

# Plumage variability in Marsh Harriers

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**Abstract** The Marsh Harrier *Circus aeruginosus* is typically illustrated in field guides as a sexually dimorphic species, with several age classes identifiable by differences in plumage pattern and colour. In some populations, however, such as the one we studied in west-central France, the species can show extreme plumage variability in adult males and, to a lesser extent, in adult females. Our study population is markedly polymorphic, with highly distinct patterns of coloration and almost continuous individual variation between those different morphs. Barely a single adult male looks like a typical 'field-guide male'. Since this plumage variability is independent of age and sex, it is almost impossible to age birds solely from their plumage, which contradicts the established view. We highlight the difficulties of ageing and sexing Marsh Harriers by plumage only, and advocate the recognition of this species as polymorphic, at least in some parts of its range.

## Introduction

The Marsh Harrier *Circus aeruginosus* is typically illustrated as a sexually dimorphic species in the literature, with distinctive adult male, adult female and juvenile plumages (e.g. Cramp & Simmons 1980, Forsman 1999, Ferguson-Lees & Christie 2001, van Duivendijk 2011). Adult males are typically trichromatic, with black wing-tips, brown upperwing-coverts and silvery-grey midwing and tail, whereas adult females are mainly brown with whitish throat and crown, and pale wing-coverts. Juveniles are similar to but darker than females, with pale, rusty cream replacing the whitish areas of adult females. First-adult males (i.e. during late autumn of the second calendar-year (hereafter CY) and summer 3CY) are also distinctive, a mix between juvenile and adult male plumage; see illustrations in Beaman & Madge (1998), Clark (1999) and Génsbøl (2009). In addition, a rare and localised dark morph has been described in the eastern part of the breeding range (Clark 1987), in all three age/sex classes mentioned above, but there are no published records of this dark morph in western Europe (Clark 1999;

Forsman 1999). Both sexes become somewhat paler with age, which may be more pronounced in males than in females (Forsman 1999; van Duivendijk 2011). Despite recent advances in digital technology, no recent publications or reviews based on photographic evidence have acknowledged the existence of individual plumages that do not fit this classic view, even though discrepancies may occur at the population level (see below). Here, we provide a detailed description of plumage variation in a large breeding population of Marsh Harriers in west-central France, in which virtually not a single male appears like a typical 'field-guide male' (plate 94 shows a selection of atypical adult male plumages) and some breeding adult males have female-type plumage throughout their adult life (Sternalski & Bretagnolle 2010; Sternalski *et al.* 2012).

Bavoux *et al.* (1988, 1991, 1993) provided detailed information on Marsh Harrier plumage variation from west-central France, in particular the variability of juvenile plumage (Bavoux *et al.* 1991). Sexing adults purely by plumage colour was shown to be unreliable, since some adult males exhibited

'female-like' (i.e. mainly brown) plumage (Bavoux *et al.* 1988, 1993, 2006; Sternalski & Bretagnolle 2010; Sternalski *et al.* 2012; see also plate 94). Other than behaviour, the only reliable method of establishing the sex of adult Marsh Harriers is by using biometrics (Bavoux *et al.* 2006) or silhouette and jizz. The studies by Bavoux *et al.* were published some 20 years ago (in French), yet the results have seemingly not reached the wider ornithological community. More recently, Forsman (1999) considered plumage variability and mentioned atypical plumages of the Marsh Harrier, but few details were provided and the existence of adult males that remained in a brown plumage for life was omitted.

Our main aim is to document the extreme plumage variability of Marsh Harriers in west-central France, where there is a breeding population of c. 300 pairs (Thiollay & Bretagnolle 2004). We describe the juvenile, adult female and adult male plumages in this population, and provide colour photographs of all plumage types in flight. Following previously published studies (i.e. Bavoux *et al.* 1988, 1991, 1993), and using Forsman's (1999) highly detailed plumage description as a reference basis, we provide a quantitative assessment of plumage variability in this population, illustrate the range of variation in adult males and females, and advocate the recognition of a polymorphic population (and therefore species). Having described the plumages, we address the following questions: (i) how does plumage coloration vary with age?; (ii) at what age do grey males acquire grey feathers?; (iii) do brown adult males show delayed plumage maturation?; (iv) when do males and females acquire their definitive plumage (or is their plumage changing continuously)?; (v) is there any fundamental sexual dimorphism and therefore reliable sexing criteria?

