



Año Nuevo Island Seabird Conservation Annual Report 2023



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Land acknowledgment

Año Nuevo is part of the unceded territory of the Awaswas-speaking Quiroste people. Their contemporary descendants are the Muwekma Ohlone and Amah Mutsun Tribal Band. You can support ongoing indigenous stewardship of these lands by donating to the Amah Mutsun Land Trust at www.amahmutsunlandtrust.org.

Acknowledgments, Partners, Volunteers

The success of this project depends on the hard work and collaboration of many individuals and organizations. California Department of Parks and Recreation, Go Native, California College of the Arts master ceramicist Nathan Lynch, UC Santa Cruz Año Nuevo Reserve, US Fish and Wildlife Service, and the University of California Santa Cruz. We are grateful to the staff and volunteers who began the initial restoration work in 2002-05 and on whose shoulders we stand. Our triumphs are shared with the hundreds of volunteers who have contributed countless hours to the project. Thank you to the volunteers and student interns who joined us in 2023! (Listed page 23).

Oikonos Ecosystem Knowledge

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Cover photo: Año Nuevo Island taken by Danielle Devincenzi

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Introduction

Año Nuevo Island (ANI) at ANSP is the largest seabird breeding colony within the Monterey Bay National Marine Sanctuary, with seven breeding species and over 12,000 individual seabirds breeding annually. Located adjacent to Monterey Bay and just a kilometer offshore, ANI allows marine predators to access near and offshore resources (e.g., Año Nuevo and Ascension submarine canyons). Island habitat is rare in California, making ANI's predator-free habitat essential breeding habitat for local seabird populations. Additionally, ANI hosts Rhinoceros Auklets at the southernmost tip of their range, making ANI the southernmost breeding colony for the species and their local presence unique.

Through long-term monitoring and habitat restoration, Oikonos seeks to protect seabirds breeding at Año Nuevo Island (ANI) and conserve the natural resources they rely on. This report places the 2023 seabird breeding and diet monitoring results in the context of the past years of research and describes our most recent habitat restoration efforts.

This year, 2023, marks the 31st year of seabird research and conservation at Año Nuevo State Park (ANSP). In 2023, we documented the nesting success and population size of seven species of seabirds that breed at ANI: Rhinoceros Auklets, Cassin's Auklets, Pelagic Cormorants, Brandt's Cormorants, Western Gulls, Pigeon Guillemots, and Black Oystercatchers. Many birds that breed annually on ANI nest within the central terrace, a one-acre plot surrounded by the Habitat Ridge sea lion exclusion structure built in 2011 to reduce trampling of seabird burrows by California sea lions. We also monitored a small population of Pelagic Cormorants breeding on the mainland cliffs of ANSP.

Specific highlights and accomplishments in 2023 include:

1. The **highest recorded counts of Brandt's Cormorants** on the island for the third year in a row (see page 11)
2. **Trained three undergraduate interns** in field research and conservation practices (see page 22)
3. **Northern anchovy was the predominate prey in Rhinoceros Auklet chick diet** for the 6th year in a row (see page 21)
4. **Collaborated with four scientific illustrators** for community outreach and engagement about ANI seabirds (see page 27)

Seabird Breeding Success and Population Status

Rhinoceros Auklet

ANI is situated at the southernmost tip of the Rhinoceros Auklet (*Cerorhinca monocerata*) breeding range and is one of just three island groups where they breed in California. The first documentation of Rhinoceros Auklets breeding on ANI was in 1982 (LeValley and Evans 1982), and regular monitoring of the colony began in 1993. We changed artificial nest sites from wooden boxes to ceramic nest modules after initiating major habitat restoration work in 2011. Pairs in artificial nests have stayed relatively stable since ceramic module installation. In contrast, pairs in natural burrows have increased dramatically since the erection of the Habitat Ridge sea lion exclusion fence in 2010 (Fig.1).

As a burrow nesting seabird, we monitor Rhinoceros Auklets in the central terrace with customized infrared burrow cameras and visually in ceramic nest modules. On the north and south terraces,

outside of the Habitat Ridge, we count burrows twice annually (once in early and once in late season) to determine viable burrows to include in the total island count. We then multiply unmonitored burrows by a year-specific burrow occupancy rate based on a sample of camera-monitored burrows to determine the breeding population for the entire island. Reproductive success was measured by monitoring the contents of burrows weekly with cameras for hatching and fledge success.

Population

In 2023, we generated the occupancy rate by checking the contents of 50 burrows, 39 occupied by a breeding pair, determining a 78% occupancy factor for the year.

We could not conduct island-wide burrow counts in 2023 due to potential disturbance to nesting Brandt's Cormorants. However, in 2023, we monitored the central terrace, where approximately 90% of the Rhinoceros Auklet population had nested in previous years. To estimate the total population for 2023, we added our central terrace counts in 2023 (500 individuals) to the average burrow count for the south terrace from 2017-2021 (25 individuals) multiplied by our 2023 burrow occupancy factor (78%; 525 individuals; Fig. 1).

From 2011-2023, the population of Rhinoceros Auklets nesting on the central terrace of ANI increased by 95% (Fig. 1). Since 2020, the population has declined slightly. This decline corresponds with increased nesting Brandt's Cormorants on the island since 2020. Brandt's cormorants can block burrows with guano and nesting material, which may cause Rhinoceros Auklets to abandon or not attempt reproductive efforts.

We estimated the number of Rhinoceros Auklet chicks fledged from ANI in 2023 by calculating the rate of chicks fledged per pair for a subsample of followed burrows and multiplying this rate by the number of occupied burrows where chick fledge status was unknown. In 2023, 178 Rhinoceros Auklet chicks fledged from ANI.

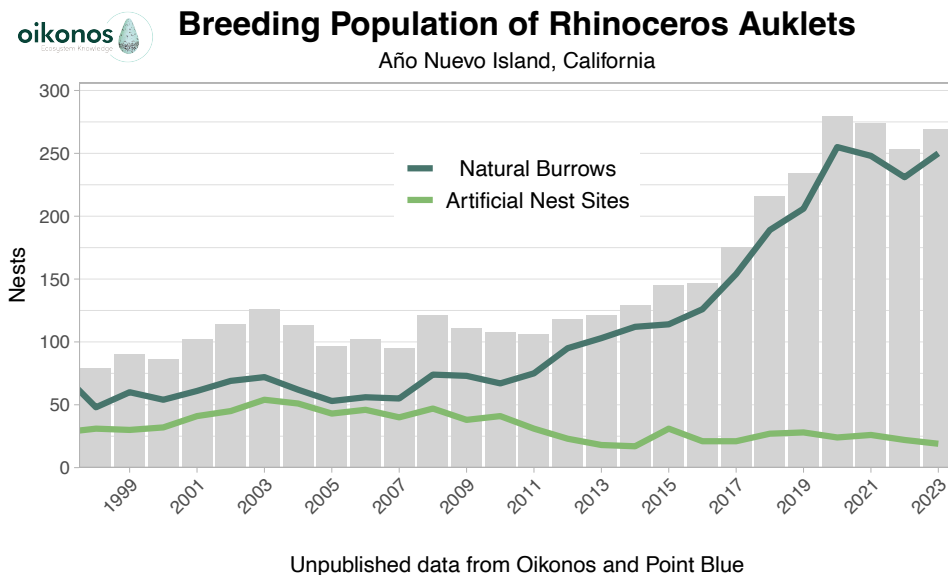


Fig. 1: Total Rhinoceros Auklet breeding population in the central terrace of ANI monitored with standardized methods, 1993 – 2023. The bars indicate total population numbers, and the lined colors indicate the number of individuals breeding in natural burrows versus artificial nest sites.

Productivity

We measured reproductive efforts by checking the contents of 29 burrows weekly for hatching and fledging success. We define productivity as the number of chicks fledged per active nest, where an active nest was indicated by the presence of an egg or an adult incubating during two consecutive weeks during the early breeding season. Rhinoceros Auklet productivity in 2023 was 0.59 chicks fledged per pair ($n=29$) in natural burrows. This year's productivity was slightly lower than the long-term average (0.66 ± 0.15 ; Fig. 2). Productivity in the artificial nest modules was 0.50 chicks fledged per pair ($n=18$). See page 20 for further discussion of artificial nest site results.

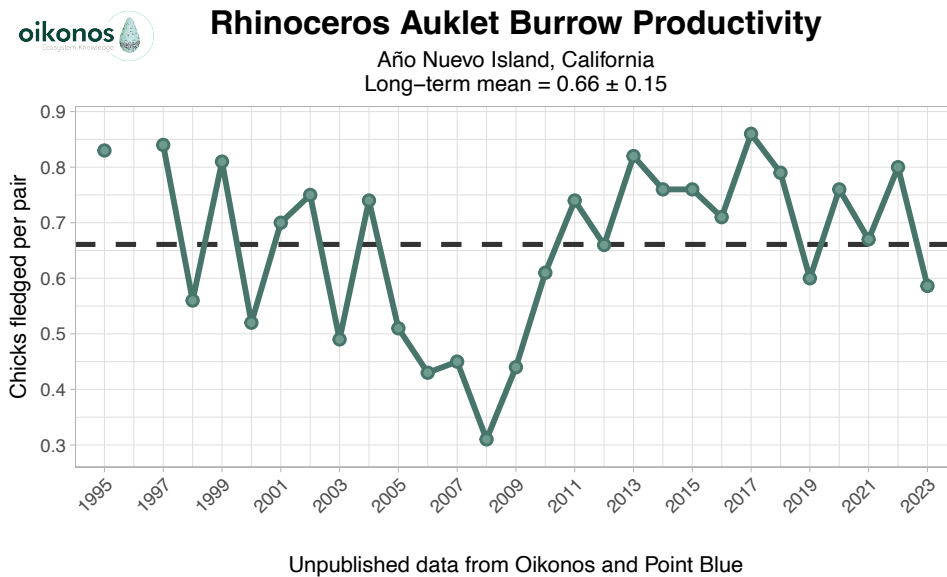


Fig. 2: Average productivity of Rhinoceros Auklets (chicks fledged per pair) in natural burrows, 1995 – 2023 ($n=29$ in 2023). Burrows were not monitored in 1996. The dashed line represents the long-term average of chicks fledged per pair. The sample size for burrows observed for productivity ranged from 25 to 72.



