



HABITAT & SOUNDS: Investigating the Effects of Habitat and Predator Sounds on Vigilance in the American Coot, *Fulica americana*

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Vigilance in American Coot

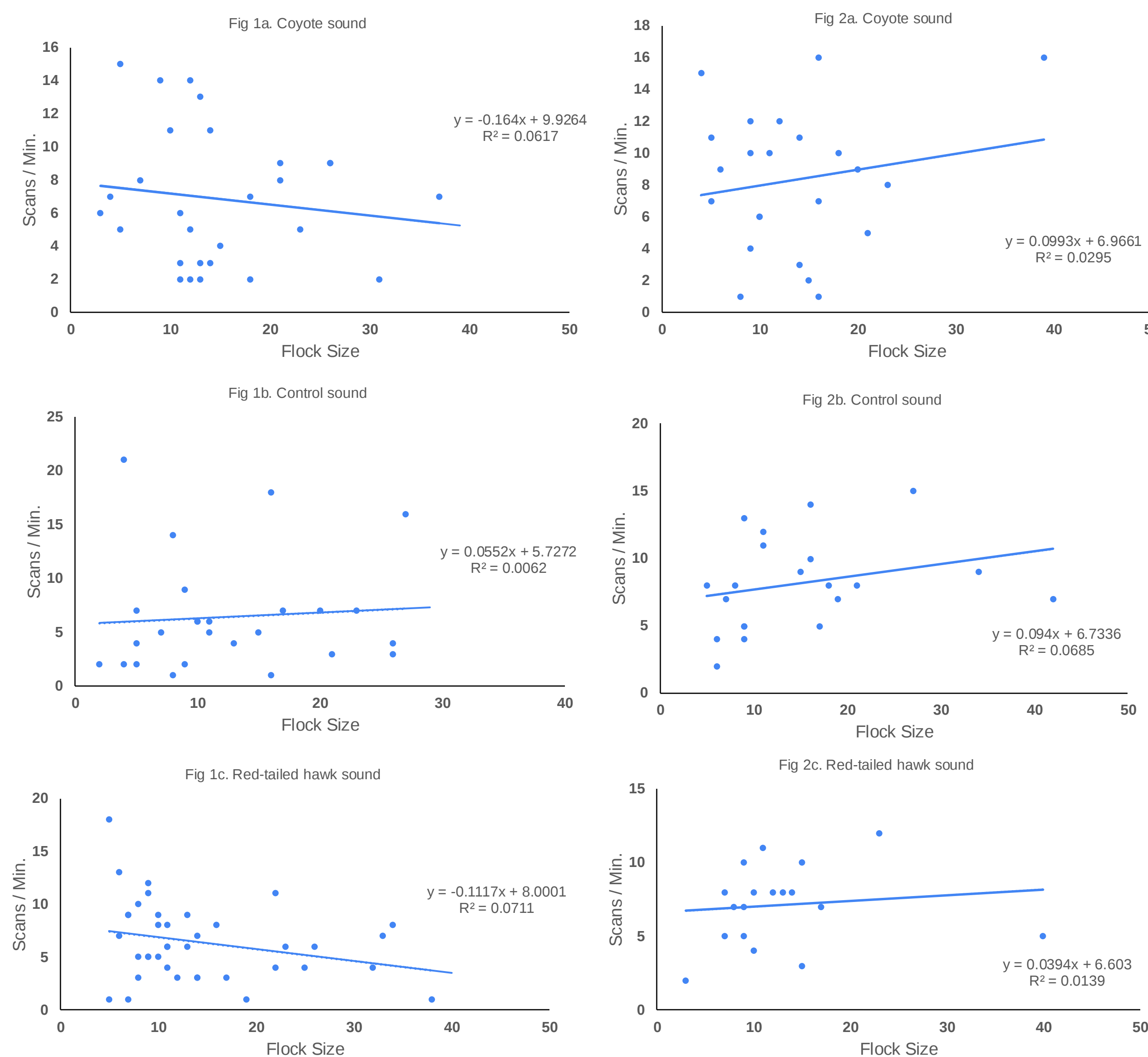
- Organisms often need to balance the need for growth with the need for survival. Animals facing predation risks have adapted a myriad of ways to survive¹. These “anti-predator mechanisms” allow animals to perform regular tasks like foraging while minimizing predation risk.
- Vigilance in foraging animals is a form of anti-predator response. Vigilance is defined as an animal’s surveying of its immediate surroundings. In birds, vigilance appears in the form of the animal raising its head to scan its vicinity².
- Generally, vigilance is negatively correlated to group size; that is, the observed rate of vigilance in a group of animals decreases as the size of the group increases. Prior research indicates a larger flock increases the collective scanning potential, heightening group vigilance and reducing individual vigilance in a group-size effect³.
- Studies have shown that habitat characteristics can also influence vigilance^{4,5}. American Coots either feed in water (by diving, dabbling, or surface feeding) or on land (by grazing or picking up food from the ground). These two environments might be perceived differently in terms of predation risk. Birds on land might be susceptible to both aerial and terrestrial predators, while birds in water are only exposed to aerial threats. In a previous study, feeding-bout lengths in aquatic habitat were longer than terrestrial feeding in Eurasian Coots possibly due to increased safety in water than land⁶. It is understood that animals can recognize sounds of predators, and then take appropriate vigilant action to minimize their risk of predation⁷. Even in the presence of physical cover or a large flock size, aural predatory messaging has the propensity to elicit a vigilant response.
- We examined vigilance in the American Coots (*Fulica americana*) in water and land in presence and absence of avian and terrestrial predator sounds while controlling for the effect of flock size. We hypothesized if predator sounds influence vigilance, these birds’ vigilance will increase with the presence of predator sound in both land and water.

