

Adult and Juvenile Osprey (*Pandion haliaetus*) Foraging Behavior on San Juan Island, WA

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Abstract

The osprey (*Pandion haliaetus*) is a widespread piscivorous raptor with unique adaptations for plunge-diving to capture live fish. In the Pacific Northwest, breeding occurs in late spring throughout summer, during which juveniles learn how to hunt before leaving the nest and becoming independent. This study examined the foraging behavior of adult and juvenile ospreys at False Bay, San Juan Island, WA, with attention to how tidal conditions influenced foraging activity. We conducted 10 hours of observations over four days in August 2025 on a nesting pair with their two fledged offspring. Behavioral data were collected continuously and analyzed with respect to foraging trip timing, dive attempts, strike success, and tidal conditions. In total, 14 foraging trips were recorded, with adults making 11 trips and juveniles making 3. Adults were consistently more efficient, capturing prey in nearly three-quarters of trips, while juveniles did not capture any fish despite diving more frequently per trip. Adults made fewer but more precise dives, whereas juveniles often aborted dives or failed to recover altitude between attempts. Foraging occurred most often at mid-tide heights, around 2 to 3 ft, consistent with osprey diving limits. Ospreys also foraged at high tide heights during ebb tides compared to flood tides, suggesting that fish movement with tidal currents shapes prey availability. These findings highlight the learning curve juveniles face before achieving independence and emphasize the role of tidal dynamics in shaping foraging opportunities. Continued study of juvenile development and prey-tide relationships will clarify how dynamic ecosystems influence osprey foraging behavior.

Keywords: Osprey, *Pandion haliaetus*, foraging behavior, adults and juveniles, False Bay, San Juan Island

Introduction

The Osprey (*Pandion haliaetus*) is a large piscivorous raptor found nearly worldwide, occurring on every continent except Antarctica. In North America, breeding populations are widespread, inhabiting coastal shorelines, estuaries, large lakes, and river systems during the spring and summer months before migrating to Central and South America for the winter. Osprey populations are on the rise globally, receiving an IUCN rating of “least concern” (BirdLife International, 2021).

Ospreys are morphologically and behaviorally adapted to capture live fish, which make up more than 99% of their diet (Poole et al. 2020). Moreover, ospreys are the only raptors known to regularly plunge-dive into water to seize prey with their talons. They enter feet-first and typically access only the upper 1 m of the water column (Bierregaard, 2020).

Ospreys nest on natural and artificial platforms, cliffs, and trees. A female osprey lays 1 to 4 eggs per breeding season. Young learn to fly before they learn to hunt (Bierregaard, 2020). At around 50 to 55 days post-hatch, ospreys take their first flight. From this point, juvenile ospreys learn how to hunt from their parents before gaining independence and leaving the nest. Osprey breeding season in Washington generally occurs between March and mid-July. This suggests that at the time of the study, the osprey at False Bay were at the age where they are learning how to hunt before becoming independent.

Our overall research interest was the foraging behavior of osprey at False Bay, San Juan Island, WA. We set out to address three specific questions. Firstly, what is the foraging success for ospreys in a marine environment? Secondly, what is the difference in foraging success between adults and juveniles? And thirdly, how is osprey foraging success affected by tides?

Methods

Study site

False Bay is a large biological reserve on the southwest side of San Juan Island, owned and managed by the University of Washington. The bay covers more than a square kilometer of intertidal

habitat, which at low tide heights becomes exposed mudflats, sand bars, and tide channels. At higher tide heights, the bay becomes almost entirely submerged, creating vast expanses of shallow water, ideal for osprey to forage. The regular pattern of exposure and flooding creates a multitude of diverse foraging habitats for a variety of ecologically important species. We spent a cumulative 10 hours at False Bay over four days, from August 11th to 16th, 2025, observing an osprey nest with two adults and two juveniles, totaling four individuals.

Behavioral sampling

We collected continuous observations of any individuals present based on focal sightings using binoculars and a spotting scope. Our observation site was approximately 450 meters away from the nest (Fig. 1). We defined a ‘nest area’ as a small radius containing the immediate vicinity of the nest (Fig. 2). Two people maintained constant monitoring of the osprey, while a designated recorder documented foraging activity.

