

# THE JOURNAL OF RAPTOR RESEARCH

A QUARTERLY PUBLICATION OF THE RAPTOR RESEARCH FOUNDATION, INC.

VOL. 54

MONTH 2020

NO. 4

*J. Raptor Res.* 54(4):000–000

© 2020 The Raptor Research Foundation, Inc.

## CANNIBALISM IN RAPTORS: A REVIEW

MAXIMILIAN L. ALLEN<sup>1</sup>

*Illinois Natural History Survey, University of Illinois, 1816 South Oak Street, Champaign, IL 61820 USA*

AKINO INAGAKI

*Graduate School of Agriculture, Tokyo University of Agriculture and Technology, 3-5-8 Saiwai-Cho, Fuchu, Tokyo 183-8509 Japan*

MICHAEL P. WARD

*Illinois Natural History Survey, University of Illinois, 1816 South Oak Street, Champaign, IL 61820 USA*  
*and*

*Department of Natural Resources and Environmental Sciences, University of Illinois, 1102 South Goodwin, Urbana, IL 61801 USA*

**ABSTRACT.**—Feeding strategies, including cannibalism (in which an individual eats a member of the same species), are an important aspect of predator ecology. Cannibalism comprises five forms in raptors: siblicide, filicide, non-parental infanticide, conspecific strife, and conspecific scavenging. Cannibalism by raptors has been documented opportunistically for over a century, but it is unknown how frequent or widespread the behavior is. We performed the first systematic literature review and meta-analyses of the studies documenting filicide, non-parental infanticide, conspecific strife, and conspecific scavenging by raptors. We found 29 reports of these types of cannibalism; we did not review reports of siblicide due to the high frequency of the behavior, making it nearly ubiquitous among raptors. Filicide had nearly twice as many reports ( $n = 11$ , 37.9%) as any other type of cannibalism. Most reports were direct observations ( $n = 23$ , 79.3%), and nearly half the reports came from North America ( $n = 14$ , 48.3%) and approximately a third from Europe ( $n = 10$ , 34.5%). The 29 reports involved 25 raptor species from four families, with those from Acciptridae most common ( $n = 19$ , 65.5%). Cannibalism in raptors varies but most involves nestlings, which are easier to kill than adults, possibly because brood reduction can help the stronger young survive. Documented reports of cannibalism are increasing, possibly due to recent technological advancements that have increased our ability to document cannibalism and other ecological processes. Nevertheless, we encourage future reports of cannibalism from under-represented locations and for taxa that are less well-studied.

**KEY WORDS:** *camera trap; cannibalism; competition; diet; filicide; infanticide; scavenging; siblicide.*

---

### CANNIBALISMO EN RAPACES: UNA REVISIÓN

**RESUMEN.**—Estrategias de alimentación, incluyendo el canibalismo (en el cual un individuo come un miembro de su misma especie), son un aspecto importante de la ecología de la depredación. El canibalismo incluye cinco formas en las rapaces: fratricidio, filicidio, infanticidio no parental, lucha entre individuos conspecíficos y consumo de carroña de individuos conspecíficos. El canibalismo por parte de las rapaces ha sido documentado de modo oportunista desde hace más de un siglo, pero se desconoce cómo de frecuente o generalizado es este comportamiento. Realizamos la primera revisión sistemática de la literatura y un meta-análisis de los estudios que documentaron filicidio, infanticidio no parental, lucha entre

---

<sup>1</sup> Email address: maxallen@illinois.edu

individuos conespecíficos y consumo de carroña de individuos conespecíficos por rapaces. Encontramos 29 informes de estos tipos de canibalismo; no revisamos los informes de fratricidio debido a la alta frecuencia de este comportamiento, haciéndolo casi ubicuo entre las rapaces. El filicidio apareció en casi el doble de informes ( $n = 11$ , 37.9%) que cualquier otro tipo de canibalismo. La mayoría de los informes fueron observaciones directas ( $n = 23$ , 79.3%), y cerca de la mitad de los informes vinieron de Norteamérica ( $n = 14$ , 48.3%) y aproximadamente un tercio de Europa ( $n = 10$ , 34.5%). Los 29 informes involucraron 25 especies de rapaces incluidas en cuatro familias, siendo los Acciptridae los más comunes ( $n = 19$ , 65.5%). El canibalismo en rapaces varía, pero la mayoría involucra polluelos, que son más fáciles de matar que los adultos, posiblemente porque la reducción de la nidada puede ayudar a la supervivencia de los jóvenes más fuertes. Los informes que documentan el canibalismo van en aumento, posiblemente debido a avances tecnológicos recientes que han aumentado nuestra capacidad para documentar el canibalismo y otros procesos ecológicos. Sin embargo, alentamos la realización de futuros estudios de canibalismo provenientes de lugares subrepresentados y para taxones que son menos estudiados.