## Materials and methods

We began a monitoring and wing-tagging programme of the Marsh Harriers of west-central France (the district of Charente-Maritime, 45°51'N, 01°04'W) in 2006. This programme has been carried out at four distinct study sites, which are close to each other (c. 20 km between them) but differ in terms

of available food resources and habitats (Sternalski *et al.* 2013). The monitoring project has included searching for nesting pairs and recording breeding success (for, on average, c. 100 nests per year), but also a weekly/monthly population census during winter, since Marsh Harriers in this area are sedentary (Bavoux *et al.* 1992). Wing-tagging has been restricted to nestlings and a total of 473 fledglings have been tagged since 2006. Both in the winter and in the breeding season, a particular focus of the study has been to photograph as many individuals as possible, in particular breeding and wing-tagged birds.

Photographs were used to establish colour categories using five key areas of the plumage: the upperwing, upperwing-coverts (i.e. the presence and/or size of pale patches on the upperwing), underwing, tail, and head (plumage description following terminology given in Forsman 1999). The number of subcategories for each of these five parameters was established as a balance between power (i.e. sufficient and similar sample size within each category) and the extent of variation within the population for this parameter. Hence, seven subcategories were used for general coloration of the upperwing (ranging from very dark brown to wide extent of grey colour in secondaries and primaries); five subcategories for the upperwing-coverts (varying in extent from lesser coverts to median coverts); eight subcategories for general underwing coloration (ranging from very dark brown to light); eight subcategories for the head (ranging from completely brown to creamy-white); and four subcategories for the tail (ranging from entirely brown to grey). For fledglings, plumage colour categories focused only on the head (in particular the crown and chin) and upperwing-coverts, since these are the most important variable parts of plumage at this age.

To assess adult plumage variability, c. 3,000 photographs were available, allowing plumage descriptions for 352 breeding harriers (168 males and 184 females, all years combined). The sex of the individuals was determined by observing copulation behaviour and participation in incubation (Bavoux *et al.* 1988). Not all parameters were assessed for each individual, so sample size may differ



**94.** Adult male Marsh Harriers from west-central France (all from the Marais de Brouage) showing various plumage coloration patterns (note that the same individual is shown in images 4 and 8). All photos in plates 94–97 are by Jean-François Blanc, Audrey Sternalski and Vincent Bretagnolle.



between parameters. In addition, a minimum age class was introduced for breeders given that sexual maturity occurs at one year for females and two years for males, at least in this population (Bavoux 1995; pers. obs.). To assess fledgling plumage variability, a total of 327 fledglings were photographed, colour-scored, wing-tagged and sexed (using blood samples and the method developed by Fridolfsson & Ellegren 1999) between 2006 and 2011. When possible, iris coloration was also scored from photographs for both adults and fledglings.

Trends in plumage variation with age were assessed using photographs of 164 individuals of known age: 152 of these were wing-tagged at fledging and photographed at least once in subsequent years (66 males and 86 females), and 12 were radio-tagged fledglings. In addition, no fewer than 38 breeding birds (25 males and 13 females) were photographed in successive years (at the same nest location).

## Results

### Plumage patterns according to age and sex

#### *Juveniles (n=327)*

This includes all 1CY birds and 2CY before their first summer. As in other Marsh Harrier populations, all fledglings were uniformly dark brown (with the exception of a few birds with aberrant plumage, see plate 95, 10), with variably pale areas on the head and upperwing-coverts. Juvenile plumage varied

in terms of both the presence/absence and size of these patches. In very fresh plumage, fledglings exhibited pale tips to the primaries, secondaries, tail, rump, and wing-coverts (plate 95, 5 & 6). As described by Forsman (1999), some fledglings had a pale crown and throat, divided by a dark brown mask through the eye (plate 95, 4), others had only a pale patch on the nape, which did not extend to the forehead (plate 95, 3; see also illustration in Clark 1999, plate 17), and some had an all-dark head (plate 95, 1 & 2).

There was a limit to the combination of these various characters in the individuals sampled: we never observed a fledgling with a pale crown but *without* a pale throat, or with a nape patch *and* a throat patch, or with *only* a pale throat patch. Among all fledglings for which we colour-scored the head pattern, those that displayed a pale crown and throat were particularly frequent (n=245, 75%), while those that displayed only a pale nape patch occurred less frequently (n=79, 24%) and those with an all-dark head were very rare (n=3, 1%).

