea otters and other marine mammals for at least 9,000 years (15–18). Terrestrial breeding species [Northern fur seal (*Callorhinus ursinus*), Guadalupe fur seal (*Arctocephalus townsendi*), California sea lion (*Zalophus californianus*), Steller sea lion (*Eumetopias jubatus*), and Northern elephant seal (*Mirounga angustirostris*)] declined on the islands through time compared with aquatic breeders [sea otters and harbor seals (*Phoca vitulina*)] (4). Following the arrival of Europeans (explorers, whalers, sealers, and sea otter hunters), an industry developed during the 18th and 19th centuries focused on the commercial harvest of whales, sea otters, and pinnipeds for their oil and hides (19–22). This intensive harvest decimated marine mammal populations on the Channel Islands and led to the extirpation of sea otters, Northern elephant seals, Northern fur seals, and Guadalupe fur seals from the islands (22). Pinnipeds were fairly uncommon on the Channel Islands during the early and mid-1900s because of overexploitation by commercial sealers and indiscriminant killing (22). Following protection from commercial harvest in the mid-20th century, pinniped populations on the Channel Islands have grown at exponential rates. In 1927 a total of 1,229 nonpup California sea lions were counted on the Channel Islands (23). Since then, California sea lion populations have shown exponential growth with 49,335 pups (238,000–241,000 individuals) counted in 2000 in the Southern California Bight (24). Northern elephant seal populations have exhibited similar dramatic increases in their breeding populations at the Channel Islands (25) with more than 20,000 pups born at colonies on San Nicolas and San Miguel islands in 2003. With the exception of Guadalupe fur seals, Steller sea lions, and sea otters, all the pinnipeds found today on the Channel Islands are at population levels equal to or greater than at any time since humans colonized the Channel Islands 12,000–13,000 years ago (22). Six species of pinnipeds occur today on the Channel Islands, with the most species and largest colonies located on San Miguel Island (22). Fairly large colonies of elephant seals, California sea lions, and harbor seals also occur at San Nicolas Island, and smaller pinniped colonies are located on the other islands (22).

Ferrelo Point Nest Excavation and Faunal Identifications. The historic Ferrelo Point nest (Fig. 1) was investigated as if it was an archaeological site, with surface collections, hand excavations, and field screening (26, 27). During our field research in September 2000, the collapsed remnants of the historic Ferrelo Point nest were ≈2.8 m high and 2.0 × 2.7 m wide. Faunal remains were collected from 12 areas of the nest, with faunal material from nine areas collected by hand and three areas sampled using a 1/16-inch (1.6-mm) screen. Smaller faunal elements generally dominated the screened samples and larger elements the hand samples, but taxonomic composition of these samples did not differ significantly, so data were combined. Faunal remains were sorted initially into four broad taxonomic groups: fishes, birds, other vertebrates (mammals and reptiles), and invertebrates (e.g., shellfish). The faunal remains generally were in excellent condition, including articulated specimens, fragile elements, and complete bird and fish crania. Consistent with this good preservation, most of the bones were classified within Stage 1 (28), where little to no bone cracking was observed, but tissues, grease, and ligaments were absent. The remains of more than 90 taxa were identified, including at least 45 types of birds, 29 marine mollusks and other invertebrates, 13 marine fishes, 4 land mammals, 3 marine mammals, and 1 reptile. Among the faunal elements recovered were those of domestic sheep, three types of pinnipeds, thousands of fish and seabird bones, and several large abalone shells (Tables S1 and S2).

D.A.G. identified the bird remains using comparative collections at the Joint Science Department of the Claremont Colleges and the Natural History Museum of Los Angeles County. Seventeen elements [crania, maxilla, lower mandible, pelvic bones, sternum, sacral vertebrae, humerus, ulna, radius, carpometacarpus, and D4P (phalange of wing, coracoid, scapula, clavicle, femur, tibiotarsus, and tarsometatarsus)] were generally identified to species. Some bones were too similar to differentiate to species, so they were assigned to one of the following groups: Pacific and red-throated loons (*Gavia* spp.), large gulls (*Larus* spp.), Brandt's and double-crested cormorants, and ancient (*Synthliboramphus antiques*) and marbled (*Brachyramphus marmoratus*) murrelets.

