BIOLOGY OF THE HOUSE SWIFT *APUS NIPALENSIS* (HODGSON) IN VIETNAM

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RÉSUMÉ. — *Biologie du Martinet des maisons* Apus nipalensis nipalensis *(Hodgson) au Viêt-Nam*. — Un total de 6 000 à 7 000 Martinets des maisons nicheurs ont été recensés en 1944 et 1995 au Viêt-Nam, dans les provinces de Lam Dong, Binh Thuan, Khanh Hoa ainsi qu'à Ho Chi Minh Ville. Tant par leurs dimensions que par leur masse il correspondent bien aux oiseaux topotypiques du Népal. La plupart des nids sont établis sous les toits de vieilles maisons d'architecture française, et quelques-uns dans des falaises loin des habitations. La saison de reproduction dure de 164 à 168 jours, et deux nichées sont produites habituellement. Les gonades et les glandes salivaires des oiseaux suivent un cycle annuel en rapport avec le cycle reproducteur. La taille moyenne de la première nichée fut d'environ 2,4 œufs en 1994 et 1995, et celle de la seconde nichée à peu près moitié moindre en 1995. En 1994 le succès de la reproduction de la première nichée fut de 1,55 jeunes par nid. En 1995 il fut de 1,03 jeunes par nid pour la première couvée et de seulement 0,62 pour la seconde. Au Viêt-Nam, les Martinets des maisons muent toute l'année, sauf en janvier. Leur nourriture se compose d'insectes volants et en particulier d'Hyménoptères, d'Isoptères, de Coléoptères, d'Hémiptères et de Diptères. La composition de la nourriture que reçoivent les poussins diffère quelque peu de celle des adultes. Le spectre alimentaire des adultes est semblable à celui de la Salangane à nid blanc *Aerodramus fuciphagus germani*, mais il est plus étroit en termes de diversité et plus large en termes de masse des proies. Comme ces deux espèces vivent l'une près de l'autre depuis des temps immémoriaux, la compétition alimentaire entre elles doit être assez limitée mais les choses pourraient changer si les insectes volants devenaient moins abondants, par exemple à la suite d'un usage intense de pesticides.

SUMMARY. — A total of 6 000-7 000 House Swifts *Apus nipalensis nipalensis* were censused breeding in the provinces of Lam Dong, Binh Thuan, Khanh Hoa as well as in Ho Chi Minh City, Vietnam in 1994 and 1995. By their dimensions and mass they agree well with topotypical specimens from Nepal. Most nests are established in old houses of French architecture, and some in cliffs in the wild. The breeding season lasts 164-168 days, and two broods are usually produced. Gonads and salivary glands follow a yearly cycle according to the bird's breeding cycle. The average size of the first clutch was about 2.4 eggs in 1994 and 1995, and that of the second clutch about half of this value in 1995. In 1994, the breeding success for the first clutch was 1.55 young per nest, and only 1.03 in 1995. That year, it was just 0.62 young for the second clutch. Vietnamese House Swifts moult almost all the year round, except in January. Its food consists in flying insects, above all Hymenoptera, Isoptera, Coleoptera, Hemiptera and Diptera. The food delivered to chicks differs somewhat from that of adults. The food spectrum of the House Swift in Vietnam is similar to that of the White-nest Swiftlet *Aerodramus fuciphagus germani*, but is narrower in terms of diversity, and larger in terms of prey mass. As both species lived alongside since time immemorial, they manage to limit competition between them, but things may change in the future if flying insects become less abundant, for instance following a widespread use of pesticides.

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The House Swift *Apus nipalensis* (Hodgson, 1837) is an Asiatic species which breeds willingly in buildings and is distributed from the Himalayas across Assam and Bengladesh to the Chinese Sea and southern Japan, Sumatra, Java and Borneo (Chantler, 1999). It has long been considered conspecific with the Little Swift *Apus affinis* (J.E. Gray, 1830), which is spread from Africa south of the Sahara and the Maghreb to Pakistan and India, but its range meets that of the House Swift in the Himalayas without any sign of intergradation (Snow, 1978), and now the two taxa are usually considered as allospecies (Sibley & Monroe, 1990; Chantler, 1999). The subspecies present in Vietnam was long thought to be *A. nipalensis subfurcatus* (Blyth, 1849) (Delacour & Jabouille, 1931; Vo Quy, 1975; Vo Quy & Nguyên Cu, 1999), but Brooke (1971) showed that it belongs in fact to the nominate subspecies *A. nipalensis nipalensis* (Hodgson, 1837), a conclusion retained by Chantler & Driessens (1995) and Chantler (1999).

During our field-work on the White-nest Swiftlet *Aerodramus fuciphagus germani* in Vietnam (Nguyên Quang *et al.,* 2002), our attention was drawn to the House Swift as a potential competitor of this latter species for food and breeding sites. From 1993 to 1995 we carried out systematic biological observations on the House Swift, the biology of which has been little studied, contrary to that of the Little Swift, which is much better known.

