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PREDICTORS OF OSPREY NEST SUCCESS IN A HIGHLY URBANIZED ENVIRONMENT

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Abstract.—Ospreys (*Pandion haliaetus*) are adaptable fish-eating raptors that readily nest on artificial structures in heavily human-dominated areas. Although the Osprey is a well-studied species, few researchers have investigated the factors that influence nest success and productivity in an urban environment. We monitored Osprey nests from 2013 to 2017 in highly urbanized Pinellas County, located on the west coast of central Florida, USA. We used logistic exposure models to assess the effects of timing of nesting, nest attributes (nest substrate, height), and landscape-level variables (inter-nest distance, distance to water, and surrounding habitat type) on daily survival rate (DSR) of Osprey nests. The number of active nests (i.e., nests with eggs) in the study area ranged from 53 in 2013 to 79 in 2016, with an overall total of 329 during the 5-yr study. Although most nests produced at least one young near fledging age, 131 of the nests failed. We attributed 45% of nest failures to storm events and 50% to unknown causes. The best logistic exposure model specification included only two variables: the discrete variable representing the date incubation started and the nominal variable indicating the year 2015. Osprey nests initiated earlier in the season were more likely to survive, and later nests (initiated after 22 April) averaged only one fledgling each. Osprey nests in 2015 had the highest DSR and relatively few failed due to storms. Our results supported previous research indicating that early nesters were more successful than late nesters. Our results also indicate that storms may play a role in nest success of Ospreys in Florida. Other variables, such as the amount of urbanized land surrounding Osprey nests did not appear to influence nest survival, indicating that Ospreys can be productive even in highly urban environments.

Key Words: *Osprey*; Pandion haliaetus; *breeding*; *daily survival rate*; *Florida*; *nesting*; *reproductive rate*; *spatial scales*; *urban.*

PREDICTORES DEL ÉXITO DE ANIDACIÓN DE *PANDION HALIAETUS* EN UN AMBIENTE ALTAMENTE URBANIZADO

Resumen.—*Pandion haliaetus* es un ave rapaz que se alimenta de peces y que fácilmente anida en estructuras artificiales en áreas fuertemente dominadas por humanos. Aunque es una especie bien estudiada, pocas investigaciones han analizado los factores que influyen en el éxito y la productividad de los nidos en un ambiente urbano. Seguimos los nidos de *P. haliaetus* de 2013 a 2017 en el condado altamente urbanizado de Pinellas, ubicado en la costa oeste del centro de Florida, EEUU. Usamos modelos de exposición logística para evaluar los efectos del tiempo de anidación, de los atributos del nido (sustrato del nido, altura) y de variables a nivel del paisaje (distancia entre nidos, distancia al agua y tipo de hábitat circundante) en la tasa de supervivencia diaria (TSD) de los nidos de *P. haliaetus*. El número de nidos activos (i.e., nidos con huevos) en el área de estudio varió de 53 en 2013 a 79 en 2016, con un total general de 329 durante el estudio de cinco años. Aunque la mayoría de los nidos produjo al menos una cría cercana a la edad de emplumar, 131 de los nidos fallaron. Atribuimos el 45% de estos fracasos a tormentas y el 50% a causas desconocidas. La mejor especificación del modelo de exposición logística incluyó solo dos variables: la variable discreta que representa la fecha de inicio de la incubación y la variable nominal que indica el año 2015. Los nidos de *P. haliaetus* iniciados antes en la temporada tuvieron más probabilidades de sobrevivir, y los nidos posteriores (iniciados después del 22 de abril) promediaron solo un volantón cada uno. Los nidos de *P. haliaetus* en 2015 tuvieron la TSD más alta y relativamente pocos nidos fallaron debido a las tormentas. Nuestros resultados apoyan investigaciones previas que indican que los primeros nidos tuvieron más éxito que los tardíos. Nuestros resultados también indican que las tormentas pueden influir en el éxito de los nidos de *P. haliaetus* en Florida. Otras variables, como la cantidad de tierra urbanizada que rodea los nidos de *P. haliaetus*, no

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parecen influir en la supervivencia de los nidos, lo que indica que *P. haliaetus* puede ser una especie muy productiva incluso en entornos altamente urbanizados.