We defined a ‘foraging trip’ as every time an osprey left the nest area and exhibited foraging behavior such as hovering or circling over the bay, diving aerially towards the water, or plunging into or making contact with the water. During every foraging trip, we recorded when it was initiated when the osprey left the designated nest area, whether the individual was an adult or a juvenile, the time of any dives and if the dive resulted in a ‘strike’ (plunge into the water) or as an aborted dive where no contact with the water was made, whether or not the strike was successful and if any accompanying characteristics about their prey if possible, and finally the time they returned to the nesting area to determine the length of the foraging trip.

In addition to foraging behavior, in the field, the recorder noted abiotic conditions such as wind speed and cloud cover. From the recorded time data, we were retroactively able to determine tide height and current direction. Other notable behaviors that occurred when an osprey left the nest were recorded, such as interactions with other raptors, but are not included in our analysis. After transcribing our field

notes, we translated our observations into raw data tables and performed various statistical analyses in both R and Excel.

Results

We observed 14 foraging trips total, 3 of which were made by juveniles, and 11 by adults. The ospreys made an average of 2.3 foraging trips per hour. Of those foraging trips, 57% were successful.

Foraging behavior was different between adults and juveniles (Fig. 3, 4). 0% of juvenile foraging trips and 73% of adult foraging trips resulted in success. Adults brought back 1.33 fish per hour, and juveniles brought back none. Adults were better across all categories, particularly in their efficiency. They were less likely than the juveniles to abort dives during a foraging trip (juveniles = mean 2.3 aborted dives per foraging trip, adults = mean 0.4 aborted dives), which conserves energy. The adults also had a higher rate of strikes per dive (adults = 0.77 strikes per dive, juveniles = 0.22 strikes per dive). When surveying juvenile foraging trips, we often observed them failing to regain altitude in between dives, even getting mired in the water at one point, and generally displaying much less coordinated behavior than what we observed from the adults during foraging.

Osprey foraging patterns were strongly correlated with tide height (Fig. 5). The tides we sampled ranged from 0.21 to 4.76 feet, with a mean of 2.69 feet, but ospreys preferred to forage at medium tide heights, with over half the foraging trips we observed occurring between 2.5 and 3.5 feet of tide height. The mean tide height at which they foraged was 2.72 feet. The lowest tide height we observed on a foraging trip was 0.65 feet, and the highest was 4.64 feet.

During this study, osprey foraging behavior appeared to vary depending on tidal current direction (Fig. 6). They showed a pattern of making foraging trips at different tide heights during ebb and flood tidal current directions; however, they did not show a preference for foraging between the different tidal current directions, nor a difference in foraging success. We found that ospreys forage at significantly higher tide heights during ebb tides and significantly lower heights during flood tides ($p = 0.01827$).

Discussion

Our findings on general osprey foraging behavior are consistent with other previous studies on osprey hunting and foraging. In a study done at False Bay several years ago (Hollister, 2019), they found that the ospreys had a strike success rate of 57%, very similar to our calculation of a 62% strike success rate. Comparing our results with Castellanos-Vera, A., & Rivera, E. (2007), Szaro (1978), and Hollister (2019), we all found that the mean # of dives it takes to obtain prey was around 2. Hollister (2019) calculated 1.85 fish per hour, and we calculated 1.33 fish per hour.

It was not unexpected that we found discrepancies between the success of adult and juvenile ospreys, as well as observed differences in foraging behaviors. Juvenile ospreys stay in the nest for several weeks even after they are fledged, while they are learning to hunt for themselves, and this usually occurs in mid to late summer (Bent, 1961). The two young ospreys we were watching were both good fliers, and their plumage was that of an older juvenile. We also saw the parent ospreys bring fish back to the nest several times. This suggests these juveniles were in a stage of development in which they have fledged and become quite adept at flying, but are just beginning to learn to forage on their own.

Our finding that ospreys prefer to forage during medium tides (about 2.5-3.5 feet) can be explained by their diving mechanics and diet. Ospreys can only dive up to about 3 feet deep, so shallow waters are often ideal foraging grounds for them (Bierregaard, 2020). They prefer to feed on benthic fish, so their prey is typically close to the bottom. Foraging when the tide height is ~3 feet ensures that they can access their benthic prey at a depth that does not require much effort to reach.

