BioOne COMPLETE

Nest-site Characteristics of Red-tailed Hawks and Common Ravens on San Clemente Island, California

Authors: Sullivan, Brian L., Kershner, Eric L., Finn, Sean P., Condon, Anne M., Cooper, Douglass M., et al.

Source: Journal of Raptor Research, 45(3) : 252-256

Published By: Raptor Research Foundation

URL: https://doi.org/10.3356/JRR-10-44.1

BioOne Complete (complete.BioOne.org) is a full-text database of 200 subscribed and open-access titles in the biological, ecological, and environmental sciences published by nonprofit societies, associations, museums, institutions, and presses.

Your use of this PDF, the BioOne Complete website, and all posted and associated content indicates your acceptance of BioOne's Terms of Use, available at www.bioone.org/terms-of-use.

Usage of BioOne Complete content is strictly limited to personal, educational, and non - commercial use. Commercial inquiries or rights and permissions requests should be directed to the individual publisher as copyright holder.

BioOne sees sustainable scholarly publishing as an inherently collaborative enterprise connecting authors, nonprofit publishers, academic institutions, research libraries, and research funders in the common goal of maximizing access to critical research.

Downloaded From: https://complete.bioone.org/journals/Journal-of-Raptor-Research on 19 Apr 2024
Terms of Use: https://complete.bioone.org/terms-of-use

SHORT COMMUNICATIONS

J. Raptor Res. 45(3):252–256
© 2011 The Raptor Research Foundation, Inc.

NEST-SITE CHARACTERISTICS OF RED-TAILED HAWKS AND COMMON RAVENS ON SAN CLEMENTE ISLAND, CALIFORNIA

BRIAN L. SULLIVAN,[1] ERIC L. KERSHNER,[2] SEAN P. FINN,[3] ANNE M. CONDON,[4] DOUGLASS M. COOPER[5] AND DAVID K. GARCELON
Institute for Wildlife Studies, P.O. Box 1104, Arcata, CA 95518 U.S.A.

KEY WORDS: *Red-tailed Hawk*; Buteo jamaicensis; *Common Raven*; Corvus corax; *island nesting*; *raptors*; *San Clemente Island*.

Red-tailed Hawks (*Buteo jamaicensis*) and Common Ravens (*Corvus corax*) are widespread throughout North America. Both species are found in a variety of open and woodland habitats with scattered, elevated perches and use similar nest sites (Preston and Beane 2009, Boarman and Heinrich 1999). Red-tailed Hawks typically build bulky stick nests in tall trees with open canopies (Preston and Beane 2009). However, they will also nest on cliffs and human-made structures such as utility poles and buildings (Bechard et al. 1990, Preston and Beane 2009). Common Ravens also build bulky stick nests typically under shelter, yet are known to use a wider variety of nest sites (Boarman and Heinrich 1999).

On San Clemente Island (SCI), California, Red-tailed Hawks and Common Ravens have been resident breeders since at least the early 1900s (Howell 1917), but little is known about the nesting habits of insular populations of these species, including those on SCI. There are few trees on SCI due to the introduction of feral grazers in the early 1800s (USDN 2001). The large trees that still remain are located in the bottom of deep canyons across the island, and do not provide a high vantage point allowing a view of the surrounding landscape, which is a feature typical of these species' nest sites across much of their ranges (Preston and Beane 2009). As these species are the only two large nesting birds on the island, we sought to better understand nest-site characteristics of these species on SCI. Nest-site selection might provide insight as to whether niche partitioning might be occurring in this island environment with potentially limited nest sites. Our objective was to describe nest sites of both species, monitor nest success, and compare general nest-site characteristics between species.

METHODS

Study Area. San Clemente Island (32°50′N, 118°30′W) is the southernmost of the California Channel Islands, located approximately 92 km west of Palos Verdes, California. SCI is administered by the U.S. Navy and used for active military training as part of the Southern California Offshore Range. The Navy also manages for protection and conservation of natural resources on the island (USDN 2001). The island is 44 km long and 2.4–6.4 km wide, encompassing approximately 14 764 ha. Elevation ranges from sea level to 599 m. The island consists of a central plateau incised by canyons along the western and eastern slopes. The east side is a precipitous escarpment, descending from the plateau to the Pacific Ocean; the west side consists of a series of more gentle marine terraces. Annual temperature ranges from 10 to 22°C and annual precipitation averages 15.7 cm (Olmstead 1958, Vedder and Howell 1980).