[Traducción del equipo editorial]

INTRODUCTION

Ospreys (*Pandion haliaetus*) are adaptable fish-eating raptors whose numbers in human-dominated landscapes have increased, in part due to their ability to nest on artificial structures (Ewins 1997, Watts and Paxton 2007, Forys et al. 2016, Canal et al. 2018, Poole 2019, Petersen et al. 2020). Although Ospreys are well studied, only a few investigations have evaluated the factors that influence nest success and productivity in an urban environment (Rattner et al. 2004, Toschik et al. 2005, Petersen et al. 2020). Osprey productivity in more natural environments can be affected by human disturbance (Van Daele and Van Daele 1982), but most studies have found that Ospreys can quickly adapt to human presence (Spitzer and Poole 1980, Ewins 1997). Ospreys, like other species of raptors living in urbanized environments, are also at risk from threats such as collisions and disease (Washburn 2014). Because Ospreys are obligate piscivores, reproductive success in urbanized areas also requires access to adequate fish prey resources (Bowman et al. 1989).

Multiple nest site characteristics can potentially influence Osprey nesting success and productivity including nest substrate, nest height, proximity of breeding conspecifics, and land cover near the nest. Nest substrate and nest height may be important in urban environments. Artificial structures are increasing in abundance in urbanized areas, are generally more stable than trees, and are more difficult for mammalian predators to climb (Poole 1989). A study of nest sites that focused exclusively on trees in north-central Florida found that tree height did not significantly influence choice of nesting tree. However, the trees were relatively similar in height (21.4 m $\pm$ 0.4 [SD] m) and were approximately half the height of many artificial nest substrates such as cell phone towers or major utility poles that are typically 40 m tall (Edwards and Collopy 1988).

In some locations, Osprey breeding success is influenced by the presence of nearby conspecifics. Ospreys select nest sites that are close to other Osprey nests (Cape Verde Islands; Siverio et al. 2013) and produce more young when nesting in a colony (Nova Scotia, Canada; Flemming et al. 1991). This could be due to increased foraging efficiency resulting from information gained from other Ospreys (Greene 1987), enhanced opportunities for group foraging by Ospreys (Flemming et al. 1991), or decreased predation risk (Hagan and Walters 1990).

The habitat surrounding Osprey nests can also influence productivity and nest site selection, possibly through effects on fish availability or predator abundance (Lohmus 2001, Bai et al. 2009). Proximity of the nest to water for foraging affects nest site selection (Bai et al. 2009) and productivity (Lohmus 2001). In addition, the salinity of the water can impact nest productivity; in the Chesapeake Bay (USA), fish found in lower salinities were longer than fish found in higher salinity habitats, which may have contributed to variation in nestling growth rates (Glass and Watts 2009). In Germany, Ospreys were more likely to nest in areas with more forests and fewer human settlements, but nest success was significantly higher at nests surrounded by more agricultural land and fewer forests; the amount of human settlements around Osprey nests had no impact on nest success (Bai et al. 2009).

Raptor productivity can also be influenced by a variety of other factors including food availability, weather conditions, and the age and experience of the breeders (Newton 1979, 1998) For example, Osprey pairs that nest earlier appear to have larger clutches and fledge more young, perhaps because earlier breeders are more likely to be experienced pairs (Steeger and Ydenberg 1993, Bierregaard et al. 2020).

Our study determined nest success of Ospreys during five breeding seasons (2013–2017) in highly urbanized Pinellas County, located on the west coast of central Florida, USA. Osprey nesting in central Florida begins in late December and early January, but the timing is complicated by the presence of both nonmigratory residents and breeding birds that migrate south during the winter (E. Forys unpubl. data). Ospreys that breed north of central Florida are likely long-distance migrants (Poole 1989), but populations in southern Florida are nonmigratory (Bierregaard et al. 2020). A previous in-depth analysis of nest success by nest substrate in Pinellas during the 2014 breeding season found that Ospreys primarily nested on a wide variety of artificial structures and were more successful at producing young when nesting on artificial substrates than when nesting on trees (Forys et al. 2016). The objective of this study was to determine whether timing of nesting, nest attributes (nest substrate, height), and landscape-level variables (inter-nest distance, distance to water, and surrounding habitat type) influence nest success.

Methods

Study Area. This study was conducted in the southern half of Pinellas County, Florida (27.7676° N, 82.6403° W). Pinellas County is a peninsula in west-central Florida, bordered by the Gulf of Mexico and Tampa Bay. There are several larger freshwater lakes suitable for foraging, most notably Lake Maggiore (146 ha) in southern Pinellas County. Pinellas is the most densely populated county in Florida, with approximately 94.7% of the county classified as urban or suburban, 0.3% as rural, and 5% set aside for parks and preserves (Rayer and Wang 2014). Since 2009, we have monitored nesting Ospreys in southern Pinellas County (Fig. 1). Nests were located by gathering knowledge from the local birding community and methodically walking/driving the study area.

Reproductive Data. We visited nests weekly from September 2011 to August 2018. During each visit we recorded nest condition, presence of adults, presence of an adult in incubation posture, and number of young. If an adult Osprey was seen in incubation posture during more than two visits, it was assumed to be incubating eggs and we considered the nest active (Forys et al. 2016, Steenhof et al. 2017).

