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Willow Flycatcher nestling parasitized by larval fly, *Protocalliphora cuprina*.—Blowfly larvae of the genus *Protocalliphora* (Diptera: Calliphoridae) are hematophagous parasites that feed on nestlings of nidicolous birds. With the exception of *P. aenea* (Halstead, unpubl. data) and *P. hirudo* which are subcutaneous parasites, all other Nearctic species of *Protocalliphora* are intermittent ectoparasites that live largely in the nest material (Gold and Dahlsten 1983, *Wilson Bull.* 95:560–572, 1983). Death of the host from infestation is uncommon (Whitworth 1976, Ph.D. diss., Utah State Univ., Logan, Utah; Gold and Dahlsten 1983). This note reports the first occurrence of *P. cuprina* on the Willow Flycatcher (*Empidonax traillii*).

On July 16, 1987, while banding Willow Flycatcher nestlings in Long Meadow, a Sierran montane meadow, elevation 2135 m, in Fresno County, California, we found a blowfly larva feeding near the cloaca of one nestling. The larva was collected, reared to adulthood, and sent to the Systematic Entomology Laboratory, USDA-ARS for identification. Since banding was initiated in 1983, 33 nestlings from 26 nests have been banded. No other blowfly larvae were noticed during this time.

Sabrosky (pers. comm., unpubl. data) reports 12 hosts for *P. cuprina*, of which two are flycatchers, the Dusky Flycatcher (*E. oberholseri*) and Western Flycatcher (*E. difficilis*). Our information adds the Willow Flycatcher to the hosts of *P. cuprina*.

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Flexible incubation system and prolonged incubation in New Zealand Snipe.—Shorebirds of the family Scolopacidae (Charadriiformes) have a wide variety of mating systems (Jenni 1974, Pitelka et al. 1974, Pienkowski and Greenwood 1979). Monogamy, with shared incubation of the same clutch, is presumed to be the primitive mating system (Jenni 1974, Pitelka et al. 1974). However, in a number of species, male or female emancipation has led to uniparental care by either sex (Hogan-Warburg 1966, Norton 1972, Pitelka et al. 1974, Reynolds 1987), or both sexes incubate different clutches simultaneously (Parmelee and Payne 1973, Hildén 1975, Pienkowski and Greenwood 1979). Species with shared incubation of the same clutch keep the eggs covered almost continuously (Norton 1972), while shorebirds

with single-sex incubation have an incubation constancy of 80–90% (Drury 1961, Parmelee 1970, Norton 1972, Cartar and Montgomerie 1985, Lofaldli 1985), because the incubating parent must divide time between nest attentiveness and food gathering (White and Kinney 1974, Lofaldli 1985). The incubating parent may take frequent foraging excursions which are short enough to maintain the eggs above physiological zero temperature (Lofaldli 1985, Kalas 1986), or it may take longer feeding trips, allowing the eggs to cool (Lill 1979).

New Zealand snipe *Coenocorypha* are typically monogamous, with shared incubation. However, in a study of 20 pairs of Snares Island Snipe (*C. aucklandica huegeli*) over six years, I observed simultaneous polygyny by two different males in separate field seasons. The remaining males were all monogamous. Here I document the incubation system associated with polygyny (three nests) and compare it with that of typical, monogamous pairs (37 nests). The polygynous males devoted almost all of their parental effort to one nest. The additional females incubated by themselves; thus, the incubation system became more like that found in other snipes (i.e., female, single-sex, intermittent incubation; Tuck 1972, Cramp and Simmons 1983, Lofaldli 1985). Both solo-incubating females paired monogamously and shared incubation with their mates in previous seasons.

Study area and methods.—Snares Island Snipe were studied in *Olearia* forest on the Snares Islands (48°01'S 166°36'E) south of New Zealand. Six visits to the study area were made each summer beginning in 1982. The most intensive work was carried out from 2 Nov. 1985 to 10 Mar. 1986, and from 22 Oct. 1986 to 20 Feb. 1987. All adult snipe within the 7.5-ha study area individually were color banded for the duration of the study. Territories and home ranges of snipe were plotted in relation to a 20-m grid system during daily surveys of the study area. Pairs were identified by mating, courtship feeding, or prolonged consorting. Snipe were sexed by measurements during handling (females are larger; Miskelly, unpubl. data) and by sex-specific calls and displays after marking. Most breeding attempts were detected during incubation; laying dates for nests with shared incubation were recorded directly, or calculated from hatching dates by subtracting 22 days for incubation (determined from three nests) and three days for egg interval (determined from five nests; the typical clutch is two eggs). Incubation length was taken as the time from laying of the second egg to hatching of either egg. Eggs, when found, were weighed to 0.5 g and measured to 0.1 mm. Fresh egg masses were obtained before incubation for 9 eggs. For nests with single-sex incubation, fresh egg masses were calculated using the equation: $M = 0.000526 \times L \times B^2$, where M is initial egg mass (g), L is egg length (mm) and B is maximum egg breadth (mm). Nests were checked at least once daily, and more frequently during hatching. If no bird was sitting, the eggs were touched to determine whether they were warm. Blinds were erected near four nests (one with female single-sex incubation), and five continuous 24-h watches were undertaken. A chart recorder, light beams and photo-electric cells were used to record incubation constancy at two nests with shared incubation in November–December 1987. Daily air temperatures were taken within the study area.

