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Pouhala Marsh State Wildlife Sanctuary

Waterbird Report, 2024

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I. Overview

Pouhala Marsh State Wildlife Sanctuary (hereafter ‘Pouhala Marsh’) is an 84-acre wildlife sanctuary designated for the recovery of federally and state-listed endangered waterbirds in Waipahu, Hawai‘i. Pouhala Marsh is a brackish, estuarine wetland in the Pearl Harbor Basin on the island of O‘ahu (Figure 1).

The US Fish and Wildlife Service (USFWS; hereafter the Service) has identified Pouhala Marsh as a core wetland in its *Recovery Plan for Hawaiian Waterbirds, 2nd Revision*. The Service defines core wetlands as being able to provide habitat essential for the larger populations of Hawaiian waterbirds that comprise the bulk of the numbers prescribed for recovery (USFWS 2011). Pouhala Marsh provides foraging, loafing, nesting, and roosting habitat for three endemic and endangered waterbirds: Hawaiian Coot (*Fulica alai*), Hawaiian Common Gallinule (*Gallinula galeata sandvicensis*), and Hawaiian Stilt (*Himantopus mexicanus knudseni*). In addition, Pouhala Marsh provides habitat for many migratory waterfowl, shorebirds, and wading birds during the Fall and Winter months. In the Winter of 2020 alone, White-faced Ibis (*Plegadis chihi*), Dunlin (*Calidris alpina*), Northern Pintail (*Anas acuta*), Common Snipe (*Gallinago gallinago*), Green-winged Teal (*Anas carolinensis*), and Northern Shoveler (*Anas clypeata*), were observed at Pouhala Marsh.

Hawaiian waterbirds are considered ‘conservation reliant’, meaning that populations will require active management for the foreseeable future (Reed et al. 2012, Underwood et al. 2013). Wetland managers mitigate threats to Hawaiian waterbirds by controlling invasive plants and removing invasive predators. Monitoring the success of these strategies over time allows managers to adapt management actions to most efficiently protect waterbirds.

II. Habitat Management

Approximately 26 acres of the sanctuary are usable waterbird habitat; 35 acres are comprised of mangrove forest, the canal and adjacent bank are 4 acres, 2 acres are ocean, and 17 acres are dry upland areas surrounding the wetland basins (Figure 1). Habitat manipulations in 2024 did not occur due to maintenance issues with the habitat manipulation equipment (Marsh Master MM-2XL; Table 1).

The hydrology seems to have changed; the tide levels have increased, and the water has become more saline. The increased saline conditions killed the large patch of bulrush (*Schoenoplectus* sp.) and cattails (*Typha latifolia*), although a remnant remained. When the bulrush was controlled in 2019, I identified it as the nonnative *Schoenoplectus californicus*, but the bulrush that followed was identified as the native *S. tabernaemontani*. Perhaps the control of the nonnative *S. californicus* promoted the natural seed bank, and *S. tabernaemontani* resulted.

III. Waterbird Monitoring

a. Waterbird Surveys

1. Methods

Surveys.—A census technique was employed to count all waterbirds present using the direct count method. Waterbird surveys were conducted using consistent observation lines to maintain consistency among different observers. When conducting waterbird surveys, observers survey the Landfill area by accessing the road between the Landfill and the Main Pond (Figure 1). Waterbirds are counted in the Main Pond by observing the area near the freshwater spring (area of cattails and bulrush) and across the water toward the Waikele Ponds. The waterbirds are counted from left to right, and numbers are recorded. Next, the observer will move from the west side of the Main Pond to the eastern portion of the Main Pond toward the upper road that runs parallel to Kapakahi Stream. To verify waterbird numbers in the Main Pond, the Main Pond is surveyed again from the upper road, and the larger number is recorded into the data sheet. It is necessary to survey from both locations to obtain accurate numbers in the freshwater spring portion of the Main Pond in conjunction with the northern portion of the Main Pond and the imaginary boundary between the Waikele Ponds. The observer continues north on the upper road to gain visual access to the Waikele Ponds and counts the waterbirds utilizing the Waikele Ponds separate from the Main Pond, although the water within both ponds may be connected. Lastly, waterbirds are surveyed in Kapakahi Stream from north to south. A spotting scope should be used to obtain a visual on the westernmost portion of the Main Pond via the vantage from the upper road.

Observers also recorded ancillary environmental data: cloud cover, vegetation cover, rainfall, wind and gust speed, water level, and the degree of human influence. Cloud cover was estimated as a continuous percentage between 0 and 100 by tens. Vegetation cover was ranked in discrete categories from 0 to 3: 0 = open water, 1 = 26–50% cover, 2 = 51–75% cover, and 3 = ≥75% cover. Rainfall was recorded in discrete categories of 0 = no rain, 1 = mist or fog, 2 = drizzle, and 3 = light rain. Wind and gust speed were recorded as Beaufort categories: 0 = no wind, 1 = smoke drifts (4–7 mph), 2 = wind felt on face, and 3 = leaves, small twigs in constant motion (8–12 mph). Water level was recorded as a discrete category ranging from 0 to 3, where 0 = dry, 1 = lower than normal, 2 = normal, and 3 = higher than normal. Human impact was recorded as ranging from 0 to 2: 0 = indirect, 1 = moderate, and 2 = heavy.

Chicks and fledglings were recorded separately for each of the endangered wetland birds, and all banding information observed was recorded. Specific nesting activities measured include pairing, territory, and chick survival rates to the fledging stage.