[Traducción del equipo editorial]

## INTRODUCTION

Feeding strategies and prey selection are central to ecology, especially for predators. Prey choice dictates the ecological niches and habitats selected by predators, and to a large extent their reproductive success and survival (Newton 1998, 2010). Most vertebrate predators scavenge or steal food on occasion (Sebastian-Gonzales 2019, Inagaki et al. 2020). Cannibalism is a less common strategy for food acquisition in which an individual consumes a conspecific. Cannibalism occurs throughout the animal kingdom, and is often a means of increasing fitness and survival by improving nutrition while also reducing competition (Markham and Watts 2007, Hadjikyriakou and Kirschel 2016). Consuming a competitor provides nutrition and reduces competition for food (e.g., killing a sibling in a nest also reduces immediate competition for food brought by parents).

Cannibalism may take one of five forms: siblicide, filicide, non-parental infanticide, conspecific strife, and conspecific scavenging. Siblicide is the killing and eating of siblings in the nest, and is a form of competition linked to brood reduction (Bechard 1983, Redondo et al. 2019). Filicide is the killing of nestlings by parents who then eat the nestling or feed it to other nestlings; usually it is nestlings that are unlikely to survive that are killed (Bortolotti et al. 1991). Non-parental infanticide is conspecific killing and eating of young animals still dependent on their parents. In birds, this type of predation is most common at nests (Hadjikyriakou and Kirschel 2016). Conspecific strife, in which birds aggressively fight and occasionally kill their adult competitors, can also lead to cannibalism if the winner of the contest eats the competitor it killed (de Lecea et al. 2011). Scavenging is behavior in which animals consume

carion (e.g., Wilson and Wolkovich 2011), sometimes via kleptoparasitism in which an individual actively steals procured food (e.g., Holthuijze et al. 1987, Negro 1992). In this report, we limit our treatment of scavenging behavior to conspecific scavenging (i.e., cannibalism); one example of this is the scavenging of dead nestlings by their parents or siblings (Miller et al. 2015).

Raptors are predatory birds that specialize in the capture of mobile prey. Among raptors, siblicide is so common that it is nearly ubiquitous (Ingram 1959, Bechard 1983), and has been documented at least once in most families of raptors: Cathartidae (e.g., Margalida et al. 2004), Acciptridae (e.g., Pilz and Seibert 1978, Bortolotti et al. 1991), Tytonidae (e.g., Lenton 1984), Strigidae (e.g., Ingram 1962, Anderson 2015), and Pandionidae (e.g., Forbes 1991), but not in Sagittariidae. In comparison, filicide, non-parental infanticide, conspecific strife, and conspecific scavenging are much less reported.

We opportunistically documented scavenging activity on the carcass of a Red-tailed Hawk (*Buteo jamaicensis*) killed by a vehicle collision. We placed the carcass in a hedgerow on 11 January 2019 in Champaign County, Illinois, USA (40°07'N, 88°09'W), and monitored the carcass with a camera trap (Bushnell NatureView HD, Lenexa, KS, USA). On 23 January at 12:43 H we recorded an incident of a conspecific scavenging (Fig. 1), an event that prompted our investigation of cannibalism. To our knowledge there has never been a systematic review to determine how common cannibalism behaviors are in raptors.

## METHODS

**Literature Review.** We performed a systematic literature review and meta-analysis of the scientific



Figure 1. Red-tailed Hawk exhibits conspecific scavenging in an Illinois hedgerow on 23 January 2019.

literature to understand the frequency and pattern of four types of cannibalism (filicide, non-parental infanticide, conspecific strife, and conspecific scavenging) in raptors. (We excluded siblicide because it is so common.) On 12 May 2019 we performed a systematic literature search using Web of Science for the cannibalism terms combined with the common and genus names for the orders Cathartiformes, Accipitriformes, and Strigiformes as listed in Clements et al. (2018). We removed publications not documenting cannibalism in raptors, publications not from peer-reviewed journals, and studies of domesticated raptors, and augmented our systematic review of the literature by searching the references of papers that we reviewed (e.g., snowball sampling). For each report, we considered meteorological seasons (Trenberth 1983), corresponding to spring (March to May), summer (June to August), fall (September to November) and winter (November to February) for the northern hemisphere and the opposite for the southern hemisphere. We also recorded whether the raptor observed was nesting at the time the cannibalism occurred, as reported by the author. We documented the frequency, type, and geographic extent of cannibalism, as indicated in the published reports.