METHODS

The main part of our work was carried out in 1994 and 1995 in Da Lat (Lam Dong province). Complementary observations were conducted in the towns of Phan Tiêt (Binh Thuân province) and Ho Chi Minh City, as well as in few places in the Khan Hoa province. Da Lat is a locality at 1 500 m of altitude and houses the largest House Swift population in Vietnam. It enjoys a more temperate climate than the coast, with air temperature between 15 and 20°C, sometimes going down to 5° in winter mornings. On the contrary, the climate of the other coastal localities is tropical, with yearly temperatures between 25 and 30°C. All these places receive abundant rainfall, most of it during the summer and/or autumn months.

House Swift colonies were censused by walking through the streets and making enquiries of local people. In each colony, nests were counted or, when access was not possible, estimated as exactly as possible. Observations on the breeding biology were conducted on nest samples chosen in Da Lat (182 nests in 1994, 207 in 1995, total 389), Hô Chi Minh City (50 nests each year) and in Nha Trang, Khanh Hoa (20 nests each year). The chicks of these nests were weighed and measured at intervals of five days from hatching to the time they left their nests.

Ten adult swifts were captured in Da Lat between 25th and 28th of every month at about 18:00. Immediately after capture they were killed, their weight, wing and tail lengths were measured, and their moulting stage assessed. Their salivary glands, gonads and stomach contents were preserved in 70% alcohol. Twenty food-balls delivered to the young by their parents were also sampled for feeding studies. Twenty nests were collected, and the swift saliva connecting their elements was analyzed using the method of Kjeldahl and Soxhlet (Jayaramern, 1988; Boyer, 1993).

As a measure of breeding success we took the percentage of fledged chicks relative to the total number of eggs laid.

RESULTS

Dimensions and mass of the birds

The House Swift populations of the four localities where we worked do not show any significant difference in body size nor weight ($P < 0.05$, Table I). The wing and tail lengths of these birds agree with those of topotypical specimens from Nepal (wing: 128-138 mm, average 132.8; tail: 42-49 mm; n = 22) given by Abdulali (1966), and of birds from coastal China (wing: 134-142; tail 48-55; n = 4) given by Brooke (1971).

The average dimensions and weight of 50 eggs are given in Table II.

Table I

Dimensions and masses of House Swifts from four Vietnamese localities

Locality	Latitude	n	Weight (g)	Wing (mm)	Tail (mm)
Da Lat	11°57	50	30.2 ± 0.75	138.7 ± 3.36	48.5 ± 1.05
Phan Thiêt	10°56	50	30.4 ± 0.70	133.0 ± 2.41	48.0 ± 0.30
Hô Chi Minh City	10°47	20	29.0 ± 0.80	132.0 ± 3.85	48.0 ± 0.20
Khanh Hoa	12°15	20	29.0 ± 0.71	136.0 ± 3.02	48.0 ± 0.20
Mean			29.6 ± 0.75	134.9 ± 3.04	48.1 ± 0.25

n: sample size. No significant difference could be found between localities (Student's t-test, $p > 0.05$).

TABLE II

Measurements and masses of 50 House Swift eggs from Vietnam

Length (mm)	Breadth (mm)	Weight (g)
21-26 (23.2 ± 1.32)	14-16.2 (15.2 ± 0.65)	2.7-3.2 (2.9 ± 0.15)

NUMBERS AND NEST SITES OF HOUSE SWIFTS ACCORDING TO LOCALITIES

In Khanh Hoa, where they are present in small numbers, about two thirds of the House Swifts breed in cliffs on six small coastal islands and the other third in buildings in the towns of Nha Trang and Cau Da, as well as near the train tunnel of Ca pass in the north of that province. In the cities of Da Lat (Lâm Dông province), Phan Thiêt (Binh Thuân province) and Hô Chi Minh City they breed exclusively in buildings (Table III). In the collections of the Muséum national d'Histoire naturelle, Paris, there are two specimens taken in 1926 in Phan Rang (Ninh Thuân) by J. Delacour and P. Jabouille. Now a few pairs still breed in a small crevice in a cliff north of that town. We estimate the total number of House Swift breeding pairs in all these localities to be about 6 000-7 000. House Swifts are by far the most abundant in Da Lat and Phan Thiêt, two towns with numerous houses of French architecture. These houses are lofty, with protuding eves, which make convenient places for the swifts to build their nests. Vietnamese houses use to be rather low, closed structures at roof level, making them unsuitable as sites for the swifts to breed. The rapid urbanization taking now place in Vietnam implies the frequent replacement of old houses by modern ones with closed attics, quite an unfavourable change for the House Swift.