The differences in foraging tide height during different tidal current directions are likely caused by prey entering and leaving the bay during different tide directions. During ebb tides as the tide goes out, the water carries fish from shallow areas out to deeper waters, flushing out prey. The opposite is true for flood tides, as the incoming water brings fish into the shallower areas of the bay. It makes sense for the ospreys to forage for fish at higher tide heights as the prey is leaving, and lower tide heights when there is an influx of prey. It should also be noted that due to the short time span of the study, ebb tide always fell

in the morning and flood tide in the afternoon; therefore, it was not possible to decouple time of day from the tidal current direction relationship.

For future research, we suggest a longer study that can isolate time of day from tidal current direction and other abiotic factors. We would also be interested in investigating the energetics of osprey foraging behavior, for example, what an aborted dive costs, and how much they need to forage per day, depending on different behaviors. This data could explain foraging preferences in different weather and tidal conditions.

Ospreys come to the San Juan Islands for breeding from spring to fall, but are often chased away and intimidated by bald eagles due to resource competition. There is very little research on ospreys in this area, likely because of their rarity, but their numbers have been increasing for the last several years. However, bald eagles have also been growing in population size. Continuing to study ospreys in the San Juan Islands can give us valuable insight into their interactions with the environment and other species, such as bald eagles, that may be a threat to them. Learning more about osprey nesting and foraging behavior in particular can help protect the habitat they need and identify vulnerabilities, which is essential for their conservation in this region.

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Tables and Figures

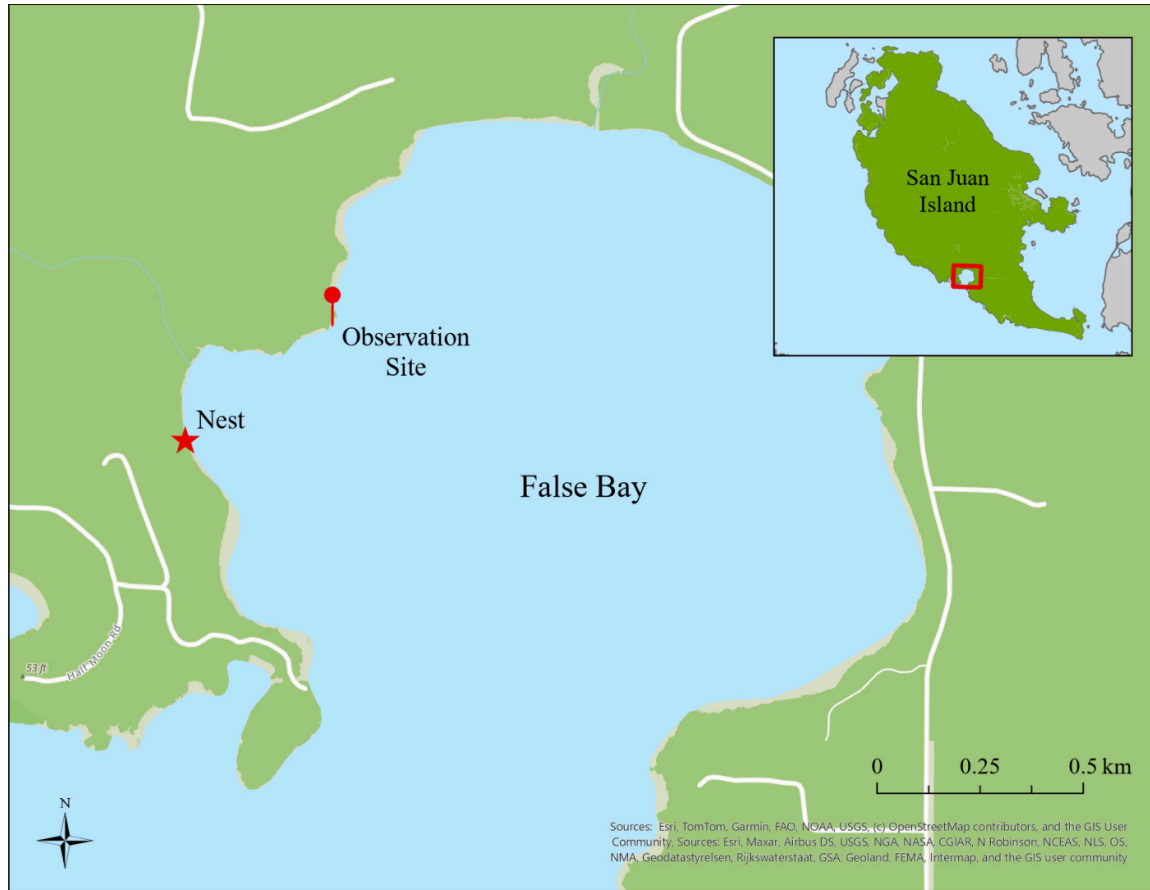


Figure 1: Observation site and nest location relative to False Bay in the context of San Juan Island