If a previously active nest was found empty during the weekly monitoring visit, we looked for signs of storm damage (part of the nest, eggs, or dead or live nestlings on the ground) or evidence of predation. To determine the daily survival rate (DSR), we used the date of the midpoint of the observation interval for both the start and end of incubation. The incubation period for Ospreys ranges from 34–42 d and young fledge at 50–55 d old (Bierregaard et al. 2020). We counted the number of nearly fledged young (>42 d old) observed in the nest prior to fledging (Steenhof and Newton 2007). A successful nest was one where at least one nestling survived until near fledging age. We defined mean productivity as the total number of nearly fledged young divided by the total number of active nests, and nesting success as the percentage of active nests that were successful. We categorized nesting substrate as natural (i.e., tree), artificial and not intended for Ospreys (i.e., light pole, cell phone tower), or an Osprey platform. We calculated nest height using a clinometer, measured from the base of the nest to the ground.

Spatial Data. We used ArcGIS 10.1 (Redlands, CA, USA) and the Florida Cooperative Land Cover, Version 3.3 10-m resolution raster (Florida Fish and Wildlife Conservation Commission 2018) for all spatial analysis. Saltwater distance was measured as the distance from nest to the nearest open saltwater or large saltwater bay. Freshwater distance was measured as the distance from nest to the nearest freshwater lake or pond >1 ha (Bai et al. 2009). We also calculated the distance to the nearest water of any type (fresh or salt). To calculate inter-nest distance, we measured the shortest distance between an active nest and the nearest other active nest in that year.

Determining the spatial scale at which landscape-level habitat variables affect nest success is an important consideration (Jackson and Fahrig 2015). At each nest, we quantified the land cover types in a circular plot with a radius of 200 m, 1 km, and 2 km around each nest. Similar Osprey research done in a less developed area in Germany (Bai et al. 2009) used plots with larger radii (2, 4, and 7 km) based on the home range and movements of local Ospreys. Because Ospreys in Pinellas County nest on a peninsula that has a maximum width of 24 km, the 7 km radii was too large. For our study we chose additional smaller plots that were similar to those for Ospreys in urban environments (Hogg and Nilon 2015, Petersen et al. 2020). We grouped land cover types into four classes: (1) forest, (2) low-lying vegetation such as grass and shrubs, (3) parks and athletic fields, and (4) urban cover (suburban, industrial, and other urban areas).

Statistical Analysis. We used logistic exposure models to evaluate factors influencing daily survival rate (DSR) for Osprey nests (Shaffer 2004, Brown et al. 2013). The logistic exposure model estimates nest survival as a series of binomial trials over monitoring intervals, measured in days. The model calculates nest survival from the time incubation begins until there is a nearly fledged young in the nest, or the nest has no viable young. This approach uses a modified logit link function that controls for monitoring intervals (Shaffer 2004).

We used the R programming environment (R Core Team 2020) and the *glm* function with a binomial response distribution and the modified logit link function with cluster-robust standard