Habitat Use.—Microhabitat was assessed for all the endangered birds encountered. Microhabitat was identified as: *stream*, *stream bank*, *open mudflat*, *vegetation*, *0–3" water*, *3–6" water* and *>6" water*. *Stream* is defined as stream water that is deeper than the tarsal-tibiotarsal joint (i.e., joint not visible) for stilts and water deep enough for the coot or gallinule to be swimming; *stream bank* is stream water not deeper than the tarsal-tibiotarsal joint (i.e., joint visible) in stilts, or coots and gallinules observed standing on vegetation inside the stream channel or in shallow enough water where swimming is not allowable; *open mudflat* is defined as exposed or bare soil with no emergent vegetation; *vegetation* is emergent vegetation with small pockets of mudflat or water present; *0–3" water* is water no deeper than the tarsal-tibiotarsal joint (i.e., joint visible) for stilts and walking in water for coots and gallinules; *3–6" water* is deeper than the tarsal-tibiotarsal joint (i.e., joint not visible) for stilts and swimming for coots and gallinules; and *>6" water* is such that no part of the leg is visible in the stilt, for the coot and gallinule depth of water was estimated by reading the nearest water gauge.

Fledging success.—Endangered waterbird fledging success was measured using this formula: (# of observed fledglings/# of observed chicks) x 100 = % fledgling success. Fledglings and chicks were mapped in each survey to aid in identifying each brood's chicks-to-fledging ratio.

2. Results

Surveys.—A total of 23 surveys were conducted at Pouhala Marsh in 2024. Mean abundances (range) for coots were 1.3 individuals (0–3), gallinules were 4.7 individuals (1–8), and stilts were 55.7 (0–208) individuals per survey (Figure 2). The peak occupancy for stilts was December (Figure 3).

Habitat Use.—Habitat utilization differed by species. The Hawaiian Coot was found most often in stream habitat with 66.7% of the observations; the Hawaiian Gallinule was found most often in vegetation with 34.6% of the observations; and the Hawaiian Stilt was found most often in 0–3" water with 73.6% of the observations (Figure 4). Coots utilized deeper water habitats, gallinules used vegetation, and stilts used shallow water and mudflats.

Fledging success.—Zero coot chicks were observed. One stilt chick was observed, and zero fledglings. We had a missed gallinule nest that fledged one chick (Table 2).

3. Recommendations

Increasing waterbird habitat through vegetation control is necessary to create nesting habitat for the stilts; otherwise, few nests are initiated. Removal of mangrove would create nesting and foraging habitat for migratory shorebirds and resident waterbirds.

Using cameras on nests at Pouhala could help us understand nest failure rates and causes. In 2025, more effort will be made to monitor nests with cameras to provide a relative sense of nest loss and the potential for mitigative management actions based on the cause of nest failures.

b. Nest Surveys

1. Methods

Nest Monitoring. Nests were located during routine weekly surveys using an area-search survey. During these surveys, a team of 1-2 observers walked meandering transects with the goal of locating all nests in a given area.

Waterbird nests were monitored from May through June 2024. Nest success was monitored using SPYPOINT Solar Dark (GG Telecom, Quebec, Canada) passive infrared cameras (trigger speed: 0.07s) placed about 1 m from the nest, mounted on a 7.6-cm wide metal post 1.8 m long, fixed with a fully-adjustable camera mount that allows a camera angle of 0–90°. Cameras were programmed to take two images back-to-back immediately upon infrared motion activation. Cameras were programmed to take photos instantly for each activation (Instant setting recovery speed: 0.3s). Cameras were checked weekly for battery life and SD card data retrieval, and were removed either immediately after a nest was confirmed failed or after a nest was confirmed successful.

Reproductive Success.—Reproductive metrics were used to determine nest, fledging, and overall reproductive success for coots, gallinules, and stilts. *Nest Success* was determined by using the formula: (# of broods observed/# of nests observed)*100 = % nests that hatched ≥1 chick; *Fledging Success* was determined by using the formula: (# of broods that produced ≥1 fledgling/# of broods observed)*100 = % of broods that produced ≥1 fledgling; and *Overall Reproductive Success* was determined using the formula: (# of broods that produced ≥1 fledgling/# of nests observed)*100 = % of nests that produced ≥1 fledgling.

2. Results

Nest Monitoring.—Three surveys were conducted from May through June 2024. During 2024, zero coot, zero gallinule, and one stilt nest were observed (Figure 6).

<u>Overall Nest Outcomes</u>
Out of one nest discovered, 0% (*n* = 0) produced at least one chick, 0% (n = 0) failed due to predation or partial predation, 0% (n = 0) failed due to abandonment, and 100% (*n* = 1) had unknown fates (Table 3).

<u>Outcomes of Nests Monitored with Cameras</u>
Out of one nest, zero (0%) had a camera placed on them. Cameras were placed on 0%, 0%, and 0% of coot (n = 0), gallinule (*n* = 0), and stilt (*n* = 0) nests, respectively. Of the zero nests with cameras, 0% (*n* = 0) produced at least one chick, 0% (n = 0) failed due to predation, 0% (n = 0) failed due to abandonment, and 0% (n = 0) failed for unknown reasons (Table 4).

Reproductive Success.—We observed zero coot, one gallinule, and one stilt broods; and 0 gallinule and zero stilt broods produced ≥1 fledgling (Table 2). The number of broods observed per nest were 0.0, 1.0 and 1.0 broods for coots, gallinules, and stilts, respectively. The number of fledglings per brood was 0, 0, and 0 fledglings for coots, gallinules, and stilts, respectively. The number of fledglings per nest was 0, 0, and 0 for coots, gallinules, and stilts, respectively.

