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Behavioral Observations of Ospreys Breeding at Fort Wainwright, Alaska

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ABSTRACT. This study documents observations of breeding behavior at two Osprey *Pandion haliaetus carolinensis* nest sites discovered at Fort Wainwright, Alaska. We developed Osprey location criteria and behavior and activity classifications from observations in 2006 and 2007, and subsequently measured those behaviors and activities at those locations in 2008–10. Eleven separate observers documented breeding behavior in and around each nest site from 2008 to 2010 for a total of 858 hours. Ground-based behavioral observations by researchers from an enclosed vehicle minimized anthropogenic disturbance. This study provides quantitative and qualitative assessments of breeding behavior that includes incubation, brooding, nest defense, and interloper occurrences from 2008 to 2010 and describes breeding timelines, mean brood size, and productivity from 2006 to 2011. Female Ospreys incubated and brooded significantly more than male Ospreys. Behavioral data suggest that breeding adult females and male Ospreys have differing nest and nest area defensive priorities. Breeding timelines and behaviors documented in this study are similar to those described in the literature. This study provides the first account of breeding phenology and behavior for Ospreys in Interior Alaska.

Key words: Alaska; Osprey; breeding; behavior; nest; Fort Wainwright; nesting duties; defensive priorities

RÉSUMÉ. La présente étude fait état de l'observation du comportement reproducteur à deux sites de nidification de balbuzards pêcheurs *Pandion haliaetus carolinensis* découverts à Fort Wainwright, en Alaska. Nous avons élaboré des critères propres à l'emplacement de même que des classifications relatives aux comportements et aux activités des balbuzards pêcheurs à partir d'observations réalisées en 2006 et en 2007, après quoi nous avons mesuré ces comportements et ces activités à ces mêmes emplacements de 2008 à 2010. Onze observateurs distincts ont pris note des comportements reproducteurs à chaque site et près de chaque site de 2008 à 2010, ce qui a représenté 858 heures d'observation. Les observations du comportement au sol réalisées par les chercheurs à partir d'un véhicule fermé ont minimisé la perturbation anthropique. Cette étude permet d'obtenir des évaluations quantitatives et qualitatives du comportement reproducteur, notamment en ce qui a trait à l'incubation, la couvaison, la défense du nid et la présence d'intrus de 2008 à 2010. Elle décrit également les chronologies de reproduction, la taille moyenne de la nichée et la productivité de 2006 à 2011. Les balbuzards pêcheurs femelles incubaient et couvaient les oisillons beaucoup plus souvent que les balbuzards pêcheurs mâles. Les données relatives au comportement suggèrent que les femelles adultes reproductrices et les balbuzards pêcheurs mâles ont des priorités différentes pour ce qui est de la défense des nids et les environs des nids. Les chronologies et les comportements de reproduction cités dans cette étude sont semblables à ceux décrits dans diverses publications. Cette étude présente le premier recensement de la phénologie de reproduction et du comportement des balbuzards pêcheurs de l'intérieur de l'Alaska.

Mots clés : Alaska; balbuzard pêcheur; reproduction; comportement; nid; Fort Wainwright; tâches de nidification; priorités de défense

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INTRODUCTION

The Osprey (*Pandion haliaetus carolinensis*) is an uncommon migratory species in Interior Alaska. Very little published or unpublished information exists regarding this raptor and its breeding biology in Interior Alaska; historical information suggests only that Ospreys are rare and perhaps widely distributed (Gabrielson and Lincoln, 1959; Yocum, 1963; Armstrong, 1980). The Tetlin National Wildlife Refuge (Tetlin NWR) holds the preponderance of existing data regarding Ospreys in Interior Alaska. Susitna Valley and Interior Alaska productivity surveys were initiated by the Alaska Department of Fish and Game in 1983 and augmented by occupancy surveys in 1986 (Hughes, 1985, 1990; Hughes and Wright, 1990). The U.S. Fish and Wildlife Service began to help collect annual nesting territory occupancy and productivity data for the Tetlin NWR in 1990, assuming the principal role in 1994 (Timm and Johnson, 2006; H. Timm, pers. comm. 2011). Alaska refuge and state fish and game reports document estimated productivity on the basis of aerial, road, and boat surveys of raptor nests and the presence of chicks during banding.