Results.—*Case 1.* Of 20 territory-holding males in the study area in 1985–86, one (Male A) had two mates simultaneously. Initially he courted only Female A, his mate of the previous three seasons. Female A was suspected to have commenced incubation about 24 Nov., as she was not seen during surveys of the study area after 23 Nov.; her nest (Nest 1) was not found until 5 Dec. The male commenced courting Female B on 22 Nov., the day after the estimated first egg-laying date of Female A. Male A and Female B shared incubation at Nest 2, which was found on 9 Dec. Both eggs in Nest 2 hatched on 21 Dec., giving estimated laying dates of 27 and 30 Nov. Female A at Nest 1 incubated by herself. No other birds were seen during 57 spot checks over 28 days at Nest 1. Female A frequently left the nest for extended periods to feed (over 100 min on one occasion), during which the eggs cooled to ambient temperature (7.5–19.0°C). Egg mass loss at this nest over 23 days averaged

TABLE 1
INCUBATION DETAILS FOR NEW ZEALAND SNIPE UNDER TWO DIFFERENT INCUBATION REGIMES

Incubation regime	Shared	Solo		
	N = 37	Case 1 (Nest 1)	Case 2 (Nest 4)	Case 3 ^a (Nest 5)
Clutch size	2	2	2	2
% Female incubation	38 ^c	100 ^d	99.9 ^f	100 ^g
Incubation constancy (%)	100 ^c	ca 69 ^e	72 ^f	—
Egg mass loss (gd ⁻¹)	0.182	0.125	—	—
Incubation length ^d	22	37–39	Failed	Unknown
Male reproductive success ^b	≤2	3		≤4 ^h
Female reproductive success	≤2	1		≤2 ^h

^a For first 5 days only, after which incubation was shared.

^b Measured as number of young raised to fledging in one breeding season.

^c Obtained from 24-h recordings at 5 different nests.

^d From 57 nest checks over 28 days.

^e Estimated from rate of egg mass-loss (see text).

^f From two 24-h watches.

^g From 7 nest checks over 5 days.

^h Cases 2 and 3 refer to the same male and female in the same breeding season.

69% of that found for nests with shared incubation (Table 1). Using my equation to obtain fresh egg weights, and assuming a constant rate of water loss (Drent 1970, Rahn and Ar 1974), it appeared that incubation at Nest 1 started about 26 Nov. (cf. 24 Nov., determined by behavior). Water loss probably occurred mainly during active incubation in the humid environment of the Snares Islands, as a fresh egg which was deserted had lost no measurable mass after seven days in the nest; this suggests that incubation constancy at Nest 1 was approximately 69%. Both eggs in Nest 1 developed fully, although one chick died while hatching. Hatching occurred 28 days after the nest was found and 37–39 days after the estimated start of incubation, which is 68–77% longer than normal. The surviving chick from Nest 1 and both chicks from Nest 2 were raised to fledging.

Case 2. Male A and Female B disappeared between Mar. and Oct. 1986. In 1986–87 Male B from an adjoining territory defended an enlarged area which combined both males' territories. He courted three females: Female A, the solo-incubating female of 1985–86; Female C, his mate from 1985–86; and Female D, a female from another previously adjoining territory, whose mate had also disappeared. Male B was seen mating with Female A on 13 and 14 Nov. Female A laid eggs on 22 and 25 Nov. (Nest 3) and shared incubation with Male B; the eggs hatched on 17 and 18 Dec. Between incubation shifts at Nest 3, Male B courted Females C and D and was seen mating with Female D on 26 and 27 Nov. Female C probably laid eggs soon after 15 Dec. when she was captured and determined (by palpation) to be near egg-laying condition. Female C is presumed to have deserted early in incubation, since she was paired with another male by 21 Jan. Female D was found incubating two eggs (Nest 4) on 27 Dec., although she was suspected (by behavior and egg masses) to have commenced incubation about 16 Dec. Male B was caring for a nine-day-old chick from Nest 3 when Nest 4 was found. Female D incubated largely by herself for the next 11 days, although the male visited the nest up to four times a day and incubated for short periods (e.g., a 5-min shift during a 24-h watch on 30 Dec.). The female fed for long periods (up to

11 h 55 min) after replacement at the nest by the male; but as the male left the nest soon after the female, the eggs were uncovered for much of this time. Incubation constancies during 24-h watches at Nest 4 on 30 Dec. and 5 Jan. were 60% and 83%, respectively. Nest 4 was deserted about 7 Jan., about 22 days after incubation started. Both eggs contained half-developed embryos; I do not know if the embryos were alive when the nest was deserted.

