DIET OF BREEDING WHITE-THROATED AND BLACK SWIFTS IN SOUTHERN CALIFORNIA

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ABSTRACT: We analyzed the diet of nestling White-throated (*Aeronautes saxatalis*) and Black Swifts (*Cypseloides niger*) in southern California. White-throated Swifts fed their nestlings on boluses of insects more taxonomically diverse, on average (over 50 arthropod families represented), than did Black Swifts (seven arthropod families, primarily ants). In some cases White-throated Swift boluses contained primarily one species, while other boluses showed more variation. In contrast, all Black Swift samples contained high numbers of winged ants with few individuals of other taxa. Our results provide new information on the White-throated Swift's diet and support previous studies of the Black Swift.

Swifts are among the most aerial of birds, spending most of the day on the wing in search of their arthropod prey. Food items include a wide array of insects and some ballooning spiders, all gathered aloft in the air column (Lack and Owen 1955). The food habits of a number of species of swifts have been recorded (Collins 1968, Hespenheide 1975, Lack and Owen 1955, Marín 1999, Tarburton 1986, 1993), but there is still little information available for others, even for some species that are widespread and common. Here we provide data on the prey size and composition of food brought to nestlings of the White-throated (*Aeronautes saxatalis*) and Black (*Cypseloides niger*) Swifts in southern California. The White-throated Swift is a common resident that nests widely in southern California, while the Black Swift is a local summer resident, migrating south in late August (Garrett and Dunn 1981, Foerster and Collins 1990).

METHODS

When feeding young, swifts of the subfamilies Apodinae and Chaeturinae return to the nest with a bolus of food in their mouths (Collins 1998). This bolus is passed to the nestlings. Each bolus, made up of an array of arthropods loosely stuck together with saliva, can contain only a few large items or several hundred small ones (Lack and Owen 1955, Collins unpubl. data). We collected five boluses from adult White-throated Swifts (subfamily Apodinae) returning to nests in a man-made structure in Glendale, Los Angeles County, California. All collections were made between 14:00 and 16:00 on 6 June 1997, 6 and 27 July 1999, and 21 June and 28 July 2000, in conjunction with banding and studies of nestling growth at this site. We collected boluses infrequently in order to minimize disturbance and possible effects on the study of nestling growth (Collins unpubl. data). The dominant land-cover type within 15 km of the nest site is urban with some areas of chaparral, coastal scrub, and montane hardwood forest (Davis et al. 1998).

Black Swifts and other members of the subfamily Cypseloidinae carry a larger mass of food in the esophagus, enabling them to return to provision the nestling at longer intervals, perhaps only once or twice a day (Collins 1998, Marín 1999). While we were banding the swifts, we took four samples of this esophageal food mass on 7 August 2000 from adults returning at dusk to nests at Lawlor Falls, located in the San Jacinto Mountains near Idyllwild, Riverside County, California. Foerster (1987) and Marín (1999) previously studied Black Swifts at this site. The dominant land-cover types within 15 km of this site are chaparral, montane hardwood forest, ponderosa pine (*Pinus ponderosa*), Jeffrey pine (*P. jeffreyi*), urban, coastal scrub, and annual grassland (Davis et al. 1998).

We stored the food samples in 70% ethanol for later analysis. We sorted the samples under a dissecting microscope and, using Borror et al. (1989), identified the prey to order and, when possible, to family. Using an ocular micrometer, we measured the body length of each prey item to the nearest 0.1 mm. Standard deviations are reported along with mean values.

RESULTS AND DISCUSSION

White-throated Swifts fed on a variety of prey with Hemiptera (bugs, hoppers; 41.86 %), Psocoptera (bark lice; 27.24%), and Diptera (flies; 21.94 %) being the dominant orders represented (Table 1). Over 50

Table 1 Arthropod Composition of Five Boluses of White-throated Swift Prey[a]

	Bolus				
Order and Family (or Superfamily)	1	2	3	4	5
Hymenoptera (ants, wasps, bees: 6.58%)					
Andrenidae	—	2	2	—	2
Apidae	3	—	—	—	—
Braconidae	—	—	1	—	—
Eupelmidae	—	1	—	—	—
Formicidae	—	—	2	1	—
Halictidae	—	—	2	1	—
Ormyridae	—	—	1	—	—
Pteromalidae	—	—	10	2	—
Torymidae	—	—	1	4	—
Superfamily Cynipoidea	—	—	1	—	—
Hemiptera (bugs, hoppers: 41.86%)					
Achilidae	—	1	—	—	—
Aphididae	—	26	1	23	3
Berytidae	—	—	—	3	—
Cercopidae	—	—	4	—	—
Cicadellidae	1	—	3	139	2
Lygaeidae	—	—	2	7	—
Miridae	—	—	1	—	—
Psyllidae	—	1	—	—	—

