quency of lesions and species of vegetation used as nesting substrate. Further, all the colony sites listed in Table 1 were mixed-species colonies, which included nestlings with no obvious lesions. However, we noted that only 9.7% of the affected nests ($n = 59$ nests) were higher than 7 m. While our failure to examine these nestlings in hand may have biased or detection of abdominal lesions, female dermestid beetles and soldier flies may have difficulty in colonizing stork nests located in taller trees.

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WINTERING SWAINSON'S HAWKS IN ARGENTINA: FOOD AND AGE SEGREGATION[1]

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Key words: Swainson's Hawks; Buteo swainsoni; *winter; diet; Argentina.*

Traditionally, the Swainson's Hawk (*Buteo swainsoni*) has been considered to be largely insectivorous (Bent 1937, Snyder and Wiley 1976). Many workers report *B. swainsoni* feasting on grasshoppers (Bent 1937, Taylor 1946, Littlefield 1973, Woffinden 1986). In contrast, other studies found that mammals and birds make up most of the food brought to the nest (Dunkle 1977, Johnson 1978, Houston 1990, Gilmer and Stewart 1984). Johnson et al. (1987) observed that summering flocks of non-breeding individuals were almost strictly insectivorous. They proposed that *B. swainsoni* is insectivorous, but that breeding pairs switch to vertebrate prey due to the energetic demands of reproduction.

Food habits of *B. swainsoni* on their non-breeding range are poorly known. The only report of the food of *B. swainsoni* in the wintering grounds is the comment by C. C. Olrog (in Smith 1980) that in Argentina they exploit local outbreaks of locusts. Apparently based on this comment, it has been generally accepted that locusts are the main food on the wintering grounds (Palmer 1988b, Houston 1990).

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Here I report that in the pampas of Argentina, juvenile *B. swainsoni* feed on the migratory dragonfly *Aeshna bonariensis*. The hawks appear to be nomadic, following swarms of *A. bonariensis*, and feeding mostly on the wing. I also found evidence that juveniles and adults segregate on the wintering grounds.

STUDY AREA AND METHODS

The field site was located within the Punta Rasa reserve, about 7 km northeast of San Clemente del Tuyú, Buenos Aires Province, Argentina. The site is approximately 300 km south-south-east of Buenos Aires, on a north-pointing peninsula that separates the brackish waters of the Bahia Samborombon of the Rio de la Plata Estuary from the open Atlantic Ocean. Swainson's Hawks often roosted in the woods surrounding a small settlement near the tip of the peninsula. The rest of the peninsula is lightly to moderately grazed native pampas grasslands, with few trees, interspersed by both freshwater ponds and brackish canals. Field work was conducted in the region from late October to mid-January; within this period the field site was visited on most days.

Dragonflies (Family Aeshnidae) were conspicuous unless temperatures were low or it was raining. However, their numbers varied greatly due to the periodic migratory invasions. Aeshnid abundance was scored on a four-point scale: none, no dragonflies seen; light, up to 100 seen in a day; moderate, between 100 and 1,000; heavy, 1,000+. I recorded the weather patterns with which the dragonfly movements were associated. Movements of Swainson's Hawks were also documented, and numbers present were counted or estimated. Age and morph data were collected.

When hawks were present in the area, fresh, moist pellets were collected for future analysis. These were assumed to have been regurgitated during the early morning or during the preceding night. Pellets were collected between 24 November and 25 December, 1991.

I identified and counted food remains in the pellets. Most remains were insect fragments. Insects, other than dragonflies, were identified to Order. Dragonfly parts were compared to a reference collection of odonates made in the field. To obtain an estimate of the number of individual dragonflies per pellet, I counted the number of heads, the number of mandibles divided by two, and the total number of reproductive organs, i.e., the number of ovipositors and male epiprocts (inferior appendages). The largest of these three was taken as the best estimate of dragonflies present in each pellet. The sex ratio of the dragonflies was determined by counting the numbers of epiprocts and ovipositors found in the pellets. Numbers of the other invertebrates present in the pellets were calculated by counting identifiable parts such as heads, legs, or elytra.

Twenty-eight complete pellets were analyzed and another 12 were sampled. To sample a pellet, 25% of its dry mass was used and analyzed as above. In calculations where the total number of dragonflies per pellet was required, the sample value was multiplied by four. To test whether the percentage of dragonflies found in pellets changed on different days, I arcsine transformed the proportions to normalize the data (Zar 1984). Transformed data were tested by one-way analysis of variance (ANOVA), and Scheffe's a posteriori test. Only days in which three or more pellets were found were used in the test.

