ORNITOLOGÍA NEOTROPICAL
(2026) 37: 21–28
DOI: 10.58843/ornneo.v37i1.1447
ORIGINAL ARTICLE

Sociedad de Ornitología Neotropical

EARLY SITE-BASED MANAGEMENT ACTIONS IMPROVE AMERICAN OYSTERCATCHER *HAEMATOPUS PALLIATUS* REPRODUCTIVE SUCCESS IN THE QUINCHAO BAY WETLAND NATURE SANCTUARY, SOUTHERN CHILE

Claudio Delgado[1] · Patricio Fuentes[2] · José Cárdenas-Vejar[1] · Daniela Ruz[1,3] Ana M. Pfeifer[1] · Jaime A. Cursach[1]*

[1] Fundación Conservación Marina, Puerto Montt, Chile
[2] Oficina Municipal de Medio Ambiente, Ilustre Municipalidad de Quinchao, Achao, Chile.
[3] Becaria Programa Soluciones Costeras - Cornell University.
E-mail: Jaime A. Cursach · jcurval@gmail.com

Abstract · Effective management of coastal protected areas is essential for sustaining shorebird populations, but there is limited empirical evidence on how management actions influence reproductive success in human-dominated coastal landscapes. We evaluated the influence of management actions implemented between 2019 and 2026 on reproductive performance of the American Oystercatcher *Haematopus palliatus* in the Quinchao Bay Wetland Nature Sanctuary, southern Chile. We conducted nest monitoring over four breeding seasons (2022–2026), recording number of nesting attempts, hatching success, and chick survival. We recorded 6.25 ± 2.06 nesting attempts/season (range 4–9 nesting attempts), with a mean 2.5 ± 0.7 eggs/nesting attempt. There was complete hatching failure in the first two breeding seasons (2022–2023, 2023–2024). However, after establishment of management strategies of restricted vehicular access, a human exclusion zone, construction of bird observatories, and responsible pet ownership ordinance, the system transitioned from a scenario of complete reproductive failure to partial recovery. Hatching success increased in the latter two breeding seasons to just over a third of all eggs hatching in 2025–2026, with high chick survival. Vegetation encroachment also led to displacement of nests outside the human exclusion zone, a pattern that was reversed following targeted substrate restoration. Overall, our results suggest that early management actions, informed by ecological monitoring, can contribute to improved reproductive success by addressing specific demographic bottlenecks, particularly during the egg-to-chick stage. This study provides applied evidence of how the integration of monitoring, adaptive management, and local governance can guide effective conservation interventions in coastal systems shaped by human activities.

Resumen · Acciones tempranas de manejo en sitio mejoran el éxito reproductivo del Ostrero Americano *Haematopus palliatus* en el Santuario de la Naturaleza Humedal Bahía de Quinchao, sur de Chile.
La gestión efectiva de áreas protegidas costeras es esencial para sostener las poblaciones de aves playeras, pero existe evidencia empírica limitada sobre cómo las acciones de manejo influyen en el éxito reproductivo en paisajes costeros dominados por actividades humanas. Evaluamos la influencia de acciones de manejo implementadas entre 2019 y 2026 sobre el desempeño reproductivo del Ostrero americano *Haematopus palliatus* en el Santuario de la Naturaleza Humedal Bahía Quinchao, sur de Chile. Realizamos monitoreo de nidos durante cuatro temporadas reproductivas (2022–2026), registrando número de intentos de nidificación, éxito de eclosión y supervivencia de polluelos. Registramos 6,25 ± 2,06 intentos de nidificación/temporada (rango 4–9 intentos), con un promedio de 2,5 ± 0,7 huevos/intento. Hubo un fracaso completo de eclosión en las dos primeras temporadas reproductivas (2022–2023, 2023–2024). Sin embargo, tras el establecimiento de estrategias de manejo como restricción de acceso vehicular, creación de una zona de exclusión humana, construcción de observatorios de aves y ordenanza de tenencia responsable de mascotas, el sistema pasó de un escenario de fracaso reproductivo completo a una recuperación parcial. El éxito de eclosión aumentó en las dos últimas temporadas reproductivas, alcanzando poco más de un tercio de todos los huevos eclosionados en 2025–2026, con mayor supervivencia de polluelos. La invasión de vegetación también provocó el desplazamiento de nidos fuera de la zona de exclusión humana, un patrón que se revirtió tras la restauración dirigida del sustrato. En conjunto, nuestros resultados sugieren que acciones de manejo tempranas, informadas por monitoreo ecológico, pueden contribuir a mejorar el éxito reproductivo al abordar cuellos de botella demográficos específicos, particularmente durante la etapa de huevo a polluelo. Este estudio aporta evidencia aplicada de cómo la integración de monitoreo, manejo adaptativo y gobernanza local puede guiar intervenciones de conservación efectivas en sistemas costeros moldeados por actividades humanas.

Keywords: *Adaptive management · conservation · protected natural area · shorebird.*

INTRODUCTION

Developing effective governance and management practices for protected natural areas is crucial to safeguard ecosystems and the vital services they provide (Bennett et al. 2019). In this context, governance involves a combination of policies, strategies, stakeholders, and processes that enable participatory and effective decision-making (Lockwood et al. 2010). Establishing governance frameworks that are inclusive, transparent, and functional is critical to the success of conservation initiatives (Bennett et al. 2019). Continuous learning and lessons derived from managing protected areas offer valuable insights for identifying best practices and avoiding past mistakes (Suškevičs et al. 2018).