T.C.R. identified the fish remains using comparative collections at the University of Oregon, the University of California, Santa Barbara, the National Marine Mammal Laboratory in Seattle, and the California Academy of Sciences. The angular, dentary, maxilla, parasphenoid, premaxilla, preopercle, and vertebra were most commonly identified, but others (i.e., basioccipital, ceratohyla, epihyla, frontal, hyomandibular, interopercle, opercle, palatine, parietal, pharyngeal, posttemporal, radial, scapula, supracleithrum, supraoccipital, and vomers) also were identified in smaller numbers. To calculate minimum number of individuals (MNI), we used the total of sided, nonrepetitive cranial elements from a particular taxon, or, in some cases, the number of fish vertebrae identified was divided by an average number of vertebrae for that taxon (29).

P.W.C. identified the mammal and reptile remains using comparative collections housed at the Santa Barbara Museum of Natural History. Twenty-one skeletal elements (skull, mandible, teeth, scapula, humerus, radius, ulna, carpal/tarsal bones, metacarpal, metatarsal, phalanges, ribs, long-bone epiphyses, pelvis, femur, patella, tibia, fibula, calcaneus, and astragalus) and teeth generally were identified to species. Fragmentary, nondiagnostic specimens were identified as undifferentiated mammal, but nearly all other vertebrate remains were assigned to a species.

Shellfish and other invertebrates were identified by J.M.E. with assistance from H. Chaney and P. Scott of the Santa Barbara Museum of Natural History. Identifications were made using comparative specimens at the University of Oregon and the Santa Barbara Museum of Natural History or, occasionally, with standard reference books. MNI values were calculated using nonrepetitive elements: the apex for gastropods, "right" and "left" hinges for bivalves, end plates for chitons, and the number of whole or nearly whole shells for barnacles.

Potential Biases in Using Nest Remains to Determine Diet. Although the Ferrelo Point eagle nest had been abandoned for more than 50–60 years, prey remains at the site were still prevalent and well preserved. The faunal material recovered during excavation of this nest site provides an accurate assessment of the diversity and relative occurrence of various prey components of the eagles' diet at this nest site. Analysis of prey remains is biased and is known to omit or underestimate the importance of some prey categories of food, such as small mammals, small fish, soft-bodied fish, and large prey/carrion not carried back to the nest or consumed whole. Prey categories that may be underrepresented in this sample probably include soft-bodied and smaller fish, and large fleshy carrion such as marine mammal and adult sheep carcasses. Bones from soft-bodied and smaller fish species generally do not preserve well or may have been consumed whole. Also, eagles probably brought back to their nests a greater quantity of flesh rather than bones from larger carrion such as adult sheep and marine mammals. The screening techniques used here, however, are designed to capture small fish remains, including vertebrae and otoliths of sardines, herring, and midshipman as well as a variety of small invertebrates, small mammals, lizards, and small terrestrial birds (27). Furthermore, the preservation of bones in the nest was outstanding, including numerous bones that were still articulated and fragile cranial elements of small fish would have survived as they do in many island archaeological sites. Thus, the large quantity of bird and fish bone recovered from this nest site provides a good qualitative and quantitative picture of seabird and fish use. This material also provides a reasonably accurate picture of the relative importance of these prey categories in the overall diet. Our study has shown that by completely excavating a nest site it is possible to obtain an adequate faunal sample to reconstruct a reasonably accurate picture of the broad components of the diet. Because nest site excavation integrates dietary information over longer timescales than possible with analysis of recently deposited prey remains at active nests or by direct observation of prey being returned to a nest, it provides a greater amount and diversity of faunal remains. Although biases exist with prey remains data, nest site excavation provides the best and only reliable method for reconstructing the diet of an extirpated eagle population. The recovered remains appear to represent a long-term record of bald eagle feeding patterns at Ferrelo Point that spans decades and numerous generations of eagles.