(continued)

Table 1 *(Continued)*

Order and Family (or Superfamily)	Bolus 1	2	3	4	5
Reduviidae	—	—	4	—	—
Rhopalidae	—	—	—	1	—
Scutelleridae	—	—	1	—	—
Superfamily Fulgoroidea	—	—	1	—	—
Unknown	—	—	5	—	—
Diptera (flies 21.94%)					
Agromyzidae	—	1	—	—	—
Bibionidae	—	—	10	—	—
Bombyliidae	—	—	—	—	5
Calliphoridae	—	—	1	—	—
Cecidomyiidae	—	1	—	—	—
Chloropidae	—	—	—	1	—
Conopidae	—	—	1	—	—
Empididae	—	—	—	—	5
Muscidae	—	1	2	2	—
Oestridae	—	—	—	—	1
Pipunculidae	—	1	1	—	1
Scenopinidae	—	—	2	—	—
Sciaridae	—	—	—	1	—
Sciomyzidae	—	—	—	—	1
Simuliidae	—	—	—	—	1
Sphaeroceridae	—	—	—	1	—
Stratiomyidae	—	—	3	—	—
Syrphidae	—	—	1	—	3
Tachinidae	—	—	4	—	1
Tephritidae	—	—	1	—	—
Therevidae	—	—	32	—	31
Trixoscelididae	—	—	—	—	1
Section Acalyptratae	—	1	—	—	—
Unknown	—	2	—	—	—
Coleoptera (beetles: 1.28%)					
Elateridae	—	—	1	—	—
Melyridae	—	—	1	—	1
Anobiidae	—	—	2	—	—
Superfamily Curculionoidea	—	—	2	—	—
Psocoptera (bark lice: 27.24%)					
Liposcelidae	—	—	122	22	3
Unknown	—	—	—	—	2
Lepidoptera (butterflies, moths: 0.18%)					
Unknown	—	—	—	—	1
Thysanura (silverfish: 0.18%)					
Lepismatidae	—	—	—	—	1
Araneae (spiders: 0.73%)					
Unknown	—	—	3	—	1
Total	4	38	231	208	66

[a]Values are the number of individuals (by family) for each bolus. The percentage of arthropod orders from the pooled boluses is also given. The orders Hemiptera and Homoptera of Borror et al. (1989) are combined under the Hemiptera.

different families of arthropods were identified from among the 547 prey items contained in the 5 boluses (Table 1). The mean number of individuals per bolus was 109.4 ± 103.1, range 4 to 231. Taxonomic diversity also varied from bolus to bolus. For example, one bolus contained three individuals of the family Apidae (bees) and one member of the family Cicadellidae (leafhoppers), while another contained representatives of 33 families in 6 orders. Two boluses contained many individuals belonging almost entirely to a single taxon (in one case Cicadellidae, in the other Psocoptera). In other boluses these same taxa were represented only minimally (Table 1).

The size of White-throated Swift food items also varied extensively. Mean body length of prey items in millimeters was 3.9 ± 2.0, range 0.7 to 16.7, in the pooled sample of 5 boluses (Figure 1). As expected, some boluses contained fewer large insects, while others had many smaller ones (Table 1). Large, heavy-bodied, or wingless insects were hardly represented, as all prey items were gathered in the air column by flying adult swifts. However, two individuals of the heavy-bodied superfamily Curculionoidea (weevils) were captured, as was one small thysanuran (silverfish), the latter perhaps having been carried aloft by wind currents along with a single ballooning spider. Glick (1939) found thysanurans at altitudes of 330 m, with a single individual captured at over 2500 m. Many other small, weakly flying insects recorded in these boluses may have similarly been passively carried aloft by air currents to the altitudes at which White-throated Swifts typically forage.