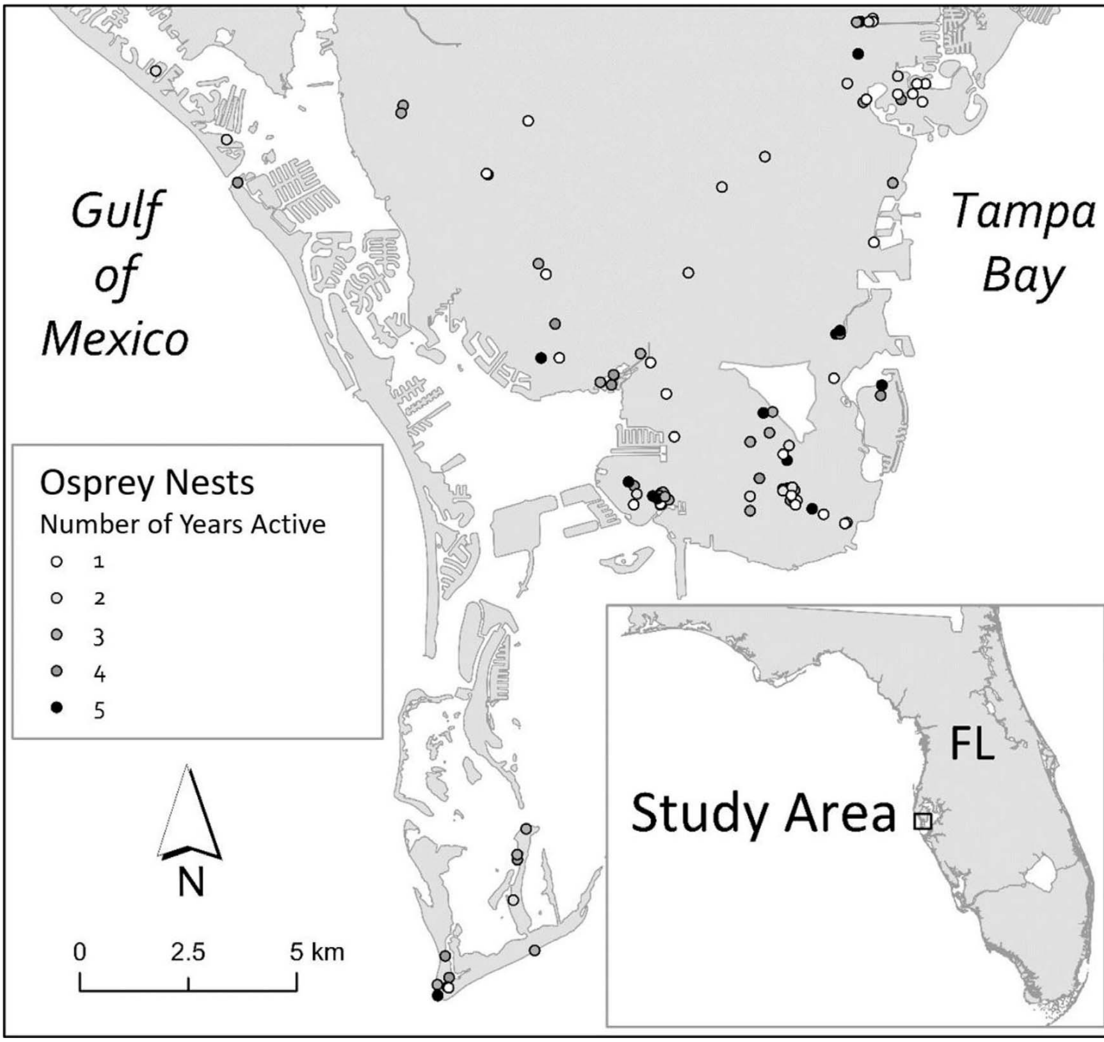

Figure 1. Locations of Osprey nests ($n = 127$) in southern Pinellas County, Florida, from 2013 to 2017. Nests shown were active (i.e., eggs laid) one to five times each during the 5-yr study.

errors, clustered by nest identification (ID). We originally tested for unobserved nest-related effects that may have influenced nest success by including nest ID as a random effect within our most complex model (Zuur et al. 2009). The standard error for this random effect was close to zero, indicating little explanatory power in the model. As such, we opted to include only fixed effects in our model specification, and we controlled for repeated measures using the cluster-robust standard errors.

We included nominal indicator variables to control for the calendar year (2013–2017) and nest substrate (natural, artificial, platform). The date incubation began was included as a discrete quantitative variable. Continuous quantitative variables included the distance to saltwater, distance to freshwater, height of the nest, and inter-nest distance. We estimated correlations between continuous variables to rule out collinearity within the regression models. All absolute correlations fell well below 0.7 (Dornmann et al. 2013). Within a specific circular plot determined by the radii around each nest (200 m, 1 km, 2 km), each specification also includes variables measuring the percentage of the

Table 1. Number of active Ospreys nests, successful nests (nests that produced >1 nearly fledged young), and average number of nearly fledged young per active nest in southern Pinellas County, Florida, from 2013–2017.

Year	Number of Active Nests	Number of Successful Nests	Avg. Number of Nearly Fledged Young/Active Nest (SD)
2013	53	32	0.81 (0.76)
2014	64	40	1.00 (0.93)
2015	57	44	1.19 (0.90)
2016	79	40	0.92 (1.01)
2017	76	42	0.96 (0.99)

Table 2. Causes of nest failure of 131 Osprey nests in southern Pinellas County, by year, cause of failure, and phase of the nesting period (eggs or nestlings).

	Number of Osprey Nests that Failed by Cause						
	Predator		Storm		Unknown		% of Total Nests
Year	Eggs	Young	Eggs	Young	Eggs	Young	that Failed
2013	0	0	2	7	4	8	40%
2014	0	2	3	8	5	3	36%
2015	0	2	1	4	1	5	23%
2016	0	3	6	11	3	10	46%
2017	0	0	4	7	9	14	45%
Total	0	7	16	37	63	40	

plot (×100) covered with (1) forest, (2) low-lying vegetation, (3) parks and athletic fields, and (4) urban cover. We z-standardized all quantitative variables for estimation so they had a mean of 0 and standard deviation of 1.