Image 1: A researcher handling a Rhinoceros Auklet chick to monitor its growth through the breeding season

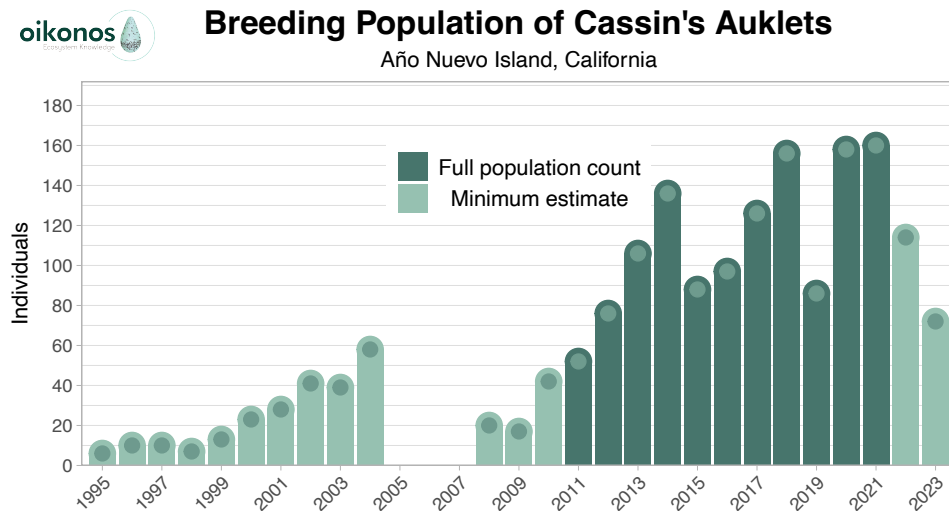
Cassin's Auklet

Cassin's Auklets (*Ptychoramphus aleuticus*) were first recorded breeding at ANI in 1995, and their population grew slowly for ten years before a rapid rise in numbers around 2011-2020 (Carle et al. 2019). Cassin's Auklets nest in rock crevices and shallow burrows, at ANI they also breed in artificial ceramic nests (Carle et al. 2019). We monitor Cassin's Auklets with the same methods as Rhinoceros Auklets.

Population

In 2023, we estimated a minimum of 70 breeding individual Cassin's Auklets on the island (Fig. 3). Although Cassin's Auklets have been slowly increasing for the past ten years, annual fluctuations of about 50 individuals have regularly occurred since 2015.

Exclusion by Brandt's Cormorants could explain recent low numbers of breeding individuals as their population has nearly doubled in the past three years. Like Rhinoceros Auklets, Brandt's Cormorants can cause Cassin's Auklets to not attempt or abandon reproductive efforts due to blocking access to natural burrow entrances. Cassin's Auklets are in decline at other breeding colonies in the California Current Ecosystem; therefore, other unknown factors, such as prey availability or mortality factors may affect annual fluctuations at ANI (Rodway and Lemon 2011).



Carle et al. 2020 and unpublished data from Oikonos and Point Blue

Fig. 3: The minimum number of breeding Cassin's Auklets at ANI, 1994 – 2023. No nests were recorded in 2005, and no data for 2006 and 2007. Bars are labeled minimum estimates for years where the whole island was not checked for nests.

Productivity

In 2023, Cassin's Auklet productivity in natural burrows and ceramic nest modules was 0.55 chicks per pair (n=20). Productivity was slightly lower than the long-term average (0.66 ± 0.26 chicks per pair; Fig. 4). In years of high marine productivity Cassin's Auklets will often lay a second clutch after successfully fledging a first chick (termed "double-clutching; Johns et al. 2017). No pairs double-clutched in 2023 on ANI.

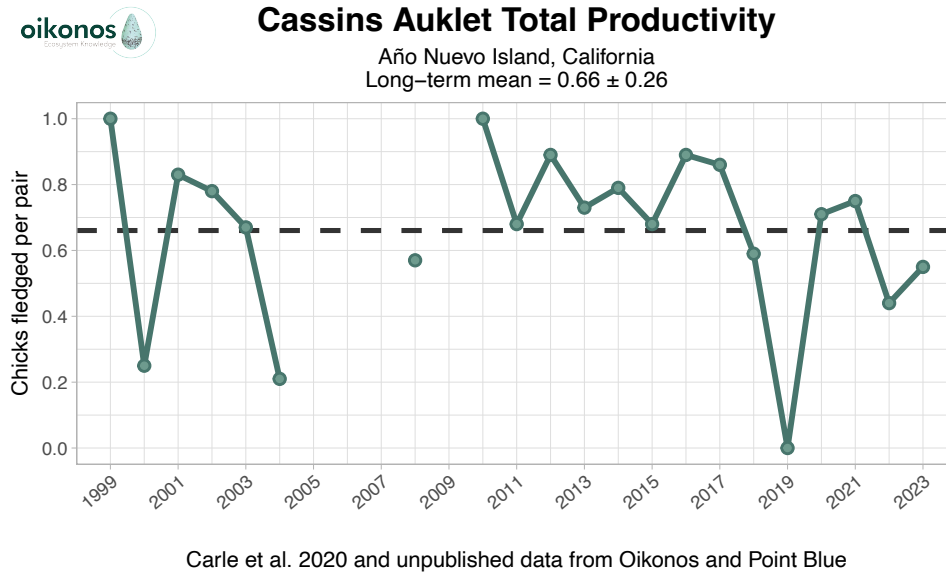


Fig. 4: The average productivity of Cassin's Auklets (chicks fledged per pair) from 1999 – 2023 in natural burrows and artificial nest modules, including single and double clutch efforts (n = 20 in 2023). Sample sizes for productivity ranged from 4 – 44. There were no Cassin's Auklets on the island in 2005 and none or insufficient data in 2006, 2007, and 2009.

Western Gull

Western Gulls (*Larus occidentalis*) are endemic to the California Current, and the colony at ANI is one of three major island populations in California's central coast (ANI, Southeast Farallon Island, Alcatraz). Western Gulls nesting at ANI were historically affected by human disturbance when the Coast Guard operated a light station between 1872 and 1948 and during unrestricted human access to the island from 1949 to 1967 (Tyler and Briggs 1981).

Population counts of breeding Western Gulls at ANI began in 1976 (Sowls et al. 1980). Researchers began standard ground and boat-based monitoring during the peak incubation period in 1999. In recent years, we have used aerial photographs to survey inaccessible areas and reduce disturbance from island-wide ground surveys. We follow a subsample of the population that nests in the central terrace annually to measure reproductive success.

Population

In 2023, we counted 592 Western Gull nests on the island, an increase of 37 nests from the prior year. After the historic occupation and disturbance of the island, the first island-wide nest counts for Western Gulls in 1976 counted 120 nests (Sowls et al. 1980). This number steadily increased in the following years, peaking in 2005 at 1,234 nests (Fig. 5). The population steadily declined for the next ten years, following similar trends recorded on Southeast Farallon and Alcatraz Islands. The cause of this decline is unknown, and since 2015, the ANI population has remained relatively stable, fluctuating between 644 and 555 nests.

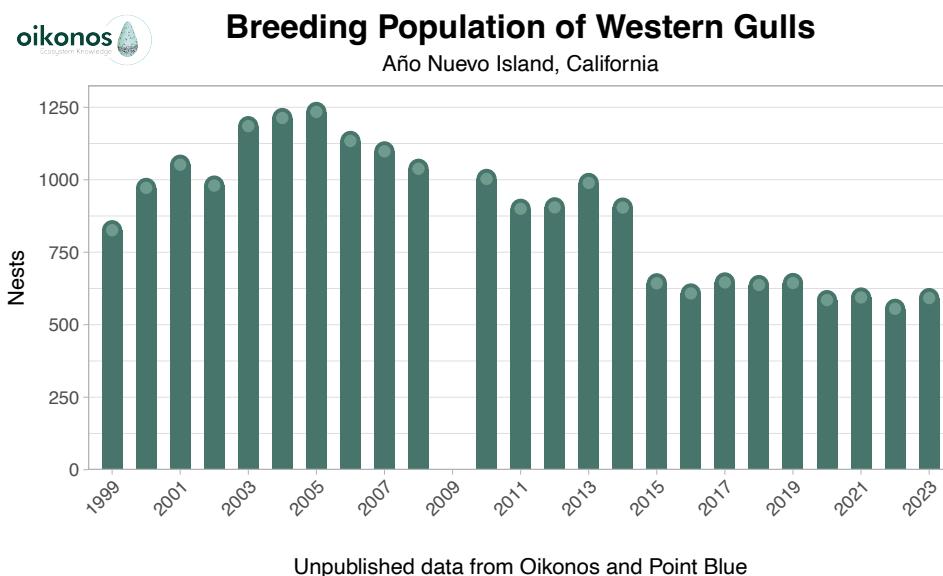


Fig. 5: Western Gull nests counted through standardized methods at ANI 1999 – 2023. In 2009, the population was not estimated.