We found that the presence and/or extent of upperwing-covert patches, described as independent of fledgling head pattern by Forsman (1999), actually varied with head pattern and sex. All 82 fledglings with an all-dark head or just a pale nape patch showed dark upperwing-coverts (46 males, 36 females; plate 95, 6). In contrast, among the 245 fledglings that showed a pale crown and throat, around two-thirds showed dark

**95.** Plumage patterns of juvenile (1–10) and breeding adult female (11–20) Marsh Harriers from west-central France (upper section), with head patterns of males and females (21–30).

**1–5:** Head patterns of wing-tagged juveniles (just before fledging), covering the entire range of variation from absence to presence, and then extent, of pale head patches (i.e. crown, throat, nape): 1–2, absence of pale head patches (same bird); 3, nape patch only; 4, pale crown and throat (classic juvenile head pattern); 5, pale crown and throat head pattern with additional light patches on back. **6–7:** Juveniles displaying clear ‘border lines’ on primaries and secondaries (6), and a light collar (7). **8–9:** Iris colour of wing-tagged juveniles (just before fledging), showing colour variation from paler to darker. **10:** A partially leucistic juvenile. **11–14:** Light-morph breeding adult females, involving an individual without pale lesser wing-coverts (12), and those with pale upperwing-covert patches (11, 13–14), the palest bird also with a whitish back (14). **15–16:** Dark-morph breeding adult females, with pale nape patch only (15), or with all-dark head (16). **17:** Breeding female displaying greyish tint on upperwing flight feathers. **18–19:** Breeding adult females, showing dark underwing (18), and paler underwing (19). **20:** Partially leucistic female. **21–25:** Head pattern and iris colour of breeding adult females, showing variation from all-dark (21), more classic crown and throat head patterns (22–24), to extreme light pattern (25); and with iris colour dark (21), amber (22–23) and yellow (24–25). **26–30:** Head patterns and iris colour of breeding adult males, showing variation from nape patch only (26; the same male as in plate 94, 4 & 8) to paler head patterns (27–30). Note that the collar is always present in males, and that the yellow iris colour varies somewhat.

upperwing-coverts (75 males and 75 females) whereas the remainder showed pale areas on the upperwing-coverts (56 males and 26 females; note that for the 13 fledglings, the upperwing-coverts were not colour-scored). In addition, a few fledglings displayed further light feathers on the back or collar (plate 95, 5 & 7). Iris colour was scored in 246 fledglings, and in the majority the iris was dark-brown (192, 78%; plate 95, 9). Greyish-brown irides were found in 54 (22%) of fledglings (plate 95, 8), particularly in males (98% of the 54 fledglings with greyish-brown irides were males). However, unlike Hen *C. cyaneus* and Montagu's Harriers *C. pygargus* (see Picozzi 1984 and Leroux & Bretagnolle 1996, respectively), this overlap between sexes, albeit small, means that this criterion cannot be considered diagnostic.

#### *Breeding females (n=184)*

Most breeding females displayed the classical plumage, with a chocolate-brown plumage and whitish patches on crown and throat (n=134, 73%; plate 95, 11), with tail colour ranging from dark brown to rufous-brown. Among these females, upperwing-covert patches were absent in 21 birds (16%), while in 109 birds (81%) they ranged from small (covering the lesser coverts only) to large (extending across both median and lesser coverts); note that for four birds (3%) the upperwing-coverts were not colour-scored. Females that sported the largest upperwing-covert patch usually also showed pale-mottled mantle and upper breast (plate 95, 14, 19).

In addition to this classic female plumage, we found a relatively high proportion of a second type (n=39, 21%), which consisted of an all-dark plumage, most birds with just a pale nape patch (n=30, 77%; plate 95, 15). The remainder were entirely dark (n=9, 23%; plate 95, 16 & 21).

Finally, the remaining 11 females (6%) showed a greyish tint on the primary coverts (plate 95, 17).

Female underwing pattern was usually a faded brown, with a paler inner hand and the 'fingers' and secondaries contrastingly darker brown, and a paler patch of variable extent on the underwing-coverts (plate 95, 18). The underwing pattern usually appeared darker

in all-dark females and in those that displayed only a pale nape patch, but some females showed a rather pale underwing (plate 95, 19). Up to 8% of females showed some degree of plumage aberration (plate 95, 20), most often the darkest females.