What we did?

- The study was conducted from February to May 2022 at Apollo Regional Park, Lancaster, CA. The areas and times (7:30 AM - 12:30 PM) of observation were selected to minimize human influence.
- On land flocks ranged from 3 – 38 birds, and in water they ranged from 3 – 42 birds.
- Observations were made from 3-5 meters away. Vigilance was defined as an individual raising its head (scanning), and non-vigilance was any other behavior in which the coot’s head was not parallel with the ground. A random number generator was used to select a sound order to play per observation. Audio recordings of the Red-tailed Hawk (*Buteo jamaicensis*) and Coyote (*Canis latrans*). To control for confounding variables from the speaker, a silence file was also played in between trials for a period of 10 minutes.
- Individual coots were observed on land or in water, using the focal sampling method⁸. Each observation was recorded for 1 minute. Scans per minute and total scan time of the individual within the flock were recorded on a smartphone while the sound was played for 1 minute. Videos were uploaded and analyzed using JWatcher.
- MANCOVA (using Wilks’ lambda), with flock-size as the covariate, was used to evaluate the influence of habitat (land vs water) and predator sound on vigilance.



What did we find?!



Figures 1 & 2. The relationship for flock size and vigilance for birds on land (Figure 1) and water (Figure 2)

Table 1. Mean vigilance (scans / minute) and scan time (Seconds) for birds exposed to different predator sounds in two different habitats

	Sounds	Scans / min. (Mean ± S.E.)	Scan time (sec.) (Mean ± S.E.)
Land	Coyote	6.86 ± 0.76	26.79 ± 3.27
	Control	6.42 ± 1.03	31.96 ± 3.64
	Red-Tailed Hawk	6.38 ± 0.59	29.72 ± 2.80
Water	Coyote	8.30 ± 0.93	31.01 ± 3.49
	Control	8.14 ± 0.75	39.61 ± 2.90
	Red-Tailed Hawk	7.11 ± 0.67	25.63 ± 3.31