Goats (*Capra hircus*) altered the native vegetation of SCI since they were introduced in the late 1800s (Johnson 1975, Jorgensen and Ferguson 1984), by removing nearly all woody vegetation and severely eroding soils. Areas once dominated by stands of hardwood trees are gone, and woodland habitats are now restricted primarily to the bottoms of deep canyons. Current vegetation on SCI includes mixed native and nonnative grasslands (including *Avena, Bromus,* and *Stipa* spp.) on the upper terraces, maritime desert scrub, and remnant patchy shrubland/woodland characterized by island cherry (*Prunus illicifolia s. lyonii*), lemonade berry (*Rhus integrifolia*), island oak (*Quercus tomentella*), canyon live oak (*Q. chrysolepis*), and Catalina ironwood (*Lyonothamnus floribundus*; Raven 1963, Sward and Cohen 1980, Kellogg and Kellogg 1994).

[1] Present address: Cornell Lab of Ornithology, 159 Sapsucker Woods Road, Ithaca, NY 14850 U.S.A.
[2] U.S. Fish and Wildlife Service, Division of Migratory Birds, 4401 North Fairfax Drive, Mail Stop MBSP, Arlington, VA 22203 U.S.A.; email address: eric_kershner@fws.gov
[3] U.S. Fish and Wildlife Service, Great Northern Landscape Conservation Cooperative, Snake River Field Station, 970 Lusk Street, Boise, ID 83706 U.S.A.
[4] Present address: U.S. Fish and Wildlife Service, 6669 Short Lane, Gloucester, VA 23061 U.S.A.
[5] Present address: U.S. Fish and Wildlife Service, 2493 Portola Road, Suite B, Ventura, CA 93003 U.S.A.

Downloaded From: https://complete.bioone.org/journals/Journal-of-Raptor-Research on 19 Apr 2024
Terms of Use: https://complete.bioone.org/terms-of-use

Nest-site Characteristics. To locate nests across the island, we surveyed all accessible habitats on foot or from a boat during the 2001 and 2002 breeding season (February–June). We determined nest locations by following adults flying to nests, or by visual inspection of potential nest sites (e.g., cliffs, utility poles, trees). In some cases, we located nest sites that were not directly visible due to topography by adult behavior (e.g., prey deliveries). Nests were considered active when we directly observed an incubating female, eggs or nestlings, or dependent young near a used nest; the use of such active nests was considered a breeding attempt. We plotted all nest-site locations on topographic maps using Global Positioning System (GPS) and Geographical Information System (GIS) technology.

We measured nest-site characteristics after fledging or nest failure (June–August) for all active nests where the exact nest location was known. If the same nest site was used in two consecutive years by the same species, we only included the first year's data in the analyses to avoid pseudo-replication. We categorized each nest site as being on a canyon cliff, sea cliff, tree, or artificial structure. Available artificial structures included utility poles, buildings, and abandoned trailers.

For nests located on canyon cliffs, we measured wall height, cliff height, and nest height (i.e., the distance from the nest rim to the canyon bottom) from the closest accessible perpendicular vantage point, using a laser rangefinder and clinometer. We measured wall height as the distance from the canyon bottom to the canyon rim or terrace edge, described as ''brink'' in White and Cade (1971), including vegetated slopes, sheer cliff faces, and rock outcroppings. We measured cliff height as the facet of the wall (e.g., rock outcropping, sheer face) containing the nest, from its bottom to its top. In some cases when walls were near vertical, wall and cliff height were identical. We categorized nest cliffs as less than vertical (i.e., $<90^\circ$ slope that provided some overhang), vertical (i.e., a sheer cliff face with 90° angle), or greater than vertical (i.e., $>90^\circ$ slope providing a more open face slope location). We determined whether a nest was on an open ledge or in a cave (>75% overhead cover). We determined the presence of vegetation as nest support and classified nests into two categories: those with vegetation and those lacking vegetation.