3. Recommendations

Nest Monitoring.—Increase chick monitoring to determine fledgling success for nests monitored with cameras.

b. Long-term Waterbird Population Analysis

1. Results

Survey.—A total of 285 waterbird surveys were conducted during 2017–2024 (*n*=15, *n*=32, *n*=40, *n*=43, *n*=48, n=42, n=42, n=23, respectively). The average coot abundance for those years were 2.9, 1.8, 2.8, 5.1, 5.2, 4.1, 2.8, and 1.3 individuals; the average gallinule abundance was 1.6, 1.7, 2, 1.8, 2.2, 3.3, 3.6, and 4.7 individuals; and the average stilt abundance was 45.7, 29, 60.9, 52.7, 52.3, 50.8, 47.0, and 55.7 individuals, respectively (Figure 6).

2. Discussion

The populations of coots have decreased, with gallinules increasing recently due to five successful fledglings from the last two seasons (Table 2). The stilt population has remained stable.

IV. Predator Control

a. Methods

The DOC-200 kill traps (*n* = 22) were closed for a mongoose study set to take place in 2025. One cat kill-trap or conibear trap was used; the cat trap was installed with two conibears on each end with an entrance in the top and later modified for entrance on both ends of the trap. The cat trap was not baited this year.

b. Results

DOFAW trapped 5 small Indian mongooses (*Urva auropunctata*), 0 rats (*Rattus* sp.), and 0 feral cats (*Felis catus*; Table 4) in 49 trap days.

c. Recommendations

Predator control efforts in 2024 were down compared to 2020–2022 (0.007 mongoose captured per trap day). Mongoose take was well below the reported take in 2019 (167 mongooses according to USDA-WS) when live traps were used. We continued with the closure of the traps for the CSWG Mongoose Control Project. We hope to continue the project in August 2025. After the project is completed, we will initiate trapping again.

Predator control efforts will continue as mongooses are a major threat to stilt nests and waterbird chicks. At Pouhala Marsh, the mongoose population seems to be very high, like Kawainui Marsh, and could benefit from more predator control. In 2021, at Hāmākua Marsh, one of 31 nests (3%) monitored by a camera was predated by a mongoose. Kawainui captured on camera three of seven (43%) nests preyed upon by mongooses, and Pouhala Marsh had three of five (60%) stilt nests predated by a mongoose. In 2022, no mongoose was captured on camera depredating waterbird nests. However, we observed a Ruddy Turnstone predate on a stilt nest. Mongooses were likely involved with chick mortality, as we had very low fledgling success, and our monitoring methods do not currently account for chick predation events. In 2024, we had a few nests initiated, possibly due to a high population of predators.

Kill traps are one method necessary to control mongoose, but bait stations filled with toxicant bait could be another useful tool to reduce mongoose effectively in critical waterbird habitats. In 2025, we will partner with USDA-WS to conduct a study of a mongoose bait toxicant in the field at Pouhala Marsh for EPA registration.

V. Conclusions and Goals for 2025

Pouhala Marsh provides adequate habitat for stilts. In the winter months, stilt abundance approaches 200 individuals, yet provides little in the form of nesting habitat. We observed 30 stilt nests with minimal effort. The number of stilt nests was high compared to previous years, but most of the nests were probably second and third nests from the same pairs that failed due to mongoose predation. In 2025, an effort will be made to understand the stilt nesting habitat and the impacts predators have on nest success. In 2023, trap distribution increased by 40% with the addition of 10 more DOC-200 traps, but increased trap density resulted in the same number of mongoose captures, suggesting mongoose trap placement is key to trap success. The USDA-NWRC-Hilo Field Station will partner with DLNR-DOFAW to conduct a mongoose toxicant study. This study will provide home range data for the mongoose through GPS technology and could aid in discovering the mongoose habitat use at Pouhala Marsh. The information received from tracking adult mongoose will aid in trap placement in corridors of high mongoose activity.

VI. Literature Cited

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van Rees, C. B., P. R. Chang, J. Cosgrove, D. W. DesRochers, H. K. W. Gee, J. L. Gutscher-Chutz, A. Nadig, S. E. Nagata, M. Silbernagle, J. G. Underwood, K. Uyehara, and J. M. Reed. 2018. Estimation of vital rates for the Hawaiian Gallinule, a cryptic, endangered waterbird. Journal of Fish and Wildlife Management 9:117–131.