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Ospreys observed in Alaska are migratory; bands from Alaskan Ospreys have been recovered in winter (the non-breeding season) from locations in Mexico (along the southwestern coast; Hughes and Wright, 1990), California, and Nevada (H. Timm, pers. comm. 2011). A re-sighting of a returning three-year-old adult in 1998 is the first record of survivorship or return of an Osprey to Alaska (H. Timm, pers. comm. 2011). As of yet, there are no published data reporting on the phenology and breeding behavior of this raptor species in Alaska.

In 2006, when a pair of Ospreys was discovered breeding at Fort Wainwright in an easily viewable and accessible location along the Chena River, I took the opportunity to study the breeding biology and behavior of this species in the highly active and anthropogenically dynamic environment of a military installation. My goal was to describe (1) Osprey breeding phenology at Fort Wainwright, Alaska, (2) adult breeding behavior in and near the nest throughout the breeding season, and (3) chick behavior and development in comparison to published information (especially Poole, 1979, 1982b, and 1989).

STUDY AREA

Fort Wainwright (64˚49′40.08″ N, 147˚38′34.44″ W) is located in Interior Alaska adjacent to Fairbanks. The military installation is divided by the Chena River into the North Post (mostly wooded training areas) and the Main Post (developed areas encompassing the administrative district, personnel barracks, the Alaska Fire Service, and Ladd Army Airfield). Chena River habitat at Fort Wainwright is classified as a patchwork of mixed balsam poplar (*Populus balsamifera*) and white spruce (*Picea glauca*) forests that includes a tall shrub component strongly dominated by alder (*Alnus crispa*) and willow (*Salix* spp.) (A. Davis, pers. comm. 2011). The Chena River, primarily a clear-water, non-glaciated tributary of the Tanana River, provides habitat for various fish species, including Arctic grayling (*Thymallus arcticus*), and northern pike (*Esox lucius*) (A. Behr, pers. comm. 2011). On average, Chena River water flows are highest after spring precipitation and breakup in May; maximum annual precipitation occurs in July (mean = 1.78") and August (mean = 1.86"), and river discharges increase for short periods after such events (USACE, 1997). The interior Alaskan climate is strongly continental, with average maximum temperatures in summer (May–September) ranging from 12.5˚C in September to 22.6˚C in July (Thoman, 2011).

METHODS

This study focused on two Osprey nest sites. I located the West Nest (WN) in 2006 on a power pole 70 m from the Chena River. Breeding Ospreys reused the power pole annually through 2009. I discovered the East Nest (EN) in 2009, on another power pole along the Chena River located 3.1 km east of the West Nest. Ospreys constructed nests atop "double pole" power-line structures, centered and stabilized by two cross braces approximately 0.6 m from the top of the poles. The Ospreys simply placed sticks across the two brace boards to build their nest. Prior to the 2009 breeding season, both power poles were scheduled for replacement by the utilities services and treated with nesting deterrents. These deterrents successfully prevented the WN pair from producing young in 2009; however, the EN pair managed to fledge a single chick despite the physical obstacles. Alternative nesting platforms were erected after the 2009 breeding season, following documented guidelines and designs (J. Kaiser, pers. comm. 2009), and placed within 70 m of the river and the power poles previously used by the Ospreys. Materials (mainly large sticks) from the 2009 nests interwoven with the platform provided an attractive "starter site" for 2010. Breeding Ospreys took to the nesting platforms in 2010, and breeding pairs returned to both platforms in 2011.

Observation Methods

Daily nest-site checks (brief 10-minute visits) initiated each year in mid-April ascertained annual arrival dates and occupancy. Two observers documented in detail the breeding Osprey behaviors seen in and around the WN in 2006 and 2007. I categorized Osprey activity, behavior, and location in and near the nest from the 2006 and 2007 observations and then used those behavior classification and location criteria categories to measure breeding behavior observed from 2008 to 2010. Once breeding adults were detected attending nest sites, I initiated a daily two-hour survey period on five days a week. For the WN and EN pairs in 2009 and 2010, observation protocol documented behavior and activity duration to the minute. Behavior and activity documentation in 2008 for the WN pair was more loosely timed, and these data are not analyzed together with the 2009–10 data.