We measured nest orientation and nest cliff aspect using the mean compass reading of two or three independent observers. We used Program ORIANA (Kovach 1994) to calculate circular statistics for nest/cliff orientation: mean vector and standard error. We used Rayleigh's test of uniformity to test mean exposures for nonrandom orientations (Batschelet 1981, Zar 1984). Concentration (r) or length of the mean vector as calculated by circular methods, ranges from 0 to 1 and is affected by variation in circular data, sample size, and grouping. Values of r near 1 indicate data points closely concentrated near the mean angle, or in our case, nest-sites with a preferred directional orientation.

Nesting Success. We monitored nesting activity and documented the outcome of all breeding attempts where we could observe the nest contents. We considered a breeding attempt successful if at least one young fledged, confirmed by the observation of dependent fledglings near the nest site. We considered a breeding attempt failed when, on a subsequent visit, the nest was empty when it previously contained eggs or nestlings. We also considered nests abandoned when the adults were not found attending the nest over the course of successive visits. We calculated the number of young per successful nest, and the apparent success rate (i.e., percentage of breeding attempts monitored that were successful).

RESULTS

We located 37 Red-tailed Hawk and 26 Common Raven active nests on SCI during 2001 and 2002. Due to restricted accessibility we were able to measure nest-site characteristics only for 20 Red-tailed Hawk and 19 Common Raven pairs. Therefore, we used this subsample for all analyses of nest-site characteristics and nesting success.

We found both species nesting on steep cliffs islandwide. Nests consisted largely of sticks with occasional flotsam and other debris. Common Ravens used both canyon cliffs (42%, $n = 8$) and sea cliffs (58%, $n = 11$) for nesting, whereas Red-tailed Hawks nested almost exclusively on canyon cliffs (95%, $n = 19$). We found no nests of either species in trees or on human-made structures.

Red-tailed Hawks nested more frequently on cliffs with $<90^\circ$ slope ($n = 9$) and vertical cliffs ($n = 8$) than on the more open-sloped cliffs (i.e., slope $>90^\circ$, $n = 3$; $X^2 = 3.09$, df = 2, $P = 0.21$), although these differences were not significant. Common Ravens appeared to favor nesting on vertical cliffs ($n = 11$) compared to nesting on cliffs with a slope $<90^\circ$ ($n = 5$) or more open-sloped cliffs (i.e., slope $>90^\circ$, $n = 3$; $X^2 = 5.5$, df = 2, $P = 0.064$). Red-tailed Hawks used open ledges with little to no overhang (65%, $n = 13$) more than caves (35%, $n = 7$; $X^2 = 1.8$, 1 df, $P = 0.18$), although this result was not statistically significant, whereas Common Ravens used caves (84%, $n = 16$) significantly more than open ledges (16%, $n = 3$; $X^2 = 8.9$, 1 df, $P = 0.003$). In general, Red-tailed Hawks nested on taller cliffs ($t = 2.63$, df = 37, $P = 0.012$) and were subsequently higher from the ground ($t = 2.67$, df = 37, $P = 0.011$) compared to Common Ravens (Table 1). There was no difference in size of the cliff feature where Red-tailed Hawks or Common Ravens nested ($t = 1.54$, df = 37, $P = 0.13$). Half of the 20 Red-tailed Hawk nests included live vegetation (typically *Constancea nevinii*) for nest support, whereas Common Ravens did not incorporate live vegetation into their nests.

Red-tailed Hawk nest exposure was oriented to the southeast with a mean vector of $129 \pm 19^\circ$ SE ($r = 0.46$, $P = 0.02$), whereas Common Raven nests showed no directional grouping ($129 \pm 57^\circ$ SE; $r = 0.16$, $P = 0.62$; Fig. 1). Red-tailed Hawks nested on cliffs with a southeast-facing exposure and a mean vector of $126 \pm 20^\circ$ SE

Downloaded From: https://complete.bioone.org/journals/Journal-of-Raptor-Research on 19 Apr 2024
Terms of Use: https://complete.bioone.org/terms-of-use

Table 1. Mean values ± SE (95% CI) for three nest-site characteristics of Red-tailed Hawk and Common Raven nests on San Clemente Island, California, 2001–02.