## RESULTS

We reviewed reports that documented one of four types of cannibalism (Table 1). Filicide had nearly twice as many reports ( $n = 11$ , 37.9%) as the other types of cannibalism we reviewed ( $n = 6$  for each; Table 1). Cannibalism occurred during each of the four seasons, but most occurred during the species'

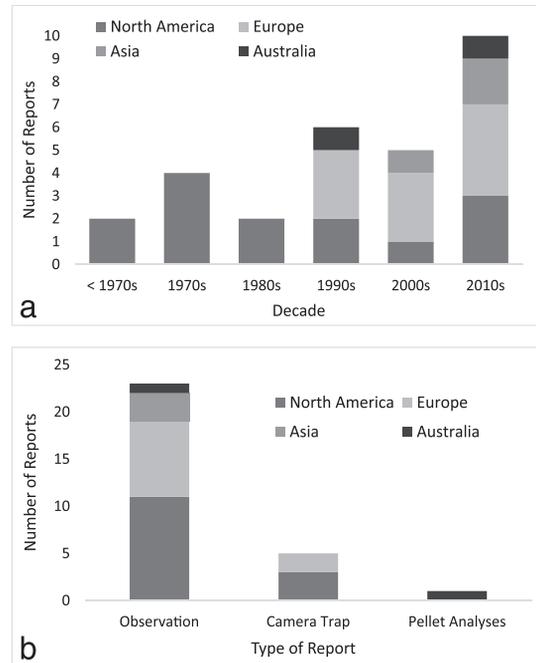


Figure 2. Frequency of reports of cannibalism by raptors represented by continent for (a) each decade and (b) type of report.

nesting season ( $n = 18$ , 64.3%; Table 1). The 29 reports involved 25 raptor species from four families. Raptors from Acciptridae were most common ( $n = 19$ , 65.5%), followed by Strigidae ( $n = 5$ , 17.2%), Cathartidae ( $n = 4$ , 13.8%), and Tytonidae ( $n = 1$ , 3.5%), but we found no reports for Sagittariidae or Pandionidae (Table 1). Among the genera in Acciptridae, the majority of reports concerned either *Falco* spp. ( $n = 7$ , 36.8%) or *Buteo* spp. ( $n = 5$ , 26.3%). Among raptor species, only Red-tailed Hawks ( $n = 4$ , 13.8%) and Eleonora's Falcon (*Falco eleonora*;  $n = 2$ , 6.9%) had multiple reports.

There has been a general increase in reports of cannibalism over time (Fig. 2a). The 2010s had the most reports ( $n = 10$ , 34.5%), followed by the 1990s ( $n = 6$ , 20.7%) and 2000s ( $n = 5$ , 17.2%). Most reports were direct observations ( $n = 23$ , 79.3%), with a few observations from camera traps ( $n = 5$ , 17.2%), and one record derived from pellet analyses (3.5%; Fig. 2b). Nearly half of the observations of cannibalism occurred in North America ( $n = 14$ , 48.3%) and approximately a third in Europe ( $n = 10$ , 34.5%). There were also reports from Asia ( $n = 3$ , 10.3%) and Australia ( $n = 2$ , 6.9%), but none from

Table 1. Literature review of cannibalism by raptors, including the raptor family and species, location, study type, season (\*indicates nesting season), and type of cannibalism.