VII. Appendix

a. List of Figures and Tables

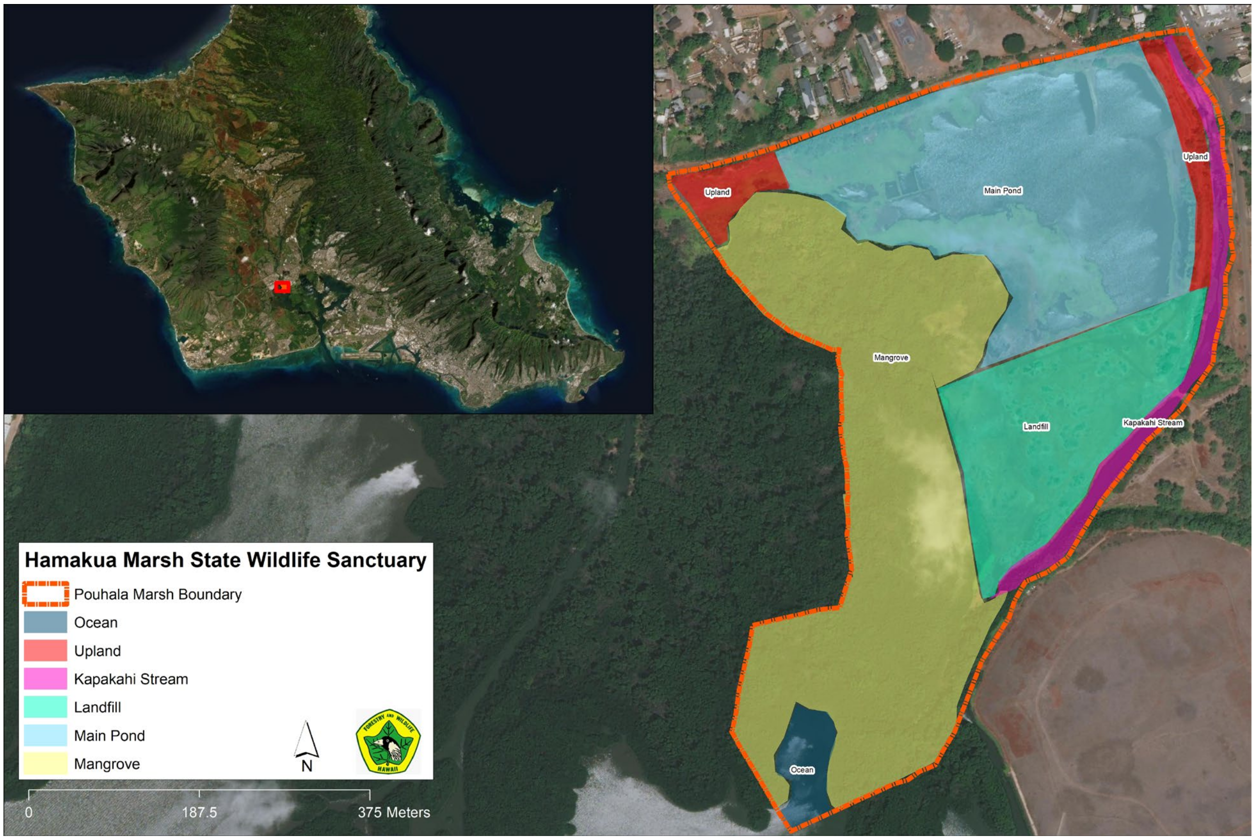

Figure 1. Map of Pouhala Marsh State Wildlife Sanctuary, Waipahu, Oahu, Hawaii, USA.

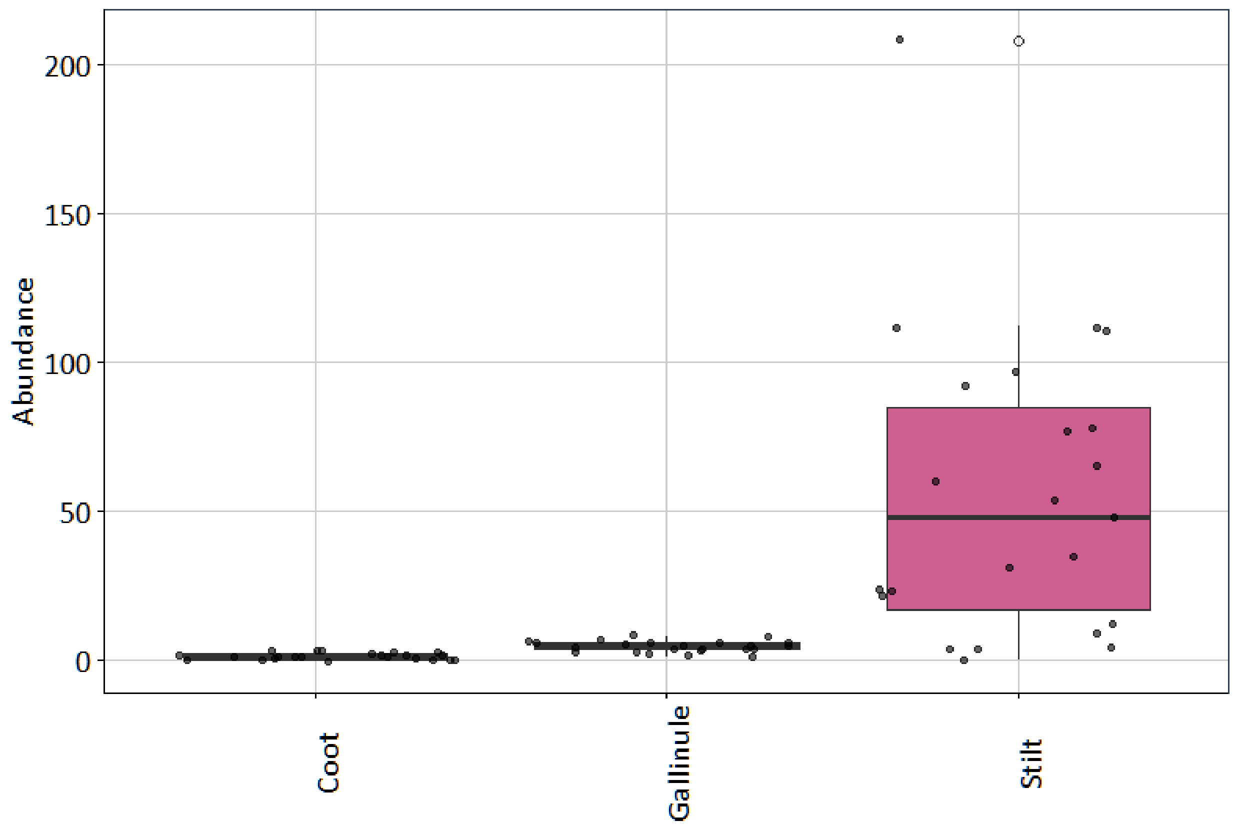

Figure 2. Boxplot displaying median values and interquartile ranges for coots, gallinules, and stilts in 2024. Black points represent abundances for each individual survey (n = 23). Open circles are outliers and whiskers represent minimum and maximum.