Given the length of time that has transpired since eagles last used the Ferrelo Point nest, it is possible that other birds such as the common raven (*Corvus corax*), red-tailed hawk (*Buteo jamaicensis*), American kestrel (*Falco sparverius*), barn owl, and gulls could have used this abandoned nest structure to perch or (at least for common ravens and red-tailed hawks) to nest. These species could have been responsible for depositing some of the smaller prey items in the nest site. Although it is not possible to determine with certainty which prey items were brought to the nest site by species other than bald eagles, it is important to keep in mind that some of the prey recovered from this nest site may not have been brought to the site by eagles.

Isotopic Considerations. To make direct isotopic comparisons between bald eagles and their potential prey (Fig. 3), we corrected eagle bone and feather values for trophic and tissue-specific discrimination. Because all of the prey and most of the bald eagle samples we analyzed were bone collagen, our bald eagle versus prey isotopic comparisons (Fig. 3 and Table S3) are presented in bone collagen isotopic space. All historic and prehistoric eagle bone collagen values were corrected only for trophic discrimination by subtracting 1.5‰ and 3.0‰ from measured δ^{13}C and δ^{15}N values, respectively (30). Correction of historic bald eagle feathers required the application of both a tissue-specific and trophic discrimination factor. To correct for tissue-specific discrimination in δ^{13}C, we assumed that bone collagen is enriched by ~5‰ compared with average prey muscle, whereas consumer keratin (i.e., feathers) is enriched only by ~2‰

relative to average prey muscle (30); thus there is an ~3‰ difference between bone collagen and keratin, irrespective of diet. Because our consumer versus prey comparisons (Fig. 3 and Table S3) are for bone collagen, and we assume that consumer bone collagen δ^{13}C is ~1.5‰ enriched in comparison with average prey bone collagen δ^{13}C, we added ~1.5‰ to consumer keratin δ^{13}C values to account for both tissue-specific and trophic discrimination factors (Fig. 3 and Table S3). Tissue-specific corrections are not required for δ^{15}N, but as with bone collagen, historic eagle feathers must be corrected for trophic discrimination by subtracting 3‰ from consumer values. These discrimination factors represent estimates, and recent laboratory and field studies show that they can vary at the taxonomic and individual level (31, 32).

Theoretical considerations and a limited amount of empirical evidence suggest that δ^{15}N trophic discrimination factors ($\Delta^{15}N_{\text{tissue-diet}}$) are smaller by ≤1‰ in growing (i.e., young) versus nongrowing (i.e., adult) animals (33, 34). The efficiency of nitrogen utilization likely correlates with age, such that nongrowing animals are in neutral nitrogen balance, whereas growing animals are in positive nitrogen balance (ratio of N inputs to N outputs is <1). Thus, $\Delta^{15}N_{\text{tissue-diet}}$ should decrease with the efficiency of nitrogen deposition as measured as the ratio between protein assimilation and protein loss. Experimental studies that examined young animals in the "exponential" phase of growth show a significant negative relationship between $\Delta^{15}N_{\text{tissue-diet}}$ and growth rate in a wide variety of taxa with an overall decrease of ≤1‰ in rapidly growing versus adult animals (35–38). To our knowledge, no study has reported a significant change in $\Delta^{13}C_{\text{tissue-diet}}$ with growth rate (i.e., age). For the large marine versus terrestrial isotopic gradients used here, however, relatively small interindividual variations (~1‰) in δ^{15}N (or δ^{13}C) trophic discrimination factors related to tissue- or age-specific differences do not compromise our assessment of bald eagle diets through time.