Case 3. Female D relaid in a new nest (Nest 5) on 5 and 8 Feb. 1987, and incubated solo for the next five days. Male B continued to care for his 7.5-week-old chick from Nest 3 until 13 Feb., when he commenced his full share of incubation at Nest 5. Incubation at Nest 5 was continuing when I left the island on 20 Feb., so Male B potentially fathered four chicks during the breeding season (cf. a maximum of two for a monogamous male).

Discussion.—Other shorebirds have flexible mating and incubation systems. Spotted Sandpiper (*Actitis macularia*) (Hays 1972, Maxson and Oring 1980) and Eurasian Dotterel (*Eudromias morinellus*) (Kalas 1986) usually have male, single-sex, intermittent incubation, but females occasionally assist. Incubation constancy at Eurasian Dotterel nests where both sexes incubated was similar to nests where the male incubated alone; no decrease in incubation length with shared incubation was found (Kalas 1986). Solo incubating male Wilson's Plovers (*Charadrius wilsonia*) increased their time on the nest significantly, but there was a decrease in total incubation constancy compared with nests where incubation was shared (Bergstrom 1981). There was no concomitant increase in incubation length with single-sex incubation in Wilson's Plovers, possibly because the change in incubation pattern occurred late in incubation, and the ambient temperatures were much higher than on the Snares Islands (Bergstrom 1981). Lessells (1983) experimentally induced extended, successful incubation by one parent in Kentish Plovers (*C. alexandrinus*) analogous to the situation for New Zealand Snipe. Warriner et al. (1986) also recorded successful single-parent incubation by Kentish Plovers, for up to 10 days (by one male) and 7 days (one female), but this occurred only if the mate deserted after the 16th day of incubation. Erckmann (1983) found that neither males nor females were able to incubate alone in Western Sandpipers (*Calidris mauri*).

New Zealand Snipe incubating by themselves did not achieve incubation constancies of other scolopacids with single-sex, intermittent incubation (80–90%; Norton 1972, Cartar and Montgomerie 1985, Lofaldi 1985), although solo-incubating females did increase the time spent at the nest compared with females at nests with shared incubation (Table 1). Eggs cooled to ambient temperature during feeding excursions and did not remain above physiological zero temperature as found during the shorter excursions of shorebirds with single-sex incubation (Lofaldi 1985, Kalas 1986). Decrease in incubation constancy at nests with single-sex incubation caused a concomitant increase in incubation length. Delayed development is also the main effect of egg neglect in other birds (Boersma and Wheelwright 1979, Boersma 1982 and references therein, Murray et al. 1983, Sealy 1984). However, increase in incubation length in New Zealand Snipe resulted from a change in incubation regime rather than by periods of egg neglect within the normal incubation pattern (as occurs in all other species with variable incubation length; see references above).

Female New Zealand Snipe incubating by themselves had low hatching success. Males benefited from emancipation as additional breeding opportunities increased their reproductive success compared with monogamous males. However, male emancipation was rare, and female single-sex incubation was observed only for two of 43 female-years. The change from shared to single-sex incubation resulted in a decreased incubation constancy and delayed embryonic development, with one female successfully hatching an egg after an incubation length 68–77% longer than normal.

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Food sharing by sibling Common Barn-Owls.—Interactions among nestling Common Barn-Owls (*Tyto alba*) range from cannibalism (Baudvin 1975, Colvin 1984, Lenton 1984, pers. obs.) to food sharing (Bunn and Warburton 1977, Epple 1979). In this paper I present the first documented case of food sharing among siblings in the North American race of the Common Barn-Owl (*T. a. pratincola*).

I observed food deliveries of adult barn-owls and food consumption behavior of their young in an abandoned agricultural silo in Davis County, Utah. Observations were made at a distance of less than 1 m. I watched through a one-way mirror in the back of a nest box lighted from within by a small battery-powered bulb. I made 27 h of observations on five nights over a 4-week period in April and May 1983.

Initial observations occurred during 4 h on 14 April when the four nestlings ranged from 7 to 14 days of age. The adult female remained in the box with the young on this night and spent most of her time brooding. When the male delivered prey, she tore it into pieces and fed it to the young. On the second night of observation, 26 April, the young were 19–26 days old. Both adults brought food to the young but neither entered the box. Nine prey items, all small rodents, were delivered during the 9.5-h activity period. The two oldest young obtained most of the prey items because of their greater size and agility. I did not see the youngest owlet eat on this night. Observation was limited to the first 2 h of activity on 30 April during which the same pattern was seen as on 26 April. On 3 May all four young still survived and were 24–31 days old. The adults delivered a total of 15 prey items over 9.5 h, mostly rodents and shrews. Each time an adult arrived at the nest, all of the young rushed to meet it. Once an owlet had control of a prey item, there was little, if any, attempt by the others to wrest it away. The largest owlet obtained and ate prey brought in delivery numbers 1, 2, 3, 5, 7, and 9. The next largest young obtained and ate prey from deliveries 6 and 8, and the third largest ate item 4. One of the smallest two young ate the prey delivered 12th. Despite having eaten six prey items and apparently being satiated, the largest young persisted in rushing to meet adults arriving with food. It also managed to obtain the prey brought in deliveries 10, 11, 13, 14, and 15, but made no attempt to eat