RESULTS

The dragonfly *Aeshna bonariensis* made up the majority of the food remains in the pellets. The first movement of *A. bonariensis* I observed was on 18 October 1991 near Atalaya, Buenos Aires Province, about 150 km north-north-east of the field site. The last movement that I witnessed occurred on 10 January 1992, just prior to the end of field work. It is not known if *A. bonariensis* migrations continued throughout the austral summer. All five of the large movements occurred as a cold front passed and the swarm generally travelled northward. No copulations or pairs flying in tandem were observed. Migratory populations were numerically spectacular. The leading edge of the mass arrived with the first gusts of wind accompanying the front. Densities were high enough to entangle over 30 individuals in a 40′, 1½″ mesh size, mist net in less than a minute; many others bounced out. Several million *A. bonariensis* must have been involved in every swarm. Most of them flew more than 3 m above ground. The major part of the swarms passed by within 0.5 hr. Most specimens of *A. bonariensis* collected were teneral, meaning that they had emerged relatively recently.

On three occasions, migrant dragonflies were grounded due to rain. They perched on the leeside of trees in a mass so thick that all that could be seen was the shimmer of wings. Each time, most dragonflies had left by the next day. The only passerine observed to feed on grounded migrant dragonflies was the Great Kiskadee, *Pitangus sulphuratus*.

I first saw a Swainson's Hawk on 15 November 1991 near Puerto Piramides, at the base of the Valdez Peninsula, Chubut Province. This is likely the southernmost wintering locality for the species as it is much farther south than shown in published range maps (Olrog 1984, Narosky and Yzurieta 1987, Houston 1990). Two *B. swainsoni* have been seen in this area in other years during the same time of year (Brett Whitney, pers. comm.). Swainson's Hawks were first observed in the study area on 18 November 1991, and seen almost daily during the study period.

The number of *B. swainsoni* observed during a day were positively correlated to the abundance of *A. bonariensis* (Spearman Rank Correlation = 0.54; $P < 0.001$). When a migratory swarm of *A. bonariensis* passed, there was a lag of several minutes before the hawks arrived. Hawks rode wind currents, flapping little as they fed on the dragonflies. The hunting method consisted of hawks stooping and quickly thrusting out their talons and grabbing dragonflies, which they immediately transferred to the bill and devoured whole. This method of hunting is similar to that described by Crone in Bent (1937) and in Woffinden (1986). On three occasions, over 1,000 Swainson's Hawks per day were seen. During the 23 November movement, over 5,000 arrived; possibly twice as many were present, but some birds were only visible through a telescope and thus difficult to count. Unexpectedly, almost all *B. swainsoni* observed during the study period were juveniles. However, several pale adults were seen during the 23 November movement, and two "rufous" morph adults

TABLE 1. Contents of analyzed Swainson's Hawk pellets.

Date	Females	Males	Percent female	Total Odonata	Total non Odonata	Percent Odonata
Nov. 24	23	16	59.0	72	13	84.7
Nov. 24	3	4	42.9	7	8	46.7
Nov. 24	3	2	60.0	5	26	16.1
Nov. 24	1	1	50.0	8	41	16.3
Nov. 24	4	2	66.7	8	5	61.5
Dec. 5	29	36	44.6	65	3	95.6
Dec. 8	2	19	9.5	26	7	78.8
Dec. 8	4	8	33.3	12	1	92.3
Dec. 8	18	21	46.2	50	4	92.6
Dec. 8	14	25	35.9	39	9	81.3
Dec. 8	23	24	48.9	64	7	90.1
Dec. 8*	17	14	54.8	31	2	93.9
Dec. 8*	24	11	68.6	39	2	95.1
Dec. 10	12	10	54.5	35	0	100.0
Dec. 10	14	25	35.9	39	5	88.6
Dec. 10	57	37	60.6	156	2	98.7
Dec. 10	26	36	41.9	74	2	97.4
Dec. 10	36	43	45.6	88	0	100.0
Dec. 10*	9	10	47.4	25	4	86.2
Dec. 10*	2	3	40.0	8	2	80.0
Dec. 10*	12	13	48.0	32	1	97.0
Dec. 10*	4	5	44.4	16	0	100.0
Dec. 10*	13	10	56.5	32	0	100.0
Dec. 10*	7	10	41.2	23	0	100.0
Dec. 14	33	38	46.5	115	0	100.0
Dec. 14	42	21	66.7	94	1	98.9
Dec. 16	40	29	58.0	91	0	100.0
Dec. 16	31	41	43.1	105	0	100.0
Dec. 16	59	53	52.7	132	0	100.0
Dec. 20	30	65	31.6	109	0	100.0
Dec. 20	14	9	60.9	46	4	92.0
Dec. 20*	17	8	68.0	31	7	81.6
Dec. 25	25	44	36.2	103	1	99.0
Dec. 25	32	33	49.2	69	2	97.2
Dec. 25	9	19	32.1	42	15	73.7
Dec. 25	31	73	29.8	109	1	99.1
Dec. 25	30	38	44.1	83	1	98.8
Dec. 25*	18	11	62.1	34	2	94.4
Dec. 25*	12	14	46.2	30	2	93.8
Dec. 25*	6	3	66.7	16	0	100.0
Total	786	884		2,163	180	
Mean per pellet			48.0	55.1	4.6	87.7
Standard deviation			12.4	38.7	7.8	20.1