Finally, the differences in isotopic incorporation rates in the tissues we analyzed—bone collagen and feathers—and in the prey muscle that is consumed by eagles is an important consideration for some species of avian prey [e.g., scoters (*Melanitta* spp.) and grebes (*Podiceps* spp.)] that use both terrestrial and marine habitats at different times of the year. Isotopic turnover rates can vary within or among individuals as a function of body size and growth rate as well as among tissue types within an individual (33, 39). For metabolically active tissues, bone collagen has the slowest isotopic incorporation rate and represents a multiyear average of diet (39). Muscle has an intermediate isotopic incorporation rate and represents an ~3–6 month average of diet for the size of birds that are common prey items for bald eagles. As such, muscle tissue in a bird that utilizes both marine and terrestrial habitats on a seasonal basis could have a significantly different isotopic composition than its bone collagen. Our analyses of eagle diets are based primarily on a comparison of bone collagen isotope values among eagles and their prey and thus are estimates of dietary inputs over multiyear timescales. Comparison of eagle feather and prey bone collagen isotope values could be problematic, however, because feathers are metabolically inert tissues that record information only during the time of feather growth; for primaries, this period coincides with the late summer and early fall. Thus, if the isotopic composition of prey muscle consumed by eagles during this time period is significantly different from the long-term average represented by the prey's bone collagen, dietary inferences could be misleading. Our bone collagen data for prey show this consideration may be an issue only for surf scoters (*Melanitta perspicillata*), which have bone collagen isotope values suggestive of a mixed marine and terrestrial diet. Eared grebes (*Podiceps nigricollis*) and white-winged scoters (*Melanitta fusca*) have relatively low δ^{35}C and δ^{15}N bone collagen values indicative of a reliance on freshwater aquatic ecosystems. All other avian prey analyzed had isotope values of obligate marine foragers. Thus, our multitissue comparison of eagle feathers and prey bone collagen isotope values are reliable, because the only potentially problematic prey species for this comparison is surf scoters, which are a relatively minor component of nest prey remains (Table S1).

Isotopic Nomenclature. Isotopic results are expressed as δ values, $\delta^{13}C$ or $\delta^{15}N = 1{,}000^{*}\ [(R_{\text{sample}}/R_{\text{standard}}) - 1]$, where R_{sample} and R_{standard} are the $^{13}C/^{12}C$ or $^{15}N/^{14}N$ ratios of the sample and standard, respectively. International standards are Vienna-Pee Dee Belemnite limestone (V-PDB) for carbon and atmospheric N_2 for nitrogen. The units are expressed as parts per thousand, or per mil (‰). The within-run SD of an acetalinide standard was ≤0.2‰ for both δ^{13}C and δ^{15}N values. Duplicate isotopic measurements were performed on ~20% of all samples and yielded a mean absolute difference of less than 0.2‰ for δ^{13}C and δ^{15}N.