TABLE III

Numbers and location of House Swift nests in four Vietnamese localities

Localities	Numbers of nests		Number of nest sites	
	in houses	on islands	in houses	on islands
Da Lat	2 356-2 400	0	35	0
Phan Thiêt	1 929-2 000	0	10	0
Hô Chi Minh City	400-500	0	14	0
Khanh Hoa	60-65	118-120	4	6

In Vietnam, the White-nest Swiftlet *Aerodramus fuciphagus* nests almost exclusively in caves on offshore islands, rarely on the coast (Nguyên Quang *et al.,* 2002). As it is capable of echolocation, it nests deep inside caves, something swifts cannot do. In these conditions, even if a number of House Swift pairs also breed on offshore islands, there should not be any competition for nesting sites between the two species. Nest building in the wild, away from human structures, is not very usual for the House Swift.

REPRODUCTION

Nest structure

In Vietnam, most House Swifts build their nests on the underside of eves roofs, as usual for the species (Chantler, 1999). These nests are untidy, flat structures made of leaves, needles of coniferous trees, feathers, plumous seeds (i.e. cotton, grown near their colonies), scrap paper, etc., glued together by the bird's saliva. Their shape depends on the space available for the birds to build them, if there is ample room they are more or less rounded. They may cluster in rows up to two meters long. Their average weight is 28 ± 1.3 g (n = 50; range: 25-30 g), and thus much like that of the owner birds. The salivary secretion sticking together the material makes up about 10% of the total mass of the nests. Its basic chemical composition is essentially proteic (Table IV), as that of the White-nest Swiftlet (Nguyên Quang *et al.,* 2002). House Swifts which have lost their nest are able to build a second one within one month.

TABLE IV

Chemical composition of the salivary secretion of the House Swift in Da Lat

Chemical component	% of dry material
Proteins	45.50 ± 0.0151
Glucids	not measured
Lipids	2.49 ± 0.010
Water	14.86 ± 0.010
Ash minerals	1.92 ± 0.0010

The annual reproductive cycle

The first egg-laying period lasts about three weeks in Da Lat, and a few days more in coastal localities. The second egg-laying period starts about 45 days after the first one and is more protracted, lasting about ten days in Da Lat (Table V). The last fledglings of the first clutch leave the nest between 1 and 4 June and those of the second clutch between 12 and 15 September. The second clutch is laid a week or two after the departure of the fledglings of the first one. Egg-laying and fledgling departure occured at the same dates in 1994 and 1995 and in the same locality. In coastal localities like Khanh Hoa or Hô Chi Minh City, the first eggs were laid on 10 March, but in Da Lat, where the climate is cooler than along the coast, they were laid two to three weeks later (Table V). We did not record any third brood in our observation colonies.

TABLE V

Breeding season of the House Swift in three Vietnamese localities

Locality	First clutch		Second clutch	
	Beginning	End	Beginning	End
Da Lat	27-28 March	19-20 April	7-10 June	15-17 June
Ho Chi Minh City	10 March	5-10 April	25-30 May	1-5 June
Khanh Hoa	10 March	5-10 April	25-30 May	1-5 June

As in many Apodid species which use a salivary secretion to glue together the nest material (Chantler, 1999), the sublingual salivary glands of the House Swift follow a yearly cycle in size and weight, being largest during the breeding season (February-August), and mainly so at the beginning of it (March-May) (Fig. 1).

The testes of males increase in weight from the end of February and reach a peak in March. Then they regress rapidly to their quiescent weight in July. A secondary peak was noted in May 1994, that is at the onset of the second laying period. It was not visible in 1995, a year during

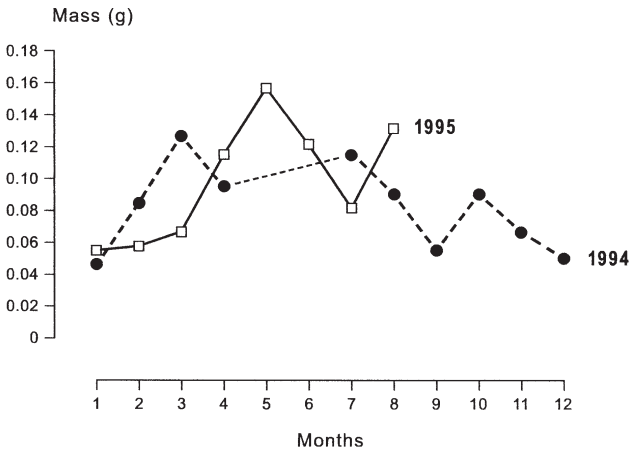

Figure 1. — Change in mass of the sublingual salivary glands of the House Swift in Da Lat in 1994 and 1995. Ten birds were sampled every month.