We used an iterative variable selection process in which the inclusion of single model terms must improve the null model by at least two AIC_c values (Arnold 2010). This iterative process begins with the intercept-only null model and then fits all univariate models, followed by the additive and interactive combinations of those variables which improved the null model by the two AIC_c thresholds.

Results

The number of active Osprey nests in the study area ranged from 53 in 2013 to 79 in 2016, for a total of 329 nests during the 5-yr study (Table 1). Osprey productivity (i.e., the number of nearly fledged young per active nest) ranged from 0.81 ± 0.76 to 1.19 ± 0.90 (SD; Table 1). Ospreys used a total of 127 nest locations during the study; some nest locations were only used once, while others were used during all 5 yr (Fig. 1). Overall, 202 active nests produced at least one nearly fledged young and were considered successful (61%), and 131 active nests were unsuccessful.

Nesting success ranged from 51% in 2016 to 77% in 2015 (Table 1). Storms caused 45% of all nest failures, 6% of failures could be attributed to predators, and for 50% of nest failures we were unable to determine the cause (Table 2). Most nest failures occurred during the brood-rearing period.

The earliest incubation date was approximately 1 January and dates for incubation onset extended until the third week in June (Fig. 2). There was a small peak in the onset of incubation in late January

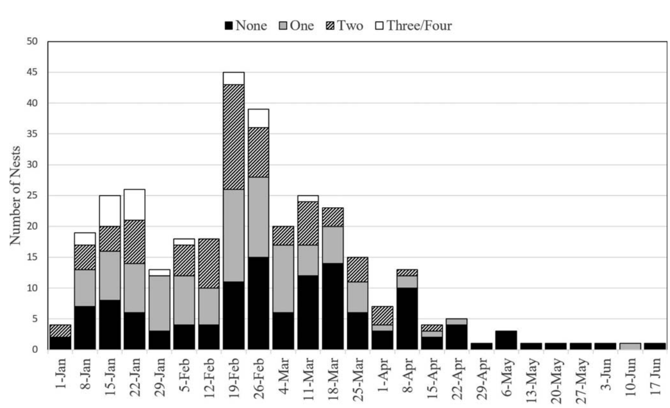

Figure 2. Number of Osprey nests that produced zero, one, two, three, and four nearly fledged young, shown by the date of onset of incubation, Pinellas County, Florida. Nests from all 5 yr (2013 to 2017) were combined.

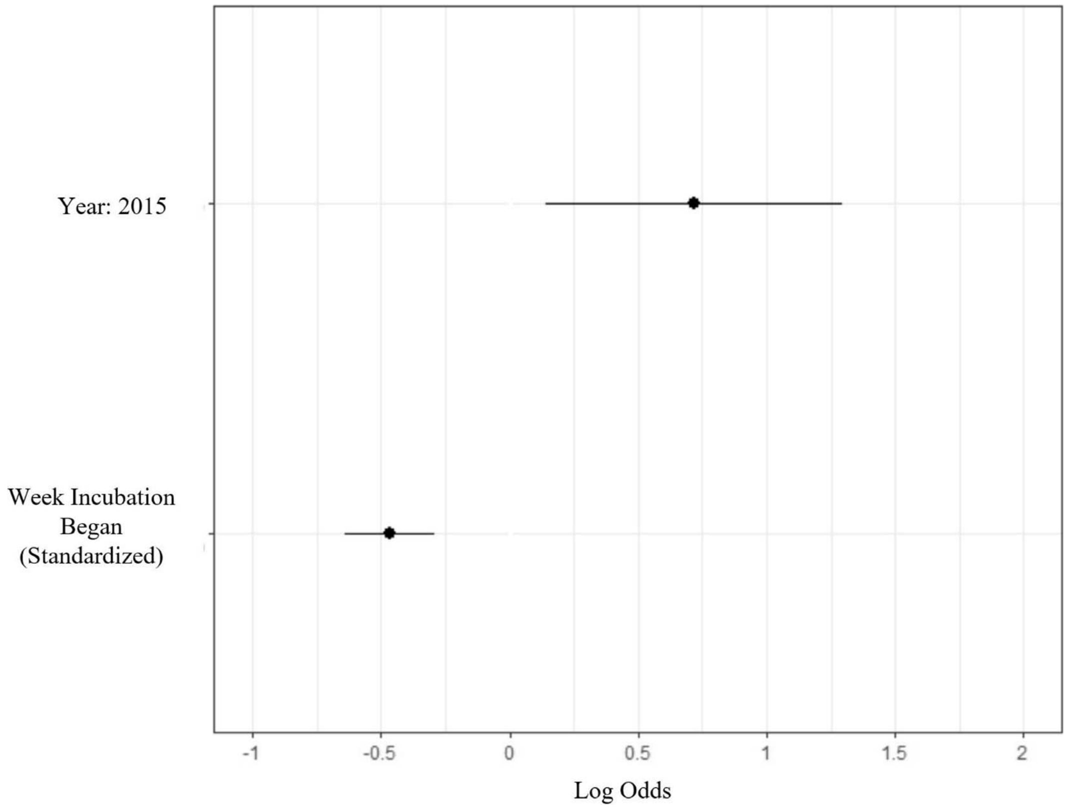

Figure 3. Parameter estimates (95% CI) from the logistic exposure model presenting the year 2015 and the first week of incubation (week 1 began 1 January) as log-odds for Ospreys nesting in Pinellas County, Florida, from 2013 to 2017.