* Sampled pellets.

were present on 24 November. Completely dark juveniles were rare, comprising less than 1% of the population observed. Most were of the pale morph, but with much variation.

Aeshna bonariensis was present in all pellets examined (n = 40, Table 1). *A. bonariensis* was the most abundant prey type on a numerical basis (Table 1), making up 92.3% of total insect numbers in pellets. The average *A. bonariensis* weighed 0.3 g. Heteroptera were the next most numerous prey (3.3%), followed by: Coleoptera other than Carabidae (1.8%), Carabidae (1.6%), Gryllotalpidae (1.2%); other categories counted for less than 1% each. The remaining taxa recorded in pellets were: Hymenoptera, the crab *Chasmagnathus granulata*, mammalian hair, Diptera, Arachnida and unidentified arthropods. The percentage of dragonflies was significantly lower on 24 November, than on the other days (ANOVA $P < 0.0001$; Scheffe's test, $\alpha = 0.05$). The sex ratio of *A. bonariensis* in pellets was not significantly different from unity ($\chi^2 = 2.18$, 1 df, $0.10 < P < 0.25$).

I suspect that scavenged food was present in six pellets. Four contained the legs of the crab *Chasmagnathus granulata*. These common crabs are often run over on the road that passes through the field site. Since it is unlikely that *B. swainsoni* would kill one of these hard-shelled animals, the hawks must have consumed road killed crabs. Hair was discovered in only two

pellets, but no bones were found. The color and length of the guard hairs suggest that they belonged to the opossum *Didelphis albiventer.* This abundant species is probably too large to be killed by *B. swainsoni,* but is also commonly killed on roads.

DISCUSSION

Almost all published reports of the food of Swainson's Hawks report data from North America. In these studies, *B. swainsoni* has been found to be insectivorous except when breeding (Johnson et al. 1987, Palmer 1988b, Johnsgard 1990). My data provide strong evidence that in the wintering range *B. swainsoni* is almost strictly insectivorous. In the study area, they fed largely on migrant swarms of the dragonfly *A. bonariensis.* The numbers of *B. swainsoni* present in the area were highly correlated to the abundance of *A. bonariensis.* Migratory masses of *A. bonariensis* were accompanied by flocks of hawks that left with the dragonflies as they passed. Swainson's Hawks foraged for *A. bonariensis* on the wing. In Argentina, Swainson's Hawks have also been observed standing on the ground, plucking dragonflies from groups sheltering from high winds on the leeside of clumps of vegetation (D. Sterling, pers. comm.).

In a review of dragonfly-eating Nearctic birds, Kennedy (1950) reported that of 30 *B. swainsoni* stomachs examined from North America, only two contained dragonflies. He found no species that relied on dragonflies to the extent reported here. Interestingly, the species that showed the highest proportion of individuals feeding on dragonflies was the Merlin (*Falco columbiarius*), with 421 of 700 stomachs examined containing dragonflies. Some of these specimens were collected while feeding on "migrant swarms" of aeshnids in autumn near New York City, similar to the one described by Osburn (1916). Another raptor that commonly feeds on large flying insects is the Mississipi Kite, *Ictinia mississipiensis* (Bent 1937, Palmer 1988a, Johnsgard 1990). This insectivorous kite also migrates to South America during the non-breeding season.