1. Roberts L. (1989) *Northern Channel Islands Anthology*, ed Daily M, Santa Cruz Island Foundation Occasional Paper No. 2 (Santa Cruz Island Foundation, Santa Barbara, CA), pp 147–177.
2. Holland FR, Jr (1962) Santa Rosa Island: An archaeological and historical study. *J West* 1:45–62.
3. Browne JR (1874) The island of Santa Rosa. *The Overland Monthly* 13:209–213.
4. Thompson TH, West AA (1883) *History of Santa Barbara and Ventura Counties, California* (Thompson and West, Oakland, CA).
5. Thayer WM (1888) *Marvels of the New West: A Vivid Portrayal of the Unparalleled Marvels in the Vast Wonderland West of the Missouri River* (Henry Bill, Norwich CT).
6. Storke TM, Thompkins WA (1958) *California Editor* (Westernlore, Los Angeles).
7. Mason JD (1883) *History of Santa Barbara County, California* (Thompson and West, Oakland, CA).
8. Towne CW, Wentworth N (1945) *Shepherds' Empire* (Univ of Oklahoma Press, Norman, OK).
9. Van Vuren D. (1992) *Fifteenth Vertebrate Pest Conference* (Univ of California, Davis, CA), pp 377–381.
10. Schuyler P (1993) *Third California Islands Symposium*, ed Hochberg FG (Santa Barbara Museum of Natural History, Santa Barbara, CA), pp 443–452.
11. Hunt GL., Jr, Pitman RL, Jones HL (1980) In *The California Islands: Proceedings of a Multidisciplinary Symposium*, ed Power DM (Santa Barbara Museum of Natural History, Santa Barbara, CA), pp 443–459.
12. Sowls AL, DeGange AR, Nelson JW, Lester GS (1980) *Catalog of California Seabird Colonies,* FWS/OBS 37/80 (US Department of the Interior, Washington, DC).
13. Carter HR, et al. (1992) *Breeding Populations of Seabirds in California, 1989–1991* Vol. 1: Population Estimates (U. S. Fish and Wildlife Service, Newark, NJ).
14. Carter HR, et al. (2008) *Status of Breeding Seabirds in the San Miguel Island Group, California* (Victoria and California Institute of Environmental Studies, Davis, CA).
15. Jones TL, Hildebrandt WR, Kennett DJ, Porcasi JF (2004) Prehistoric marine mammal overkill in the northeastern Pacific: A review of new evidence. *J Calif Gt Basin Anthropol* 24:69–80.
16. Erlandson JM, Rick TC, Braje TJ (2009) Fishing up the food web?: 12,000 years of maritime subsistence and adaptive adjustments on California's Channel Islands. *Pac Sci* 63:711–724.
17. Braje TJ, DeLong RL (2009) *Proceedings of the Seventh California Islands Symposium*, eds Damiani CC, Garcelon DK (Institute for Wildlife Studies, Arcata, CA), pp 43–52.
18. Erlandson JM, Rick TC (2010) Archaeology meets marine ecology: The antiquity of maritime adaptations and human impacts on fisheries and marine ecosystems. *Annu Rev Mar Sci* 2:165–185.
19. Scammon CM (1968) *The Marine Mammals of the Northwest Coast of North America* (Dover Publishing Company, New York).
20. Ogden A (1933) Russian sea otter and seal hunting on the California coast. *Calif HistSoc Q* 12:29–51.
21. Cass VL (1985) Exploitation of California sea lions, *Zalophus californianus*, prior to 1972. *Mar Fish Rev* 47:36–38.
22. Stewart BS, Yochem PK, DeLong RL, Antonelis GA (1993) In *Third California Islands Symposium: Recent advances in research on the California Islands*, ed Hochberg FG (Santa Barbara Museum of Natural History, Santa Barbara, CA), pp 501–516.
23. Bonnot P, Ripley WE (1948) The California sea lion census for 1947. *Calif Fish Game* 34: 89–92.
24. Lowry MS, Maravilla-Chavez O (2005) *Proceedings of the Sixth California Islands Symposium*, eds Garcelon DK, Schwemm CA (Institute for Wildlife Studies, Arcata, CA), pp 485–489.
25. Stewart BS, et al. (1994) *Elephant seals: Population Ecology, Behavior and Physiology*, eds Le Boeuf BJ, Laws RM (Univ of California Press, Berkeley, CA), pp 29–48.
26. Collins PW, Guthrie DA, Rick TC, Erlandson JM (2005) *Proceedings of the Sixth California Islands Symposium*, eds Garcelon DK, Schwemm CA (Institute for Wildlife Studies, Arcata, CA), pp 103–120.
27. Erlandson JM, Rick TC, Collins PW, Guthrie DA (2007) Archaeological implications of a bald eagle nesting site at Ferrelo Point, San Miguel Island, California. *J Archaeol Sci* 34:255–271.