STUDY	RAPTOR FAMILY	RAPTOR SPECIES	LOCATION	STUDY TYPE	SEASON	CANNIBALISM TYPE
Steffen 1977	Acciptridae	Red-tailed Hawk ( <i>Buteo jamaicensis</i> )	Wisconsin, USA	Observation	Summer*	Conspecific Strife
Coffin 1906	Acciptridae	Red-tailed Hawk ( <i>Buteo jamaicensis</i> )	Indiana, USA	Observation	Not Reported	Conspecific Strife
Clevenger and Roest 1974	Acciptridae	Red-tailed Hawk ( <i>Buteo jamaicensis</i> )	California, USA	Observation	Winter	Conspecific Strife
Kang 2018	Cathartidae	Cinereous Vulture ( <i>Aegypius monachus</i> )	South Korea	Observation	Winter	Conspecific Strife
de Lecea et al. 2007	Cathartidae	Griffin Vulture ( <i>Gyps fulvus</i> )	Spain	Observation	Winter	Conspecific Strife
Fisher 1975	Strigidae	Great Gray Owl ( <i>Strix nebulosa</i> )	Alberta, Canada	Observation	Winter	Conspecific Strife
Bortolli et al. 1991	Acciptridae	American Kestrel ( <i>Falco sparverius</i> )	Saskatchewan, Canada	Observation	Summer*	Filicide
Caro et al. 2014	Acciptridae	Bonelli's Eagle ( <i>Aquila fasciata</i> )	Spain	Observation	Spring*	Filicide
Lyons and Mosher 1982	Acciptridae	Broad-winged Hawk ( <i>Buteo platypterus</i> )	Maryland, USA	Observation	Summer*	Filicide
Korman and Macek 2011	Acciptridae	Golden Eagle ( <i>Aquila chrysaetos</i> )	Slovakia	Observation	Spring*	Filicide
Temple 2008	Acciptridae	Merlin ( <i>Falco columbarius</i> )	England	Observation	Not Reported*	Filicide
Lewis 2017	Acciptridae	Northern Goshawk ( <i>Accipiter gentilis</i> )	Alaska, USA	Camera Trap	Summer*	Filicide
Frankie et al. 2013	Acciptridae	Peregrine Falcon ( <i>Falco peregrinus</i> )	Nunavut, Canada	Camera Trap	Summer*	Filicide
Hollhuijzen 1987	Acciptridae	Prairie Falcon ( <i>Falco mexicanus</i> )	Idaho, USA	Observation	Not Reported*	Filicide
Hollingsworth 2017	Strigidae	Powerful Owl ( <i>Ninox strenua</i> )	Victoria, Australia	Observation	Spring*	Filicide
Webster et al. 1999	Strigidae	Powerful Owl ( <i>Ninox strenua</i> )	Australia	Pellet Analyses	Not Reported*	Filicide
Sheffield 1994	Tyrtonidae	Barn Owl ( <i>Tyto alba</i> )	Texas, USA	Observation	Winter*	Filicide
Markham and Watts 2007	Acciptridae	Bald Eagle ( <i>Haliaeetus leucocephalus</i> )	Virginia, USA	Observation	Spring*	Non-parental Infanticide
Jones and Manez 1990	Acciptridae	Black Kite ( <i>Mitrus migrans</i> )	Spain	Observation	Summer*	Non-parental Infanticide
Hadjikyriakou and Kirschel 2016	Acciptridae	Eleonora's Falcon ( <i>Falco eleonora</i> )	Cyprus	Camera Trap	Autumn*	Non-parental Infanticide
Steen et al. 2016	Acciptridae	Eleonora's Falcon ( <i>Falco eleonora</i> )	Greece	Camera Trap	Autumn*	Non-parental Infanticide
Negro et al. 1992	Acciptridae	Lesser Kestrel ( <i>Falco naumanni</i> )	Spain	Observation	Not Reported*	Non-parental Infanticide
Arroyo 1997	Acciptridae	Montagu's Harrier ( <i>Circus pygargus</i> )	Spain	Observation	Summer*	Non-parental Infanticide
Mori 2017	Acciptridae	Greater Spotted Eagle ( <i>Clanga clanga</i> )	Gujarat, India	Observation	Autumn	Scavenging
<i>This Study</i>	Acciptridae	Red-tailed Hawk ( <i>Buteo jamaicensis</i> )	Illinois, USA	Camera Trap	Winter	Scavenging
Camina and Palomo 2003	Cathartidae	Eurasian Griffon Vulture ( <i>Gyps fulvus</i> )	Spain	Observation	Winter	Scavenging
Rana and Prakash 2001	Cathartidae	White-backed Vulture ( <i>Gyps bengalensis</i> )	Rajasthan, India	Observation	Spring	Scavenging
Robinson 1954	Strigidae	Burrowing Owl ( <i>Athene cunicularia</i> )	Kansas, USA	Observation	Spring	Scavenging
Millard et al. 1978	Strigidae	Great Horned Owl ( <i>Bubo virginianus</i> )	Idaho, USA	Observation	Winter	Scavenging

Africa, Antarctica, or South America (Fig. 2). In North America, most of the studies took place in the USA ( $n = 11$ , 78.6%) and the rest in Canada (Table 1). In Europe, most of the studies came from Spain ( $n = 6$ , 60%), with no other country having more than one report (Table 1).