VARIABLE	RED-TAILED HAWK (n = 20)	COMMON RAVEN (n = 19)
Wall height (m)	91.0 ± 10.0 (70.1–111.9)	51.8 ± 10.9 (29.0–74.6)
Cliff height (m)	29.1 ± 6.3 (15.8–42.4)	18.5 ± 2.1 (14.1–22.9)
Nest height (m)	58.5 ± 8.2 (41.3–75.7)	26.0 ± 9.0 (7.1–44.9)

(r = 0.43, P = 0.02), whereas Common Ravens nested on cliffs showing no directional orientation and a mean vector of 84 ± 50° SE (r = 0.18, P = 0.54).

Of the 20 Red-tailed Hawk nests monitored, 18 (90%) produced at least one young, with an average reproductive rate of 1.8 ± 0.2 young/successful nest. All 19 (100%) Common Raven nests monitored fledged young, producing 2.9 ± 0.34 young/successful nest. Because most nests were found during the nestling stage, it is likely that nests that failed early were undetected and, thus, the reproductive rate and apparent nest success may be overestimated.

DISCUSSION

Despite a few large trees remaining in canyon bottoms on SCI, both species exclusively used cliffs for nesting, although cliff characteristics differed. On SCI, Common Ravens used nest sites typical for that species in coastal mainland habitats, whereas Red-tailed Hawks seem to have developed a more specialized nesting behavior on the island. Although Common Ravens have been known to use cliffs extensively for nesting (Harlow 1922, White and Cade 1971, Hooper 1977, Knight et al. 1982), Red-tailed Hawks nest less frequently on cliffs, and rarely exclusively on cliffs. In most cases where cliffs and trees were available, a larger proportion nested in trees (Knight et al. 1982, Bechard et al. 1990). In areas where trees are sparse or unavailable, Red-tailed Hawks have used other species such as Saguaro cacti (*Carnegiea gigantea*; Mader 1978) or nested on ridge tops or cliffs (Walter 1990). There is no evidence that there is immigration into this resident island population for either species (Sullivan and Kershner 2005), suggesting that Red-tailed Hawks nesting on SCI have adapted to the unique nest sites available on the island.

Trees on SCI, though available in some areas, may not be suitable for nesting Red-tailed Hawks for several reasons. The majority of sizable trees are found in canyon bottoms, which lack a view of the surrounding landscape. Red-tailed Hawks tend to nest in trees or on structures that provide a vantage point of the surrounding landscape (Preston and Beane 2009), possibly explaining why they generally do not nest on low-elevation sea cliffs, but rather are found higher on walls than Common Ravens (Table 1).

Another notable difference between SCI Red-tailed Hawks and Common Ravens was the amount of overhead cover at the nest site. As in other studies, Common Ravens nested more often in caves with complete nest cover (White and Cade 1971, Hooper 1977, Boarman and Heinrich 1999, Frydenlund 1999). On SCI, Red-tailed Hawks predominantly nested on open ledges. Nest accessibility has been considered important to Red-tailed Hawk nest-site selection in tree-nesting populations (Titus and Mosher 1981, Bednarz and Dinsmore 1982, Preston and Beane 2009) and likely explains why Red-tailed Hawks do not use caves on SCI. In addition, the canopies of *Prunus* and *Quercus* on SCI may be too dense to allow easy nest access.

In previous studies, Red-tailed Hawk nests have generally been oriented to the southeast and southwest (Craig and Craig 1984, Bechard et al. 1990). However, MacLaren et al. (1988) found Red-tailed Hawk nests on cliffs in Wyoming did not depart significantly from random orientation. Like American Kestrel (*Falco sparverius*) nests on SCI (Sullivan et al. 2003), Red-tailed Hawk nests facing southeast were in the lee of the predominant winds from the northwest, providing protection from inclement weather patterns on SCI. Nest orientation could be one strategy that Red-tailed Hawks use to protect nest contents from strong prevailing northwest winds and damp fog (weather patterns common on SCI) as they rarely nest under any overhead cover. Common Raven nests showed more variable directionality, indicating that nest orientation is not as important for protection from inclement weather as more nests were found in caves that provide this protection.