Submitted 12 Apr 2025 · First decision 04 May 2025 · Acceptance 15 Apr 2026 · Online publication 18 May 2026
Communicated by Juan Pablo Isacch

Each protected natural area presents a unique context and set of challenges. Consequently, conservation processes must be adaptive and flexible, allowing for iterative learning from past experiences (Lockwood et al. 2010). One recommended methodology for studying and analyzing conservation practices is participant observation, which enables researchers and practitioners to actively engage in field-based conservation efforts (Bernard 2006, Puri 2011). This approach allows for direct involvement in the field, supporting the observation and documentation of various management stages and challenges encountered during implementation.

Although globally classified as a species of Least Concern (BirdLife International 2016), the American Oystercatcher *Haematopus palliatus* is recognized as facing conservation challenges in several countries —including Canada, the United States, Mexico, El Salvador, and Brazil (Clay et al. 2010). In Chile, it is listed as Near Threatened (MMA 2020). It is the most widely distributed oystercatcher in the Americas, ranging along the Atlantic coast from the northeastern United States to southern Argentina, and along the Pacific coast from northern Mexico to Chiloé, southern Chile (Clay et al. 2014). It is also a focal species under the Pacific Flyway Shorebird Conservation Strategy of the Americas (Senner et al. 2017). As a strictly coastal bird, it is particularly sensitive to pressures on coastal ecosystems, including habitat loss from development, recreational disturbance, pollution, and predation by non-native species (Clay et al. 2014). These pressures are exacerbated by its relatively small population and low reproductive success (Clay et al. 2010, 2014), increasing its vulnerability. Five subspecies are currently recognized, including *H. p. pitanay*, which ranges from northern Ecuador along the coasts of Peru and Chile, reaching as far south as Chiloé. The estimated population ranges between 10,000 and 15,000 individuals (Clay et al. 2014).

Early site-based management actions aimed at supporting conservation of the American Oystercatcher were implemented between 2019 and 2025 in the Quinchao Bay Wetland Nature Sanctuary, Chiloé, southern Chile, prior to formal approval of the site's management plan by the Chilean Ministry of the Environment. While previous research has extensively documented the effects of disturbance, predation, and habitat loss on shorebird populations, there remains limited empirical evidence linking early-stage, site-based interventions to measurable reproductive outcomes, particularly in contexts where conservation efforts emerge prior to fully formalized management frameworks. Therefore, we aimed to address a critical knowledge gap on how early, locally implemented conservation actions can influence the reproductive success of shorebirds in human-dominated coastal landscapes. For this, we integrated findings from ornithological monitoring and participant observation conducted by Fundación Conservación Marina to evaluate the influence of these early actions on nesting and reproductive success of oystercatchers.

METHODS

Study site. The Quinchao Bay Wetland Nature Sanctuary (42°33'S, 73°25'W) is located in Quinchao Bay, south of Villa Quinchao, in the southern section of Quinchao Island —part of the Chiloé Archipelago, southern Chile (Figure 1). This protected site spans approximately 102.3 ha. Its boundaries extend over the water column of Quinchao Bay up to the high tide line and exclude any previously granted aquaculture concessions (FCM 2023).

The bay is narrow, elongated, and zigzag-shaped, with strong tidal influence. Its shores feature an extensive intertidal plain composed of silt and fine sand, while the supratidal zone contains marshes, grasslands, dunes, sand-gravel beaches, and two stream outlets (FCM 2023). The climate is humid and influenced by the Pacific Ocean, with an average annual temperature of 12°C and precipitation exceeding 2,000 mm (FCM 2023). The local context is rural, with a small population living along

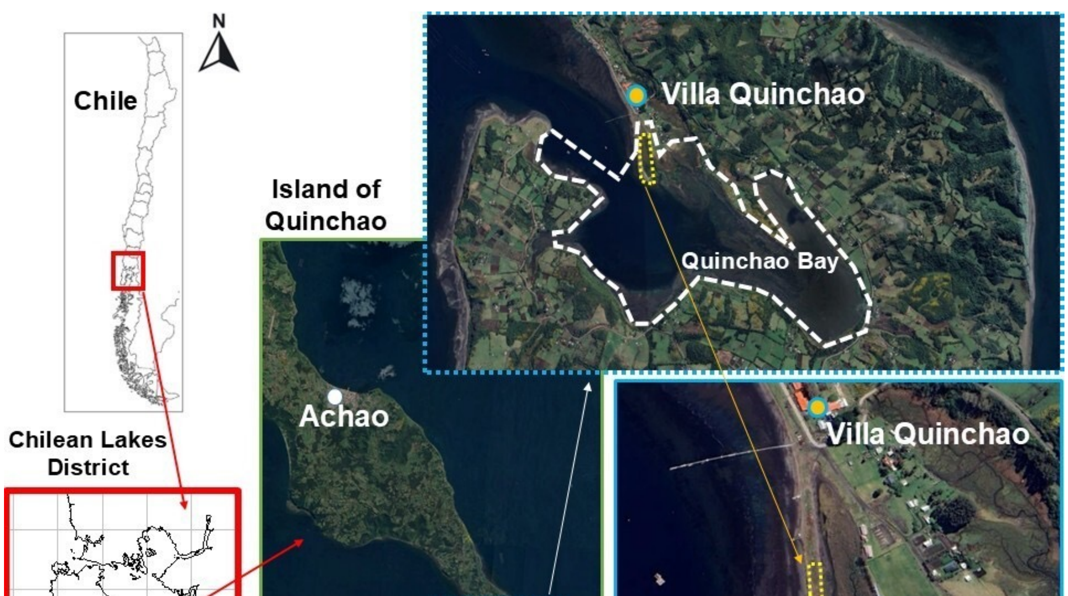

Figure 1. Geographical location of the Quinchao Bay Wetland Nature Sanctuary on Quinchao Island, Chiloé Archipelago, southern Chile. The spatial boundaries of the protected area are shown (Quinchao Bay: white dashed line), along with the zone used by the American Oystercatcher *Haematopus palliatus* for nesting (A: yellow dashed line). The location of the village of Villa Quinchao is also indicated.

the bay and surrounding hills. The main settlement, Villa Quinchao, includes a school, church, and rural health center, with a population of fewer than 50 residents.