28. Behrensmeyer AK (1978) Taphonomic and ecologic information from bone weathering. *Paleobiology* 4:150–162.
29. Rick TC, Erlandson JM, Vellanoweth R (2001) Paleocoastal marine fishing on the Pacific coast of the Americas: Perspectives from Daisy Cave, California. *Am Antiq* 66:595–614.
30. Koch PL (2007) *Stable Isotopes in Ecology and Environmental Science*, eds Michener R, Lajtha K (Blackwell Publishing, Boston), pp 99–154.
31. Vanderlift MA, Ponsard S (2003) Sources of variation in consumer-diet δ^{15}N enrichment: A meta-analysis. *Oecologia* 136:169–182.
32. Newsome SD, et al. Variation in δ^{13}C and δ^{15}N diet-vibrissae trophic discrimination factors in a wild population of California sea otters (*Enhydra lutris nereis*). *Ecol Appl*, in press.
33. Martinez del Rio M, Wolf B (2005) Mass-balance models for animal isotopic ecology. In *Physiological and Ecological Adaptations to Feeding in Vertebrates*, eds Starck JM, Wang T (Science Publishers, Enfield, NH), pp 141–174.
34. Martinez del Rio M, Wolf N, Carleton SA, Gannes LZ (2009) Isotopic ecology ten years after a call for more laboratory experiments. *Biol Rev Camb Philos Soc* 84:91–111.
35. Fantle MS, Dittel AI, Schwalm SM, Epifanio CE, Fogel ML (1999) A food web analysis of the juvenile blue crab *Callinectes sapidus* using stable isotopes in whole animals and individual amino acids. *Oecologia* 120:416–426.
36. Gaye-Siesseger J, Focken U, Abel H, Becker K (2003) Feeding level and diet quality influence trophic shift of C and N isotopes in Nile tilapia (*Oreochromis niloticus*). *Iso Environ Health* 39:125–134.
37. Gaye-Siesseger J, Focken U, Muetzel S, Abel H, Becker K (2004) Feeding level and individual metabolic rate affect δ^{13}C and δ^{15}N values in carp: Implications for food web studies. *Oecologia* 138:175–183.
38. Trueman CN, McGill RAR, Guyard PH (2005) The effect of growth rate on tissue-diet isotopic spacing in rapidly growing animals: An experimental study with Atlantic salmon (*Salmo salar). Rap Comm Mass Spec* 19:3239–3247.
39. Carleton SA, Martinez del Rio C (2005) The effect of cold-induced metabolic rate on the rate of ^{13}C and ^{15}N incorporation in house sparrows (*Passer domesticus*). *Oecologia* 144:226–233.

Table S1. Summary of major prey remains in the Ferrelo Point bald eagle nest

Common name (scientific name)	Habitat	NISP	MNI	% NISP*	% MNI*	δ^{13}C ± SE (n)	δ^{15}N ± SE
Rockfish (*Sebastes* spp.)	M	1012	45	56.5	50.0	−12.1 ± 0.2 (27)	15.3 ± 0.2
Surfperch (Embiotocidae)	M	375	17	20.9	18.9	−10.6 ± 0.3 (24)	14.6 ± 0.2
Rhinoceros auklet (*Cerorhinca monocerata*)	M	736	55	14.0	18.5	−14.7 ± 0.3 (15)	17.9 ± 0.2
Double-crested or Brandt's cormorant (*Phalacrocorax* spp.)	M	452	28	8.6	9.4	−13.4 ± 0.2 (15)	16.3 ± 0.3
Sooty shearwater (*Puffinus griseus*)	M	315	25	6.0	8.4	−15.2 ± 0.2 (15)	15.8 ± 0.3
Cassin’s auklet (*Ptychoramphus aleuticus*)	M	96	23	1.8	7.7	−15.3 ± 0.3 (14)	16.5 ± 0.2
Pelagic cormorant (*Phalacrocorax pelagicus*)	M	308	21	5.9	7.1	−12.7 ± 0.2 (15)	16.2 ± 0.1
Large gulls (*Larus* spp.)	M	170	14	3.2	4.7	−14.7 ± 0.4 (14)	17.0 ± 0.3
Eared grebe (*Podiceps nigricollis*)	M/T	102	11	1.9	3.7	−19.0 ± 1.0 (11)	11.7 ± 0.8
White-winged scoter (*Melanitta fusca*)	M/T	418	29	7.9	9.8	−17.3 ± 0.4 (15)	12.0 ± 0.3
Surf scoter (*Melanitta perspicillata*)	M/T	112	10	2.1	3.4	−15.3 ± 0.7 (15)	12.9 ± 0.6
Sheep (*Ovis aries*)	T	328	14	77.4	43.8	Adults: −19.6 ± 0.1 (3) Lambs: −17.7 ± 1.0 (5)	Adults: 9.7 ± 0.5 Lambs: 10.9 ± 0.5