#### DISCUSSION

Our literature review of cannibalism in raptors showed that cannibalism takes multiple forms with different evolutionary drivers. Most raptor cannibalism involves nestlings at the nest, the life stage during which raptors are the most vulnerable. Reports of siblicide during the nestling phase are so prevalent in the literature that it is likely nearly ubiquitous among raptor species. After siblicide, filicide was the most common type of cannibalism. There were also as many reports of non-parental infanticide as there were of conspecific strife or conspecific scavenging. Brood reduction via cannibalism (siblicide or filicide) can contribute to the success of a nest, with stronger young surviving (Bechard 1983), and appears to be an important evolutionary motivation for cannibalism by raptors.

Most reports of cannibalism were from Acciptridae species (65.5%), including every report of non-parental infanticide, 72.7% of the reports of filicide, and half of the reports of conspecific strife. We expect this is due to both the abundance of members of the Acciptridae and to the fact that many species occur in urban areas. Red-tailed Hawks were the species with the most reports of cannibalism, likely due to their large geographic range and abundance, although three reports were of conspecific strife. Reports of conspecific scavenging were evenly split with two reports each for Acciptridae, Cathartidae, and Strigidae. Reports of non-parental infanticide were most common among falcons, which are bird-hunters and sometimes nest at high densities in colonial or semi-colonial situations that may provide the opportunity for falcons to actively hunt the young in other nests.

The relative scarcity of studies in previous decades may also have been due to a lack of attention by researchers. All reports prior to the 1990s occurred in North America, with reports from Europe increasing after that. Other continents have few reports, but we doubt this is due to a lack of cannibalism by raptors in these areas but rather a lack of interest in publishing these reports by researchers. For example, observations of cannibalism by raptors in Africa are available through social

media, but have not made their way into peer-reviewed literature. We also note that some published observations of cannibalism are reported incidentally in the text of a larger paper on another topic (e.g., Red-shouldered Hawks (*Buteo lineatus*) cannibalizing their dead nestlings; [Woodford et al. 2008, Miller et al. 2015]); and these reports were not found using our literature review protocol. We hope this review increases interest in reporting observations of cannibalism, and we encourage reports from under-represented locations, and for taxa that are less well known, and of the more uncommon behaviors.

Although nest observations are a key study method in ornithology, recent technological advancements such as camera traps have increased our ability to document scavenging and other ecological processes (Krofel 2011, Allen et al. 2019, Inagaki et al. 2020). These techniques may increase documentation of cannibalism by raptors, but cannibalism may also be rarely observed because it is intrinsically rare due to the possible costs of the behavior (e.g., contracting parasitic infection or disease). Cannibalism by raptors seems to occur when they are energetically stressed; for example, most incidents occurred during the nesting season when the parents are providing food for young, and young are easily killed. One might expect that there would be selective pressure against conspecific scavenging unless the benefits of the food resource outweighed the risks of contracting a disease or parasite. Future research should focus on the fitness benefits of cannibalism, and other fundamental reasons it occurs. An experimental approach could also be used to determine the frequency of conspecific scavenging and cannibalism behavior, possibly by placing carcasses of different raptor species and other animals in the territory of a variety of raptors.

#### ACKNOWLEDGMENTS

We thank the Illinois Natural History Survey, and the University of Illinois for their support. We thank D. E. Varland and an anonymous reviewer for their thoughtful comments on previous versions that greatly improved this report.

#### LITERATURE CITED

Allen, M. L., M. P. Ward, D. Južnič, and M. Krofel (2019). Scavenging by owls: A global review and new observations from Europe and North America. *Journal of Raptor Research* 53:410–418.