Within the Quinchao Bay Wetland Nature Sanctuary (hereinafter Quinchao Bay Sanctuary), a dune area is used by the American Oystercatcher for nesting (Figure 1). This area covers about 0.5 ha and ranges from bare sand to zones dominated by *Puccinellia* sp., with scattered *Ulex sp*. shrubs. At the eastern edge of the dune lies a marsh habitat dominated by *Sarcocornia* sp., also used by oystercatchers for resting and social interactions.

Conservation status and early management strategies. At the beginning of 2019, the *Oficina de Medio Ambiente de la Ilustre Municipalidad de Quinchao*, in collaboration with Fundación Conservación Marina, made preparations for establishment of the protected area through data collection, participatory workshops, and field observations. These workshops facilitated identification of the main conservation threats for the area, including: (i) free-roaming dogs attacking aquatic and shorebirds; (ii) unregulated tourism and harmful practices; (iii) environmental pollution from solid waste; and (iv) livestock grazing freely in the supratidal zone and marshes of the wetland. The application for the legal creation of the protected natural area was the first early management action of the site.

During 2019, the dune zone in the northeastern sector of Quinchao Bay was crossed by a vehicular traffic route, and clear signs of gravel and sand extraction were observed. Following the initial detection of American Oystercatchers nesting in the area, vehicle access to the dune habitat was subsequently closed. This measure constituted the second early site−management action and began to be implemented in January 2020, with progressive improvements to its physical structure that ultimately resulted in a complete mesh−fence enclosure along the northern boundary of the Nature Sanctuary —achieved in April 2025 (Figure 2A). The third early management action, implemented in March 2020, was a human exclusion zone (0.12 ha) around the nesting area of the American Oystercatchers the dunes, with information signs (Figure 2B).

In September 2020, two bird observatories were built, one at the northern (Figure 2C) and the other at the southern (Figure 2D) area of the bay, to regulate tourism and promote good practices. These structures offered panoramic views of the protected area and were built in partnership with the local community —represented by the *Agrupación Social y Cultural Humedales de Quinchao*— which also contributed to design and partial financing. Each observatory features infographics highlighting the conservation value of Quinchao Bay. The construction of this infrastructure was the fourth early management action of the site.

In July 2022, the Quinchao Bay Sanctuary was legally declared a protected natural area by the State of Chile (MMA 2022). Subsequently, development of the management plan was initiated, incorporating updated information and a new series of citizen participation workshops, based on the Open Standards for Conservation Practice (CMP 2020). Accordingly, on 18 November 2022, a participatory workshop was held at the headquarters of the Villa Quinchao Neighborhood Council to identify and prioritize threats to the conservation targets of Quinchao Bay. Key threats included solid waste pollution and irresponsible pet ownership, followed by climate change, harmful tourism, and water pollution. A second workshop on 16 December 2022, presented video evidence of nest predation. Residents deemed the situation unacceptable and supported immediate municipal action. The *Oficina de Medio Ambiente de la Ilustre Municipalidad de Quinchao* therefore developed a "Responsible Pet Ownership" ordinance (Municipalidad de Quinchao 2023). Within Quinchao Bay, this was the fifth early management measure, promoting free sterilization campaigns for dogs and cats, especially in Villa Quinchao. This ordinance