M, marine; NISP, number of identifiable specimens; T, terrestrial.

*Percents of total NISP and MNI are per specific faunal category (e.g., fish, birds, or mammals).

Table S2. General faunal categories represented at the Ferrelo Point nest

Prey type	NIP	MNI	Weight (g)	%NISP	%MNI
Fish total	*4,048*	*90*	*1,391.6*	*40.7*	*18.6*
Fish, undifferentiated	(2,257)	ND	(304.2)	(22.7)	ND
Reptiles, total	*21*	*7*	*0.6*	*<0.5*	*1.4*
Birds, total	*5,261*	*297*	*6,427.3*	*52.9*	*61.2*
Marine birds	1,366	108	3,350.8	13.7	22.3
Waterfowl	580	45	987.0	5.8	9.6
Herons/egrets	3	1	7.2	<0.5	<0.5
Shorebirds	15	6	5.7	<0.5	1.2
Gulls/terns	298	33	5,70.6	3.0	6.8
Alcids	959	71	766.7	9.6	14.6
Terrestrial birds	71	10	357.3	<0.5	2.0
Birds, undifferentiated	(1,969)	ND	(381.7)	(19.8)	ND
Mammals, total	*413*	*25*	*2,508.8*	*4.2*	*5.2*
Terrestrial mammals	371	21	2,386.8	3.7	4.3
Marine mammals	32	4	113.1	<0.5	0.8
Mammals, undifferentiated	(10)	ND	(8.9)	(<0.5)	ND

Table S3. Isotope values, tissue type, trophic and tissue-specific corrected (TDF) isotope values, [C]/[N] ratios, collection location, collection year, time period (historic or prehistoric), and age of bald eagle specimens analyzed in this study

