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Call types of the Common Swift *Apus apus*: adult call given at the nest

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Abstract - Vocalizations of the Common Swifts were studied during two consecutive springs in southern France. I found that three call types were given by the adults at the nest, and these are described quantitatively. Significant differences in the acoustic parameters of the calls are highlighted, as well as a probable sexual dimorphism. This, together with the precise signification of the different call types, remain however to be critically assessed by playback experiments.

Introduction

Swifts (Order Apodiformes) are unusual among birds because many of their life history traits (i.e. longevity, delayed maturity, large egg size) make them atypical compared to similar-sized birds (Lack 1956, Gaillard *et al.* 1989), and convergent evolution of life histories with, e.g., long lived seabirds such as Procellariiformes, have been suggested repeatedly (e.g. Lack and Lack 1951, Malacarne *et al.* 1991). Although investigations have been carried out on the Common Swift *Apus apus* with regard to demography (Lack 1956, Perrins 1971, Lebreton *et al.* 1992), diet (Owen 1955), metabolism (Koskimies 1950), and breeding biology (Lack and Lack 1951, Lack 1956, Gory 1987), nearly nothing has been published on its vocal behaviour (Cucco *et al.* 1987). The only studies available are incomplete sketches of the calls of either the common swift or the Pallid Swift *A. pallidus* (Cramp 1985, Cucco *et al.* 1987, Malacarne *et al.* 1989, Malacarne and Cucco 1990. Cucco *et al.* in press), or concern their peculiar "social flights" (Farina 1980,1988). In this paper I report some preliminary results on the calls of the Common Swift, derived from a more complete study that focuses on the behavioural ecology of three swift species (*A. apus, A. pallidus* and *A. melba*), in which mating, mate retention and coloniality are the main topics covered.

Methods

Common Swifts were studied during April, May and June 1991 and 1992 in the city of Nîmes (southern France), where a large colony is easily accessible for field studies (for further details, see Gory, this volume). A sample of 22 accessible nests was selected, for which extensive data on breeding biology and breeding success were also available dating from 1978 (Gory et Jeantet 1986). The birds were tape recorded by Uher 4400 or Nagra IV at a speed of 19.5 cm/s, on Agfa PE43 tapes, and with a Seinnheiser omnidirectional microphone MD421 placed within, or at the entrance of, the nesting cavity. Calls were analysed on a Real Time Spectrograph, which performs a fast Fourier transform (Richard 1991) at a 7000 Hz bandwith and 256 points stepsize. A total of 252 calls from 13 nests were analysed. The physical parameters studied were (Figure 1): total duration of syllable (SYL), number of syllables per call (NSY), modal frequency (MOF) of the syllable (defined as the frequency carrying the maximum energy when averaged over the whole call and the fundamental frequency at its highest value (FUN). In the case of the Duet Screaming Call, which is given sometimes in long series of antiphonal songs (Malacarne and Cucco 1990). only the first two or three syllables were analysed (syllable ranks 1 to 3). Temporal, and frequency parameters, were measured to within ± 3ms and ± 26 Hertz respectively. Sonagrams were printed on a Kay 6061B Sonagraph (wide and narrow bands). In the following, I will use Cramp (1985) as a starting reference work.

Statistical analysis was performed mainly with the Analysis of variance (ANOVA) when distributions of the call parameters did not depart from normality, and Kruskall- Wallis and Mann-Whitney U-tests for discrete variables (NSY). My aims were to investigate

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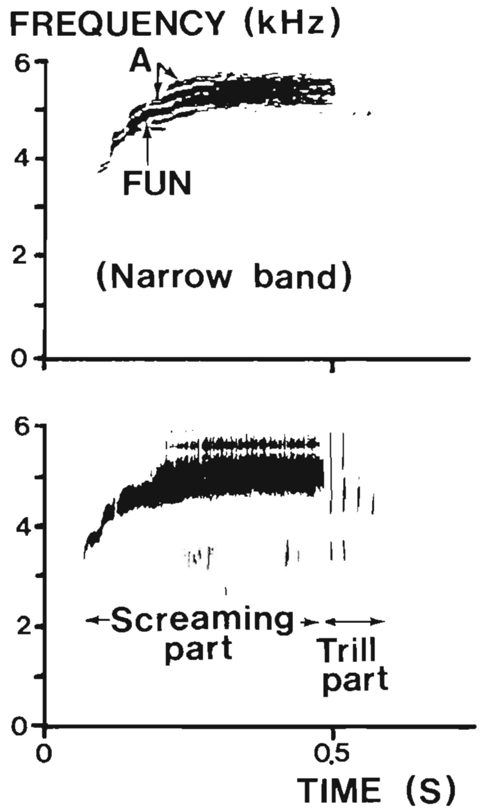