Productivity

In 2023, Western Gulls fledged 1.69 ± 1.06 chicks per pair ($n=36$; Fig. 6). This was above the long-term average of 1.27 ± 0.33 chicks per pair.

We began an annual island-wide Western Gull chick census in 2016 to compare the density of fully-grown chicks in the central terrace habitat restoration area to the north and south terraces, areas with no habitat restoration. The census occurs during late June, just before chicks start to fledge. These counts have shown the central terrace to have a higher density of chicks surviving to fledging age (Fig. 7). We believe this to be primarily due to California sea lions outside the central terrace crushing nests and discouraging breeding attempts.



Image 2: Western gull, photo by Danielle Devincenzi

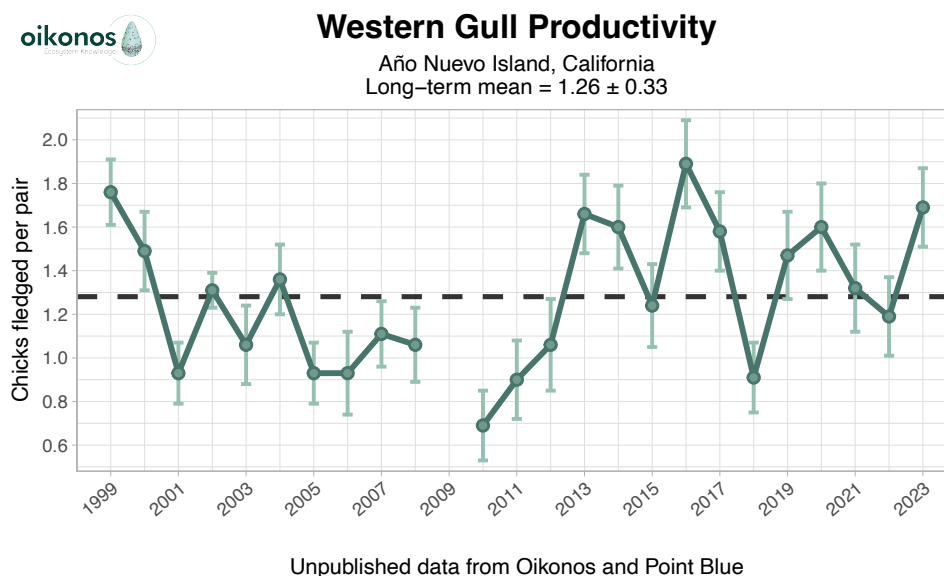


Fig. 6: Annual productivity (average chicks fledged per breeding pair $\pm$ standard error) of Western Gulls nesting in the central terrace region at ANI, 1999 – 2023 (no data for 2009; n = 36 in 2023). We monitored subsamples of 28 – 155 nests annually.

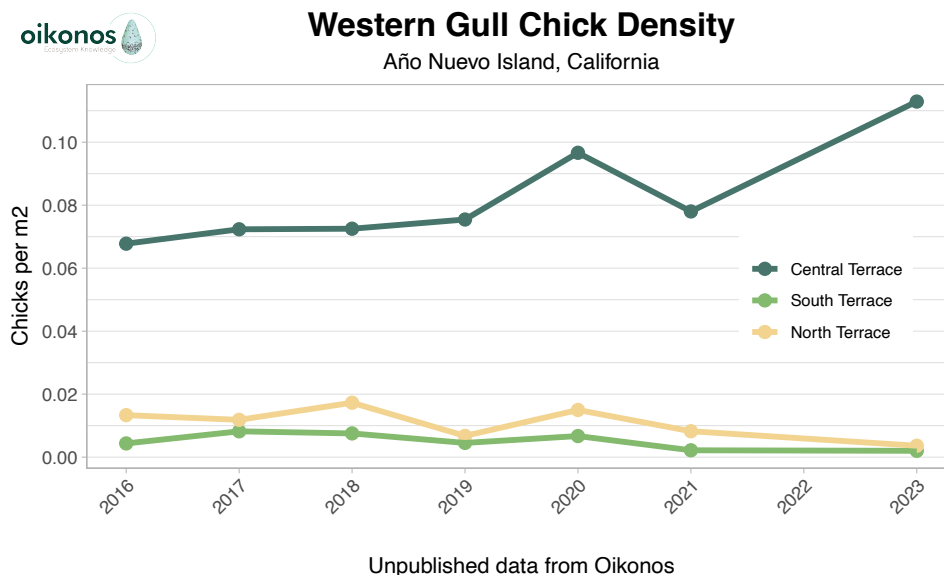


Fig 7: Western Gull chick density (chicks per m2) on ANI during mid to late July 2016 – 2023. Timing of counts coincided with chicks at mostly to fully feathered status, and few, if any, had fledged. We define the central terrace as all areas inside the Habitat Ridge fence (5,474 m2). The north terrace is all areas north of the Habitat Ridge (5,978 m2), and the south terrace is south of the Habitat Ridge (6,078 m2). We did not complete a Western Gull chick census in 2022 to reduce disturbance nesting Brandt's Cormorants.

Brandt's Cormorant

Brandt's Cormorants (*Urile penicillatus*) were first documented nesting at ANI in 1989 (Carter et al. 1992), and regular nest counts began in 1999. Brandt's Cormorants primarily breed on the ground atop the terrace around the historic light tower and Lightkeeper's house. They have recently spread to cliff edges and sites within the central terrace as their population has expanded.

The annual nesting population is estimated using a combination of ground counts and aerial images taken during the peak egg incubation period. Aerial drone images, taken every two weeks by UCSC Año Nuevo Reserve, facilitate the assessment of nesting pulses since 2018.

Population

In 2023, we used aerial images taken June 9th to count 5,578 Brandt's Cormorant nests on ANI (11,156 individuals, Fig. 8). This is the highest recorded count of breeding Brandt's Cormorants on the island, continuing a trend observed since 2021.

A likely explanation for these robust breeding efforts from 2021-2023 is the abundance of Northern Anchovy (*Engraulis mordax*), an essential prey species correlated with surges in Brandt's Cormorant population (Ainley et al. 2018, see page 21 for further discussion of Northern Anchovy). Brandt's Cormorant populations at the Farallon islands have similarly increased over the past five years, with high reproductive success (M. Johns, pers comm.). Most Brandt's Cormorants nest on the south terrace around the historic light tower. However, in 2021, they were first documented breeding within the Habitat Ridge in the central terrace, and these colonies have persisted in 2022 and 2023.

Dense groups of breeding Brandt's Cormorants excluded other species from breeding in these areas through direct competition for space, nest material kleptoparasitism of Pelagic Cormorants, and obstruction to Rhinoceros and Cassin's Auklet burrow entrances. This influx of Brandt's Cormorants also provided opportunistic foraging of Brandt's Cormorant eggs by Western Gulls. These intraspecific interactions caused some pairs of all species to lose their first eggs, relay second clutches, or experience reproductive failure.

Productivity

Brandt's Cormorant productivity was calculated by following a subsample of the population within the sub-colony at the fallen light tower on the south terrace. At this sub-colony, we followed 32 nests, 5 of which we added four to six weeks after egg-laying initiation to represent late nesters. Productivity in 2023 was 2.22 ± 1.1 chicks fledged per pair ($n=32$). Productivity was higher than the long-term average of 1.69 ± 0.67 (Fig. 9).



Image 3: Brandt's Cormorants nesting on the south terrace

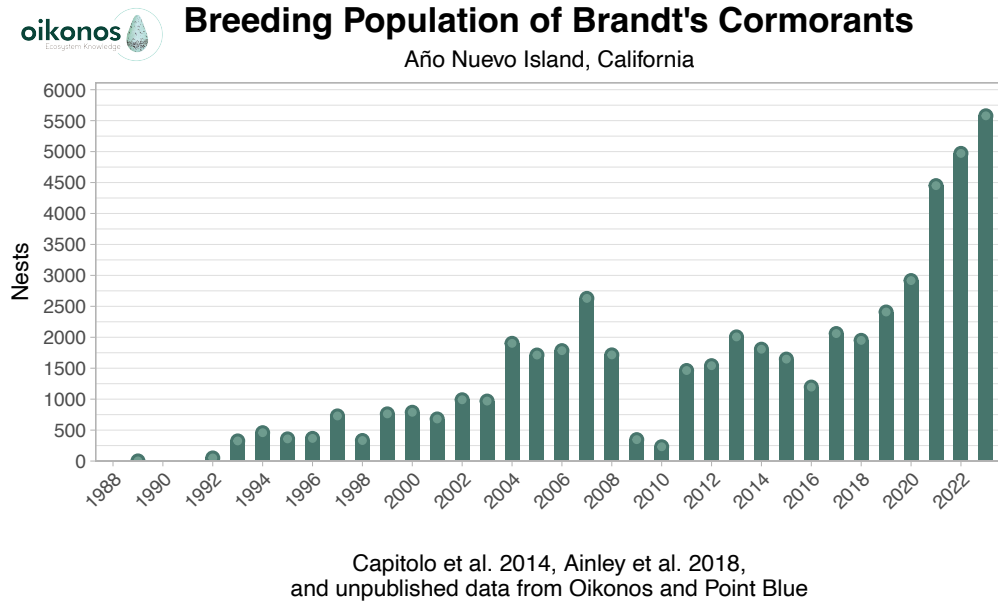


Fig. 8: Brandt's Cormorant nest counts from aerial images and inside Lightkeeper's house at ANI, 1993 – 2023. No nests were recorded in 1988 and 1990, and no data exists for 1991.