- Anderson, A., J. Russell, T. Booms, and D. Russell (2015). Siblicide and cannibalism in Alaskan Boreal Owls. *Journal of Raptor Research* 49:498–501.
- Arroyo, B. E. (1997). Between-brood cannibalism in the Montagu's Harrier. *Journal of Raptor Research* 31:390–391.
- Bechard, M. J. (1983). Food supply and the occurrence of brood reduction in Swainson's Hawk. *Wilson Bulletin* 95:233–242.
- Bortolotti, G. R., K. L. Wiebe, and W. M. Iko (1991). Cannibalism of nestling American Kestrels by their parents and siblings. *Canadian Journal of Zoology* 69:1447–1453.
- Camiña, A., and R. Palomo (2003). Observation of cannibalism in Eurasian Griffons *Gyps fulvus* in Spain. *Vulture News* 47:25–26.
- Caro, J., D. Ontiveros, and J. M. Pleguezuelos (2014). Cannibalism in Bonelli's Eagle (*Aquila fasciata*). *Journal of Raptor Research* 48:292–295.
- Clements, J. F., T. S. Schulenberg, M. J. Iliff, D. Roberson, T. A. Fredericks, B. L. Sullivan, and C. L. Wood (2018). The eBird/Clements checklist of birds of the world: v2018.
- Clevenger, G. A., and A. I. Roest (1974). Cannibalism in Red-tailed Hawk. *The Auk* 91:639–639.
- Coffin, L. V. B. (1906). A tragedy. *Bird-Lore* 8:68.
- de Lecea, F. M., A. Hernando, A. Illana, and J. Echegaray (2011). Cannibalism in Eurasian Griffon Vultures *Gyps fulvus*. *Ardea* 99:240–243.
- Fisher, B. M. (1975). Possible intra-specific killing by a Great Gray Owl. *Canadian Field-Naturalist* 89:71–72.
- Forbes, L. S. (1991). Hunger and food allocation among nestlings of facultatively siblicidal Ospreys. *Behavioral Ecology and Sociobiology* 29:189–195.
- Franke, A., P. Galipeau, and L. Nikolaiczuk (2013). Brood reduction by infanticide in Peregrine Falcons. *Arctic* 66:226–229.
- Hadjikyriakou, T. G., and A. N. Kirschel (2016). Video evidence confirms cannibalism in Eleonora's Falcon. *Journal of Raptor Research* 50:220–224.
- Hollingsworth, J., and R. J. Bilney (2017). A possible case of infanticide and cannibalism in the Powerful Owl *Ninox strenua*. *Australian Field Ornithology* 34:129–130.
- Holthuijzen, A. M., P. A. Duley, and J. C. Hager (1987). Piracy, insectivory and cannibalism of Prairie Falcons. *Journal of Raptor Research* 21:32–33.
- Inagaki, A., M. L. Allen, T. Maruyama, K. Yamazaki, K. Tochigi, T. Naganuma, and K. Shinsuke (2020). Vertebrate scavenger guild composition and utilization of carrion in an East Asian temperate forest. *Ecology and Evolution* 10:1223–1232.
- Ingram, C. (1959). The importance of juvenile cannibalism in the breeding biology of certain birds of prey. *The Auk* 76:218–226.
- Ingram, C. (1962). Cannibalism by nestling Short-Eared Owls. *The Auk* 79:715.
- Jones, A. M., and M. Maney (1990). Cannibalism by Black Kite (*Milvus migrans*). *Journal of Raptor Research* 24:28–29.
- Kang, S. G. (2018). The Cinereous Vulture, *Aegypius monachus*: Cannibalism in its wintering ground. *Korean Journal of Environment and Ecology* 32:256–260.
- Korňan, M., and M. Macek (2011). Parental infanticide followed by cannibalism in Golden Eagles (*Aquila chrysaetos*). *Journal of Raptor Research* 45:95–97.
- Krofel, M. (2011). Monitoring of facultative avian scavengers on large mammal carcasses in Dinaric forest of Slovenia. *Acrocephalus* 32:45–51.
- Lenton, G. M. (1984). The feeding and breeding ecology of Barn Owls *Tyto alba* in Peninsular Malaysia. *Ibis* 126:551–575.
- Lewis, S. B. (2017). Siblicide, parental infanticide, and cannibalism at a Northern Goshawk nest. *Journal of Raptor Research* 51:476–480.
- Lyons, D., and J. A. Mosher (1982). Food caching by raptors and caching of a nestling by the Broad-winged Hawk. *Ardea* 70:217–219.
- Margalida, A., J. Bertran, J. Boudet, and R. Heredia (2004). Hatching asynchrony, sibling aggression and cannibalism in the Bearded Vulture *Gypaetus barbatus*. *Ibis* 146:386–393.
- Markham, A. C., and B. D. Watts (2007). Documentation of infanticide and cannibalism in Bald Eagles. *Journal of Raptor Research* 41:41–45.
- Millard, J. B., T. H. Craig, and O. D. Markham (1978). Cannibalism by an adult Great Horned Owl. *Wilson Bulletin* 90:449.
- Miller, S. J., C. R. Dykstra, M. M. Simon, J. L. Hays, and J. C. Bednarz (2015). Causes of mortality and failure at suburban Red-shouldered Hawk (*Buteo lineatus*) nests. *Journal of Raptor Research* 49:152–160.
- Mori, D. (2017). An incidence of cannibalism in the Greater Spotted Eagle *Clanga clanga*. *Indian Birds* 13:111–112.
- Negro, J. J., J. A. Donazar, and F. Hiraldo (1992). Kleptoparasitism and cannibalism in a colony of Lesser Kestrels (*Falco naumanni*). *Journal of Raptor Research* 26:225–228.
- Newton, I. (1998). *Population Limitation in Birds*. Academic Press, Amsterdam, The Netherlands.
- Newton, I. (2010). *Population Ecology of Raptors*. A&C Black, London, UK.
- Pilz, W. R., and L. K. Seibert (1978). Fratricide and cannibalism in Swainson's Hawk. *The Auk* 95:584–585.
- Polis, G. A. (1981). The evolution and dynamics of intraspecific predation. *Annual Review of Ecology and Systematics* 12:225–251.
- Rana, G., and V. Prakash (2003). Cannibalism in Indian White-backed Vulture *Gyps bengalensis* in Keoladeo National Park, Bharatpur, Rajasthan. *Journal of the Bombay Natural History Society* 100:116–117.
- Redondo, T., J. M. Romero, R. Díaz-Delgado, and J. Nagy (2019). Broodmate aggression and life history variation