Figure 1. Sonagram of a Common Swift *Apus apus* screaming call (Long Screaming Call) showing some acoustic parameters that were analysed. The difference between the Screaming part and the trill part is shown. The total duration of the syllable (SYL) included the Screarning and the Trill parts. The arrow (A) denotes the occurrence of the amplitude modulation at ca. 200 Hz on the fundamental frequency.

for possible significant effects of the following factors on the call parameters that were analysed: call type, syllable rank (only in duet calls), and nest number (i.e. individual). To this end, I used two-way ANOVAs, with nest and call type as the two factors, and one-way ANOVA when considering syllable rank.

Results

Vocal repertoire of the Common Swift

The most commonly uttered call of the Common Swift, whether at the nest or when flying, is the screaming call (Cramp 1985). However, I found that the screaming call consisted more of a family of highly variable calls, rather than being a call itself, and it was found actually to encompass two different vocalizations. Screaming calls at the nest were given in a highly variable number of syllables, as swifts uttered either a single syllable, or gave the screaming calls in duets (antiphonal song: Malacarne and Cucco 1990). However, monosyllabic screaming calls could be given in a short duration version, similar to the first syllable of a duet call, or in a much longer version (Table 1). This latter vocalization should thus be described as a new call, hereafter referenced as the Long Screaming Call (LSC). Conversely, the other version, whether given in duet or not, will be named the Duet Screaming Call (DSC). Furthermore, a third call type was frequently heard, already described as the "nest call" (in Cramp 1985). In the following, I shall describe the physical structure of the screaming calls, as it is somewhat complex.

Acoustic features of the screaming calls

Although screaming calls are highly variable (see below), I found however that some acoustic features were stable; for instance, the screaming call could always be split into a screaming part sensu stricto, and a trill part ("terminal part" of Malacarne and Cucco 1990; see Fig. 1). The physical structure of the screaming part of the call results from a combination of two acoustic phenomena: first, the fundamental frequency lies around 2500 Hz, and always displays at least its first harmonic (often, only the harmonic can be detected on the sonagram), which thus lies around 5000-6000 Hz (for this study; see also Malacarne et al. 1989). Second, on the fundamental frequency, there is an amplitude modulation at ca. 200 Hz (range 190-280 Hz in this sample), which is the origin of the "clicking" or pulsating sound of Common Swift calls (Figure 2). The trill part is made of a variable (both between-, and within-individuals) number of very short syllables (three to eleven in this sample). The fundamental frequency decreases in the trill part (see also Malacarne *et al.* 1989), and there is no amplitude modulation in the trill part. Interestingly, the trill part is very distinct between the two members of a pair: invariably, one partner has a fast rhythm trill (with very short duration elements and silences between elements, and a greater number of elements), and the other one has a slower rhythm (Figure 2 see also Cucco *et al.* in press). The differences in durations, as well as in the number of elements in the trill, are highly significant (Table 2). This was already illustrated in sonagrams of Cramp (1985) and Malacarne and Cucco (1990), though these authors did not elaborate on this point. Of course, this is likely to represent a sexual dimorphism in the trill part, although the sample size of sexed birds is too small at present to establish this definitely. According to the

Table 1. Call types of the common swift *Apus apus* given at the nest. For the Duet Screaming Call, the first three syllables were analysed separately (ranks 1 to 3). See Figure 1 for the physical parame were analysed. A one way ANOVA was conducted to test for the effects of call type on each parameter; a two-way ANOVA was also conducted in order to compare the effects of nest (i.e. individual) and call type (DSC type A and DSC type B) on the call parameters.