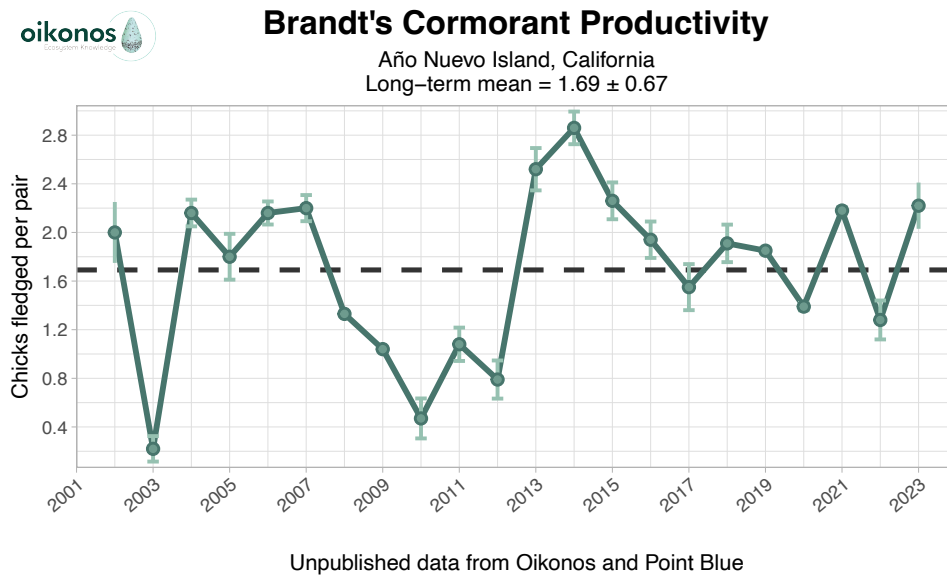


Fig. 9: Brandt's Cormorant productivity at ANI, 2002 – 2023 (n = 32 in 2023). We followed a sub-sample of nests from the Light Tower or Blind 17 (shown here combined for some years). In 2008 and 2009, we calculated productivity as the number of chicks that met fledge criteria divided by the total number of nests in the two sub-colonies rather than by following individual nests. Therefore, we could not generate error estimates in 2008 – 2009. Standard errors in 2019 – 2021 were less than 0.03. Sample size ranged from 20 – 57 nests annually.

Pelagic Cormorant

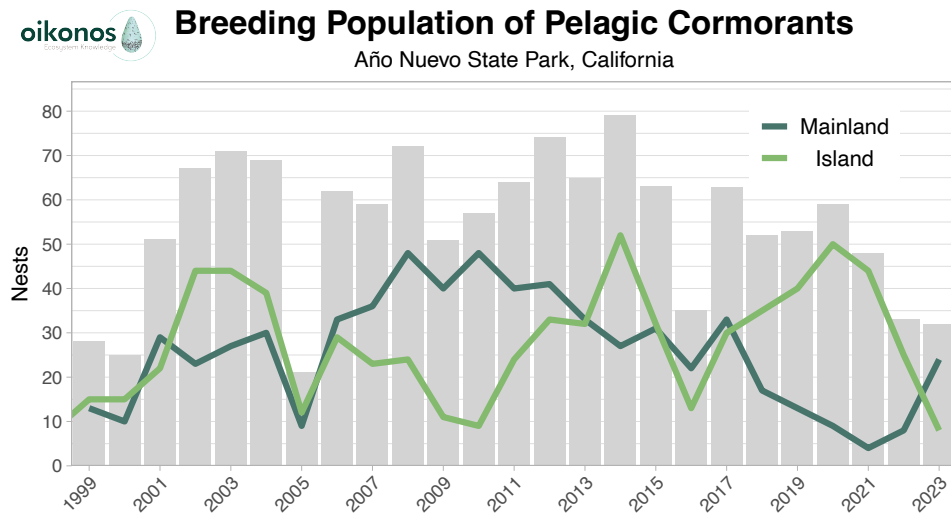
Pelagic Cormorants (*Urile pelagicus*) are smaller than Brandt's Cormorants and nest on cliffs and bluffs. At ANI, they have also adapted to nesting on the windowsills of the historic Lightkeeper's

house. Pelagic Cormorants were surveyed sporadically at ANSP from 1967 to 1987 (Carter et al. 1992), and annual standardized population and productivity monitoring began in 1996 on the island and 1999 on the mainland. We monitor all visible nests on the mainland cliffs, island bluffs, and historic Lightkeeper's house for nest contents and activity.

Population

The total number of breeding Pelagic Cormorants on the mainland and island was 64 birds in 2023 (island: 16; mainland: 48; Fig. 10); this is a minimum count due to challenges accessing nesting areas on the island's north terrace.

The island population of Pelagic Cormorants has been declining sharply since 2021, while the mainland bluff population has increased. This trend coincides with exceedingly high numbers of Brandt's Cormorants from 2021 to 2023. Observed competitive interactions between Pelagic and Brandt's Cormorants for breeding space and nesting materials lead us to believe that Brandt's Cormorants outcompete Pelagic Cormorants for breeding habitat on the island and that these individuals may be breeding on the mainland bluffs instead. This immigration to the mainland is a reversal of the trend from 2017-2021 in which Pelagic Cormorants had primarily shifted to nesting on the island from the mainland, probably in response to nest predation by Common Ravens (Carle et al. 2017). We did not observe any egg or chick depredation interactions between Common Ravens and Pelagic Cormorants in 2023, and a raven pair that used to nest on the mainland bluffs did not nest there this year (see Carle et al. 2017).



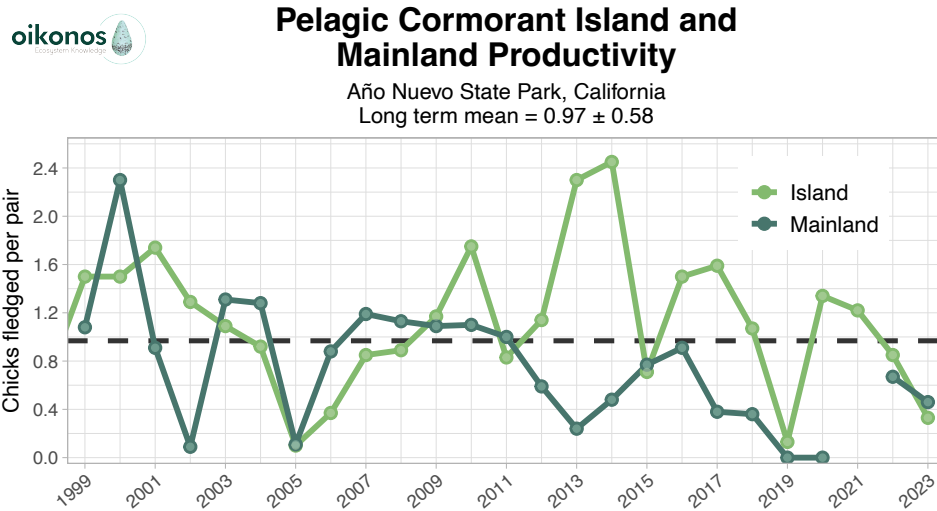
Carle et al. 2017 and unpublished data from Oikonos and Point Blue

Fig. 10: Pelagic Cormorant populations at Año Nuevo, 1999 – 2023. The grey bars represent the total number of nesting birds on the island and mainland, and the lines represent the island versus mainland populations.

Productivity

The reproductive success of Pelagic Cormorants on ANI was 0.33 ± 0.82 chicks fledged per pair in 2023 ($n=6$), while the mainland bluffs population reproductive success was higher at 0.46 ± 0.78 chicks per pair ($n=24$, Fig. 11). Both the island and mainland reproductive success was lower than the long-term average of 0.97 ± 0.58 chicks per pair. Low reproductive success may have been due to the island population competing

with Brandt's Cormorants for space. Mainland productivity was lower than the long-term average as well but was markedly better than the two years of total breeding failure on the mainland in 2019 and 2020.



Carle et al. 2017 and unpublished data from Oikonos and Point Blue

Fig 11: Pelagic Cormorant productivity at the island and mainland sub-colonies, 1999 – 2023 (n = 8 on the island and 24 on the mainland in 2023). Sample sizes range from 4 - 43 pairs on the island and 5 – 40 on the mainland. In 2021, we did not attempt to monitor of reproductive success on the mainland due to difficulty accessing sites.