The iris colour of 115 females was recorded; the majority had brown (n=38, 33%; plate 95, 21) or amber (n=63, 55%; plate 95, 22 & 23) irides, although 14 had a yellow iris (12%; plate 95, 24 & 25).

Overall, female plumage-types in our study population did not differ markedly from those described elsewhere, except that we observed: (i) a relatively high proportion (21%) of all-dark females (i.e. lacking the whitish crown and throat); (ii) 16% of 'classic' females which lacked a pale patch on the upperwing-coverts; and (iii) a generally high plumage variability with almost continuous variation from all-dark females to the palest birds.

#### *Breeding males (n=168)*

The males in our study population exhibited two characteristics that have not been described previously: (i) a proportion of breeding males with brown, 'female-like' plumage (quite unlike the 'classic' grey ones; see plate 94); and (ii) an extreme range of plumage variation, with a continuous, gradual variation between brown 'female-like' males and 'typical field-guide grey males'. For convenience, we categorised this gradual variation arbitrarily into five plumage types, according to upperwing pattern. This variation was mainly independent of age.

Type 1 (n=16, 10%) involved completely brown or rufous-brown males. This type is previously undescribed (Cramp & Simmons 1980; Forsman 1999; Ferguson-Lees & Christie 2001). Virtually indistinguishable from females on plumage alone, these adult males lacked grey feathers and had an entirely brown upperwing pattern (plate 96, 1-3), varying from very dark brown (as in all-dark females; plate 96, 1) to chocolate-brown (plate 96, 3).

Type 2 (n=40, 24%), also undescribed in Forsman (1999), involved predominantly brown males with a dark brown upperwing that displayed a greyish tint only on some of the primary coverts (plate 96, 4 & 5), similar to that observed occasionally in older females

(see above). As with females, the limited grey may be difficult to observe at distance or in poor viewing conditions.

The remaining three types encompassed males with varying degrees of grey plumage, and correspond to the plumage-types described by Forsman (1999) – although we found that these types were independent of age (see below). Type 3 (n=38, 23%; plate 96, 6) corresponded roughly to the plumage pattern depicted by Forsman for transitional males (2CY summer and autumn) or first-adult males (2CY late autumn to 3CY summer). The birds' upper primary coverts were dull grey whereas most of the secondaries and their coverts were dark brown (although the latter sometimes showed some dull grey at the base).

Type 4 (n=57, 34%) corresponded to Forsman's younger adult-type males. These birds showed a distinct upperwing pattern with black outer hand, silvery grey mid-wing (i.e. primaries and secondaries) and brownish inner wing and coverts (plate 96, 7 & 8).

Type 5 (n=17, 10%) referred to birds that approached 'typical field-guide grey males', showing extensive silvery upperparts with the greater-coverts and tail being silvery grey (plate 96, 9 & 10). Only a single bird in our sample had no trace of dark on the grey parts of the plumage.

Overall, a third of the breeding males in our study population consisted of mainly brown males (lacking any purely grey feathers or showing just a greyish tint), whereas the remaining 68% showed a significant proportion of grey colour on the upperwings that was variable in extent. In addition, none ever reached the colour pattern observed in males depicted as 'old adult' by Forsman (1999).

Males also differed in relation to the presence or absence (and extent) of whitish upperwing-covert patches (see plate 96). Underwing pattern was also highly variable – the range of variation observed matched previous descriptions (Forsman 1999), but the variation we observed was unrelated to age (see below). About 17% of breeding males had a dark underwing, difficult to distinguish from that of females (plate 96, 14 & 15), with whitish, mottled patches on the underwing

lesser coverts of varying extent. An additional 37% of males showed paler underwing primaries and secondaries with a more extensive whitish mottled patch and black tips (plate 96, 17), some with a marked dark trailing edge (plate 96, 18). The most common pattern (46%) showed either whitish secondaries and primaries with pale ochre underwing-coverts and well-marked black wing-tips (plate 96, 19 & 20) or, as described for old adult-type males by Forsman (1999), an extensively whitish underwing with black wing-tips restricted mostly to the fingers and without a dark trailing edge (plate 96, 21). Therefore, except for brown males, which showed a predominantly brown underwing, most males had a distinctively contrasting underwing pattern with a darker wing-tip (plate 96, 17–21).