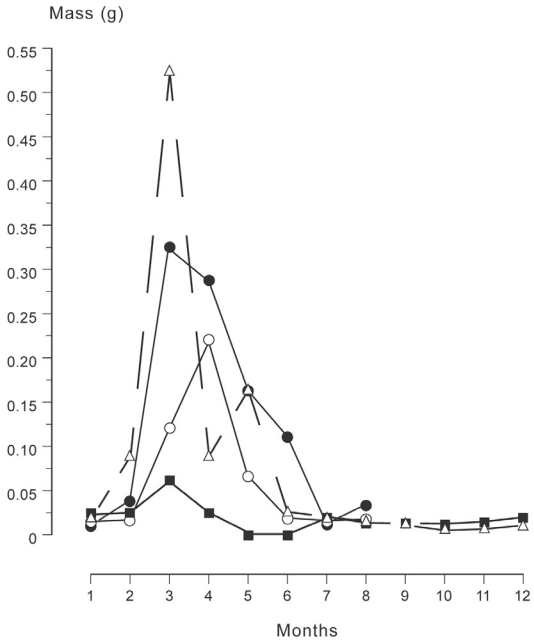

Figure 2. — Change in mass of gonads of House Swifts in Da Lat in 1994 and 1995. Δ : testes (1994), ● : testes (1995), ○ : ovaries (1995), ■ : ovaries (1994). Ten birds were sampled every month.

which the first peak was clearly less well-marked than in 1994 (Fig. 2). In 1995, the female ovaries developed about one month later than the males testes on average, and recovered their quiescent weight about a month earlier, after a well marked peak in April (Fig. 2). In 1994 on the contrary, gonads developed at the same time in both sexes. Ovaries reached a very low peak in March, then regressed and were, on average, below their quiescent weight in May and June.

The average weight of House Swifts in Da Lat reaches a peak during each laying period, separated by a marked low. In 1995, each of these peaks was reached about one month later, and the average weight of the birds from July to March was lower than in 1994 (Table VI). These differences in gonads, salivary glands and weight cycles of the adults from one year to the other were probably related to a reduced food supply in late 1994 and early 1995. During the interbreeding season 1994-95, the average weight of the birds was down to a low point in October, and reached a steep peak in November-December. These variations may be related to seasonal food availability, as the climate in Da Lat is cool in winter, which is not favourable to flying insects.

TABLE VI

Stomach contents and body mass (g) of House Swift in Da Lat in 1994 and 1995

Month	1994 Weight of		1995 Weight of	
	Stomach content	Body	Stomach content	Body
January	0.53 ± 0.25	29.5 ± 0.10	0.41 ± 0.23	29.2 ± 1.35
February	0.53 ± 0.25	29.0 ± 0.12	0.53 ± 0.25	28.6 ± 1.48
March	1.40 ± 0.30	31.0 ± 0.13	0.80 ± 0.33	29.2 ± 0.80
April	0.85 ± 0.22	30.0 ± 0.85	1.17 ± 0.35	31.5 ± 0.93
May	—	—	1.24 ± 0.35	31.0 ± 1.20
June	—	—	0.86 ± 0.33	29.5 ± 1.33
July	1.12 ± 0.35	31.8 ± 0.95	0.49 ± 0.25	31.0 ± 1.05
August	0.62 ± 0.25	30.7 ± 1.25	1.27 ± 0.35	31.8 ± 0.95
September	0.96 ± 0.33	29.6 ± 1.33	—	—
October	0.70 ± 0.25	28.4 ± 1.25	—	—
November	0.87 ± 0.35	32.5 ± 1.05	—	—
December	0.76 ± 0.26	31.8 ± 1.33	—	—

--: no data. N = 10 for every month.

As their salivary glands and gonads only undergo one development cycle a year, and their weight two successive, very close cycles, Vietnamese House Swifts can be considered as having one breeding period with two broods a year.

Our observations on the breeding season of the House Swift in Vietnam are in accordance with the little information we have on the reproduction of this species in other parts of its range. In particular, this species seems to have only one, more or less extended breeding period a year (Chantler, 1999; Table VII). The length of this breeding period suggests that two clutches are generally produced a year, and in fact two or three broods are the rule in Japan (Yamashina, 1982; Nomura & Uchimura, 1987; Hotta, 1996). The birds which we observed took 66-70 days to produce one brood, which is of the same order of magnitude as Hotta's (1996) observation of 74,1 ± 3,8 days in Japan. By contrast, our birds needed 164-168 days to produce two broods, which is about three weeks more than Hotta's birds. This difference may be due to local differences in food availability, the swifts having more food at their disposal during the Japanese temperate summer, but this is still to be verified. Taking into account this difference in breeding cycle length, it seems unlikely that House Swifts in Da Lat produce three broods a year except by exception.