Black Oystercatcher

Black Oystercatchers (*Haemaphysalis bachmani*) are the only shorebirds to breed at ANI. They forage and breed in intertidal areas along the island, building depressions lined with small pebbles in coves and bluff ledges to lay their eggs.

In 2023, we observed four active breeding pairs on the island, from which at least one chick fledged (Fig. 12). We know too little about nest contents to calculate overall ANI productivity in 2023. However, reproductive success at ANI has generally been poor, likely due to egg and chick depredation by Western Gulls, limited breeding space confining them to cove areas endangered by high tides, and incidental trampling by pinnipeds. We have also frequently observed Black Oystercatchers defending nests from Common Ravens since 2004, although we did not observe this interaction in 2023.



Image 4: Black Oystercatcher in the intertidal zone at ANI

California's coast is considered a core habitat for the species, with state-wide populations estimated at 4,749 to 6,067 individuals (Weinstein et al. 2014). Sea level rise is projected to threaten this population by reducing important intertidal habitats. Elevated nesting sites, like those at ANI, will become increasingly important for this species. Oikonos contributes ANI Black Oystercatcher reproductive success data to California Audubon to monitor the breeding population state-wide.

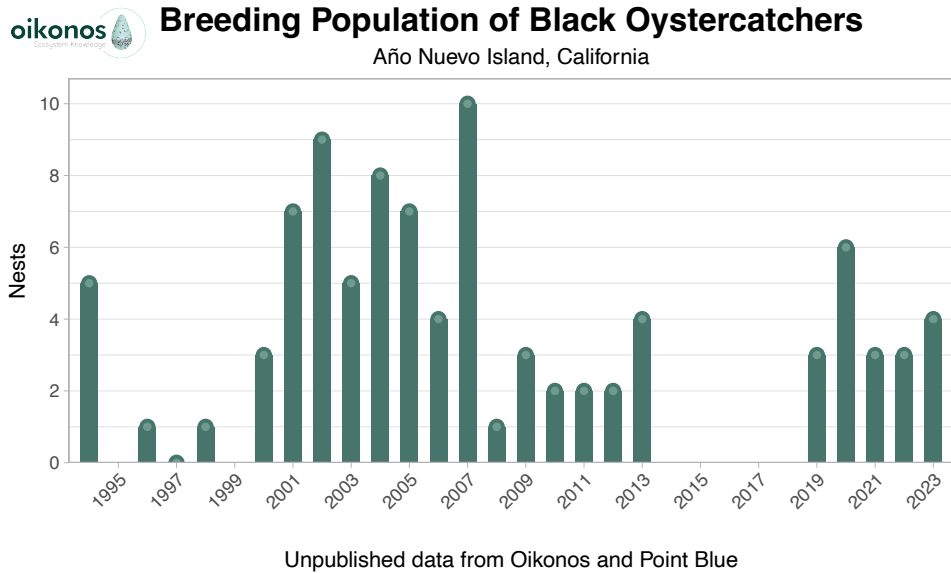


Fig. 12: The population of Black Oystercatcher nests visible from ANI ground observations from 1994 – 2023 (approximately 70% of the available habitat on the island).

Pigeon Guillemot

Pigeon Guillemots (*Cepphus columba*) breed in small numbers at ANI, nesting in burrows, rock cavities, and artificial ceramic nests. In 2023, we monitored two pairs at ANI in ceramic modules within the central terrace and seven pairs at inaccessible sites by observations of site attendance and fish carrying (fish-carries to nest sites indicate the presence of chicks; Fig. 13). We were only able to assess productivity for the pairs in artificial nests, which was 0.67 ± 1.15 chicks fledged per pair ($n=3$). Maximum productivity for Pigeon Guillemots is 2.0 chicks per pair, as they lay two eggs (versus the single egg laid by auklets).

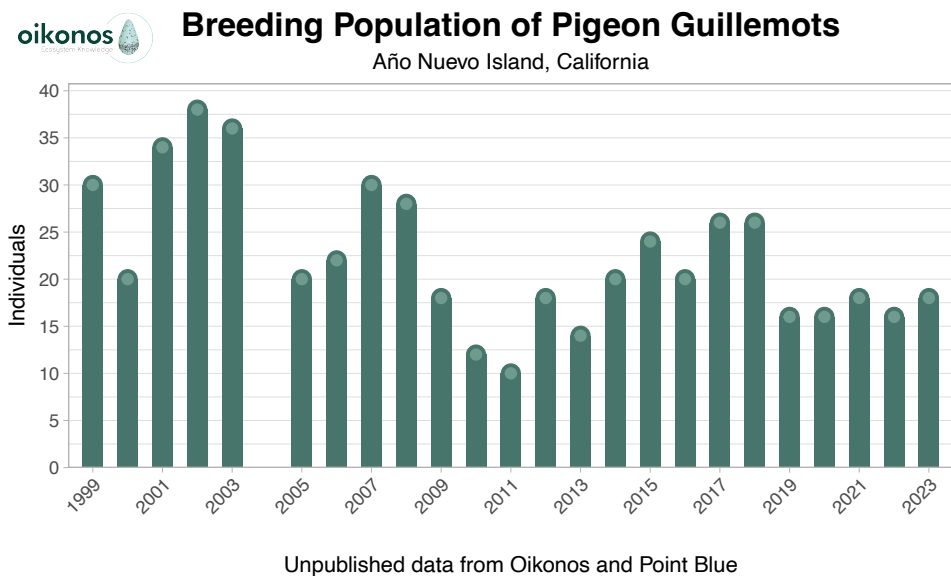


Fig. 13: Pigeon Guillemot confirmed breeding population at ANI, 1999 – 2023.

Storm-petrels

Ashy Storm-petrels (*Oceanodroma homochroa*), a small seabird listed as endangered by the IUCN, have been recorded sporadically at ANI from 1993 to 2023. In this span of 29 years, we have recorded 14 Ashy Storm-petrels during nighttime mist-netting for Rhinoceros Auklet prey during four weeks in June and July. Additionally, we captured one Fork-tailed Storm-petrel in 2000. Two Ashy Storm-petrels were caught in 2023 during mist-netting on June 16th within 20 minutes of one another (Fig. 14). Though we are uncertain, it is unlikely that storm-petrels are nesting on ANI because a study conducting acoustic monitoring during the breeding season did not detect them, and rocky crevice habitat is limited.

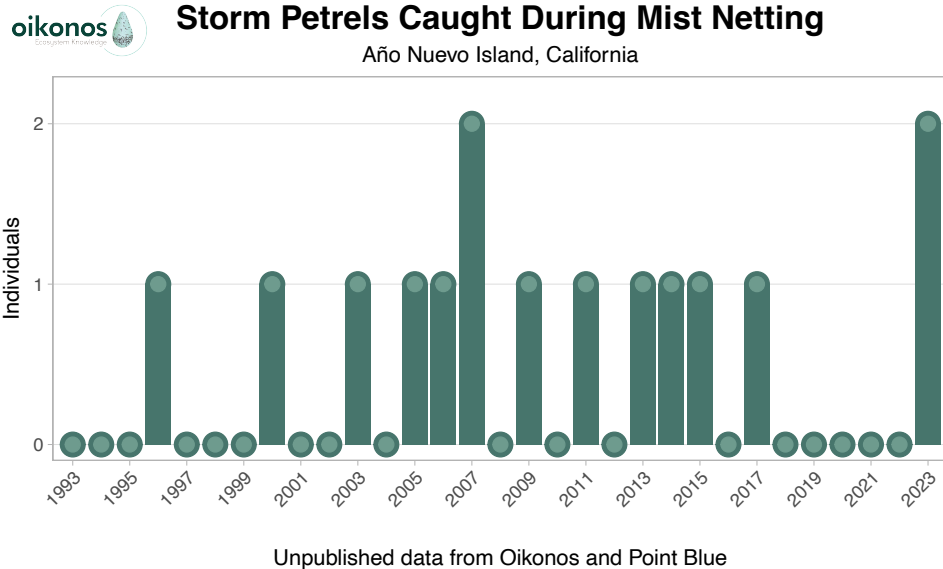


Fig. 14: Storm-petrels caught during nighttime mist-netting studies from 1993 - 2023. Points on the 0 line represent no petrels caught that year. Note that one individual caught in 2000 was a Fork-Tailed Storm-petrel.

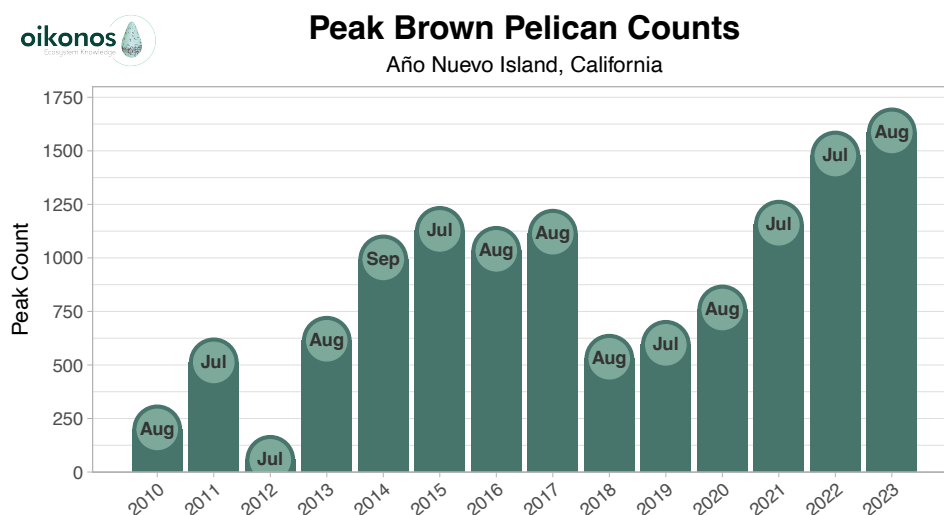
Common Raven

Common Ravens (*Corvus corax*) were first recorded nesting at Año Nuevo in 1987 (Lewis and Tyler 1987). Since 2004, there has been at least one active Common Raven nest on the island and mainland every year, except for 2016, and 2020 to 2023. In 2014, we compared Common Raven egg depredation of Pelagic Cormorants on the mainland and island and concluded that egg depredation on the mainland coastal bluffs reduced reproductive success (Carle et al. 2017). In 2023, we observed Common Ravens roosting on the island but no breeding activity or depredation events.