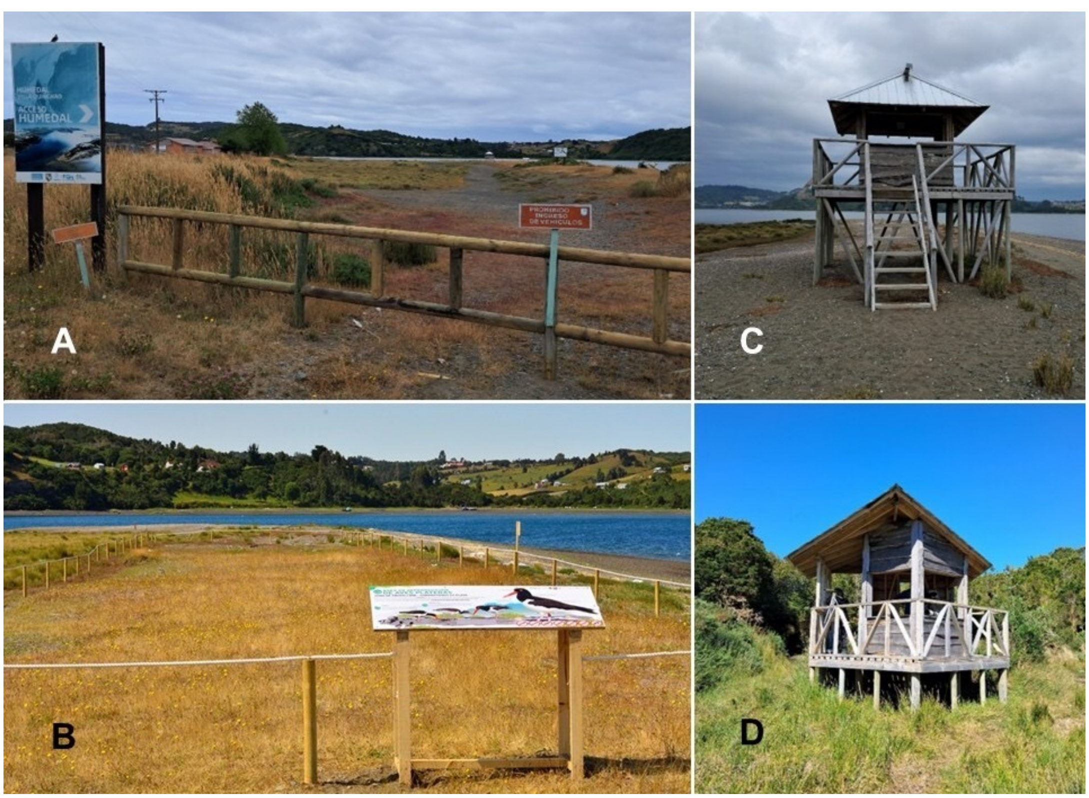

Figure 2. Photographs of the fences installed, and the two bird observatories built in the Quinchao Bay Wetland Nature Sanctuary, Chiloé, southern Chile. (A) Closure of vehicular access to the dune zone; (B) area delimited as a human-exclusion zone to protect the nesting of the American Oystercatcher *Haematopus palliatus*; C = northern observatory; D = southern observatory.

Figure 3. Photographs of American Oystercatcher *Haematopus palliatus* chicks at different developmental stages in the Quinchao Bay Wetland Nature Sanctuary, Chiloé, southern Chile. (A) Newly hatched chicks in the nest, showing dense cryptic down and limited mobility; (B) older chick on the beach, with more defined down and increased locomotor ability; (C) fledgling with developed plumage in the intertidal zone, accompanied by an adult.

began in January 2024.

Finally, the sixth early management measure consisted of reconditioning the soil —clearing the substrate— to enable American Oystercatcher nesting within the human exclusion zone. This measure was informed by nest monitoring during the study (see below). After restricting access to vehicles, livestock, and people, grass gradually encroached upon the nesting area, forcing birds to nest outside the exclusion zone. Therefore, in September 2025, before the beginning of the reproductive season, a community-led activity was organized to manually remove the grass that had invaded the exclusion zone. The work was carried out in an orderly manner, integrating scientific knowledge, educational engagement, and ethical considerations.

Nest monitoring. We monitored American Oystercatcher nests in the dune area of Quinchao Bay Sanctuary during the months of December and January in four breeding seasons (2022–2023, 2023–2024, 2024–2025, 2025–2026). Each season, we counted the number of American Oystercatcher nesting attempts, and collected data on the date, geographical location of the nest, and the number of eggs, chicks, and fledglings present. Nests were identified as small circular depressions on sandy substrates near the high tide line, often decorated with bivalve shell fragments, especially clams, that are typical of this species (Bachmann and Darrieu 2010).

With the purpose of understanding the threats that affect nesting American Oystercatchers, two camera traps (brand: Browning; model: Dark Ops Pro DCL Nano 4K No Glow) were installed in the human exclusion zone. These cameras provided a panoramic view of the area and continuously recorded nest activity through photographs and videos between November 2021 and January 2022.

We determined the following parameters of reproductive success of American Oystercatchers in Quinchao Bay Sanctuary: number of eggs hatched, chick survival, and fledgling survival (Virzi et al. 2016, Arenas et al. 2020). For each breeding season, we calculated the following indicators of reproductive success: hatching success as the proportion of eggs that hatch (no. chicks/no. eggs); fledging efficiency (no. fledglings/no. chicks); and reproductive output (no. fledglings/no. nesting attempt). We present mean values with standard deviation.

RESULTS

Over the four breeding seasons (from 2022 to 2026), we recorded a total of 25 nesting attempts (6.25 ± 2.06 nesting attempts/season) and 60 eggs (15 ± 6.7 eggs/season). Mean clutch size was 2.5 ± 0.7 eggs/nesting attempt (N = 25 nesting attempts). Egg laying began in mid-November, with additional pairs initiating nests progressively over the following weeks. Consequently, nests containing eggs were still observed through mid-January, revealing a marked asynchrony in laying dates among nests.

During the first two breeding seasons of 2022–2023 and 2023–2024, no chicks or fledglings were recorded. In the 2024–2025 season, two chicks and two fledglings were documented, and in the 2025–2026 season, four chicks and four fledglings were recorded. Chicks began to be observed from December onward. As the weeks progressed, they developed dark-pigmented feathers, increased their mobility, and eventually reached the fledging stage (Figure 3).

Of the two camera traps installed, only the one in the northern margin recorded an active American Oystercatcher nest. Footage showed that nesting activity began with laying of the first egg on 18 November 2021. The nest was completed with a full clutch of three eggs on 23 November 2021. The first egg hatched on 15 December 2021. That night, a domestic cat *Felis catus* seized the hatchling. Minutes later, the same cat —identified by distinct fur pattern— returned and attacked a second egg. The oystercatcher pair continued incubating the remaining egg, but the next night (17 December 2021), the cat re-

Table 1. Summary of reproductive parameters of the American Oystercatcher *Haematopus palliatus* in the Quinchao Bay Wetland Nature Sanctuary, Chile, during four breeding seasons (2022 to 2026).

Reproductive parameter	2022–2023	2023–2024	2024–2025	2025–2026
Total nesting attempts	9	6	4	6
Total eggs	25	13	11	11
Mean clutch size	2.8 ± 0.4	2.2 ± 1.0	2.8 ± 0.5	2.2 ± 1.0
Number of chicks	0	0	2	4
Hatching success (chicks / eggs)	0	0	0.18	0.36
Number of fledglings	0	0	2	4
Fledging efficiency (fledglings / chicks)	0	0	1.0	1.0
Reproductive output (fledglings / nesting attempt)	0	0	0.5	0.6

turned and destroyed the last egg. The entire clutch was lost to feline predation within 24 hours. A domestic dog *Canis familiaris* was also recorded sniffing the nest the following morning. The video sequence is available on the Fundación Conservación Marina YouTube channel (https://www.youtube.com/watch?v=qAbiV0jcnXQ).