TABLE VII

Breeding periods of the House Swift in several localities (data extracted from Yamashina, 1982, and Chantler, 1999)

Locality	Breeding period	Remarks
Myanmar	II-early X	--
South Japan	IV-late XI	Three laying peaks
Philippines	XII-VIII	--
Borneo	II-VI	--

By contrast, the breeding cycle of the Little Swift *Apus affinis* is quite variable from place to place (Table VIII). One breeding season is recorded in temperate regions, and generally two distinct ones in areas with marked seasonality. In some equatorial regions breeding all year round, or almost so, may occur (Chantler, 1999). In northern India, the subspecies *A. a. affinis* shows two well separated breeding seasons a year, with two distinct development cycles of its gonads, one from October to March, the other from April to September. For each season, the date of the first laying may vary within a few weeks from year to year (Naik & Naik, 1965a,b, 1966; Naik & Razack, 1967).

Clutch size

In Da Lat, the average size of the first clutch was very similar in 1994 (2.42 eggs) and 1995 (2.48 eggs) (Table IX). Four-egg nests were few in number in 1994, but accounted for about one fifth of the total in 1995, three-egg nests were the most numerous in both years. The second clutch was on average much smaller than the first one, and mainly so in 1995, when it was about half of it (Table IX). There were no nests with four eggs in the second clutches in both years, and nests with two eggs were the most frequent in both years. Occupied nests with no eggs accounted for about one sixth (first clutch 1994) to one half (second clutch 1995) of the total. On the contrary, the average size of the first clutch was 1.56 eggs in Hô Chi Minh City in 1993, and 2.07 eggs in 1994. The reasons for this difference are not clear, but we suspect there was some form of human disturbance in 1993.

The large clutches of the Vietnamese House Swift, frequently reaching four eggs for the first brood, are in accordance with the 1-5 eggs mentioned by Chantler (1999). They compare well with the 1-4 eggs (most frequent: 2) indicated for the Little Swift in Northern India by Naik & Razack (1967) and the 2-3 noted by Brooke (1971) and Maclean (1993) in Southern Africa. The much reduced second clutch in 1995 compared to 1994 may probably be put in relation to a reduced food supply, as in the case of the gonads, salivary glands and weight cycle of the adults.

The incubation and nestling periods

In Vietnam, House Swifts incubate their eggs from 23 to 30 days, 25 ± 2.2 days on average. This is a little shorter than the 19-25 days indicated by Nomura & Uchimura (1987) for that species in Japan, but these values were derived only from observations outside the nests.

Our results are in accordance with those given for the Little Swift by Moreau (1942, 1947) in Africa, but seems on average a little longer than those of Maclean (1993) for the same species in the southern part of that continent (Table X). In Vietnam, House Swift chicks leave the nest 40-48 days after hatching, on average 45 ± 2 days, in accordance with the 36-51 days (average 43.6) indicated by Nomura & Uchimura (1987) in Japan. The nestling period of the House Swift is then about ten days longer than that of the Little Swift in Africa (Table X).

TABLE VIII

Breeding periods of the Little Swift at several localities (data extracted from Lack, 1951; Naik & Razack, 1967; Maclean, 1993; Brooke, 1971, 1997; Chantler, 1999; Th. Njiné, T. Snyman and L. Tsagué com. pers.)

Locality	Breeding period	Remarks
North-west Africa	III-VII	
Senegambia	X-VII	
Nigeria	V-XII	Egg-laying
Sao Tomé	VI-VII	Egg-laying
Chad	VI	Egg-laying
South Africa	VIII-IV	
South African Highveld	IX-IV	Two breeding peaks
Zimbabwe	IX-V	Two breeding peaks
Mauretania	II-V and VIII-X	
Sierra Leone	III and IX-X	Egg-laying
Sudan	III and V	Egg-laying
Ethiopia	III-V and VII-VIII	
Malawi	II	
Zambia	X and III-IV	
Zanzibar	IX-I and V	
West African rainforest	All year round	
Yaoundé (Cameroon)	Probably all year round	
South Nigeria	Probably all year round	
Karachi	II-X	
Northern India	X-III and IV-IX	
Israel	III-early IV and VI-VII	Hatching
South India	Almost throughout the year	

TABLE IX

Clutch sizes of House Swift in Da Lat in 1994 and 1995

Year	Clutch	N	Number of eggs per nest (%) 4	3	2	1	0	Average
1994	1	182	4.7	57.7	19.2	0	15.4	2.47
	2	37	0	24.3	52.4	0	24.3	1.76
1995	1	207	20.3	49.3	8.7	1.4	20.0	2.48
	2	207	0	15.0	35.3	2.4	47.3	1.18

N: number of nests examined.