Brown Pelican

ANI is one of the four largest roosting sites for Brown Pelicans (*Pelecanus occidentalis*) on the entire U.S. West Coast (Jaques, 2019). Brown Pelicans breed from Mexico to the southern California coast and migrate north to ANI during the summer and fall. Brown Pelican counts began in earnest in 2010 after we discovered these heavy birds were impeding habitat restoration efforts by trampling and depositing guano on newly planted vegetation.

In 2023, we conducted Brown Pelican surveys on 17 days between May 5th and August 23rd. On August 16th, 2023, we counted the highest recorded number of Brown Pelicans roosting on the island since surveys began in 2010 (1,586 birds; Fig. 15). Increases in the number of Brown Pelicans roosting at ANI are likely a reflection of the increase in their population numbers since the 1970s with reduced use of pesticides such as DDT (Burkett and Logsdon 2007). Oikonos and UC Año Nuevo Reserve contributed data and aerial photos to state-wide surveys by Deborah Jaques for California Audubon and U.S. Fish and Wildlife Service (Jaques 2019).



Unpublished data from Oikonos, subject to revision

Fig. 15: Annual peak number of roosting Brown Pelicans at ANI, as counted from the central terrace, 2010 – 2023, with the month of the count labeled.



Image 5: Brown Pelicans roosting atop the foghorn building at ANI

Prey Studies

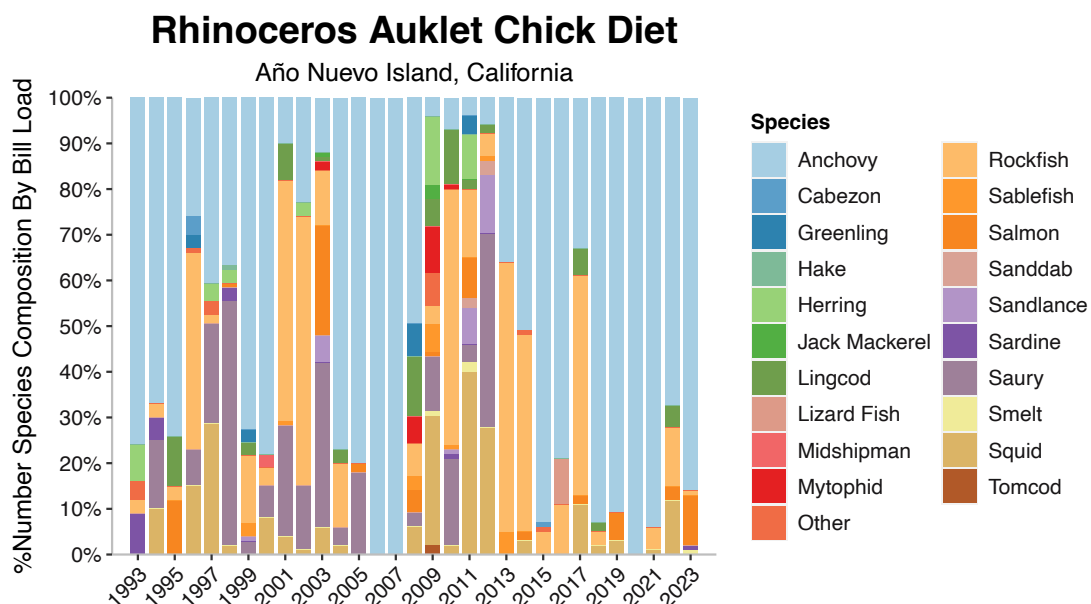
As top predators in the marine ecosystem, seabirds rely on bottom-up processes that influence their prey items, like forage fish (Piatt et al. 2007). Therefore, understanding seabird prey sources helps illuminate the health of marine ecosystems and can inform sustainable fishery management. In 2023, we collected diet samples from Rhinoceros Auklets and Brandt's Cormorants.

Rhinoceros Auklet Chick Prey Study

In 2023, we continued our 31-year dataset on Rhinoceros Auklet diet by capturing provisioning adults with mist nets for four nights in June and July. Rhinoceros Auklets return to the breeding colony at night to provision their chicks with whole fish and cephalopods carried externally in their bill (Hester, 1998). The mode of prey carried by one adult is called a “bill-load.”

In 2023, we sampled prey once a week for four weeks during peak chick-rearing (June 14th through July 12th). Our sample was 43 complete bill-loads. In our sample, Northern Anchovy was the most abundant prey species Rhinoceros Auklets brought back to their chicks (86% of the sampled diet; Fig. 16). When Northern Anchovies are abundant in the region, Rhinoceros Auklets will often feed their chicks predominately on the species. The presence of anchovies, along with juvenile rockfish, is usually associated with high chick growth and fledging success (Thayer & Sydeman 2007).

Long-term diet monitoring datasets such as the Rhinoceros Auklet diet studies at ANI and Southeast Farallon Island are essential for understanding marine ecosystem health. These data are used to inform ecosystem-based fisheries management in California (Ainley et al. 2018, Warzybok et al. 2018), understand auklet foraging ecology (Thayer & Sydeman 2007, Thayer et al. 2008, Carle et al. 2015), inform anchovy management (Thayer et al. 2021), and more. From 2018-2023, we have shared auklet diet data to help inform the NOAA California Current Ecosystem Status Report.

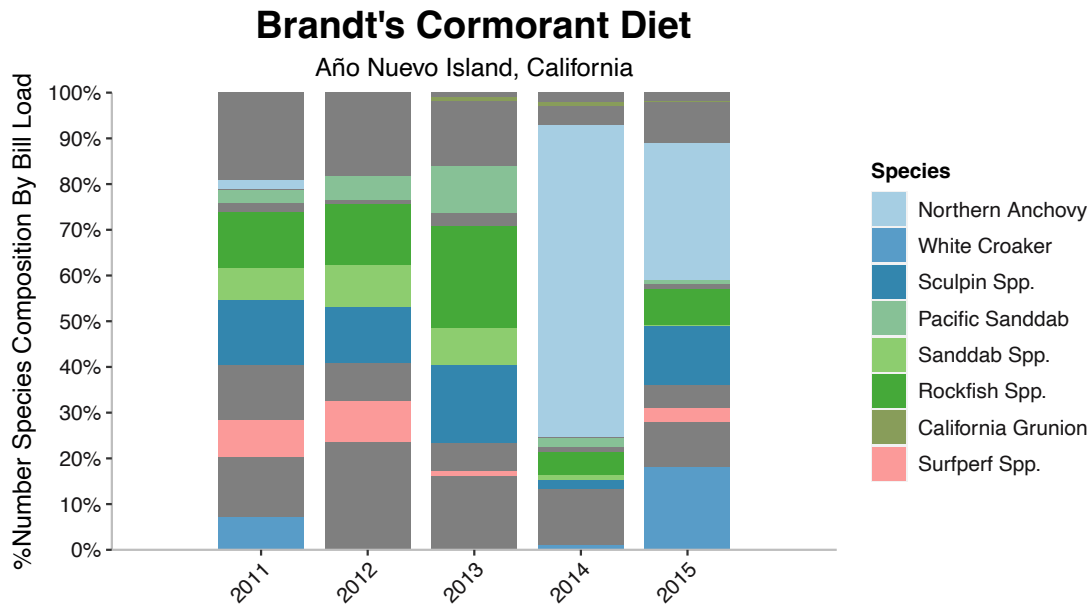


Thayer & Sydeman 2007, Carle et al. 2015, and unpublished data from Oikonos

Fig. 16: Rhinoceros Auklet chick diet at ANI from 1993 – 2023, quantified as the percent number of prey per bill-load delivered to chicks. Sample size ranged from 18 – 80 bill-loads annually. The sample size in 2023 was 43.

Brandt's Cormorant Diet Study

In pellets, Brandt's Cormorants regurgitate hard parts from ingested prey (i.e., otoliths and squid beaks). These pellets have been collected at ANI annually since 2000, and diet contents from 2011 to 2015 were summarized in Ainley et al. (2018). Brandt's Cormorant productivity strongly corresponds to the availability of Northern Anchovy in the region around ANI. For example, in 2014 and 2015, Brandt's Cormorants had large portions of anchovy in their diet and exceptionally high nesting productivity. In 2012 and 2013, anchovy was absent from the diet, and Brandt's Cormorant productivity was well below the average (Figs. 9, 17).