Table 3. Land cover characteristics for active Osprey nests in southern Pinellas County, Florida, from 2013 to 2017. Plot size (radius) indicated in parentheses following land cover variable names.

VARIABLE	MEAN	SD	MINIMUM	MAXIMUM
Distance to nearest saltwater (m)	1417.4	1199.7	5.0	4240.0
Distance to nearest freshwater (m)	967.6	1371.3	0.0	5440.0
Distance to nearest water (m)	349.3	344.5	0.0	1699.4
Height (m)	16.1	6.0	4.0	40.0
Distance to nearest active nest (m)	396.9	601.5	0.2	3803.5
% Forest (200 m)	3.0	10.7	0.0	72.9
% Low-lying vegetation (200 m)	2.8	7.1	0.0	43.1
% Parks and athletic fields (200 m)	42.2	29.2	0.0	96.5
% Urban area (200 m)	39.9	28.4	0.0	100.0
% Forest (1 km)	2.9	5.0	0.0	24.3
% Low-lying vegetation (1 km)	3.7	5.8	0.0	24.4
% Parks and athletic fields (1 km)	12.9	7.4	0.0	31.2
% Urban area (1 km)	58.9	26.2	4.0	95.4
% Forest (2 km)	2.6	2.9	0.0	11.3
% Low-lying vegetation (2 km)	3.1	3.1	0.0	11.9
% Parks and athletic fields (2 km)	7.0	2.7	0.1	12.1
% Urban area (2 km)	56.9	23.8	1.8	93.8

Table 4. Logistic exposure models describing Osprey nest daily survival rates (DSR) ranked by AIC_c scores during the brood-rearing period in Pinellas County, Florida, USA, from 2013 to 2017. Covariates include the year 2015 and week incubation began (week; week 1 began 1 January). The number of model parameters is K, LL is the model likelihood, and Cum Wt is the cumulative AIC_c weight.

Model	K	AIC_c	σAIC_c	AIC_c Wt	LL	Cum Wt
Week + 2015	3	1110.49	0.00	0.93	–552.24	0.93
Week	2	1115.64	5.16	0.07	–555.82	1.00
2015	2	1136.28	25.80	0.00	–566.14	1.00
Intercept only	1	1142.45	31.98	0.00	–570.23	1.00

followed by a large peak starting in late February and extending through March.

Most of the active nests were on artificial structures not intended for Ospreys (66%), but 22% of the nests were on platforms, and 12% on live or dead trees. Nest height ranged widely (4–40 m, Table 3). Nests tended to be close to other active nests ($\bar{x}$ = 397 ± 602 [SD] m) and to water ($\bar{x}$ = 349 ± 345 [SD] m). Parks and athletic fields covered the most area for the smallest plots (200-m radius), but urban areas dominated the land cover for the larger plots (1-km and 2-km radii; Table 3).

The best logistic exposure model specification included only two variables: the discrete variable representing the first week of the incubation period and the nominal variable indicating the year 2015 (Table 4). This specification represents the model with the lowest AIC_c value. Models with additional parameters failed to increase the AIC_c value above a two point minimum threshold (Arnold 2010). For this specification, the coefficient estimates were as follows (95% CI in parentheses): intercept = 5.42 (5.22, 5.61); first week of the incubation period (standardized) = –0.42 (–0.64, –0.29); and 2015 indicator variable = 0.72 (0.14, 1.29) (Fig. 3).

DSR for nests was extremely high from the first week of the breeding season (1 January) until mid-April (week 16), with particularly high rates in 2015 (2% higher than in the other years; Fig. 4). After week 16, the predicted DSR decreased, while the uncertainty in those estimates increased (Fig. 5). The mean DSR was 0.97 ± 0.17 (SD).

Discussion

Urban Ospreys in Pinellas County had relatively similar reproductive success compared to those in less developed parts of Florida (Szaro 1978, Bowman et al. 1989). Szaro (1978) reported productivity of 0.73 young/active nest in northwestern Florida, while Bowman et al. (1989) reported productivity ranging from 0.69 ± 0.9 to 1.21 ± 1.0 (SD) young/active nest for subpopulations in Florida Bay and the Florida Keys.