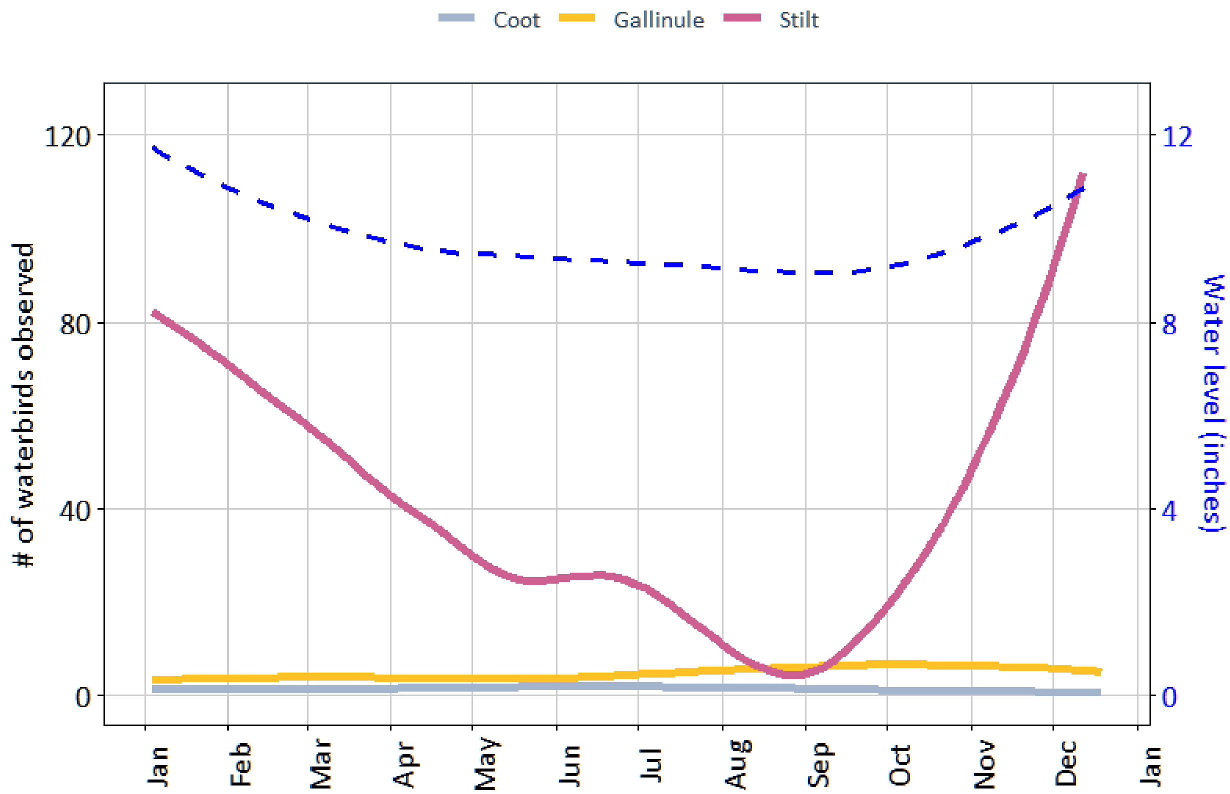

Figure 3. Coot, gallinule, and stilt individuals observed per survey throughout 2024 in Pouhala Marsh State Wildlife Sanctuary, Waipahu, O‘ahu, Hawai‘i, USA.