TABLE X

Length, in days, of the incubation and nestling periods of the Little Swift in Africa

Period		Remarks	Source
Incubation	Nestling		
22-28	38-39	Africa in general	Moreau (1942, 1947)
21-24	36-40	Southern Africa	Maclean (1993)

The remiges appear two or three days after hatching, then grow regularly and reach their definitive size when the chicks are 41 days old on average (Fig. 3). Tail quills start to grow later than remiges, about 9-10 days after hatching, and reach their definitive length at about 43 days. At the time of hatching, chicks weight on average 2.2 g, then grow rapidely and reach an average maximum of about 28 g at 32-35 days of age, then loose weight to an average 25 g when they leave the nest, 40-48 days old (Fig. 4). This growth pattern of chicks is typical of Apodids (Chantler, 1999). In the White-nest Swiftlet, it is shown by well-fed chicks only (Nguyên Quang *et al.,* 2002).

Breeding success

The breeding success of the House Swift in Da Lat (Table XI) can be considered as good for the first clutch of the year 1994, when a little less than two-thirds of the eggs laid produced fledglings. Egg mortality was low, while three quarters of the chicks left their nests. On the contrary, breeding success was low in 1995. The survival of eggs and chicks of the first clutch was clearly lower than in 1994, and the number of nests with 1 or 0 eggs was higher. Even though the proportion of four egg nests was higher in the first clutch of 1995, this is matched by a smaller proportion of three-egg and two-egg nests (Tables IX and XI). Even if the survival of eggs and chicks was better for the second clutch in 1995, breeding success was quite low because of a high proportion of nests with no eggs, the absence of four-egg nests as well as a low proportion of three-egg nests. As in the case of clutch size, food availability must have played a role in the low breeding success of 1995. A similar decrease in breeding success was observed the same year in the first and second clutches of the White-nest Swiftlet in Khanh Hoa (Nguyên Quang *et al*., 2002).

TABLE XI

Egg and chick survival and breeding success of the House Swift in Da Lat in 1994 and 1995

Year	Clutch	N	Total number of eggs laid	% eggs hatched	% chicks surviving from hatching	% chicks surviving from egg-laying	Breeding success
1994	1	182	441	86.2	74.2	63.9	1.55
1995	1	207	533	64.2	62.6	40.2	1.03
	2	207	244	72.1	72.7	52.5	0.62

N: number of nests monitored. Breeding success in average fledgling number produced by occupied nest.

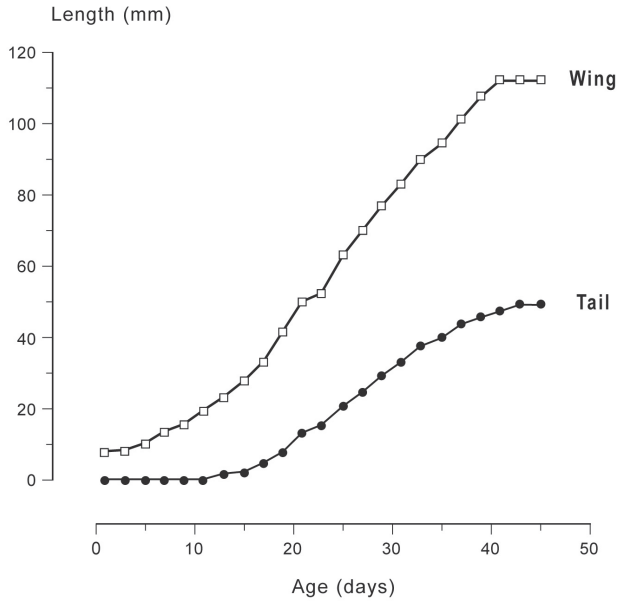

Figure 3. — Growth of the wings and tail of House Swifts chicks in Da Lat.

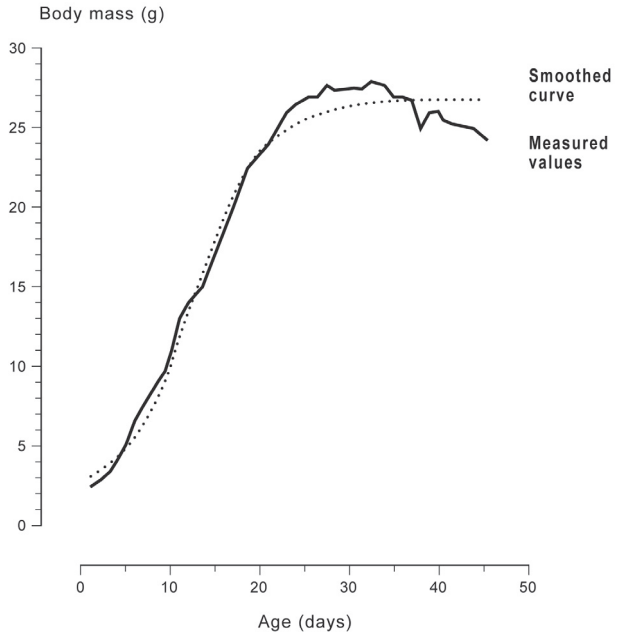

Figure 4. — Growth in mass of House Swift chicks in Da Lat.