Call type	Call parameters				
	Sample size[1]	Syllable length[2] (SYL) (MOD)	Modal frequency[3] (FUN)	Fundamental frequency[3] (NSY)	Number of syllabes
Long Screaming call (LSC)	22(6)	654.3±108.8	3966.2±1738.	16103.3±328.	61.0±0.0
Duet Screaming Call A (DSC)	100 (10)	04.0±86.1	5034.6±979.9	5494.4±461.4	3.01±1.8
Rank 1	53	449.3±86.5	5062.3±994.3	5484.6±502.9	/
Rank 2	41	352.4±51.9	5018.8±968.4	5495.6±420.3	/
Rank 3	6	355.7±33.6	4896.8±1094.4	5572.3±403.4	/
Duet Screaming Call B	99 (10)	397.5±65.0	5282.3±536.4	4866.1±928.4	2.85±2.1
Rank 1	63	419.4 ± 68.4	4899.7 ± 854.6	5201.7 ± 525.5	/
Rank 2	32	359.3±35.2	4842.0±1051.1	5420.2±547.3	/
Rank 3	4	358.0±25.3	4525.3±1209.4	5447.8±472.8	/
Nest Call	31(5)	101.3±22.4	4151.0±230.1	/	/
One-way ANOVA	df		(F-value)		
Call type	2	36.9***	2.03	13.99***	19.22***[4]
Rank effect	2	34.95***	0.27	2.30	
Two-way ANOVA					
Nest effect	9	6.23***	8.80***	3.81***	50.45***[4]
Call type effect	1	7.32**	15.2***	16.13***	1.35 [5]
Nest X Call type	9	1.46	1.35	1.88*	/

[1]: Number of calls analysed, and number of individuals sampled between brackets; [2]: measured in ms; [3]: measured in hertz; [4]: Kruskall-Wallis test; [5]: Mann-Whitney U-test

*,p<0.05; **, p<0.01; ***, p<0.001.

Table 2. Temporal parameters of the trill part of the Duet Screaming Call. Type A and Type B compared (see text). Only five pairs were analysed here, due to insufficient sample size.

Call type	Sample size[1]	Short syllable duration	Inter-syllabic duration	Number of short syllables
Duet Screaming Call				
Type A	18	10.31±2.5	5.61±5.1	8.56±2.2
Type B	16	14.2±3.0	11.43±4.6	6.31±1.5
t-test		7.6***	6.6***	3.31*
df		120	120	32

[1]: refer to the number of Duet Screaming Calls that were analysed.