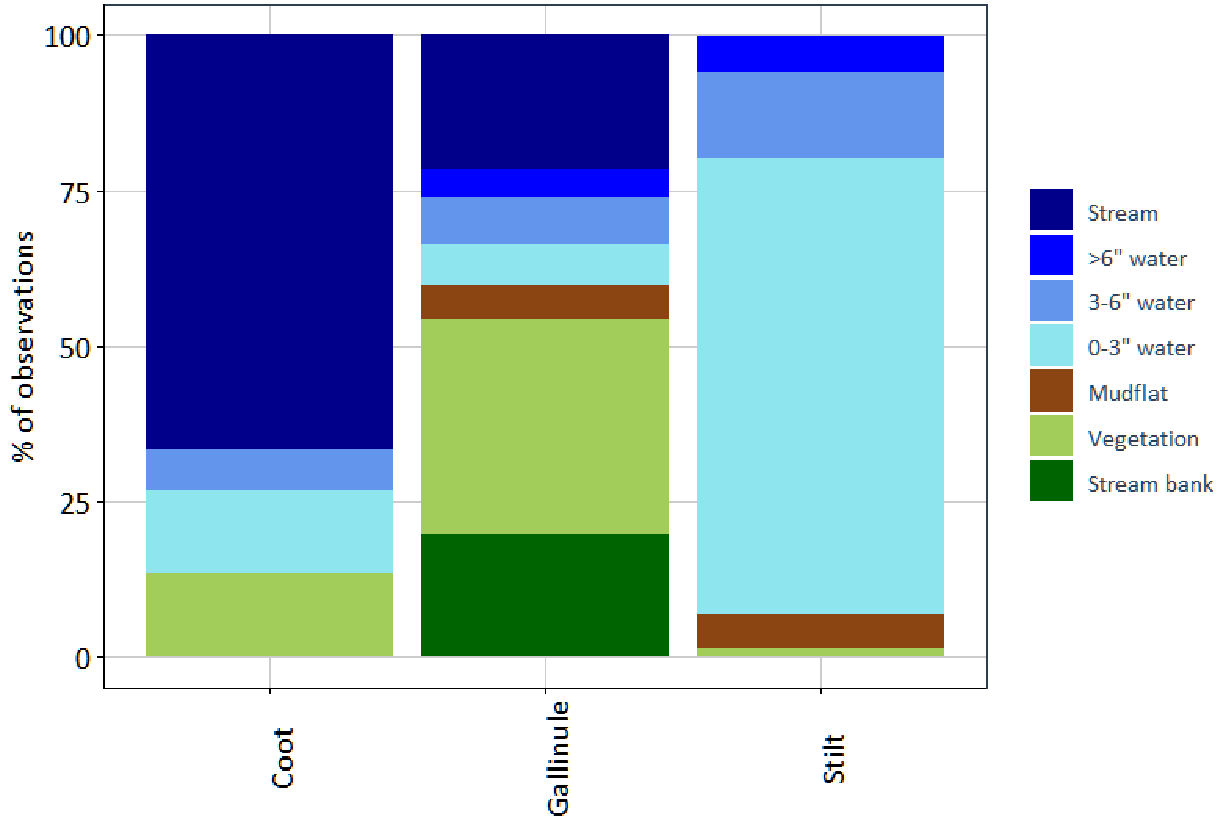

Figure 4. Percent of observations for coots, gallinules, and stilts in seven microhabitats found within Pouhala Marsh State Wildlife Sanctuary, Waipahu, Oʻahu, Hawaiʻi, USA, in 2024.

Figure 5. Nest distribution at Pouhala Marsh State Wildlife Sanctuary, Waipahu, Oʻahu, Hawaiʻi, USA. Coot (*n*=0), gallinule (*n*=0), and stilt (*n*=1) nests were distributed in pickleweed patches in the Main Pond in 2024.

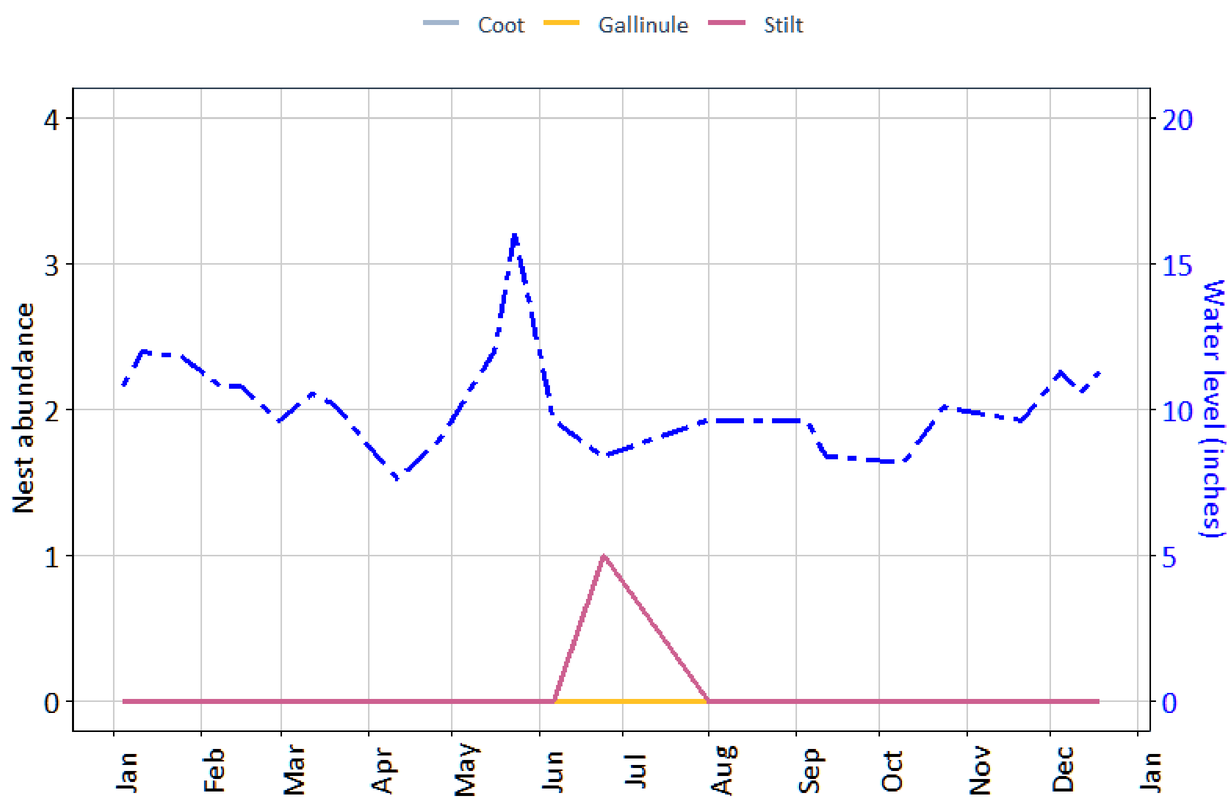

Figure 6. The number of nests observed during nest surveys or routine weekly waterbird surveys. Nest surveys were conducted weekly from May through June 2024.