Our results corresponded with previous research indicating that early nesters were more successful than later nesters, perhaps because they were more experienced, committed breeders, although we do not have data specific to our study area to support this (Poole 1985, Steeger and Ydenberg 1993). Our results are complicated by the presence of both migratory and nonmigratory Ospreys during the breeding season. We found a slightly bimodal pattern of onset of incubation with a small peak of early nesters in January followed by the majority of birds beginning incubation in late February through March. This pattern occurred in all 5 yr of the study and is consistent with predictions for the phenology of Osprey breeding in Florida (Bierregaard et al. 2020). The number of Ospreys present in the study area outside of the breeding season suggests that some individuals remain year-round. An apparent increase in Osprey abundance began in December and continued into early spring, suggesting the arrival of migrants. It is possible that the early nesters are Ospreys that stayed in the area during the fall and winter, and the late nesters are members of the returning migratory population. A satellite-telemetry study of inland Florida Ospreys at a similar latitude found that seven of nine birds migrated to South America while the remaining two stayed within Florida (Martell et al. 2004).

Another explanation for the higher success of early nesters may be the timing of severe storms later in the season and the relative impact of storms on survival. Severe storms such as Tropical Storm Colin (5 June 2016) can cause 100% mortality of nest-bound young. Tropical storms have sustained winds of 63-118 km/hr. During the 5 yr of our study, there were multiple days in May, June, and July where the strongest wind gust was >63 km/hr (National

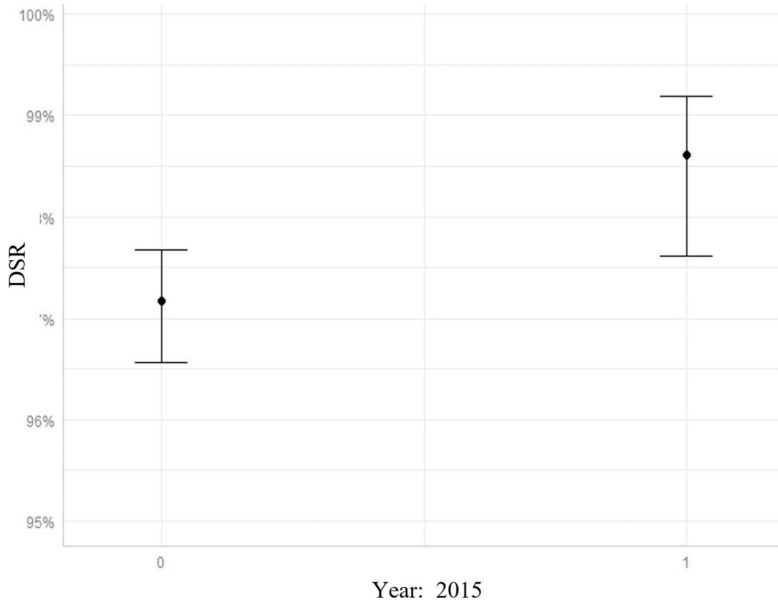

Figure 4. Predicted Osprey nest DSR when comparing the 2015 brood-rearing year (1) to other years (0) during the brood-rearing period in Pinellas County, Florida, from 2013 to 2017. Estimates (mean ± 95% CIs) derived from the best logistic exposure model as identified by AIC_c values.

Oceanic and Atmospheric Administration Climatic Data Center, Albert Whitted Airport). Previous research has documented that major storms that occur later in the nesting period are most likely to affect survival, perhaps because young are too large to be protected by adults (Reese 1977, Szaro 1978, Poole 1982, Johnson et al. 2008). This was also true in our study as nest failures were more likely to occur due to storms later in the season (Table 2).

In 2015, we documented the highest percent of successful nests, the highest number of nearly fledged young per active nest, and the lowest number and rate of nest failure due to storms ($n =$ 5 nests or 9% of active nests; Table 2). In addition to pushing nestlings out of nests and knocking nests to the ground, prolonged storms could make it more difficult for Ospreys to forage, leading to starvation of the young (Poole 1982, 1989).

We observed evidence of predation in only 6% of nest failures, although we could be underestimating its impact. We observed a Great Horned Owl (*Bubo virginianus*) killing an adult and a nestling at one nest; at five other sites Great Horned Owls took over Osprey nests and presumably killed existing young. In other studies, Great Horned Owl predation was suspected to have been a significant source of mortality of nestlings and adults, but it is difficult to document these nocturnal predation events (Reese 1977, Englund 2002, Bierregaard et al. 2020). A Bald Eagle (*Haliaeetus leucocephalus*) was observed knocking an Osprey nestling out of a nest; the nestling died and the nest was empty the following week. It is possible eagles caused more mortalities, as this has occurred at other sites (Bierregaard et al. 2020).