Where excess heat is a problem, direct exposure to the sun may govern raptor nest orientation. Mosher and White (1976) suggested that cliff-nesting Golden Eagles (*Aquila chrysaetos*) selected exposures to reduce direct insolation and thermal stress, and nest exposure in more northerly latitudes or at higher elevations was oriented to the south, while the reverse is true at lower elevations or in southerly latitudes. Contrary to the prediction of Mosher and White (1976), nests of Red-tailed Hawks on SCI were oriented to the southeast. If nests were oriented solely to reduce thermal stress on SCI, they would be exposed to harsh weather conditions (e.g., blowing fog and high winds) especially during the early nesting season (February through April).

Red-tailed Hawk apparent nest success on SCI was 90%, slightly higher than the average (83%) of multiple mainland studies (range 58–93%, Preston and Beane 2009). Compared to mainland studies (range 0.91–1.8 young fledged/nest, Preston and Beane 2009), the number of young fledged per successful nest was high (1.8 young/nest) for Red-tailed Hawks on SCI. Every Common Raven nest we found fledged at least one young on SCI during

Downloaded From: https://complete.bioone.org/journals/Journal-of-Raptor-Research on 19 Apr 2024
Terms of Use: https://complete.bioone.org/terms-of-use

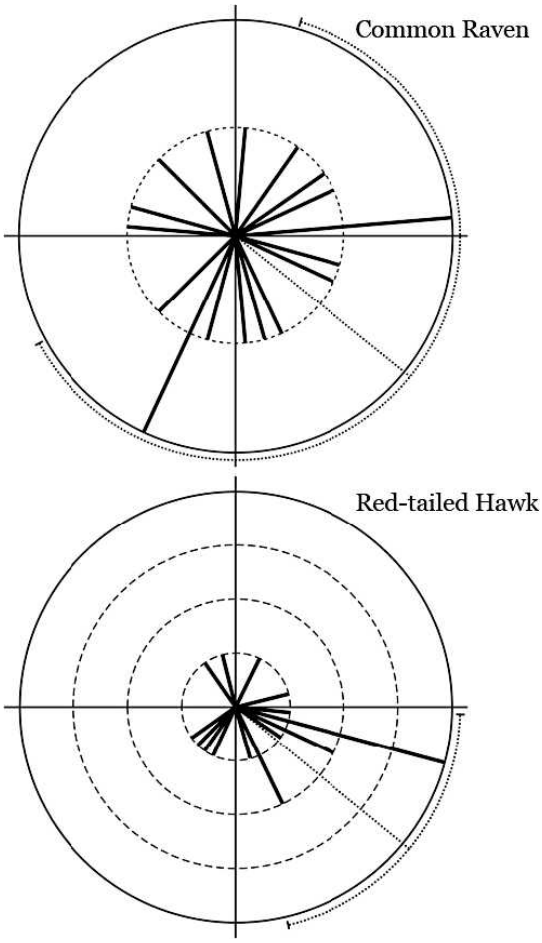

Figure 1. Vector analysis of Red-tailed Hawk (n = 19) and Common Raven (n = 19) nest aspect on San Clemente Island, California, 2001–02. The black bars represent a nest with a particular orientation. Each concentric ring indicates the number of nests with a specific orientation. Thus, the inner dotted ring is equal to one nest and each concentric ring is one additional nest. Black bars that cross multiple rings indicate multiple nests with the same orientation. Dotted lines on outside of the outer circle are the SE of the mean directional vector (perpendicular dotted line).

our study. This rate was higher than the average nest success (72.7%) found in mainland populations (range 58–100%, Boarman and Heinrich 1999). The number of young fledged/successful nest was lower on SCI (2.9 young/nest) than the average young fledged/nest in mainland studies (3.7 young fledged/nest, range: 3.3–4.2, Boarman and Heinrich 1999). These results suggest that during our study, the nest sites selected by both species provided adequate protection from inclement weather and predation (e.g., rats, feral cats, and island foxes). Lower young fledged/successful nest for Common Ravens may be related to lower clutch sizes on islands due to a finite amount of the resources required to rear young, although this requires further study.

As a caveat, we note that it was unknown how the exclusion of inaccessible nests (17 Red-tailed Hawk and 7 Common Raven nests) may have influenced our results, but when these nests were viewed from the air (i.e., from a helicopter), they appeared similar to nests we accessed from the ground. In addition, reproductive rates in our study may be biased high as most of the nests we monitored were found during the nestling stage; nests that failed prior to the nestling stage would not have been included in our sample, resulting in an overestimate of apparent reproductive success.