One of the factors affecting most egg mortality in the Little Swift is egg ejection (Razack & Naik, 1968), which occurs commonly in Vietnamese colonies of the House Swift (Table XII). It was significantly less frequent (Student's t-test, $p = 0.05$) in the first than in second clutch, and happened more often in nests with more eggs. We were not able to determine the exact causes of this phenomenon in our colonies. Eggs may be ejected accidentally when birds fight over their nests, or because they die naturally. In Japan, Hotta (1994) observed deliberate destruction of eggs by adult non-parents taking over occupied nests. Egg ejection has already been noted in other species of Apodids like the Common Swift *Apus apus* (Weitnauer, 1947; Lack, 1956).

TABLE XII

Egg ejection rates for the the House Swift in Da Lat in 1995

Clutch	Nb eggs in nest	Sample size	Eggs ejected (%)	Total	
				Sample size	Eggs ejected (%)
First	2	12	0		
	3	84	25.0	128	25.0
	4	32	34.4		
Second	2	64	28.1	169	30.7
	3	105	32.4		

Among meteorological factors which may afford for the differences observed in all aspects of the breeding of the House Swift in 1994 and 1995 (Table XIII), average temperature can be ruled out as it is about the same for those two years. On the contrary, the Da Lat region experienced heavy rains in 1995. Abundant rains may affect the flying abilities of insects (Hawkes, 1961; Taylor, 1963; Bryant, 1975; Hails, 1982) as well as the foraging abilities of the swifts, resulting in a reduction in food for both adults and chicks.

TABLE XIII

Average air temperature (°C) and rainfall (mm) in Da Lat in 1994 and 1995 (Data from the South-middle Hydrological – Meteorological Station, Da Lat)

		Months											
Year		Jan.	Feb.	Mar.	Apr.	May	June	Jul.	Aug.	Sep	Oct.	Nov.	Dec.
1994	T	15,7	17,0	17,5	18,7	19,2	18,8	17,9	18,6	18,2	17,3	17,0	16,4
	H	1	24	81	82	218	143	252	82	321	303	4	64
1995		15,7	18,0	17,6	18,8	19,2	19,4	18,6	18,6	18,4	18,2	17,4	15,5
	H	1	70	100	203	244	176	236	288	221	270	37	6

T: average air temperature, H: rainfall.

MOULT

House Swifts in Da Lat moult almost all the year round (Fig. 5). Only in January were no moulting birds to be found. In 1994, a first peak of moulting frequency was attained in February, when 100% of the checked birds were moulting. In 1995, this peak occurred first in March, with only three quarters of the birds moulting. In 1994, a second peak occurred from July to October, during which all checked birds were moulting. In 1995, this second peak started about one month earlier than in 1994 (Fig. 5). Again, these differences between both years may be due to food shortage in 1995. In Yunnan, south China, the moult of the House Swift starts with the primaries, which are shed centrifugally from May to late November. The five secondaries are moulted centripetally from late June to about the 21st of November, and the ten rectrices are also shed centripetally from about the 20th of August to late December (Kou, 1982). Yunnan House Swifts have thus a well defined, seven to eight months long moulting period, which can be put in relation with the fact that they live at a higher latitude and altitude than their Vietnamese counterparts, in a colder region with more contrasted seasons. Similar facts have been put in evidence for the White-nest Swiftlet from the south to the north of its distribution range by Nguyên Quang *et al.* (2002).

FOOD AND FEEDING

The weight of stomach contents of breeding birds, taken from March to September, is on average higher (7-8% of body weight) than that of non-breeding birds taken during the remaining of the year (*ca* 2%) ($P > 95\%$) (Table VI).

All Apodids feed regularly on aerial Hymenoptera, Diptera, Hemiptera and Coleoptera (Chantler, 1999), and the Vietnamese House Swifts are no exception. Seven classes of insects are represented in the food of adults in Da Lat (Table XIV), the Hymenoptera being by far the most important, counting for about one fourth of the food items, and being represented in all samples. Isoptera, Coleoptera and Hemiptera are taken in similar quantities, the Coleoptera being less frequent. The Diptera, Homoptera and Odonata are not frequently taken, but sometimes in large numbers, mainly so the Diptera. The food delivered to chicks differs somewhat from that of adults, with few termites, less Hymenoptera and Diptera. On the contrary, the Homoptera are dominating with a little less than one fourth of all items, and the Coleoptera are as numerous as in the food of adults. Thus, even if our food sample from chicks is not very large, it seems that, when foraging for their young, House Swifts exert a choice which is different from that they would make for themselves. A similar difference in the foods of adults and young has already been evidenced on much larger samples in the White-nest Swiftlet, a bird with a feeding ecology similar to that of the House Swift (Nguyên Quang *et al.,* 2002). The modalities of this choice are presently unknown.