The study protocol employed ground-based observations, documented from within vehicles parked approximately 200 m from each nest, to minimize disturbance. Ten observers documented behaviors in 2009 and 2010 (277 and 417 hours, respectively). Daily communications between observers maintained standard behavior categorizations and relayed any unique occurrences. Two observers documented behavior and activity for the WN pair in 2008 (164 hours). Eleven individual observers documented Osprey behavior from 2008 to 2010 (858 hours). Observers documented all nest site behaviors and activities in field notebooks, with particular annotation to the start and end times of each occurrence. I transcribed the data and then calculated the percentage of time spent in each activity or behavior during each observation visit in 2009 and 2010. Observers used binoculars and spotting scopes and recorded a suite of activities and behaviors, including incubation, brooding, feeding, and reactions to human and non-human activities.

TABLE 1. Classification of Osprey behaviors and activities at and near the nest.

Classification	Description and association
	Location
In or on nest	Osprey was physically on the nest in upright position, or in the nest incubating or brooding. Location of Osprey, not a behavior or activity.
Perching	Osprey was in upright position away from nest. (Location of Osprey, not a behavior or an activity.)
Out of sight	Osprey individual could not be seen and therefore its behavior and activity were unknown.
	Activity
Flying	Osprey was airborne for more than 60 seconds. (If the individual was transitioning from a perch to the nest and that transition occurred within one minute, that behavior was not considered flying.)
Incubation	Osprey was believed to be on eggs. Activity associated with location in or on the nest.
Brooding	Osprey was believed to be on chicks. Activity associated with location in or on the nest.
Feeding	Osprey was consuming fish in or on the nest or while perching.
Wing flapping	Reserved to categorize young Osprey exercising their wings while in or on the nest.
Preening	Grooming could be associated with locations in or on the nest or perching.
Nest-building or maintenance	Reserved to categorize gathering nesting material, nest construction and maintenance in or on the nest. Flying periods were less than 60 seconds.
	Behavior
Alarm/calling	Vocalization could be associated with various activities and locations in or on the nest, perching, or flying.

DeSorbo et al. (2005) and Poole (1989) determined that bite counts are a useful measure of food consumed by chicks. Bite counts may be used in tandem with size and type of prey brought to the nest. Observers in this study timed chick-feeding bouts and counted bites using hand tally counters. I calculated bites per minute during data analysis for 2009 and 2010.

The available daylight-viewing period (0500–2100) was divided into eight time intervals (0500–0700, 0700–0900, and so on). Ospreys were observed during one of these two-hour periods each day. Observation visits were evenly distributed across three breeding phases (incubation, brooding or pre-fledging, and post-fledging), and each phase was surveyed during all eight time intervals to account for activities during the entire daylight period. During the breeding season in 2009 and 2010, both nest sites were monitored for two hours each day (five times a week). In 2009, after the WN pair breeding attempt failed, I reduced monitoring to one hour each day, five times a week, until the pair migrated in September. Surprisingly, the WN pair occupied the nest and continued to build and maintain the structure throughout the breeding season.

This study limited observations to Osprey behavior and activity at and near the nest. Observers recorded all behavior, locations and activity during each survey period. Classifications and brief descriptions are provided in Table 1.

The total number of fish brought to the nest was recorded during observations. These tallies are considered incidental information and not an accurate valuation of the total number of fish delivered per day. Therefore I did not assess or compare these values to results of previous studies. Any rare observations, including non-resident (interloper) adult visits, non-resident (interloper) fledgling visits, and attempts to receive food, were also documented. A separate analysis of recorded behavioral reactions to human and nonhuman activities is in preparation (A. Ajmi, unpubl. data). Seasonal observations ended after adults and fledged young migrated out of the area in the fall. I identified migration status when all Osprey detections had ceased for an entire week. Migration typically occurred during the last week of September in all years. Adults were sexed on the basis of plumage characteristics (Poole, 1989; Johnsgard, 1990) and behavioral characteristics as described in Dunstan (1973), Poole (1989), and Johnsgard (1990). Basic breeding phenology observations documented from 2006 to 2011 include dates of arrival, incubation, fledging and migration. Behavioral observations recorded in 2008 (using more loosely timed methods) are not included in the activity analysis of 2009–10 data. Qualitative behavioral information from 2008 is incorporated and reported here. Dates of survey efforts from 2008 to 2010 (nests = 5) ranged from 28 April (earliest) to 1 October (latest).