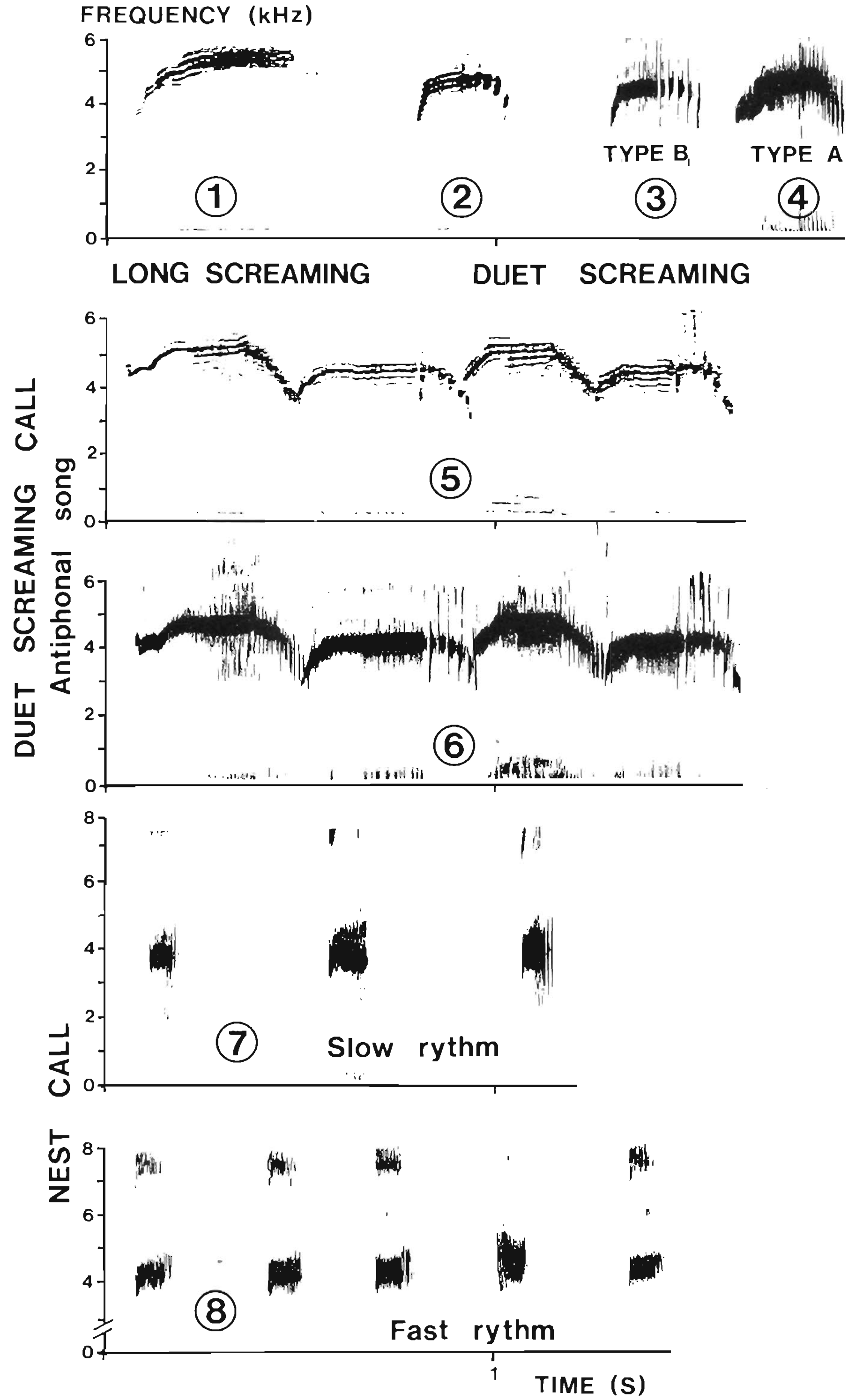

Figure 2. Sonagrams of the three call types that are uttered by the Common Swift *Apus apus* at the nest: the Long Screaming Call (1; see also Fig. 1), the Duet Screaming Call (2, 3, 4, 5 and 6) and the Nest Call (7 and 8).
Note the difference in the trill part (Type A and B) on the duet screarning call (3 and 4). Note also that the rhythm of the nest call is variable (7 and 8). Time is given in seconds and frequency in KiloHertz. Sonagrams were printed using wide band filter (300Hz) except for 1, 2, and 5 (narrow band, 45 Hz).

results found for the Pallid Swift, males probably have the fastest trill part (Cucco *et al.* in press). Until we get more sexed birds, type A (fast rhythm in the trill part) and type B (slow rhythm) screaming calls will be retained.

Long and Duet Screaming Calls share many similarities, and some overlap may occur between individuals but not within individuals: LSC are always much longer than DSC for any given individual (see also F-values on Table 1). Thus the LSC is statistically longer than the DSC, being usually twice as long as the DSC (Table l) and often, but not necessarily, higher in frequency.

Discussion

The Long Screaming Call, during this study, appeared to be given only by the presumed males, but the sample size is far too small at present to exclude the possibility that females utter this type of call. It was also found to be given mainly at the start of the breeding season, and most often in response to an intruder visit in the nest cavity. It is therefore tentatively suggested that the LSC is mainly a territorial and/or an agonistic call.

The Duet Screaming Call, which is usually given in duets, probably also has a territorial function, as it is often uttered after the LSC, following the intrusion of a third bird into the nesting cavity, but I suggest that it has other functions. First, the DSC is individually distinctive (see Table 1 for F-values with regard to nest effect) and may thus function as a cue in individual/partner identification (see, *e.g.* Bretagnolle 1989, Bretagnolle and Lequette 1990 for similar studies). Malacarne and Cucco (1990) suggested that the "terminal part" (or trill) is very constant within individuals, though I found that the number of syllables were partially variable. Second, the DSC may also function as a synchronising behaviour (see also Malacarne and Cucco 1990).

Lastly, the Nest Call (NC; Cramp 1985; see Table l) is often given by birds within their nests. However, unlike Cramp (1985), I found that it was given by a single bird (as stated in Cramp 1985) but always in a situation where the pair is present. Moreover, I found that it was the presumed male which gave it, and not the female (as stated by Cramp 1985), but this has to be checked further. This call was only given by the pairs without eggs (i.e. before egg-laying for the breeders, or at any time for the non breeders). I thus suggest that the NC has a sexual function, being involved in mating or re-pairing for established pairs.

The speculative nature of many of these results has now to be critically tested experimentally using playback tests on birds with known age, status and sex.

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Riassunto - Si descrivono quantitativamente le vocalizzazioni del Rondone comune nel Sud della Francia. Si sottolineano le differenze dei tre tipi principali di grida emesse dal nido ed alcuni aspetti sessualmente dimorfici. Il significato delle vocalizzazioni potrà essere stabilito solo con opportuni esperimenti di playback.

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