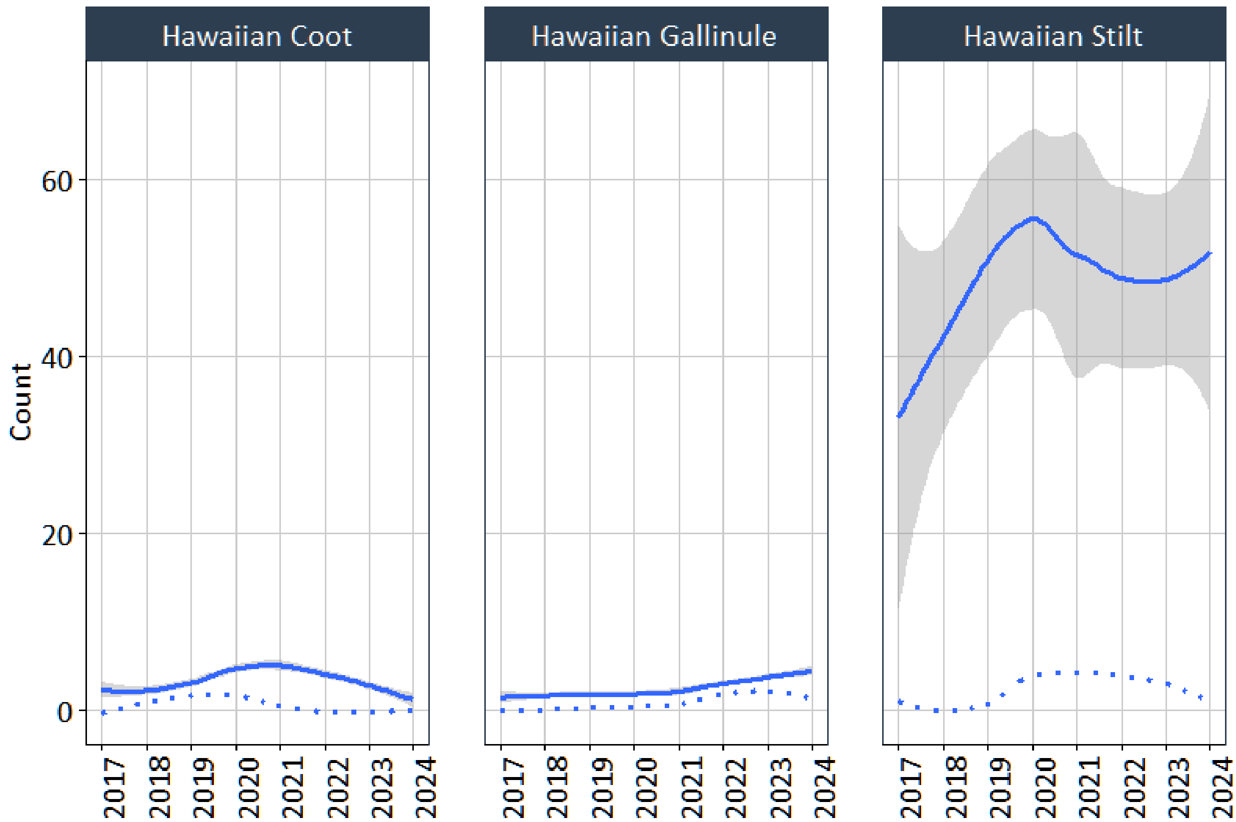

Figure 7. Average abundances for coots, gallinules, and stilts from 2017 through 2024 at Pouhala Marsh State Wildlife Sanctuary, Waipahu, O‘ahu, Hawai‘i. Gray-shaded areas are 95% confidence intervals. The dotted line represents fledgling counts for each year.