Data Analysis

I analyzed the transcribed field data to determine the time Ospreys spent in each classified activity or behavior during each two-hour survey period in 2009 and 2010. I examined male and female adult behaviors separately; chick behaviors were collectively scrutinized and are presented as qualitative behavioral data. I assessed time spent at incubation and brooding with Student's T-test, ($\alpha = 0.05$) to determine whether adult male and female Osprey behaviors differed. Other core activities (time spent out of sight, flying, perching, and building or maintaining nests) and locations relative to the nest were simply averaged and are presented here with confidence intervals.

Sample sizes for chick behaviors, bites, number of fish brought to the nest, and other behaviors were small and therefore are presented as averages with confidence intervals, or as a whole, without further analysis.

I estimated hatching dates on the basis of adult behavior while incubating. The nesting behavior of the adults during and following the estimated hatching dates included

TABLE 2. Osprey breeding phenology from 2006 to 2011. N.I. = No information was obtained. Fledging date ranges are provided for 2010 and 2011 as not all chicks in a single nest fledged on the same day.

Year	Sighted	Incubation	Brooding	Fledging	Migration	Young fledged
2006	N.I.	N.I.	6 July	14 August	N.I.	1
2007	19 May	31 May	16 July	27 August	27 September	1
2008	14 May	20 May	7 July	20 August	18 September	2
2009	4 May	Failed			19 September	0
2009	29 May	1 June	13 July	7 September	28 September	1
2010	27 April	12 May	21 June	9–13 August	27 September	3
2010	7 May	14 May	28 June	16–19 August	27 September	4
2011	29 April	11 May	Failed		N.I.	0
2011	4 May	11 May	7 July	18–20 August	N.I.	3

TABLE 3. Percentage of time (± CI) spent by female and male Ospreys in incubation and brooding in 2009 and 2010. Female Ospreys incubated more often and for longer periods than male Ospreys.

	2009 East Nest		2010 East Nest		2010 West Nest	
Activity	Female	Male	Female	Male	Female	Male
Incubation	62.8 (11.8)	27.2 (11.8)	72.1 (8.0)	20.5 (7.9)	55.5 (10.5)	30.3 (9.4)
Brooding	38.2 (11.3)	2.6 (2.6)	32.6 (16.0)	0.0 (0.0)	34.9 (14.5)	0.0 (0.0)

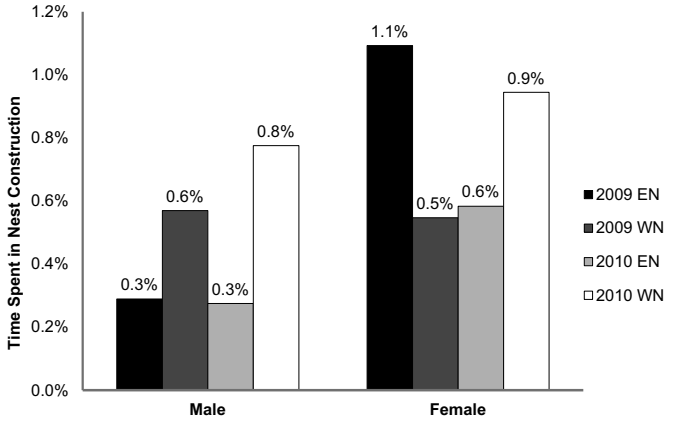

FIG. 1. Nest construction activity, 2009 and 2010. Females spent more time collecting material for the nest and building and maintaining it.

increased changes in position in the nest (restlessness) and observed chick feeding.