Sample ID	Tissue	δ^{13}C	δ^{13}C TDF	δ^{15}N	δ^{15}N TDF	C/N	Island/county	Year	Time period	Age
Nestling A	BC	−12.5	−14.0	17.1	14.1	2.8	San Miguel Island	≤1940	Historic	Nestling
Nestling B	BC	−17.5	−19.0	12.4	9.4	3.1	San Miguel Island	≤1940	Historic	Nestling
Nestling C	BC	−15.0	−16.5	14.1	11.1	2.8	San Miguel Island	≤1940	Historic	Nestling
Nestling D	BC	−13.0	−14.5	16.7	13.7	2.9	San Miguel Island	≤1940	Historic	Nestling
Nestling E	BC	−11.8	−13.3	17.5	14.5	2.8	San Miguel Island	≤1940	Historic	Nestling
Fledgling A	BC	−15.9	−17.4	13.9	10.9	2.8	San Miguel Island	≤1940	Historic	Fledgling
Fledgling B	BC	−13.1	−14.6	16.9	13.9	2.8	San Miguel Island	≤1940	Historic	Fledgling
Fledgling C	BC	−16.5	−18.0	13.9	10.9	2.8	San Miguel Island	≤1940	Historic	Fledgling
LM 991/40515	BC	−15.0	−16.5	16.9	13.9	2.8	Santa Cruz Island	1929	Historic	Immature
LM 22944	BC	−16.4	−17.9	14.6	11.6	2.8	Santa Cruz Island	1929	Historic	Immature
LM 992/40601	BC	−13.6	−15.1	16.7	13.7	2.8	Santa Cruz Island	1929	Historic	Immature
LM 626/38071	BC	−13.5	−15.0	16.7	13.7	2.8	Santa Cruz Island	1922	Historic	Immature
LACM 86837	BC	−12.6	−14.1	17.5	14.5	2.8	Santa Rosa Island	1941	Historic	Immature
MVZ 136146	BC	−13.5	−15.0	17.9	14.9	2.8	Santa Barbara Island	1957	Historic	Adult
VP 214 #9	BC	−13.9	−15.4	16.6	13.6	3.0	San Miguel Island	–	Prehistoric	Immature
VP 216 #6	BC	−13.0	−14.5	17.9	14.9	2.8	San Miguel Island	–	Prehistoric	Adult
VP 215 #17	BC	−12.8	−14.3	19.3	16.3	3.0	San Miguel Island	–	Prehistoric	Immature
VP 492 #3	BC	−12.9	−14.4	17.3	14.3	3.0	San Miguel Island	–	Prehistoric	Immature
VP 216 #5	BC	−13.2	−14.7	18.7	15.7	3.0	San Miguel Island	–	Prehistoric	Adult
VP 214 #11	BC	−14.4	−15.9	17.0	14.0	3.2	San Miguel Island	–	Prehistoric	Fledgling
VP 214 #12	BC	−13.2	−14.7	16.7	13.7	2.9	San Miguel Island	–	Prehistoric	Immature
VP 9 #4	BC	−12.6	−14.1	17.7	14.7	3.0	San Miguel Island	–	Prehistoric	Immature
VP 62 #7	BC	−14.0	−15.5	14.3	11.3	2.8	San Miguel Island	–	Prehistoric	Adult
VP 214 #10	BC	−14.6	−16.1	16.3	13.3	3.1	San Miguel Island	–	Prehistoric	Immature
VP 43 #1	BC	−18.1	−19.6	12.9	9.9	3.1	San Miguel Island	–	Prehistoric	Immature
PANS 33150	F	−16.3	−14.8	17.9	14.9	3.4	San Miguel Island	1871	Historic	Adult
PANS 33149	F	−15.1	−13.6	18.2	15.2	3.6	San Miguel Island	1871	Historic	Immature
VCNHM 34–35.1	F	−15.8	−14.3	17.3	14.3	3.4	Anacapa Island	1892	Historic	Adult
SMNH 10568	F	−17.3	−15.8	15.7	12.7	3.3	Anacapa Island	1920	Historic	Adult
LACM 5953	F	−17.0	−15.5	16.1	13.1	3.4	Santa Cruz Island	1914	Historic	Adult
CFM 14209	F	−17.5	−16.0	18.4	15.4	3.2	San Clemente Island	1903	Historic	Adult
CFM 14208	F	−17.3	−15.8	18.7	15.7	3.5	San Clemente Island	1903	Historic	Adult
MCZ 252805	F	−16.3	−14.8	17.0	14.0	3.3	San Clemente Island	1907	Historic	Adult
WFVZ 2334	F	−16.4	−14.9	17.2	14.2	3.3	Santa Catalina Island	1932	Historic	Adult
WFVZ 2333	F	−17.1	−15.6	17.4	14.4	3.2	Los Angeles County	1915	Historic	Adult
VCNHM 30–39.2	F	−17.1	−15.6	16.3	13.3	3.3	Ventura County	ND	Historic	Adult
LACM 14854	F	−22.2	−20.7	12.3	9.3	3.3	Orange County	1927	Historic	Adult
MVZ 144728	F	−21.4	−19.9	13.3	10.3	3.6	San Diego County	1922	Historic	Adult

Isotope values for feathers represent mean values for five subsamples cut from each historic specimen; within-feather SD was <0.5‰ for all specimens. BC, bone collagen; F. feather.