Published in Ainley et al. 2018, data from Oikonos and Point Blue

Fig. 17: Brandt's Cormorant diet from 2011-2015. Samples were collected in the fall, post-breeding season. Grey in the bars represents prey items that comprise small percentages of the diet and unidentified prey.

Habitat Restoration

Habitat restoration at ANI began as mitigation for seabird mortality and injury from oil contamination by the S.S. Jacob Luckenbach oil spill in the Gulf of the Farallones. The freighter sank in 1953, and subsequent oil leaks in the 1990s were linked to the mortality of Rhinoceros and Cassin's Auklets (Luckenbach Trustee Council 2006). In 2008, the Luckenbach Trustee Council determined that harm caused by the oil spill could be addressed with habitat improvement at ANI for burrow-nesting seabirds by reducing soil erosion, protecting burrows from incidental crushing, and installing artificial nest sites.

The Luckenbach Trustee Council mitigation funds supported restoration and monitoring at ANI from 2009-2018. Since then, habitat restoration efforts have received funding from the CDFW's Environmental Enhancement Fund, the Honda Marine Science Foundation, the Sandhill Foundation, the Patagonia Santa Cruz store, and others (see page 24).

Specific Restoration Accomplishments in 2023 include:

1. Five new **Ceramic Nest Modules** were added to the central terrace for Cassin's Auklets
2. **Habitat Enhancement and Protection Platforms** (HEAPs) protected burrows from trampling and erosion in fragile areas.
3. **Erosion control material** was placed within the central terrace to cover areas with the most significant erosion
4. Maintained the **Habitat Ridge** that protects the main seabird nesting habitat on the island from trampling by sea lions

Ceramic Nest Modules

Designed by California College of the Arts ceramicists, >100 clay nest “modules” provide erosion-resistant, uncrushable burrow alternatives for the burrowing seabirds at ANI. Newer designs for Cassin's Auklets have included features to keep nests cool with increased extreme heat events caused by climate change (Johns et al. 2023). First installed in 2011, these protected nesting modules are now utilized by three crevice nesting species annually (Fig. 19).

Rhinoceros Auklet productivity was substantially lower in modules than in natural burrows from 2011-2018. The disturbance of handling adults in modules during the egg incubation period might be responsible for this difference since we did not handle adults in natural burrows. Handling at modules involved banding unbanded adults or reading bands of previously banded adults, and quickly returning them to the nest. In 2019, we stopped handling adult Rhinoceros and Cassin's Auklets in nest modules. Instead, we only handled chicks when adults were not present. Since then, productivity for Rhinoceros Auklets in ceramic modules has been much more similar to that of natural burrows, and each site type shows similar interannual trends. (Fig. 18). Cassin's Auklet pairs in ceramic modules are too low in numbers to compare, but we hypothesize this also extends to Cassin's Auklets.

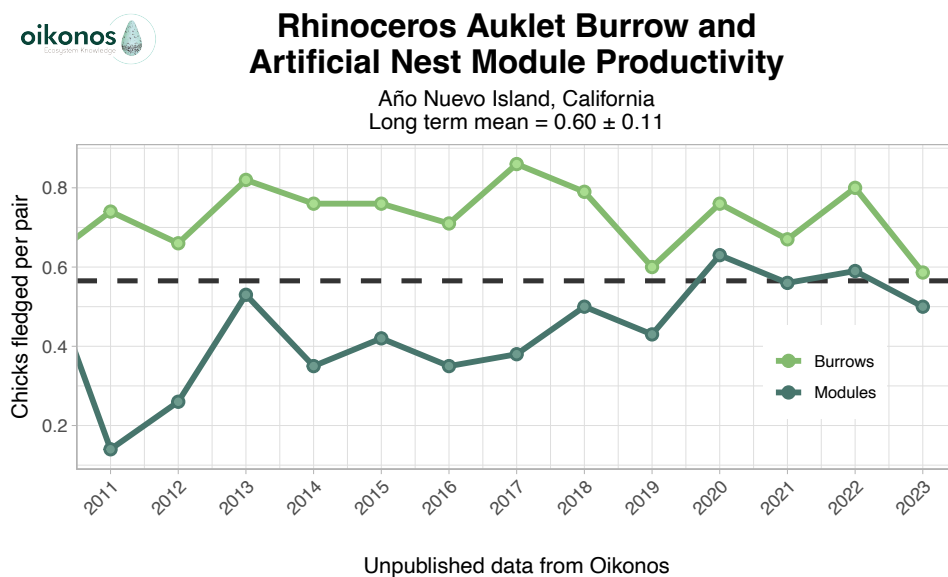


Fig. 18: Rhinoceros Auklet productivity in natural burrows and ceramic modules, 2011 – 2023. The long-term average is the chick-fledging success of both nesting sites combined. In 2020, the productivity rates of the two site types were the most similar on record after researchers stopped handling adult birds in modules. In 2023, n=35 in burrows, and n=23 in modules.

In 2023, there were 19 Rhinoceros Auklet pairs in ceramic modules, which was lower than in recent years (Fig. 22). Heavy rains in the winter of 2022 flooded numerous ceramic modules until May 11th, which may have discouraged early breeding efforts in historically occupied ceramic modules. We have modified many of the original ceramic modules and newer designs to create drainage holes in the bottom to prevent flooding, but in highly wet years, some older modules still flood.

Cassin's Auklet pairs in modules have remained relatively constant between 2020 and 2023, fluctuating by just two pairs (Fig. 20). In 2022, 10 Cassin's Auklet pairs nested in modules, the highest count on record. In 2023, there were eight pairs in ceramic modules (Fig. 20).

Pigeon Guillemots utilize ceramic nest modules placed on cliff edges to rear up to 2 chicks annually. Three pairs of Pigeon Guillemots nested in clay modules in 2023 and two chicks fledged.

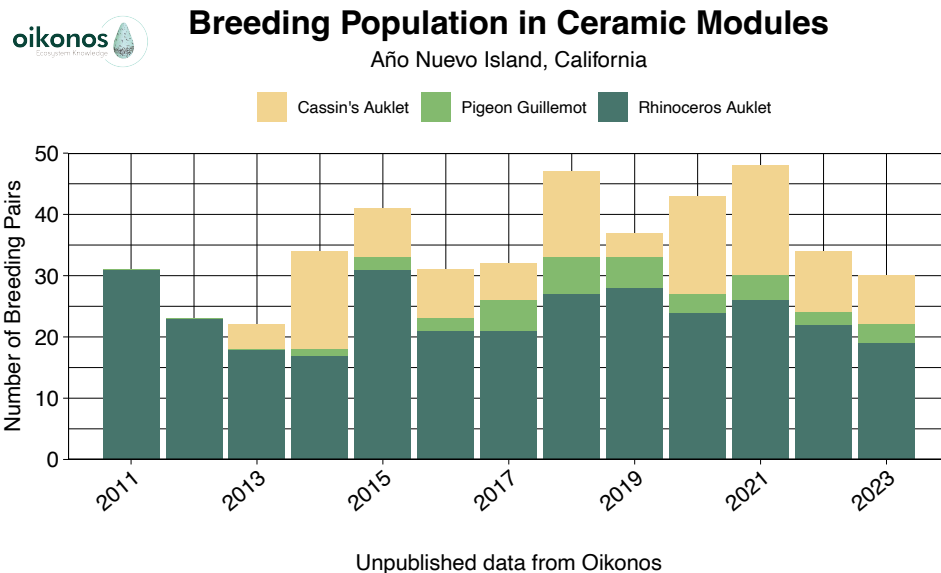


Fig. 19: Breeding populations in clay nest modules at ANI, 2011 – 2023. We considered Rhinoceros and Cassin's Auklet pairs breeding if they had a confirmed egg or chick. We considered Pigeon Guillemot pairs to be breeding if they visited the site more than three times or carried fish into the site.

Erosion control

We calculated erosion rates to burrows by documenting the burrow condition weekly and classifying the severity and causes of damage from erosion. We documented natural erosion, incidental damage by researchers, and damage by wildlife – usually by Brown Pelicans, Brandt's Cormorants, or California sea lions. In 2023, 12.5% of all Rhinoceros Auklet burrows (37 of 295) experienced damaged from either natural erosion or wildlife (Fig. 20). Of the 37 burrows, seven were damaged by wildlife, representing 2.4% of all burrows in the Central Terrace.

Erosion control material

Since 2010, we have periodically installed coconut-fiber erosion control material in high-density burrow areas and along the edges of the central terrace that are particularly susceptible to erosion and soil loss (Carle et al. 2019). Erosion control material biodegrades in 3 to 5 years, and installation is staggered as burrow density and erosion rate vary from area to area. We deployed 1.5 rolls of erosion control material in 2023 in the island's central terrace in areas with high erosion rates and dense nesting aggregations of auklets.