Some males also showed rufous colouring on specific parts of the plumage, such as tail, uppertail-coverts, rump, underwing-coverts, breast and belly (plate 96, 11 & 13). Most of these males were entirely brown (type 1), but a few type 2 males also showed this characteristic (plate 94, 2). Rufous colouring seemed unrelated to age in our population (*contra* Forsman 1999; see below). Furthermore, about 47% of breeding males showed a barred tail (i.e. one terminal or several bars; plate 94, 3), although this pattern was restricted to type 2, 3 or 4 males and was unrelated to age. Finally, some 4.5% of males showed some form of aberrant plumage.

Type 1 males displayed a head pattern similar to that of females, with either just a pale nape patch (n=5, 33%; plate 95, 26) or a pale crown and throat with dark eye-mask (n=11, 67%). In type 2 males, the head pattern was much more variable (plate 95, 27–30), although the commonest variant was a very pale head pattern with a marked whitish collar (n=18, 46%; plate 95, 28). Grey males (types 3–5) had more typical male-type head patterns, ranging from an ochre head with dark brown streaking, sometimes with a hint of a dark ear-covert spot, to an entirely whitish head. In all cases, however, the breast and upper belly were streaked rusty-brown, highlighting a distinctive collar (plate 95, 27–30).

## Trends in plumage coloration with age

### Juveniles

As in other Marsh Harrier populations, the overall upperwing pattern of juveniles does not change much during the birds' first winter, i.e. before first moult (Clark 1999; Forsman 1999).

### Females

In females, plumage variation with age involved mainly the upperwing-coverts and, to a lesser extent, underwing pattern, but was less apparent than in males. The presence of upperwing-covert patches varied with age: in some females lacking such patches as juveniles, they appeared after the first moult and remained a stable feature thereafter, whereas in other females, this feature remained absent (plate 97, 12). The extent of the pale upperwing-covert patch also varied with age (e.g. plate 97, 15) and this feature was not indicative of age in our study population. Underwing pattern became paler with age in some females, although less so than in males (plate 97, 14). However, pale crown, throat and upperwing-covert patches did not appear in very dark female fledglings ( $n=18$ ) – in contrast to males, such females remained very dark for life.

### Males

Although only five males in their second plumage (i.e. late 2CY) were photographed, we observed that the first grey feathers always appeared after the first complete moult (see plate 97, 1–3). Among these five photographed males, two were grey males (type 3 & 4) while the other three displayed 'female-like' plumage (type 1 & 2). We also found that some of the darkest juvenile males became grey males after their first complete moult (in

other words, juvenile plumage was not a good predictor of subsequent plumage).

In males of known age from type 2 to type 5, we found that plumage pattern showed slight variation between the second and third plumage (plate 97, 5) while plumage apparently stabilised after the third plumage (plate 97, 4 & 6). From all males observed within their second and third plumage ( $n=24$ ), only two reached type 3 in their third plumage from type 2 in their second plumage; all the others remained as type 2. Similarly, all males with 'female-like' plumage in their second plumage kept that female-like plumage for life (e.g. plate 97, 7). Most grey males in their second plumage showed a contrasting underwing (i.e. darker secondaries contrasting with whitish primaries and black wing-tip), but brown males (type 1 & 2) showed uniformly brown, mottled whitish-brown, or rufous coverts, with barred primaries and secondaries.

Males photographed in successive years indicated that, in some cases, and despite being absent at fledgling stage, upperwing-covert patches could appear at various life stages: this was observed for four males between their first and second plumage, for two males between their second and third plumage and for two other males between their third and fourth plumage.

Finally, several authors have suggested that males usually display both a dark subterminal band to the tail and a dark trailing edge to the wings until 3CY autumn, but that these subsequently disappear (e.g. Forsman 1997, Beaman & Madge 1998, Génsbøl 2009). However, in our study population, although the dark subterminal tail-band was shown by some males (plate 97, 3), it was not shown by many others. In addition, although these authors stated that the dark subterminal