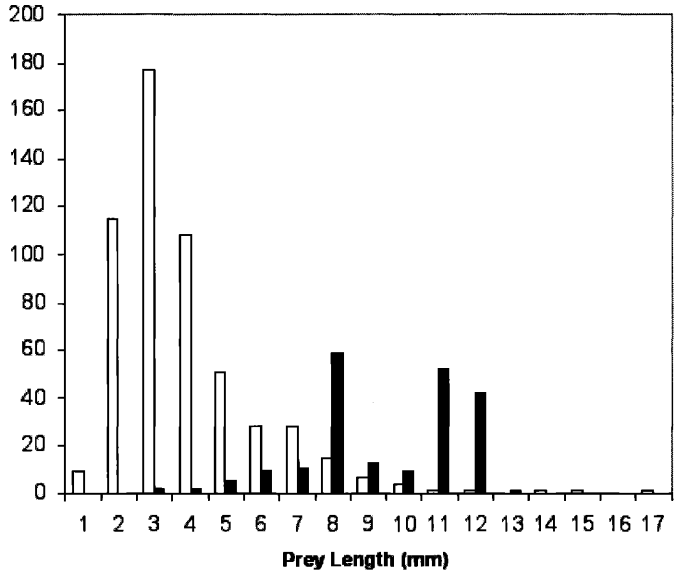

Figure 1. Distribution of arthropod body lengths in combined food boluses of White-throated Swifts (n = 5) and Black Swifts (n = 4), pooled in 1-mm size classes. Size classes contain prey items 0.5 mm greater than and less than the defining length.

The Black Swift samples had a mean number of prey items of 51.5 ± 9.6 and were much less diverse taxonomically than the White-throated Swift boluses: 94% of the prey items were of the family Formicidae (winged reproductive ants), species *Solenopsis xyloni* and *Crematogaster mormonum* (Table 2). Also represented were several hemipterans (bugs, hoppers) and dipterans (flies; Table 2). The mean body length in millimeters of all of the prey items in the pooled sample was 9.5 ± 2.2, range 2.7 to 12.8 (Figure 1).

Previous studies of the White-throated Swift ranked only the relative abundance of insect orders in the diet and did not quantify the numbers of each prey type or provide identification below the level of order (Bent 1940, Hespenheide 1975). The high taxonomic diversity of prey items and extreme variation from bolus to bolus agree with data from previous studies of other swifts (Lack and Owen 1955, Collins 1968, 1980, Bull and Beckwith 1993, Tarburton 1986, 1993). It also suggests that White-throated Swifts, like most swifts in the subfamilies Chaeturinae and Apodinae, are opportunistic foragers, quick to exploit localized abundances of prey, and readily consume any available prey within a preferred size range. Within the Apodinae, White-throated Swifts (body mass 32.1 g; Ryan and Collins 2000) took, on average, larger prey than the smaller Horus Swift (*Apus horus*: 27.9 g; Collins 1980) and smaller prey than the substantially larger Common Swift (*Apus apus*: 42.8 g; Gladwin and Nau 1964) and Alpine Swift (*Apus melba*: 108 g; Cramp 1985).

The Black Swift appears to be a more specialized forager, concentrating on patchily distributed swarms of lipid-rich insects in the form of winged reproductive ants. These swarms emerge every two to four weeks from June through August, typically a few days after rainfall (*Solenopsis* spp., Hooper

Table 2 Arthropod Composition of Four Samples of Black Swift Prey[a]

	Sample			
Order and Family	1	2	3	4
Hymenoptera (ants, wasps, bees: 94.66%)				
Formicidae	51	42	38	64
Hemiptera (bugs, hoppers: 4.37%)				
Cicadellidae	—	—	4	—
Pentatomidae	—	—	1	—
Reduviidae	—	1	—	—
Unknown	3	—	—	—
Diptera (flies: 0.97%)				
Culicidae	—	—	1	—
Chironomidae	—	—	1	—
Total	54	43	45	64

[a]Values are the number of individuals (by family) for each sample. The percentage of arthropod orders from the pooled samples is also given. The orders Hemiptera and Homoptera of Borror et al. (1989) are combined under the Hemiptera.

Table 3 Characteristics of Black Swift Prey Revealed by Four Studies

Mean prey length (mm)	Number of prey items	Range	% Formicidae	Number of samples	Source
9.9, 10.2[a]	289	7.3–12.9	98%	2	Foerster (1987)
7.4	1154	1.8–14.5	91%	10	Marín (1999)
9.5	206	2.7–12.8	94%	4	This study
8.66	276	2.0–12.0	72%	2	Collins and Landy (1968)

[a]Separate means for each of two samples.

1995) The data from this study are in close agreement in both taxonomic distribution and average prey size with previous samples obtained at the Lawlor Falls colony (Table 3) between 1982 and 1985 (Foerster 1987, Marín 1999), as well as with samples from Black Swifts nesting in Veracruz, Mexico (Collins and Landy 1968). These data represent the first case of replicate sampling of the diet of a swift at the same location over a period of many years. Such replication helps avoid misinterpretation due to short-term seasonal or annual variation. Other species of swifts in the Cypseloidinae show a similar tendency to concentrate their foraging on lipid-rich swarming reproductive insects like ants and termites (Collins 1968, Whitacre 1991, Marín and Stiles 1992). They may also adjust their breeding seasons to coincide with the time this resource is maximally available (Marín 1999).

Additional studies of other species of swifts are needed to clarify possible variation in diet by season, from year to year, from location to location, and under varying weather conditions.

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