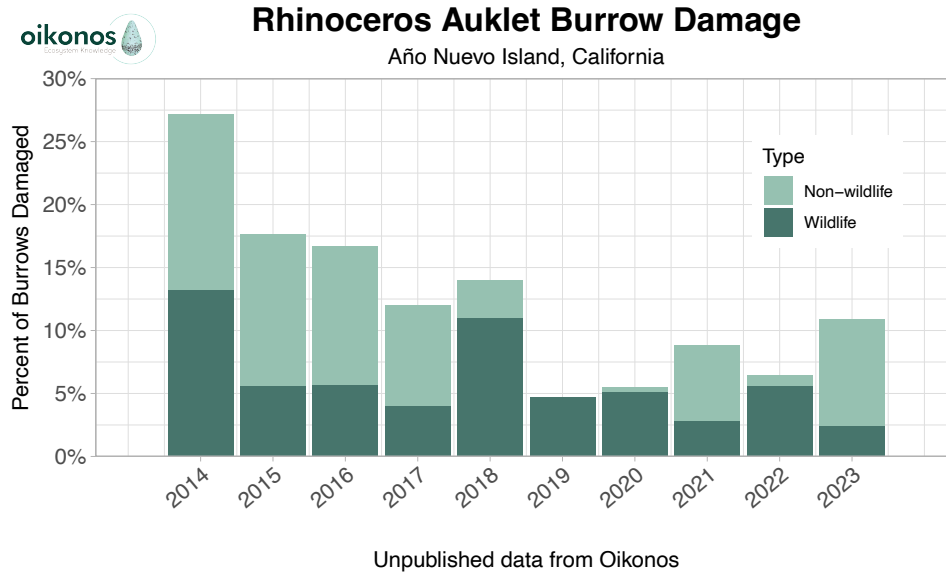


Fig. 20: Damage to Rhinoceros Auklet burrows in the central terrace (restoration area), 2014 – 2023. Wildlife damage included damage from Brown Pelicans, Brandt's Cormorants, and California sea lions. The sample size was 112 – 286 burrows per year (2023, n=295).

Island Structures

Habitat Enhancement and Protection Platforms

In fall 2019, we installed 25 4x4 foot raised wooden platforms (HEAPs) over fragile areas in the central terrace. We designed HEAPs to protect Rhinoceros Auklet burrows from trampling by Brown Pelicans while providing shelter for vulnerable Western Gull chicks and native salt grass underneath.

Habitat Ridge

The custom-built Habitat Ridge fence surrounds the restoration area and separates California sea lion habitat from the densest population of burrowing auklets. Constructed in 2011, the Habitat Ridge is almost entirely eucalyptus logs harvested from ANSP mainland, designed to have a solid interlocking zig-zag pattern that requires no below-ground anchoring in the fragile soil (Carle et al. 2019). In the fall of 2023, we repaired one critical area of the Habitat Ridge along the southern barrier, where sea lions could climb over a damaged section.

Conservation Career Training

We employ university undergraduates to participate in our seabird research and conservation program at ANI. This experience is a unique opportunity to learn hands-on science and conservation skills and receive one-on-one mentorship at a world-class wildlife reserve. In 2023, our interns were Gabriela Fonseca, Ashley Penaloza, and Skyler Williams. At Oikonos, our conservation efforts are strengthened through mentorship programs for early-career individuals that promote diversity, equity, and inclusion.



Image 6: Gabriela Fonseca, a Doris Duke Conservation Scholar

Artists at Año Nuevo Island

On July 7, Oikonos and the Seymour Marine Discovery Center hosted an art exhibition in Santa Cruz highlighting artwork from four local artists who visited ANI with researchers. Participating artists included Lizzie Schafer, Constance Speer, Hannah Kanne, and Bridget Bailey.

Each artist spent several days on ANI with researchers, then later created pieces that reflect their experience through their unique styles and lenses (see image right). Over 150 people attended the art exhibition to see the artwork and learn about the seabird research and monitoring occurring on the island. Read more about the event in the [Santa Cruz Sentinel](#).



Image 7: A nesting Western Gull on scratchboard by Bridget Bailey.

Special Note: Fungi on Año Nuevo Island

In May of 2023, we discovered several clusters of mushrooms pushing through the layers of seabird guano on the central terrace. These mushrooms were photographed and shared on iNaturalist, a citizen science platform for sharing natural plant and animal observations. Mycologist Nicolas Schwab identified the species as *Conocybe intrusa* of the Bolbitiaceae family due to vertical striations on the stipe apex (see image right). Mycologist Alan Rockefeller confirmed this identification.



Image 8: Conocybe intrusa found on ANI in May.

Although native to Northern America and Europe, this is the only iNaturalist record for this species in North America. The Global Biodiversity Information Facility (GBIF, www.gbif.org) lists six occurrences of this species in North America, with our ANI observation being the only occurrence in the western United States. As an iNaturalist “research-grade” observation, meaning the community has agreed upon an identification for the observation, our observation at ANI is automatically included in GBIF’s open-source database. Although seemingly an infrequent fungal species for the region, there are likely more *Conocybe intrusa* occurrences that have not been recorded, especially as the species is relatively unassuming in appearance. In Europe, this species is known for fruiting in artificial environments (Nicolas Schwab, pers comm.), and it is unknown how it came to be at ANI.

Volunteer and funding acknowledgments

Año Nuevo Seabird Project Volunteers 2023

Thank you to the volunteers that helped us in 2023, including Christopher Garrison, Elsie Herman, Chloe Bradburn, Scott Deppmeier, Taylor Royan, Meg Decoite, Stella Solaz, Amy Parsons, Joe Cutler, Celine San Luis, Raquel Lozano, Lisa Sheffield, Julie Chase, Kiki Tarr, Dave Calleri, Cameron Chao, and Garret Duncan.

Funders in 2023

Many agencies, foundations, and private donors support this project. We extend a huge thank you to all the grant-makers and donors who have sustained this project for 30 years. Funding agencies, foundations, and individual donors during 2016-2023 are listed below.

Thank you to the California Department of Oil Spill Prevention and Response, Environmental Enhancement Fund, Honda Marine Science Foundation, Sand Hill Foundation, Luckenbach Oil Spill Trustee Council, National Fish & Wildlife Foundation, Patagonia Santa Cruz, National Endowment for the Arts, Talcott Fund of the New York Community Trust, Wildlife Conservation Society, and Wallace Research Foundation.

We need your support to keep training early-career ecologists, restoring seabird habitats, and monitoring the response of seabirds to climate change! Please consider donating at [Oikonos.org/donate](https://oikonos.org/donate).

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Aerial images courtesy of the UC Santa Cruz Año Nuevo Reserve, permit NMFS 19108 and MBNMS-2017-018.

Recent Outreach, 2021-present

Presentations, Conferences and Meetings

Presentation for UC Santa Cruz's Natural History of Birds Course – December 2023

Long-term monitoring and proactive habitat management: The story of auklet success in a California colony. Presented by Danielle Devincenzi.

Presentation for UC Santa Cruz's Sustainability Interest Group of the Osher Lifelong Learning Institute Chapter – December 2023, online.

Long-term monitoring and proactive habitat management: The story of auklet success in a California colony. Presented by Danielle Devincenzi.

Presentation for Monterey Bay Festival of Birds – September 2022

Seabird Conservation on Año Nuevo Island: the stinky seabird jewel of Monterey Bay. Presented by Ryan Carle.

Invited Plenary at the Waterbird Society Conference's Awards Ceremony session, for winning their Outstanding Conservation Paper of the Year Award—November 2021, online.

Long-term monitoring and proactive habitat management: the story of a successful new nesting colony of Cassin's Auklets at Año Nuevo Island, California. Presented by Ryan Carle, on work by: Carle, R. Coletta, E., Bathrick, R., Beck, J., Hester, M.

Año Nuevo State Park Outreach

Año Nuevo Docent Day, December 2023

Año Nuevo Docent Day, December 2022

Seal Day at Año Nuevo State Park, January 2020

Año Nuevo bird training presentation by Jessie Beck, November 2018

University and High School Guest Lectures

Guest lecture to UC Santa Cruz Sustainability Interest Group of the Osher Lifelong Learning Institute Chapter class, December 2023

Guest lecture to UC Santa Cruz Natural History of Birds class, November 2023

Lecture to UC Santa Cruz Natural History of Birds class, November 2021

Guest lecture to UC Santa Cruz Ornithology class, October 2021

Public Outreach and Press

- [“Our ocean backyard, Santa Cruz nonprofit Oikonos invited the public to learn about Año Nuevo Island, seabirds”](#), article by Rachel Kippen. Published in the Santa Cruz Sentinel. June 24, 2023.
- [“Get to know the Cassin’s Auklet”](#), [“Get to know the Rhinoceros Auklet”](#), [“Rhinoceros Auklet and Cassin’s Auklet Chick Processing”](#), informational video series by interns Grace Bahena and Anna Douglas. 2022.
- [“How can a seabird help us understand ocean health?”](#) Outreach brochure by Tahiry Langrand, Doris Duke Conservation Scholar. 2021.
- [“Restoration is a Success: Windswept island now home to burgeoning number of ‘fancy’ seabirds”](#) article by Cypress Hansen. Published in Mercury News, Santa Cruz Sentinel. Jan 11, 2021.
- Blog posts on The Docent Rookery at Año Nuevo State Park

Peer-reviewed Scientific Publications 2015 - present

Oikonos-affiliated co-authors bolded

- Johns, M., Bradley, R., Warzybok, P., **Hester, M.**, Lynch, N., and J. Jahncke. 2023. Effectiveness of novel artificial seabird nest modules for reducing ambient temperature transfer in a warming climate. *Wildlife Society Bulletin*: e1501. <https://doi.org/10.1002/wsb.1501>
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