RESULTS

Dates of Osprey arrival in the study area and breeding events for the years 2006–11 are provided in Table 2. This study documented incubation and brooding by both sexes. Female Ospreys spent more time incubating and brooding than males: for the East Nest - 2009 incubation: $t(42) = 4.188$, $p = (0.0001)$; 2009 brooding: $t(40) = 5.89$, $p = (6.66E\text{-}07)$; 2010 incubation: $t(60) = 8.983$, $p = (1.05E\text{-}12)$; and 2010 brooding: $t(17) = 3.99$, $p = (0.0009)$; for the West Nest - 2010 incubation: $t(58) = 3.509$, $p = (0.0009)$; 2010 brooding: $t(19) = 4.72$, $p = (0.0001)$. Comparisons between years 2009 and 2010 and the two nest sites are provided in Table 3.

Tetlin NWR data show mean productivity (young per occupied nesting territory) for Ospreys in the Upper Tanana Valley from 1991 to 2012 was 1.17 ± 0.15, and mean brood size (young per successful territory) for Ospreys in the Upper Tanana Valley from 1986 to 2011 was 1.90 ± 0.12 (Timm et al., 2012). Both productivity and mean brood size for Ospreys at Fort Wainwright from 2006 to 2011 were higher than those reported for the Upper Tanana Valley; productivity was 1.67 ± .92 (n = 9 nests), and mean brood size was 2.14 ± 0.9 (n = 7 nests).

Both adults helped to build and maintain their large stick nest (1–2 m in diameter), lining the bowl with soft grasses and other objects including small buoy floats. Adult Ospreys continued nest maintenance throughout the entire breeding season. Female Ospreys observed in this study spent more time at nest construction activities than males (Fig. 1) except at the failed WN in 2009. The 2009 WN pair remained at the nest and continued to maintain it throughout the season; without a brood to rear, both adults spent equal time on this activity.

All observed copulations took place at the nest: WN = 20 (2009), EN = 13 (2010), and WN = 14 (2010). This study also documented extra-pair copulation attempts in 2010.

Mean start date of incubation in 2006–09 was 28 May. Prior to the placement of the artificial nesting platforms, utility personnel removed nest structures from power poles after the breeding season each year, which required the Ospreys to build a complete nest structure every year. Mean start date of incubation in 2010–11 was 12 May. After placement of artificial nest platforms, either nest materials were initially placed (in 2010), or nest structures were left for the next season (2011). The observed incubation period in 2008–10 was on average 44 days long (4 nests).

Nest and nest area attendance for 2009 and 2010, calculated from time spent out of sight, are provided in Table 4. Females either attended the nest or remained close to the nest site more than males until fledging.

TABLE 4. Percentage of time (± CI) spent by female and male Ospreys in nest and nest area attendance during incubation, brooding, and post fledging periods in 2009 and 2010, as delineated by time spent out of sight. The time spent out of sight was considered to be zero time nest attendance.

Nest and nest area attendance	2009 East Nest		2010 East Nest		2010 West Nest	
	Female	Male	Female	Male	Female	Male
Incubation	3.5 (3.4)	36.5 (14.7)	9.2 (5.7)	38.4 (10.1)	21.2 (8.4)	29.1 (10.6)
Brooding	4.4 (2.2)	50.4 (8.2)	7.8 (4.4)	71.7 (9.2)	6.6 (5.0)	61.7 (8.3)
Post Fledging	82.2 (19.0)	73.3 (15.6)	79.4 (12.7)	87.9 (7.4)	67.2 (13.6)	83.4 (8.6)

TABLE 5. Consumption rate measured by feeding bouts (min), feeding rates/min, and bites/min, counted for the EN in 2009 and for the EN and WN in 2010.

Year	Feeding bout (mean min)	95% C.I. (±)	Mean bites per feeding bout	95% C.I. (±)	Mean number of bites per min[1]	95% C.I. (±)
2009 (1 nest)	27.1 (n = 24)	16.5	172.8	92.6	6.79	1.01
2010 (2 nests)	20.5 (n = 21)	13.6	157.7	91.4	8.16	1.21

[1] Clancy (2005) reported a mean feeding rate of 7.8 bites per minute.

TABLE 6. Percentage of time (± CI) spent by female and male Ospreys at locations with respect to the nest and in activities in 2009 and 2010. Female Ospreys spent more time at the nest; males spent more time out of sight. Both male and female Ospreys spent similar amounts of time flying or perched.