The indicators of reproductive success of the American Oystercatcher in Quinchao Bay showed a marked temporal variation, transitioning from a scenario of total reproductive failure in the first two breeding seasons towards a phase of partial recovery in the latter two breeding seasons (Table 1). During the first two seasons (2022–2023 and 2023–2024), the hatching success was zero as none of the recorded eggs produced surviving chicks (Table 1). Under these conditions, fledging efficiency could not be assessed. This pattern indicates no chicks survived to be counted during these seasons, whether due to unhatched eggs, early chick mortality (as documented in 2021), or egg predation, consistent with strong limiting factors affecting viability or incubation conditions.

From the 2024–2025 season onwards, the system shows a partial recovery, evidenced by a steadily increasing hatching success, with just under a fifth of eggs hatching in 2024–2025, and over a third of eggs hatching in 2025–2026 (Table 1). Notably, all recorded chicks survived to the fledgling stage, with a fledging efficiency of 1.0 in the latter two breeding seasons (Table 1). This result suggests that, once the critical hatching phase is passed, the ecological conditions of the system allow for high post-hatching survival, likely linked to favorable habitat conditions for chick development. In the 2025–2026 season, hatching success was double that of the previous season (Table 1). This indicates a substantial improvement in egg viability or in incubation conditions. At the same time, fledging efficiency remained high (Table 1), showing a persistence in the high efficiency of the chick-to-fledgling stage. This pattern suggests that the system has entered a more consolidated recovery phase, where limitations in the early stages begin to decrease, while the later stages of the reproductive cycle remain functional.

Nest monitoring also revealed a progressive southward shift in nest locations relative to the human exclusion zone (Figure 4). In 2022–2023, 42.8% of nests were within the exclusion zone; this dropped to 16.6% in 2023–2024, and no nests were within the exclusion zone in 2024–2025 (Figure 4). Field observations suggested that this shift in nest locations coincided with the advance of grass over the dune, progressing in the same direction. This vegetation expansion occurred after the area was closed to vehicle traffic, pedestrians, and grazing animals. Consequently, grass was carefully removed to facilitate the return of American Oystercatchers to the site for nesting. This intervention was carried out in September 2025, and by November 2025 the first pairs were already observed using the restored area for breeding (Figure 4).

DISCUSSION

Our results showed an improvement in reproductive success of American Oystercatcher nests after implementation of early site-based management actions, such as restricting vehicular access, delineating the human exclusion zone, the Responsible Pet Ownership ordinance, as well as the removal of grass that had encroached upon the exclusion zone. The integration of ornithological research, participant observation, and conservation planning enabled the identification of necessary actions to protect American Oystercatcher nesting in Quinchao Bay. Citizen participation in developing the management plan strengthened the analyses and proposals, and supported decision-making that led to early management implementation. This explains the swift response that resulted in fencing to prevent motorized vehicle access to sensitive areas, the construction of bird observatories, and the placement of signage promoting responsible tourism. Supporting infrastructure in protected natural areas is essential for balancing biodiversity conservation with human activity (Pringle 2017, Heagney et al. 2018). When well-planned, such infrastructure facilitates sustainable use, enhances safety, boosts the local economy, and ensures long-term ecosystem protection.

The southward shift in nest locations likely reflected a behavioral response to habitat change rather than to the exclusion zone itself. Similar vegetation−driven shifts in nest−site selection have been reported for oystercatchers and other ground−nesting shorebirds when expanding vegetation reduces access to the open substrates preferred for nesting (Lauro and Burger 1989, Sabine et al. 2006). In our study area, grass encroachment followed the cessation of vehicle traffic, pedestrian use, and grazing —an unintended effect also observed in other coastal systems (Rickard et al. 1994, Wolf et al. 2017). The rapid return of American Oystercatchers after targeted grass removal in 2025 is consistent with evidence that maintaining sparsely vegetated habitat enhances nesting opportunities for the species (Clay et al. 2010).

Camera traps also showed that predation by domestic cats and dogs was an important threat to oystercatcher nests, as a single cat eliminated an entire clutch within 24 hours. Worldwide, domestic cats and dogs affect wildlife both within and outside protected areas (Parsons et al. 2016, Doherty et al. 2017, Loss and Marra 2017, Woinarski et al. 2017). Cats in particular are highly efficient predators that can severely reduce native fauna, sometimes leading to local extinctions (Frank et al. 2014, Loss and Marra 2017). Mitigating pet predation on wild birds is a global challenge, often facing public resistance (Young et al. 2018). The adoption of a municipal ordinance on responsible pet ownership in Quinchao represented a significant step forward. Still, enforcement must be strengthened, alongside public education to raise awareness on the impact of domestic animals on biodiversity. A combined approach including exclusion fencing, animal control, and community education has proven effective in reducing the threat posed by domestic animals to shorebird nesting (Smith et al. 2011, Dinsmore et al. 2014, Collins et al. 2016). While solutions vary by context, continuous monitoring and community engagement are essential for success (Burger and Niles 2013, Claassen et al. 2017).