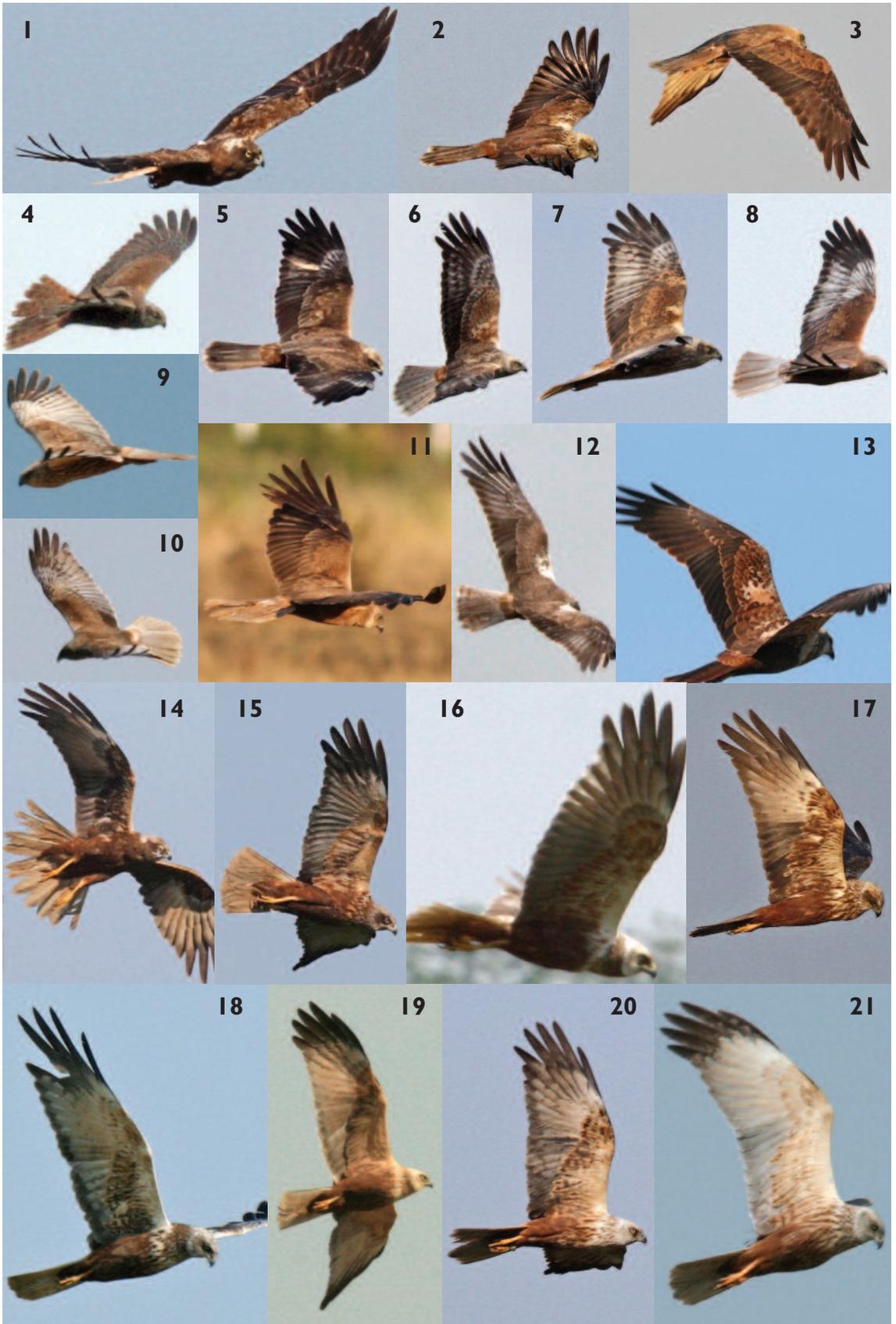
**96.** Plumage patterns of breeding adult male Marsh Harriers from west-central France belonging to the five types defined in this paper.