Locations and activities of adult	2009 East Nest		2010 East Nest		2010 West Nest	
	Female	Male	Female	Male	Female	Male
In or on nest	49.5 (7.5)	11.2 (3.8)	45.4 (7.5)	12.0 (3.9)	37.8 (7.1)	14.1 (4.0)
Flying	1.5 (0.5)	1.9 (0.5)	2.2 (0.5)	3.1 (0.6)	1.9 (0.5)	2.7 (0.6)
Out of sight	24.8 (7.8)	53.9 (6.6)	29.4 (7.8)	64.2 (6.6)	30.1 (7.3)	56.7 (6.7)
Perching	24.1 (5.8)	33.0 (6.0)	23.0 (5.4)	20.7 (5.1)	30.2 (6.6)	26.6 (5.5)

Chicks began flapping, exercising their wing muscles consistently, between three weeks and seven weeks of age (n = 8 chicks) in 2009 and 2010. This study documented the flapping behavior that Poole (1989) described as "catching between nest-mates."

Estimated time to fledging in 2008–10 was an average of 50 days (4 nests), which falls within the documented range reported by Stotts and Henny (1975). Chicks remained in the nest area for a mean of 35 days after fledging (2008–10).

Consumption rates for 2009 and 2010 (n = 3 nests) are provided in Table 5. Mouth bites per minute (Table 5) are similar to those reported by Clancy (2005).

Percentage of time spent at locations in relation to the nest is depicted in Table 6 for both the 2009 EN pair and the 2010 EN and WN pairs. Adult females of both nests spent more time at the nest and adult males of both nests spent more time out of sight, most likely fishing, or perched nearby in areas not visible to the observer. Male and female Ospreys spent comparable time flying or perching.

DISCUSSION

Ospreys returned to Fort Wainwright, Alaska, in mid to late April in 2006–11. The nest locations were within 70 m of the river and situated on the tallest structure (power poles from 2006 to 2009, and then the nesting platforms in 2010–11). Courtship displays were not observed during this study. However, this behavior could easily have been missed because observations were limited to two hours per day.

Jamieson et al. (1982) reported that male Ospreys spent more time than females in gathering nesting material for stick nest construction. In contrast, this study found that female Ospreys spent more time than males at this task; however, the difference was not significant.

Initiation of incubation at Fort Wainwright was consistent with that reported in the Upper Tanana Valley, typically beginning in late May (H. Timm, pers. comm. 2011). Incubation at Fort Wainwright was determined by observing behaviors documented by Poole (1989). Incubation at Fort Wainwright began earlier in May in 2010 and 2011, when Ospreys returned to platforms where stick structures from the previous season were already present, than in 2006–09, when previous stick constructions had been removed for utility maintenance purposes. Incubation at Fort Wainwright was longer than that reported by Poole (1989); however, hatching most likely occurred earlier and was not discernible. Observers in this study could not readily detect chicks from the observation locations in their first week of life, but sightability increased as chicks grew larger and increasingly more mobile. I determined that brooding had begun in this study when adults appeared to be "unsettled"

while in the nest, shifting their position frequently and paying particular attention to objects in the nest, particulars that observers could not determine from the ground at that time. These behaviors were inconsistent with those in the previous weeks and led to the determination that the eggs were in the process of hatching, or had hatched. Without a camera, there is no assurance that the chicks all hatched by the estimated date. The asynchronous hatching of Osprey chicks adds further difficulty to estimating a hatch date for each nest.

Male and female Ospreys share incubation and, to a lesser degree, brooding of their young (Green, 1976; Poole, 1989). The incubation results of this study are consistent with those of Green (1976), Jamieson et al. (1982), and Poole (1989). Time spent incubating by male and female Ospreys in this study differed significantly; females incubated more often and for longer periods. Female incubation times and behaviors correspond to those reported in Jamieson et al. (1982), in that females spend significantly more time in incubation duties, and when relieved by the males, spend the majority of their "off time" perched near the nest. Females would often displace males on the nest after only a short period of "off time." Male Ospreys in this study spent almost no time at all brooding; the findings are similar to those reported by Dunstan (1973), Jamieson et al. (1982), Poole (1989), and Clancy (2006).