Our results indicated that these two species use slightly different cliff sites on SCI. Common Ravens appear to use nest sites typical of those across their range (cliff sites with overhead cover). Red-tailed Hawks on SCI used nest sites less commonly used on the mainland. Differences in Red-tailed Hawk nest sites may indicate that this resident population has adapted to the resources available and weather patterns on the island. In the absence of tall trees, Red-tailed Hawks nest on tall cliff faces that provide a good vantage of the surrounding landscape and are oriented in a manner that protects the nest from local weather patterns.

CARACTERÍSTICAS DE LOS SITIOS DE ANIDACIÓN DE *BUTEO JAMAICENSIS* Y *CORVUS CORAX* EN LA ISLA DE SAN CLEMENTE, CALIFORNIA

RESUMEN.—Los sitios de anidación de los halcones *Buteo jamaicensis* y de los cuervos *Corvus corax* pueden ser escasos en la isla de San Clemente (ISC), California. Evaluamos el uso de sitios de anidación y el éxito reproductivo de estas especies en este ambiente de isla. Registramos las características del sitio de anidación de 20 halcones y de 19 cuervos en ISC en 2001 y 2002. Los halcones y los cuervos anidaron en acantilados de grandes cañones y en acantilados marinos, a pesar de la presencia de árboles y estructuras artificiales. Ambas especies utilizaron acantilados casi verticales. Los halcones utilizaron sitios más altos y expuestos e incorporaron vegetación como soporte para el nido. Los cuervos utilizaron con frecuencia cuevas en acantilados marinos pequeños. La exposición de los nidos de los halcones estuvo orientada significativamente hacia el sudeste, en oposición a los vientos dominantes del noroeste, mientras que la exposición de los nidos de los cuervos no mostró un patrón direccional significativo. Con base en los nidos monitoreados, ambas especies tuvieron >90% de éxito de anidación aparente, lo que indica que los sitios de anidación seleccionados proporcionaron una protección adecuada ante las condiciones meteorológicas y los posibles depredadores.

[Traducción del equipo editorial]

Downloaded From: https://complete.bioone.org/journals/Journal-of-Raptor-Research on 19 Apr 2024
Terms of Use: https://complete.bioone.org/terms-of-use

ACKNOWLEDGMENTS

Funding for this project was provided by the Commander in Chief, Pacific Fleet, and was conducted under contract number N68711-99-C-6665, with logistical and technical support from the U.S. Navy Region Southwest, Environmental Department, Natural Resources Office, San Diego, CA. We thank the Natural Resources Office, Commander, Navy Region Southwest, and Southwest Division, Naval Facilities Engineering Command for funding this research. We thank J.H. Plissner and S. Lynn for providing useful comments on early drafts of this manuscript. Any use of trade, product, or firm names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

LITERATURE CITED

BATSCHELET, E. 1981. Circular statistics in biology. Academic Press, New York, NY U.S.A.

BECHARD, M.J., R.L. KNIGHT, D.G. SMITH, AND R.E. FITZNER. 1990. Nest sites and habitats of sympatric hawks (*Buteo spp.*) in Washington. *Journal Field Ornithology* 61:159–170.

BEDNARZ, J.C. AND J.J. DINSMORE. 1982. Nest-sites and habitat of Red-shouldered and Red-tailed hawks in Iowa. *Wilson Bulletin* 94:31–45.

BOARMAN, W.I. AND B. HEINRICH. 1999. Common Raven (*Corvus corax*). *In* A. Poole [ED.], The birds of North America online. Cornell Laboratory of Ornithology, Ithaca, NY U.S.A, http://bna.birds.cornell.edu/bna/species/476 (last accessed 1 March 2011).

CRAIG, T.H. AND E.H. CRAIG. 1984. Results of a helicopter survey of cliff nesting raptors in a deep canyon in southern Idaho. *Journal of Raptor Research* 18:20–25.

FRYDENLUND, S.O. 1999. Gyrfalcon (*Falco rusticolus*) nest site selection at the eastern part of Hardangervidda, South Norway. *Ornis Norvegica* 22:53–59.

HARLOW, R.C. 1922. The breeding habits of the northern raven in Pennsylvania. *Auk* 39:399–410.

HOOPER, R.G. 1977. Nesting habitat of Common Ravens in Virginia. *Wilson Bulletin* 89:233–242.