Figure 2: Representation of the designated nest area immediately surrounding the nest from the perspective of our observation site

	# of foraging trips	# of dives	# of strikes	# of successes
Juveniles	3	9	2	0
Adults	11	17	13	8
Total	14	26	15	8

Figure 3: Differences in foraging behavior between adults and juveniles

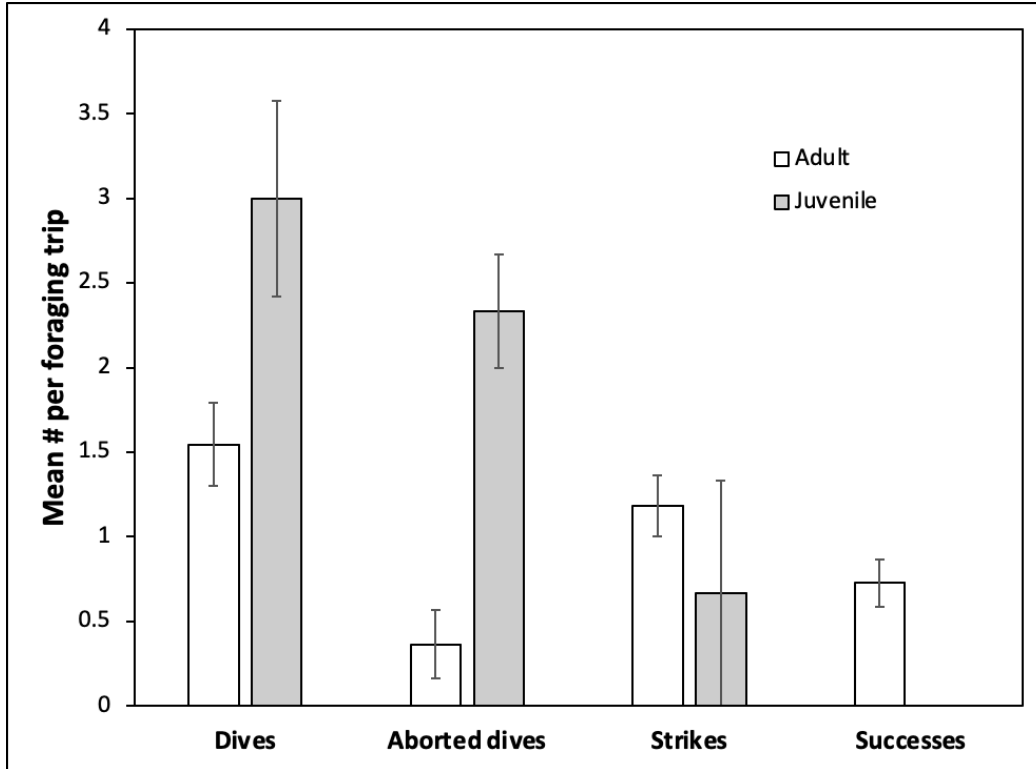


Figure 4: Mean number of behaviors observed during foraging trips made by adults and juveniles