Division of nesting duties has been described previously for raptor species. Newton (1979) suggests that food requirements for the pair are reduced if the larger bird maintains a lower activity state. The female Osprey may also accumulate larger body reserves for reproductive use if she becomes inactive during the breeding period. Newton (1979) also suggests that the consistent presence of the larger female at the nest during the most critical periods of incubating and brooding of small young is more effective for success than if the duty is split between both adults.

Newton (1979) submits that males of dimorphic species may find it difficult to incubate eggs. The smaller male Osprey, although sharing in incubation duties, may be an ineffective brooder and therefore fishes and defends the nest area instead. The smaller male Osprey is an effective fisher. Males can quickly acquire more abundant, smaller fish, returning prey items more consistently to the female and young (Newton, 1979).

Female Ospreys in this study remained close to the nest up through the fledging of their chicks, after which all females spent progressively more time away from the nest. Newton (1979) maintains that individual hunting behaviors and ranges change throughout the breeding season in response to various factors, including the need to care for young so closely. Female raptors remain very close to the nest until the young are feathered, at which time the adult females begin to roam farther and for longer periods (Smith and Murphy, 1973). This behavior may be a response to the need to build adequate reserves for fall migration, and to relieve the male of providing food for both her and the young.

The males in this study gradually increased their time away from the nest area over the entire season, most likely in response to the food needs of the growing young. However, of the two adults, only the male Ospreys were observed during the last two weeks of the season in 2009 (14–24 September) and 2010 (6–22 September).

This study detected differing defensive priorities of breeding adult female and male Ospreys. Females closely guarded their nestlings from the weather and predators and focused their attention on the nest site itself. The guardedness moderated as the chicks grew older and more capable. Adult males guarded the nest and surrounding area, as well as providing the family with food. Females were observed to perch nearby the nests when "off duty," preening continuously for minutes on end and remaining vigilant. Any avian or human presence close to the nest immediately brought the female back to the nest, displacing the male. If on the nest, the female normally remained so during these "encounters." The male would be displaced by the female if on the nest, and either reacted with a flight or chase or perched and remained alert, depending on the type of intrusion. The male was often the aggressor, chasing off the interloper when any avian threat (typically Common Ravens (*Corvus corax*), Mew Gulls (*Larus canus*), or another adult male Osprey) neared the nesting area. The female rarely left the nest during such incursions. Studies suggest a correlation between nest defense and the larger size of female Ospreys (Storer, 1966; Snyder and Wiley, 1976).

Young Ospreys often rely on their parents for food for at least 10–20 days after fledging (Poole, 1984). The nest can be critical for food transfer until young have attained adequate fishing skills. Fledged young in this study remained near the nest site, reliant on the male adult Osprey for longer than the documented 10–20 day period until migration. During that time, the young continued to receive food from the male. The nest remained the focal point for food transfer even after fledging had occurred. The Chena River is a viable and healthy source of prey for breeding Ospreys. Adult Ospreys and their young did not appear to want for food at any time during the study, even during high water stages after precipitation events. Data from 2009 and 2010 confirm observations by Green (1976), Jamieson et al. (1982), McLean and Byrd (1991), and Clancy (2005) that males provide more fish than females; males (2009–10) delivered an average of 62 fish to the nest (n = 3 males), whereas females (2009–10) were seen with a mean of only seven fish (n = 3 females). During the 2008–10 breeding seasons, fish delivery and transfer were never observed anywhere in the observation area except at the nest. Throughout the incubation period, the females would receive the fish from the males and subsequently fly off the nest and proceed to eat the offered item on a nearby pole or remain in the nest to feed themselves as well as the nestlings. Females in this study never brought fish to the adult males; however, females were observed to bring fish to the nestlings. Post-fledging, the young continued to use the nest as the food

transfer site. Males would bring the prey to the nest, and the fledglings would take the item, either feeding in the nest or flying to a nearby pole to consume the fish.