HOWELL, A.B. 1917. Birds of the islands off the coast of southern California. *Pacific Coast Avifauna* 12.

JOHNSON, D.L. 1975. New evidence on the origin of the fox, *Urocyon littoralis clementae,* and the feral goats on San Clemente Island, California. *Journal of Mammalogy* 56: 825–828.

JORGENSEN, P.D. AND H.L. FERGUSON. 1984. Birds of San Clemente Island. *Western Birds* 15:111–130.

KELLOGG, E.M. AND J.L. KELLOGG. 1994. San Clemente Island vegetation condition and trend and the elements of ecological restoration. Southwest Division, Naval Facilities Engineering Command, San Diego, CA U.S.A.

KNIGHT, R.L., D.G. SMITH, AND A. ERICKSON. 1982. Nesting raptors along the Columbia River north-central Washington. *Murrelet* 63:2–8.

KOVACH, W.L. 1994. Oriana for Windows, Ver. 1.0. Kovach Computing Services, Pentraeth, Wales, U.K.

MACLAREN, P.A., S.H. ANDERSON, AND D.E. RUNDE. 1988. Food habits and nest characteristics of breeding raptors in southwestern Wyoming. *Great Basin Naturalist* 48: 548–553.

MADER, W.J. 1978. A comparative nesting study of Red-tailed Hawks and Harris' Hawks in southern Arizona. *Auk* 95:327–337.

MOSHER, J.A. AND C.M. WHITE. 1976. Directional exposure of Golden Eagle nests. *Canadian Field Naturalist* 90: 356–359.

OLMSTEAD, F.H. 1958. Geologic reconnaissance of San Clemente Island, California. *U.S. Geological Survey Bulletin* 1071-B:55–68.

PRESTON, C.R. AND R.D. BEANE. 2009. Red-tailed Hawk (*Buteo jamaicensis*). *In* A. Poole [ED.], The birds of North America online. Cornell Laboratory of Ornithology, Ithaca, NY U.S.A, http://bna.birds.cornell.edu/bna/species/052 (last accessed 1 March 2011).

RAVEN, P.H. 1963. A flora of San Clemente Island, California. *Aliso* 5:289–347.

SULLIVAN, B.L. AND E.L. KERSHNER. 2005. Birds of San Clemente Island. *Western Birds* 36:158–273.

———, ———, S.P. FINN, A.M. CONDON, D.M. COOPER, AND D.K. GARCELON. 2003. Nest-site characteristics and linear abundance of cliff nesting American Kestrels on San Clemente Island, California. *Journal of Raptor Research* 37:330–336.

SWARD, W.L. AND R.H. COHEN. 1980. Plant community analysis of San Clemente Island. Report to Naval Ocean Systems Center, San Diego, CA U.S.A.

TITUS, K. AND J.A. MOSHER. 1981. Nest-site habitat selected by woodland hawks in the central Appalachians. *Auk* 98:270–281.

U.S. DEPARTMENT OF THE NAVY, SOUTHWEST DIVISION. 2001. San Clemente Integrated Natural Resources Management Plan Final. Prepared by Tierra Data Systems, Escondido, CA U.S.A.

VEDDER, J.G. AND D.G. HOWELL. 1980. Topographic evolution of the southern California borderland during late Cenozoic time. Pages 7–31 *in* D.M. Powers [ED.], The California Channel Islands: proceedings of a multidisciplinary symposium. Santa Barbara Museum of Natural History, Santa Barbara, CA U.S.A.

WALTER, H.S. 1990. Small viable population: the Red-tailed Hawk of Socorro Island. *Conservation Biology* 4:441–443.

WHITE, C.M. AND T.J. CADE. 1971. Cliff-nesting raptors and ravens along the Colville River in arctic Alaska. *Living Bird* 10:107–150.

ZAR, J.H. 1984. Biostatistical analysis, Second Ed. Prentice Hall, Englewood Cliffs, NJ U.S.A.

Received 29 April 2010; accepted 12 April 2011
Associate Editor: Sean S. Walls

Downloaded From: https://complete.bioone.org/journals/Journal-of-Raptor-Research on 19 Apr 2024
Terms of Use: https://complete.bioone.org/terms-of-use