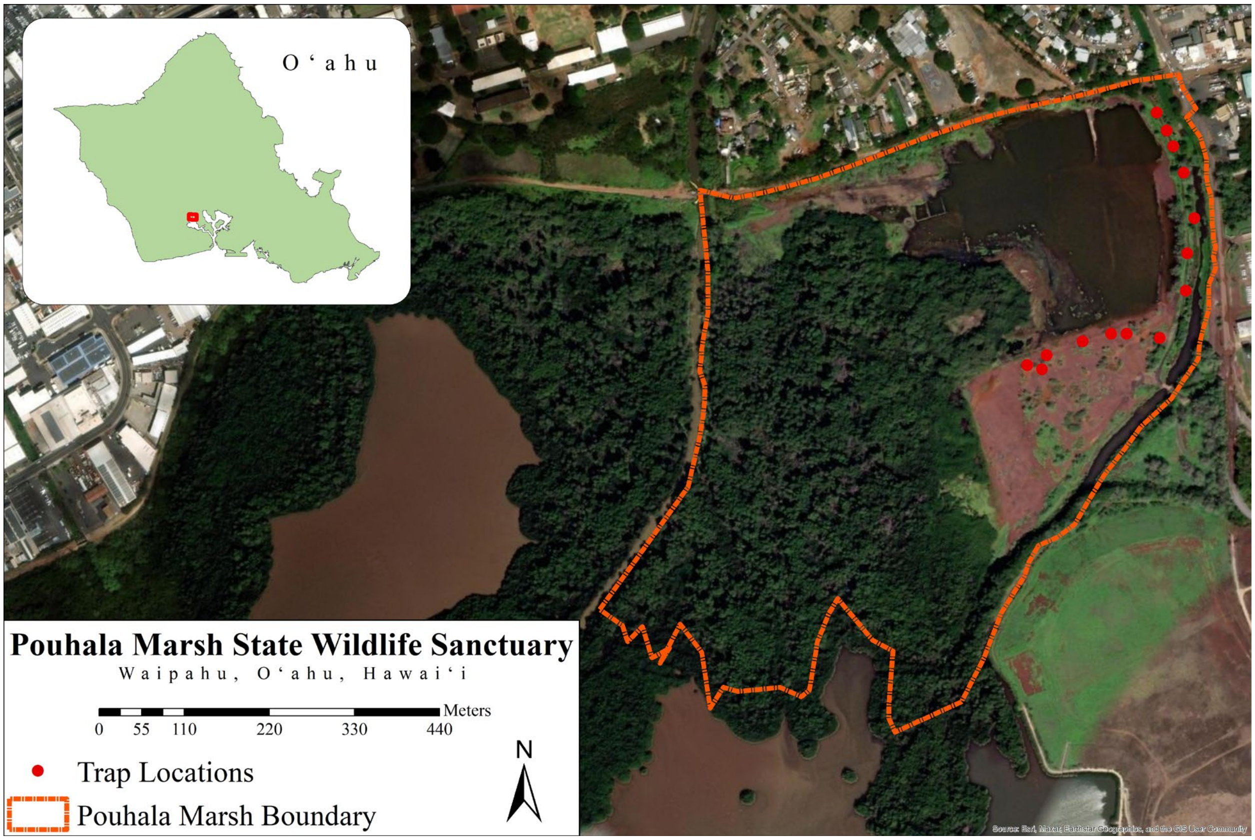

Figure 8. Historical predator trap distribution at Pouhala Marsh State Wildlife Sanctuary, Waipahu, Oahu, Hawaii, USA.

Table 1. Habitat manipulation operations and techniques used within the wetlands at Pouhala Marsh State Wildlife Sanctuary, Waipahu, Hawaiʻi, USA from 2019–2024.

Year	Habitat manipulation
2019	In early May, the Marsh Master MM-2XL equipped with the roller/chopper was used on the California grass (*Brachiaria mutica*) in Kapakahi Stream. In late September, the Marsh Master MM-2XL equipped with the disking attachment was used to control bulrush (*Schoenoplectus californicus*) and a cattail (*Typha latifolia*) patch in the Main Pond. In late October, the Marsh Master MM-2XL equipped with the cutting attachment was used to trim the bulrush and cattail patch. Subsequently, the disking attachment was used to control the remaining bulrush and cattail rhizomes.
2020	In mid-November, the Marsh Master MM-2XL equipped with the disking attachment was used to control pickleweed (*Batis maritima*) in the Main Pond and Waikele Pond. One pass was made in a north and south direction followed by a perpendicular pass (crosshatch pattern).
2021	In mid-December, the Marsh Master MM-2XL equipped with the disking attachment was used to control pickleweed (*Batis maritima*) in the Main Pond and Waikele Pond. One pass was made in a north and south direction.
2022	In early-November, the Marsh Master MM-2XL equipped with the disking attachment was used to control pickleweed (*Batis maritima*) in the Main Pond and Waikele Pond. One pass was made in a north and south direction followed by a perpendicular pass (crosshatch pattern).
2023	No habitat manipulations due to lack of Equipment Operator II time as this position had a temporary assignment for the Equipment Operator III position (Forestry Program).
2024	No habitat manipulations due to lack of machine availability.

Table 2. The number of observed chicks, broods, fledglings, percent fledging success, and fledglings per brood for Hawaiian Coot, Hawaiian Gallinule, and Hawaiian Stilt from 2019–2024 at Pouhala Marsh State Wildlife Sanctuary, Waipahu, Hawaiʻi, USA.

	Coot				Gallinule				Stilt			
Year	# chicks (broods)	# fledglings	fledging success	fledglings per brood	# chicks (broods)	# fledglings	fledging success	fledglings per brood	# chicks (broods)	# fledglings	fledging success	fledglings per brood
2017	0	0	0	0	0	0	0	0	1 (1)	1	100%	1
2018	0	0	0	0	0	0	0	0	0	0	0	0
2019	2 (1)	2	100%	2.0	0	0	0	0	4 (1)	0	0	0
2020	5 (2)	2	100%	1.5	2 (1)	1	50%	1	6 (2)	4	100%	
2021	0	0	0	0	3 (1)	0	0%	0	30 (13)	6	27%	0.5
2022	2 (1)	0	0	0	2 (1)	2	100%	2	46 (12)	1	2%	0.1
2023	5 (2)	0	0	0	3 (1)	3	100%	3	16 (7)	6	38%	0.9
2024	0	0	0	0	2 (1)	1	50%	1	1 (1)	0	0	0
Total	**14 (6)**	**4**	**29%**	**0.6**	**12 (5)**	**7**	**60%**	**1.4**	**104 (37)**	**18**	**17%**	**0.5**

Table 3. Summary of gallinule and stilt *nest parameters* (%HS = % hatching success) and *nest failures*. We collected data at Pouhala Marsh, Waipahu, Hawaiʻi, USA as determined by passive infrared cameras and manual nest surveys in 2024.

		Coot (*n*=0)	Gallinule (*n*=0)	Stilt (*n*=1)	Total (*n*=1)[a]
Camera		**0**	**0**	**0**	**0**
Nest parameters					
	Hatched (%HS)				
	Clutch size				
Nest failures					
Predator	Small Indian Mongoose (*Urva auropunctata*)				
	Unknown				
Other failure	Abandoned				
No camera		**0**	**0**	**1**	**1**
Nest parameters					
	Hatched (%HS)				
	Clutch size			4.0	
Nest failures					
Predator	Unknown				
Unknown				1	1

[a]Sum of independent hatching and nest failure events.

Table 4. Predators captured by month at Pouhala Marsh, Waipahu, Hawaiʻi, USA, 2024.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	**Total**
Mongoose	1	1	2	1	0	0	0	0	0	0	0	0	**5**
Cat	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Rat	0	0	0	0	0	0	0	0	0	0	0	0	**0**