Indicators of reproductive success of the American Oystercatcher demonstrated a shift from reproductive failure to partial recovery. Our data revealed that the primary demographic bottleneck was concentrated at the egg-to-chick stage. The con-

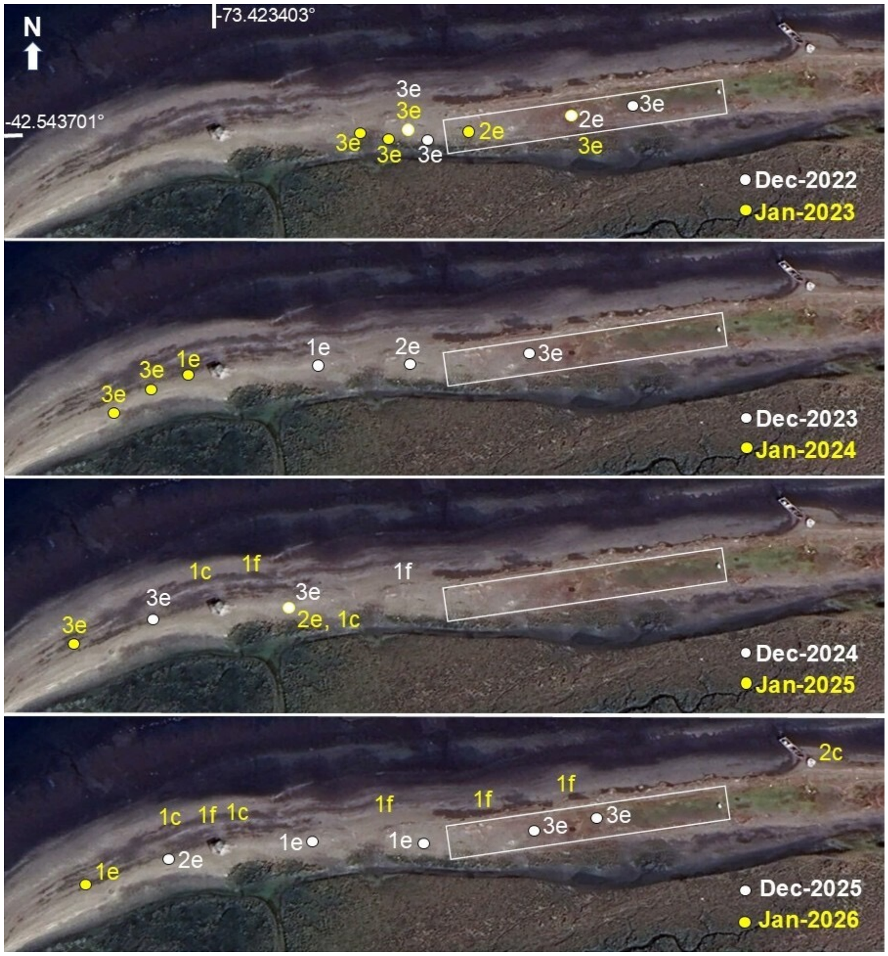

Figure 4. Total number and spatial distribution of American Oystercatcher *Haematopus palliatus* nests during the 2022–2023, 2023–2024, 2024–2025, and 2025–2026 breeding seasons in the dune zone of the Quinchao Bay Wetland Nature Sanctuary, Chile. In each season, data was recorded in December (white) and January (yellow): e = eggs, c = chicks, f = fledgling. The white rectangle delineates the human-exclusion zone.

sistently high fledging efficiency in the latter two seasons, together with the steadily increasing hatching success, indicate that processes affecting egg survival —such as nest predation, anthropogenic disturbance, or microhabitat conditions— were the dominant constraints on reproductive output. In contrast, post-hatching survival played a comparatively minor role in limiting productivity during the study period. Furthermore, the increase in hatching success in recent years suggests that early site-based management actions may be improving nest protection and reducing incubation-stage threats. Nevertheless, hatching success remained below 0.5 indicating persistent vulnerability of the nesting population, and long-term viability will depend on further gains in egg survival. A stage–specific analytical framework can be especially useful, as it identifies the demographic bottlenecks limiting productivity (Sandercock 2003, Allen et al. 2022) and provides clearer diagnostic signals for directing adaptive management where it can most effectively enhance reproductive output (Lyons et al. 2008).

Our findings are consistent with the objectives of the Pacific Flyway Shorebird Conservation Strategy, as they identified key threats, effective site-based interventions, and the importance of coordinated actions to sustain shorebird populations across coastal systems (Senner et al. 2017). Although the American Oystercatcher is largely resident in this region, the patterns observed here align with broader conservation recommendations for priority coastal habitats, including those of the Atlantic Flyway Shorebird Initiative (Mengak et al. 2019). Beyond this alignment, our study demonstrated how locally generated ecological evidence can inform targeted management by revealing stage-specific demographic constraints, particularly during the egg-to-chick transition. The integration of monitoring, community engagement, and institutional action enabled timely adjustments to conservation measures, illustrating a practical example of evidence-based adaptive management at the site scale. These results underscore the importance of protecting high-value coastal habitats while also highlighting that effective conservation in human-dominated landscapes depends on the capacity to translate ecological information into coordinated, locally grounded interventions that enhance the resilience of shorebird populations over time.

Conclusions. Early site-based management actions implemented in the Quinchao Bay Wetland Nature Sanctuary were associated with a measurable improvement in the reproductive performance of the American Oystercatcher. Following an initial period of complete reproductive failure, the system transitioned toward partial recovery, primarily driven by increases in hatching success. A stage-specific analysis revealed that the egg-to-chick phase represented the principal demographic bottleneck, indicating that reproductive limitation is concentrated at a specific life-history stage rather than reflecting a generalized system collapse. This suggests that targeted interventions addressing incubation-stage threats may yield disproportionate gains in reproductive output.

Camera trap evidence confirmed that domestic animals, particularly cats, constitute a significant source of nest loss, providing direct evidence of a key limiting mechanism. Importantly, the main threats identified in this system —pet predation, human disturbance, and vegetation encroachment— are locally manageable and, in principle, reversible. This indicates a high potential for recovery when appropriate management actions are implemented. The relatively rapid reproductive response observed across breeding seasons further supports the idea that shorebird populations in human-dominated coastal environments can retain substantial resilience when key constraints are effectively addressed. At the same time, the documented predation event illustrates how low-frequency, but high-impact disturbances can disproportionately affect reproductive outcomes, underscoring the importance of mitigating even localized threats.