Migrant swarms of *A. bonariensis* were first reported in Hudson (1895), where he mentions that flights appear only before the south-west "Pampero" wind. The "Pampero" is a strong wind that precedes cold fronts (pers. observ.). Hudson (1895) felt that dragonflies were coming from a long distance since they appeared with the "Pampero" even during heavy drought periods. Dragonfly swarms are unlike other migrations in that they always move in a northerly direction and do not return south (Hudson 1895, pers. observ.). Hudson did not observe *B. swainsoni* following *A. bonariensis.* Aggregations of *B. swainsoni* are seen annually at Punta Rasa during south-west winds (E. Bremer, pers. comm.), the same conditions that bring *A. bonariensis.*

The migrant dragonfly *Anax junius,* has been observed to swarm in an equal sex ratio (Osburn 1916), and in most dragonflies the ratio is roughly 50:50 (S. Dunkle, pers. comm.). The sex ratio of *A. bonariensis* found in pellets did not differ significantly from unity. Male *A. bonariensis* are more brightly colored than the females. Therefore, assuming that the sex ratio of the dragonflies is roughly at unity, hawks apparently do not prefer these more visibly colored individuals.

The percentage of dragonflies per pellet was significantly lower on 24 November, the first day pellets were collected, than on subsequent dates. This date is one day after the first time that *B. swainsoni* were observed associated with an aeshnid movement. Swainson's Hawks are likely opportunistic in their choice of insect food. Other insects may have been as easily available as *A. bonariensis* early in the season.

Adult *B. swainsoni* were only seen on two occasions. Olrog (in Smith 1980) mentioned that he had not observed adult *B. swainsoni* in Argentina. The lack of adults suggests that immatures and adults segregate during winter. Adult *B. swainsoni* banded in Saskatchewan and recovered in Argentina were found both south and north of my study site, but all were west of it (Houston 1968, 1990). Rainfall decreases towards the west, creating the only meaningful ecological gradient within the pampas (Narosky and Yzurieta 1987).

In summary, wintering populations of *B. swainsoni* in the eastern Pampas are composed almost completely of juvenile birds. These individuals feed mainly on the dragonfly *A. bonariensis* during the austral spring and into the middle of the summer. Hawks follow the northbound swarms of migrating *A. bonariensis* in a nomadic fashion, and usually feed on them on the wing. Where the dragonflies go, where they are coming from, and whether Swainson's Hawks follow them through the complete journey remains to be determined.

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NOTES ON THE BIOLOGY OF THE SPOT-FRONTED SWIFT[1]

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Key words: Cypseloides cherriei; *distribution; breeding; nest; nestling; molt; behavior; diet; Ecuador; Colombia.*

The Spot-fronted Swift (*Cypseloides cherriei*) is considered one of the rarest Neotropical swifts (Collins 1980). The species was described by Ridgway (1893) from a single specimen collected by G. K. Cherrie on Volcán Irazú, Costa Rica. No further details were given on date, sex, locality, or whether there was another specimen. Presumably, judging by the date of the description, the type was collected on the southwestern slopes of this volcano, above the city of Cartago, in Cartago Province. Fifty-two years later Zimmer (1945) reported a single specimen collected by Hno. Niceforo María in January 1939 at San Gil, Santander, Colombia. Zimmer (1945) examined the type and a second skin at the U.S. National Museum, which he speculated to be the paratype and that both were collected "on the top of Mt. Irazú"; however, it is doubtful that the summit was easily accessible at the time, and it is more likely that the birds were taken at a lower elevation. Soon thereafter Beebe (1949) reported nine specimens recorded or collected between 26 February and 13 June 1948 at Rancho Grande, Aragua, Venezuela. Subsequently, Collins (1968) reported on two more specimens, found at the British Museum of Natural History, collected by C. F. Underwood on 9 August 1898 at Volcán Irazú, again presumably on the southwestern slope, above Cartago, an area known to have been visited frequently by this collector. Twenty-seven years passed until the next account by Kiff (1975), who reported a single bird taken on 12 June 1971 by E. Fiala at Helechales, Prov. Puntarenas, Costa Rica. Five years later Collins (1980) described the first nest and egg for the species, found on 15 July 1976 near Rancho Grande, Aragua, Venezuela. The first detailed studies on the breeding biology of this species were reported by Marín and Stiles (1992) from the Río Tiribí, on the border between San José and Cartago Provinces, Costa Rica, where several nests were found, and they reported 15 birds either banded or collected. Here we present further information on distribution, breeding, molt, behavior and diet.

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