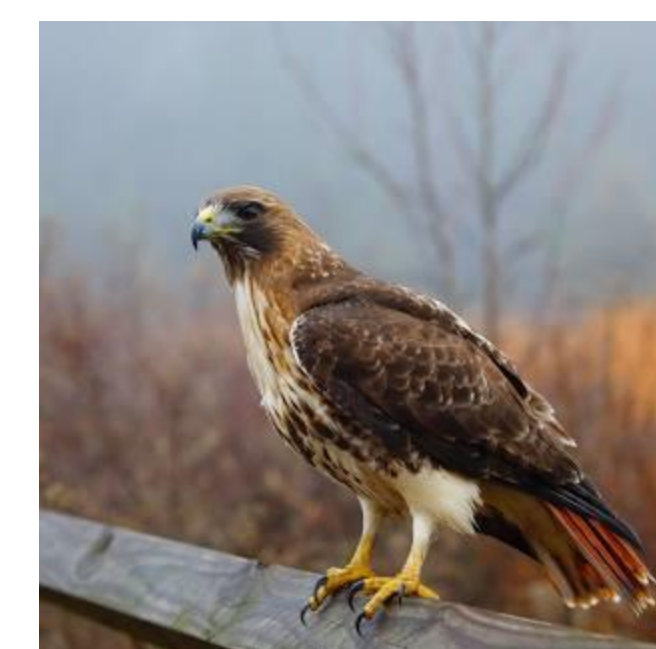
- The mean flock sizes were similar between land (13.96 ± 0.85) and water (13.82 ± 1.07).
- Overall, there was a weak correlation between flock size and vigilance (Figures 1 & 2). Although the birds in water, with predator sounds, tended to show a positive correlation between flock size and vigilance (Figures 2a,c), while birds on land showed a negative relationship (1a,c).
- The number of scans per minute were significantly different in the two habitats, $F(2, 148) = 3.28$, $p = 0.04$, $\eta^2 = 0.042$, with birds scanning more often in water (7.90 ± 0.46 scans) than land (6.54 ± 0.44 scans).
- Each individual bird on average spent more time scanning in water (32.56 ± 1.99 seconds) than land (29.46 ± 1.83 seconds).
- Scan time was also significantly different between the sound treatments (when controlling for flock size), $F(1, 148) = 5.14$, $p = 0.025$, $\eta^2 = 0.034$ (Table 1). Overall, mean scan time for control (35.8 ± 2.44 seconds) was higher than predator calls (Coyote: 28.9 ± 2.34 seconds & Red-Tailed Hawk; 27.7 ± 2.37 seconds).

Take-home message...

- The coots spent more time scanning on water compared to land, and this is consistent with previous study⁸. It is possible that food availability differs in the two habitats causing variation in the nutritional value of forage. The ecological trade-off⁹ hypothesis suggests that the food availability in the water might be greater than on land which causes the birds to have more time to scan without sacrificing food lost to conspecifics. However, more data would need to be collected regarding food availability in this location to support this.
- A weak correlation was found between flock size and vigilance. In this study, the flocks observed on land followed the group-size effect where vigilance decreased as the flock size increased. When an individual is a part of a larger group there is higher collective scanning which increases group vigilance and reduces individual vigilance⁶. In turn, individuals can spend more time on activities such as feeding or preening. The coots’ behavior observed in the water did not support the flock-size effect by exhibiting a positive correlation between flock size and vigilance. This may be due to a general increase in vigilance on water due to habitat effects.
- The scan time was also different between sound treatments, with the mean scan time for control being higher than predator calls. We attribute this to the birds being in a man-made lake with frequent visitors, causing habituation. Human coexistence with wildlife in urban settings require active management in order to counter habituation as it causes species to become vulnerable, which can only be fixed with reduced visitation¹⁰.
- Human interactions can cause changes in birds’ defense mechanisms, such as vigilance, which directs energy away from foraging in favor of these mechanisms¹¹. As such, human interactions tend to negatively affect reproduction and feeding behaviors of birds, though the degree of impact varies among species¹². In certain cases, individuals exposed to prolonged, non-threatening interaction with humans have shown to decrease their vigilance (e.g., acclimation), but still retain a level of ‘fear’ toward people¹². The combination of low predation risk with frequent positive human interaction might have induced habituation.
- Besides habitation, the reduction or absence of predators could also minimize the effect of vigilance. This might be another plausible explanation for the weakness of vigilance in the American Coots studied here. Apollo Regional Park is a low-risk habitat for wildlife with little activity of predators.

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