The observed vegetation encroachment following the exclusion of vehicles, pedestrians, and livestock highlights the potential for unintended ecological consequences of management actions. The subsequent recovery of nesting activity after targeted substrate restoration emphasizes the importance of continuous monitoring and iterative adjustment of interventions. In this context, the integration of ecological monitoring, community participation, and municipal action enabled timely and context-specific responses, illustrating a practical application of adaptive management at the site level.

Taken together, these findings suggest that early, locally implemented management actions, when informed by site-based evidence, can contribute to improvements in reproductive success by addressing specific limiting processes. More broadly, this study provides applied evidence that integrating monitoring, adaptive management, and local governance can support effective conservation in human-dominated coastal landscapes. By identifying stage-specific constraints and linking them to targeted interventions, this approach offers a transferable framework for site-based conservation aimed at enhancing the resilience and long-term persistence of shorebird populations.

ACKNOWLEDGMENTS

The authors gratefully acknowledge BIOME —International Conservation Fund of Canada for its financial support in strengthening exclusion infrastructure and shorebird monitoring at the Quinchao Bay Wetland Nature Sanctuary. We also thank Manomet Inc. and the Western Hemisphere Shorebird Reserve Network for their continued support of long-term monitoring and conservation efforts through the Chiloé Shorebird Conservation Project. We extend our appreciation to the Municipality of Quinchao for its sustained commitment to early management actions within the protected area, as well as to the Quinchao Bay Wetland Nature Sanctuary Governance Committee for its ongoing dedication to the conservation of the American Oystercatcher breeding area. We are also grateful to the Seacology Foundation for its financial support to the *Club Deportivo Escolar, Social y Cultural Teresa Cárdenas of Villa Quinchao,* which enabled the construction of bird observatories within the sanctuary. Finally, we thank two anonymous reviewers for their constructive comments, as well as Katherine Renton and Juan Pablo Isacch for their valuable contributions to improving the clarity and quality of the manuscript.

REFERENCES

Allen AM, E Jongejans, M van de Pol, BJ Ens, M Frauendorf, M van der Sluijs, H de Kroon (2022) The demographic causes of population change vary across four decades in a long-lived shorebird. *Ecology* 103: e3615. https://doi.org/10.1002/ecy.3615

Arenas A, NY Camarena Gamarra, JA Ponce Alarcon, AA Cotillo Mendoza (2020) Éxito reproductivo del *Haematopus palliatus*, ostrero común, y actividades antrópicas en el Circuito Marvilla, Pantanos de Villa, Lima, Perú. *South Sustainability* 1: e020. https://doi.org/10.21142/SS-0102-2020-020

Bachmann S, CA Darrieu (2010) Biología reproductiva del Ostrero Pardo (*Haematopus palliatus*) en el sudeste de la provincia de Buenos Aires, Argentina. *El Hornero* 25: 75−84. https://doi.org/10.56178/eh.v25i2.702.

Bennett NJ, A Di Franco, A Calò, E Nethery, F Niccolini, M Milazzo, P Guidetti (2019) Local support for conservation is associated with perceptions of good governance, social impacts, and ecological effectiveness. *Conservation Letters* 12: e12640. https://doi.org/10.1111/conl.12640

Bernard RH (2006) *Research methods in anthropology: qualitative and quantitative methods*. Altamira Press, New York, USA.

BirdLife International (2016) *Haematopus palliatus. In: IUCN Red List of Threatened Species*. Version 2016. Available at http://www.iucnredlist.org [Accessed 03 January 2025].

Burger J, LJ Niles (2013) Closure versus voluntary avoidance as a method of protecting migrating shorebirds on beaches in New Jersey. *Wader Study Group Bulletin* 120: 20−25.

Claassen AH, K Sok, TW Arnold, FJ Cuthbert (2017) Effectiveness of direct payments to increase reproductive success of sandbar-nesting river birds in Cambodia. *Bird Conservation International* 27: 495−511. https://doi.org/10.1017/S0959270916000368

Clay RP, AJ Lesterhuis, S Schulte, S Brown, D Reynolds, TR Simons (2010) *Conservation Plan for the American Oystercatcher (Haematopus palliatus) throughout the Western Hemisphere*. Version 1.1. Manomet Center for Conservation Sciences, Manomet, Massachusetts, USA.

Clay RP, AJ Lesterhuis, S Schulte, S Brown, D Reynoldes, TR Simons (2014). A global assessment of the conservation status of the American Oystercatcher *Haematopus palliatus*. *International Wader Studies* 20: 62−82.

CMP (2020) *Open standards for the practice of conservation*. The Conservation Measures Partnership. Available at https://www.conservationstandards.org/wp-content/uploads/sites/3/2020/10/CMP-Open-Standards-for-the-Practice-of-Conservation-v4.0.pdf [Accessed 01 August 2022]

Collins SA, FJ Sanders, PGR Jodice (2016) Assessing conservation tools for an at-risk shorebird: Feasibility of headstarting for American Oystercatchers *Haematopus palliatus*. *Bird Conservation International* 26: 451−465. https://doi.org/10.1017/S0959270916000095

Dinsmore SJ, DJ Lauten, KA Castelein, EP Gaines, MA Stern (2014) Predator exclosures, predator removal, and habitat improvement increase nest success of Snowy Plovers in Oregon, USA. *The Condor: Ornithological Applications* 116: 619−628. https://doi.org/10.1650/CONDOR-14-7.1

Doherty TS, CR Dickman, AS Glen, TM Newsome, DG Nimmo, EG Ritchie, et al. (2017) The global impacts of domestic dogs on threatened vertebrates. *Biological Conservation* 210: 56−59. https://doi.org/10.1016/j.biocon.2017.04.007

FCM (2023) *Plan de manejo para el Santuario de la Naturaleza Humedal Bahía de Quinchao*. Fundación Conservación Marina, Ilustre Municipalidad de Quinchao, Chiloé, Chile.