In terms of diversity, the food spectrum of the House Swift in southern Vietnam is thus very similar to that of the White-nest Swiftlet, but it is narrower. The diet of the White-nest Swiftlet encompasses the same insect orders in significant numbers, but also spiders and representatives of four more orders (Lepidoptera, Thysanoptera, Ephemeroptera, Orthoptera), all in very small numbers (Nguyên Quang *et al.,* 2002). This is true of adults as well as of chicks. In our samples, the dry mass of the preys of the House Swift ranges from 0.001 (small Diptera) to 0.2 g (large flies, bees). On the contrary, the dry mass of preys captured by the White-nest Swiftlet in the same region ranges from 0.001 (small Diptera) to 0.08 g (small Odonata). Thus, the food spectrum of the House Swift is larger than that of the White-nest Swiftlet in terms of mass, which may possibly give it a selective advantage on the latter species.

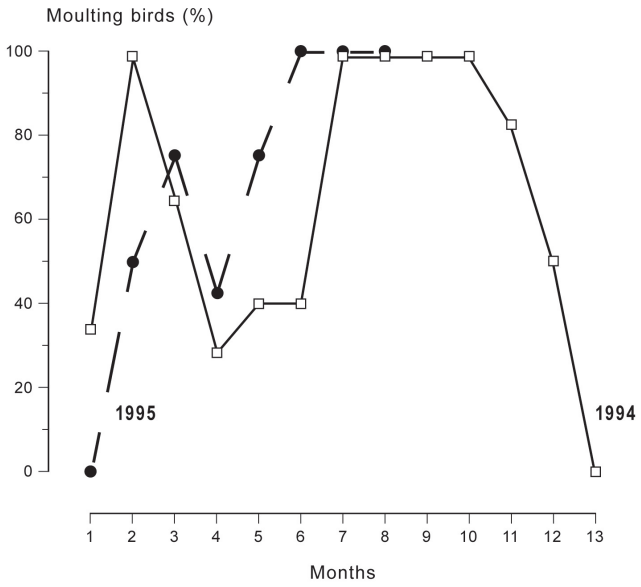

Figure 5. – Percentage of moulting birds according to months in the colonies visited in 1994 and 1995. □ : in 1994; ● : in 1995.

As the food of these two species is basically similar, we made an experiment, giving 378 White-nest Swiftlet eggs to be brooded to House Swifts in Da Lat. 84 (22.2%) of them hatched successfully. The swiftlet chicks were brought up and grew quite normally until they reached 20 days of age, and then they were suddenly left by their foster parents to starve for some still unknown reason, as, at this stage, House Swift chicks still grow very fast (Fig. 4). Thus, White-nest Swiftlets chicks can live and grow quite well for at least three weeks on the diet of House Swift chicks, which is quite similar to their own one.

TABLE XIV

Food spectrum of adult and chick House Swifts in Da Lat in 1994 and 1995

Insect orders	Adults (n = 100)			Chicks (n = 20)		
	Numbers	T	F	Numbers	T	F
Hymenoptera	2 200	24.6	100	2 356	20.7	100
Isoptera	1 780	19.9	91.0	465	4.1	40.0
Coleoptera	1 524	17.1	63.6	1 750	15.4	60.0
Hemiptera	1 504	16.8	81.8	2 875	25.3	100
Diptera	1 050	11.8	9.1	850	7.5	40.0
Homoptera	700	7.8	9.1	2 590	22.8	100
Odonata	170	1.9	9.1	462	4.1	40.0
Unidentified*	960	--	--	--	--	--
TOTAL	8 298	99.9	--	11 368	99.9	--

*: not taken into account when calculating percentages; T: percentage of individuals; F: frequency of occurrence.

In southern Vietnam, House Swifts go out foraging from 5.30 until 17.30, and White-nest Swiftlets from 5.00 until 20.00 to 22.00. House Swifts are thence less able to use insects flying at dawn and dusk than swiftlets do. Moreover, White-nest Swiftlets may fly very far into the interior from their breeding and roosting grounds (Nguyên Quang *et al.,* 2002), while House Swifts remain nearer to them. White-nest Swiftlets forage between one and 50 m above the ground during the breeding season, and above 30 m subsequently (Nguyên Quang *et al.,* 2002), while House Swifts hunt on average above 20 m. All these small differences may help lessening competition between the two species. Nevertheless, more studies on the feeding strategies of these two species are needed in order to understand how they avoid competition for food, not only between themselves, but also with the other Apodid and Hirundinid species which live

alongside them. As flying insects are still abundant in Vietnam, and House Swifts and White-nest Swiftlets have lived together since time immemorial, they must have developed foraging strategies different enough to avoid competition for food between them, but things may change in the future if food resource becomes limited, for instance following a general use of pesticides which begins to become widespread in Vietnam.

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