None of the other nest attributes or landscape-level variables we measured had a significant effect on nest survival and this was similar to findings in Minnesota (Petersen et al. 2020). Compared to studies where Ospreys nested >10 km from foraging sites (Hagan and Walters 1990), none of the nests in our study were very far from foraging areas. Many of the Osprey nests we studied were located relatively close to each other; however, we found no evidence that Ospreys had higher success when located closer to other Osprey nests. The lack of influence of landscape-level variables on survival supports research indicating that Ospreys are highly adaptable to human disturbance (Spitzer and Poole 1980, Canal et al. 2018, Petersen et al. 2020). In addition, predation appeared to be relatively low and not

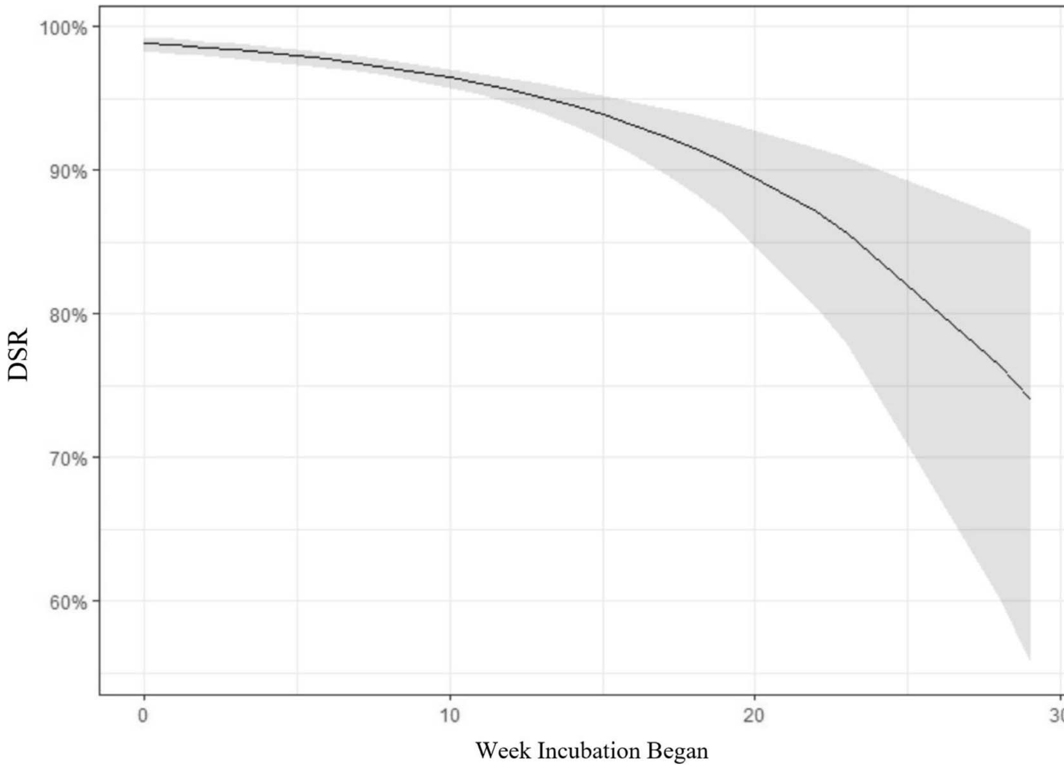

Figure 5. Osprey nest daily survival rate (DSR) in relation to the week of the year that incubation was initiated (week 1 = 1–7 January) during the brood-rearing period in Pinellas County, Florida, from 2013 to 2017. Estimates represent mean values plus 95% CIs (gray) from the preferred logistic exposure model as identified by AIC_c values.

associated with any particular habitat type as reported elsewhere (Bai et al. 2009).

In conclusion, this study provides further evidence that Ospreys can be productive in highly urban environments and this might be particularly true for areas like Pinellas County that are surrounded by water. The timing of nesting by nonmigratory compared to migratory individuals is worth further study and would be facilitated by a long-term banding study that would also provide insights on dispersal and survival. Further research into food provisioning by Ospreys, particularly during inclement weather, would help elucidate the role of storms on survival (Poole 2002, Glass and Watts 2009). Use of nest cameras would provide more accurate nest mortality data, as the cause of 50% of the failures in our study was unknown. Continued monitoring of this Osprey population may provide information about the health of the Tampa Bay ecosystem as Ospreys are the ideal indicator species to assess fish stocks as well as environmental contamination (Grove et al. 2009).

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