Heagney EC, JM Rose, A Ardeshiri, M Kovač (2018) Optimising recreation services from protected areas - Understanding the role of natural values, built infrastructure and contextual factors. *Ecosystem Services* 31: 358−370. https://doi.org/10.1016/j.ecoser.2017.10.007

Lauro B, J Burger (1989) Nest-site selection of American Oystercatchers (*Haematopus palliatus*) in salt marshes. *The Auk* 106: 185−192.

Lockwood M, J Davidson, A Curtis, E Stratford, R Griffith (2010) Governance principles for natural resource management. *Society & Natural Resources* 23: 986−1001. https://doi.org/10.1080/08941920802178214

Loss SR, PP Marra (2017) Population impacts of free-ranging domestic cats on mainland vertebrates. *Frontiers in Ecology and the Environment* 15: 502−509. https://doi.org/10.1002/fee.1633

Lyons JE, MC Runge, HP Laskowski, WL Kendall (2008) Monitoring in the context of structured decision-making and adaptive management. *The Journal of Wildlife Management* 72: 1683−1692. https://doi.org/10.2193/2008-141

Mengak L, AA Dayer, R Longenecker, CS Spiegel (2019) *Guidance and best practices for evaluating and managing human disturbances to migrating shorebirds on coastal lands in the Northeastern United States*. U.S. Fish and Wildlife Service. Hadley, Massachusetts, USA.

MMA (2020) *Aprueba y oficializa clasificación de especies según estado de conservación, decimosexto proceso*. Norma General, CVE 1836396, Núm. 42.790. Ministerio del Medio Ambiente. Diario Oficial de la República de Chile, Santiago, Chile.

MMA (2022) *Declara Santuario de la Naturaleza Humedal Bahía de Quinchao*. Norma General, CVE 2160246, Núm. 43.211. Ministerio del Medio Ambiente. Diario Oficial de la República de Chile, Santiago, Chile.

Municipalidad de Quinchao (2023) *Ordenanza municipal "Tenencia Responsable de animales de compañía"*. Ordenanza número 01/2023. Ilustre Municipalidad de Quinchao, Achao, Chile.

Parsons AW, C Bland, T Forrester, MC Baker-Whatton, SG Schuttler, WJ McShea, R Costello, R Kays (2016) The ecological impact of humans and dogs on wildlife in protected areas in eastern North America. *Biological Conservation* 203: 75−88. https://doi.org/10.1016/j.biocon.2016.09.001

Pringle RM (2017) Upgrading protected areas to conserve wild biodiversity. *Nature* 546: 91−99. https://doi.org/10.1038/nature22902

Puri RK (2011) Participant observation. Pp. 85−97 *in* Newing H, CM Eagle, RK Puri, CW Watson (eds). *Conducting research in conservation: social science methods and practice*. Routledge. Chicago, USA.

Rickard CA, A McLachlan, GIH Kerley (1994) The effects of vehicular and pedestrian traffic on dune vegetation in South Africa. *Ocean & Coastal Management* 23: 225−247. https://doi.org/10.1016/0964-5691(94)90021-3

Sabine JB, SH Schweitzer, JM Meyers (2006) Nest fate and productivity of American Oystercatchers, Cumberland Island National Seashore, Georgia. *Waterbirds* 29: 308−314. https://doi.org/10.1675/1524-4695(2006)29[308:NFAPOA]2.0.CO;2

Sandercock BK (2003) Estimation of survival rates for wader populations: a review of mark-recapture methods. *Wader Study Group Bulletin* 100: 163−174.

Senner NR, BA Andres, HR Gates (2017) *Estrategia de Conservación de las Aves Playeras de la Ruta del Pacífico de las Américas*. National Audubon Society. New York, USA.

Smith RK, AS Pullin, GB Stewart, WJ Sutherland (2011) Is nest predator exclusion an effective strategy for enhancing bird populations?. *Biological Conservation* 144: 1−10. https://doi.org/10.1016/j.biocon.2010.05.008

Suškevičs M, T Hahn, R Rodela, B Macura, C Pahl-Wostl (2018) Learning for social-ecological change: A qualitative review of outcomes across empirical literature in natural resource management. *Journal of Environmental Planning and Management* 61: 1085−1112. https://doi.org/10.1080/09640568.2017.1339594

Virzi T, JL Lockwood, D Drake, SM Grodsky, T Pover (2016) Conservation implications of reproductive success of American Oystercatchers in an urbanized barrier island complex. *Wader Study* 123: 202–212. https://doi.org/10.18194/ws.00049

Woinarski JCZ, BP Murphy, SM Legge, ST Garnett, MJ Lawes, S Comer, et al. (2017) How many birds are killed by cats in Australia? *Biological Conservation* 214: 76−87. https://doi.org/10.1016/j.biocon.2017.08.006

Wolf KM, RA Baldwin, S Barry (2017) Compatibility of livestock grazing and recreational use on coastal California public lands: importance, interactions, and management solutions. *Rangeland Ecology & Management* 70: 192−201. https://doi.org/10.1016/j.rama.2016.08.008

Young JK, DL Bergman, M Ono (2018) Bad dog: feral and free-roaming dogs as agents of conflict. *Animal Conservation* 21: 285−286. https://doi.org/10.1111/acv.12438