- in Accipitrid birds of prey. *Ecology and Evolution* 9:9185–9206.
- Robinson, T. S. (1954). Cannibalism by a Burrowing Owl. *Wilson Bulletin* 66:72.
- Sebastián-González, E., J. Magalhães Barbosa, J. M. Pérez-García, Z. Morales-Reyes, F. Botella, P. P. Olea, P. Mateo-Tomás, M. Moleón, F. Hiraldo, E. Arrondo, J. A. Donazar et al. (2019). Scavenging in the anthropocene: Human impact drives vertebrate scavenger species richness on a global scale. *Global Change Biology* 25:3005–3017.
- Sheffield, S. R. (1994). Cannibalism of a young Barn Owl (*Tyto alba*) by its parents. *Journal of Raptor Research* 28:119–120.
- Steen, R., A. Miliou, T. Tsimpidis, V. Selås, and G. A. Sonerud (2016). Nonparental infanticide in colonial Eleonora's Falcons (*Falco eleonora*). *Journal of Raptor Research* 50:217–221.
- Steffen, J. F. (1977). Cannibalism in adult nesting Red-tailed Hawks. *The Auk* 94:593–594.
- Temple, D. (2008). Merlins plucking and eating dead young. *British Birds* 101:687–688.
- Trenberth, K. E. (1983). What are the seasons? *Bulletin American Meteorological Society* 64:1276–1282.
- Webster, A., R. Cooke, G. Jameson, and R. Wallis (1999). Diet, roosts and breeding of Powerful Owls *Ninox strenua* in a disturbed, urban environment: A case for cannibalism? Or a case of infanticide? *Emu* 99:80–83.
- Wilson, E. E., and E. M. Wolkovich (2011). Scavenging: How carnivores and carrion structure communities. *Trends in Ecology and Evolution* 26:129–135.
- Woodford, J. E., C. A. Eloranta, and A. Rinaldi. (2008). Nest density, productivity, and habitat selection of Red-shouldered Hawks in a contiguous forest. *Journal of Raptor Research* 42:79–86.

Received 26 March 2020; accepted 10 June 2020

Associate Editor: Christopher W. Briggs

Queries for rapt-54-04-01

This article has been typeset from the submitted materials. Check proofs carefully for conversion or other inadvertent errors. Please follow the [Allen Press Guide to PDF Annotation](#) when marking revisions. Do not edit the PDF directly.

If present, queries will be listed below with corresponding numbers in the margins or may appear as PDF comments addressed to the author or editor. If a correction is desired in response to a query, mark the necessary changes directly in the proof using the appropriate annotation tool. If no change is desired, no action is necessary in response.