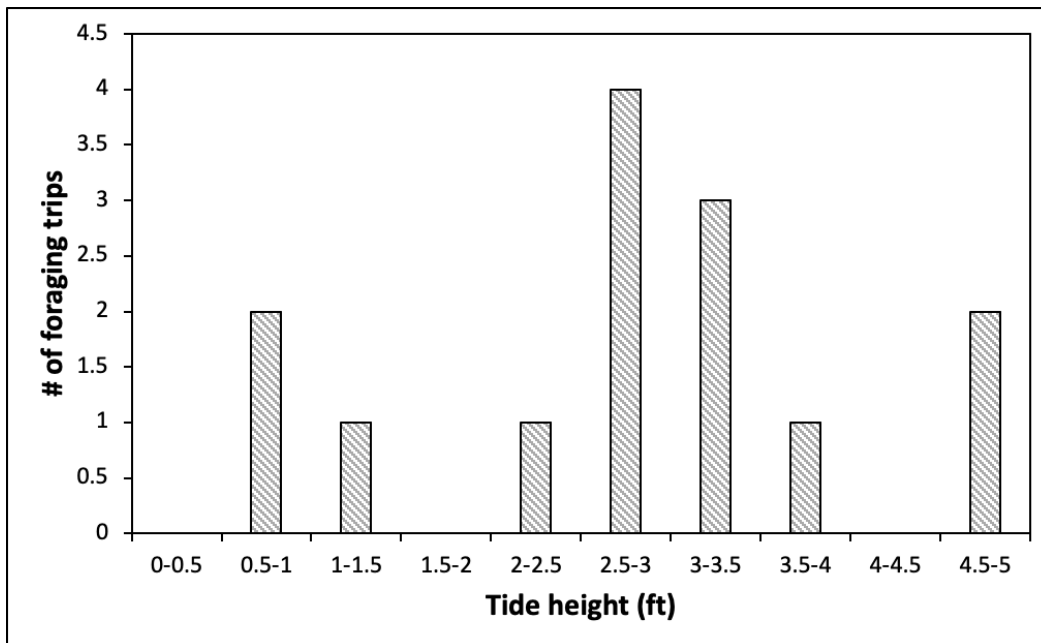


Figure 5: Tide heights at which foraging trips were initiated by both adults and juveniles

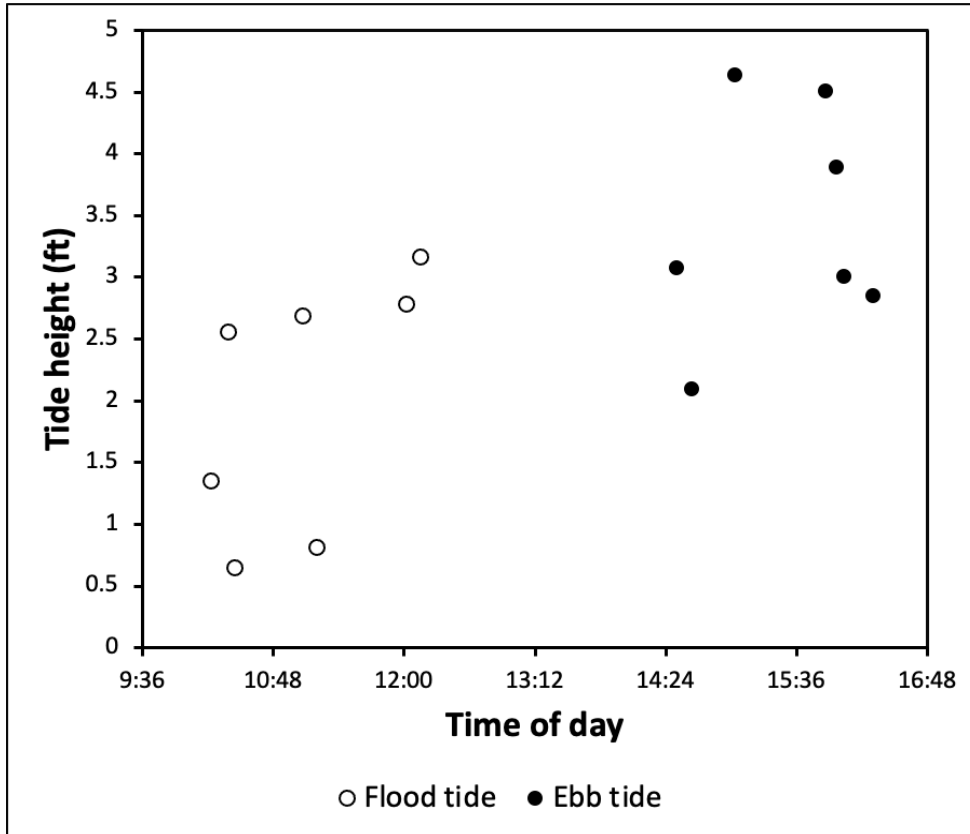


Figure 6: Ebb tide foraging trips (n=7) and flood tide foraging trips (n=7) relative to tide height and time of day