Sibling aggression has been studied in Ospreys (Poole, 1979; McLean and Byrd, 1991), and results suggest that sibling aggression is directly correlated with food availability. Osprey chicks are hatched asynchronously, with roughly 1–2 days between hatchings (Poole, 1989). The oldest chick typically has a one- or two-day head start on the second sibling, and a seven-day head start on the fourth sibling. The oldest chick often receives the most food as it is the strongest and most dominant. When food is abundant, sibling aggression may be minimal. However, chicks that are continuously hungry often fight for access to food, and the oldest chick usually dominates the younger and obtains more food (Poole, 1979, 1989). Sibling aggression events were minimal during the 2008–10 seasons, and food appeared to be plentiful. By the time of fledging, the two young in 2008, one young in 2009, and seven young in 2010 appeared to be in good condition, with very little size variation. The year 2010 was remarkable for Osprey productivity at Fort Wainwright; three chicks were fledged from the West Nest and four from the East Nest. Poole (1982a, 1984) calculated survival rates for chicks hatched asynchronously, determining the survival rate of a fourth chick hatched and surviving to fledging with an available food supply to be 27%. This value is far lower than the survival rate of a third chick in similar conditions, which is 83%.

Once fledged, young may fly to nearby, non-natal nests to obtain food. Adult Ospreys rarely chase off interloper fledglings and often feed the intruders, perhaps unable to recognize the difference between the newcomers and their own brood (Poole, 1982b, 1989). Poole (1982b, 1989) also suggested that nest-switching or adoption, in which adult Ospreys feed fledglings that are not their own, is more common in areas where nests are close together. Ospreys in general show very high site fidelity when returning to breed in an area. Inclusive fitness of adults (the fitness of an individual's genetic traits as measured in terms of the survival and reproductive success of its kin; Hamilton, 1964) can potentially be raised when feeding chicks of close relatedness, provided that adequate food resources are available (Poole, 1982b). In 2008, this study documented an interloper fledgling on four occasions. In every case, the interloper attempted either to acquire food from the adults or to steal it from the resident young. On one occasion, the adult female exhibited a high level of aggression towards the interloper, grasping the fledgling in her talons and calling loudly and incessantly. The adult female finally retreated, and the intruding fledgling remained on the nest eating remnants of fish discarded by the resident young. In another instance, the interloper made an attempt to receive fish from the returning adult male, but was challenged by one of the resident young and subsequently left the nest.

During the 2010 season, assessing interloper activities became increasingly difficult after fledging. Each nest produced multiple young, and observers could not determine from their behavior whether interloper juveniles succeeded in obtaining food from non-natal nests.

Observers did document interloper Osprey adults on multiple occasions in 2010 in behaviors ranging from flyovers to copulation attempts by non-resident males. Behaviors associated with attempts at extra-pair copulations ranged from mild indifference and light rebuffs by the female to extreme reactions in which the resident male chased off the interloper male.

In 2009, utility workers attempted to deter Ospreys from nesting before and during the breeding season on the EN and WN power poles traditionally used by breeding Ospreys. All deterrent attempts failed, and both Osprey pairs successfully constructed nests very late in May 2009. However, only the EN pair produced a fledgling; perhaps for the WN pair, the window of opportunity for breeding had already closed. Surprisingly, despite their non-breeding status, the WN pair occupied the nest and continued to build and maintain the structure throughout the breeding season. Daily observation periods for the WN pair were cut back to one hour five times a week. The 2009 EN pair began incubating late (1 June) because of the deterrent attempts; their single juvenile fledged during the first week of September, the latest fledging recorded at Fort Wainwright. The adult male remained with the juvenile until migration 21 days later (in early October). Heavy ice had begun to form on the Chena River by the time both were assumed to have migrated.

SUMMARY

Historically, little has been documented about the breeding biology of Ospreys in Interior Alaska. Alaska is currently facing ongoing development of its natural resources and industry; effective management of many wildlife species and their habitats is required for a sustainable, healthy environment. Species-specific knowledge will assist in making management decisions. This study provides helpful, timely information on the breeding phenology of Ospreys breeding at Fort Wainwright in Interior Alaska. In addition to describing breeding behavior of adults in and near the nest, it describes observations of behavior and development of their young.

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