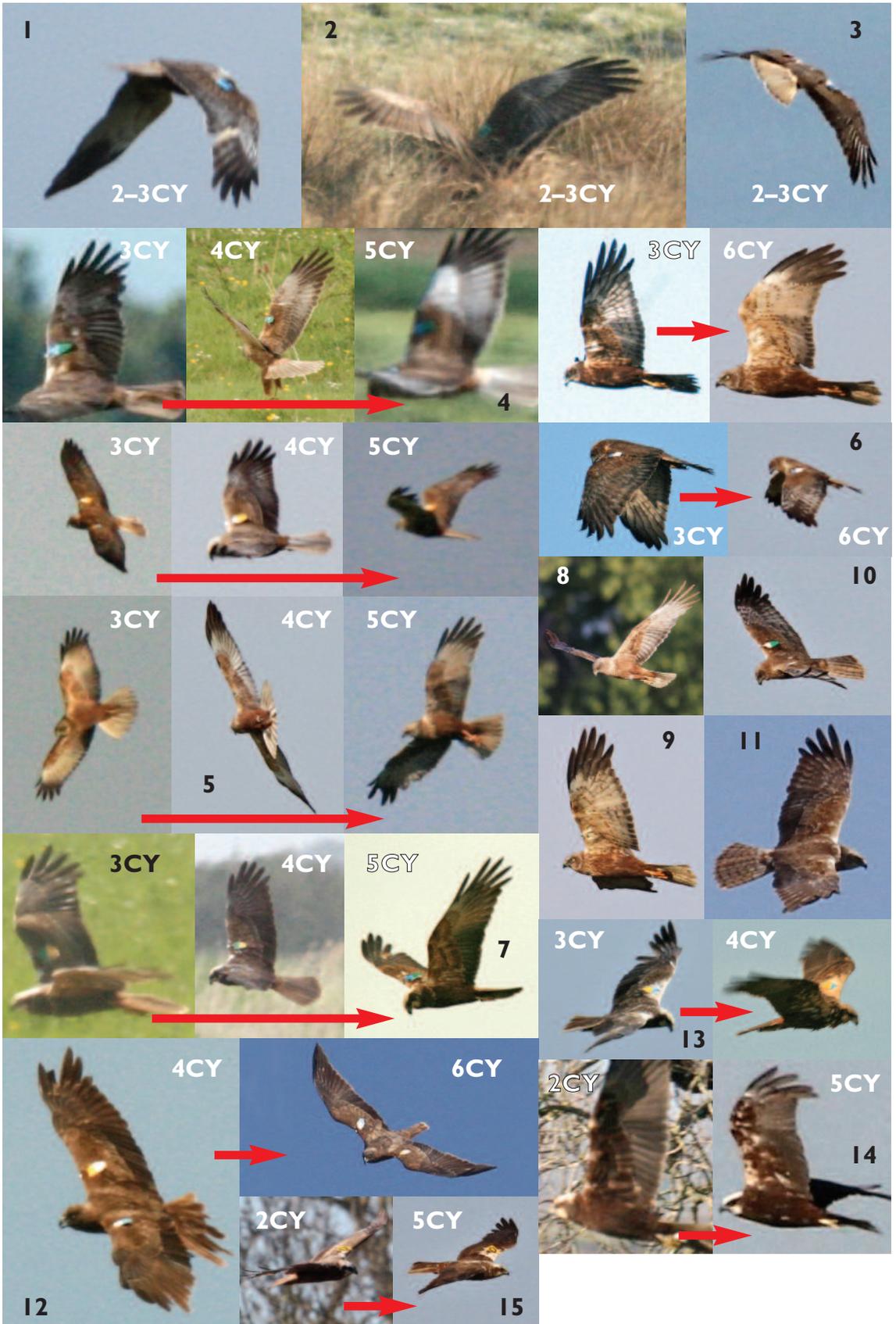
**1–3:** brown males of type 1, displaying very dark (1), or rufous-brown upperwing coloration (3).

Note that not a single grey feather is present in the plumage, though all these birds are 3CY at least.

**4–5:** brown males of type 2 displaying greyish tint on upperwing flight feathers and primary coverts to a varying extent. **6:** Grey male of type 3. This bird is 5CY at least. **7–8:** Grey males of type 4.

**9–10:** Classic 'field-guide grey males' of type 5. **11–13:** Variation of lesser wing-covert patches, from absence (11), to presence in both grey (12) and brown (13) males. **14–21:** Underwing patterns of adult breeding males. Brown males (type 1 & 2) displaying varying extent of pale underwing feathering (14–16), and contrasting primaries and secondaries (17). Grey males (type 3–5) displaying underwing patterns ranging from dark to very pale in colour (18–21).





tail-band and trailing edge disappeared after the 3CY autumn, we observed males up to 6CY with tail-bands (plate 97, 10), as well as 5CY and 6CY males with a dark trailing edge (plate 97, 8 & 9).

## Discussion

As described above, the population of breeding males in our study shows several unique and intriguing characteristics: (i) a brown, 'female-like' plumage; (ii) a wide and seemingly continuous range of plumage variation between 'female-like' males and more typical grey males; and (iii) atypical plumages in all the defined types (see plate 94). Consequently, determining the age and sex of birds by plumage alone is a challenging task in this population. This variability occurs largely independently of age and/or sex of individuals, and is so pronounced that it allows easy identification of many individuals by photographs (Sternalski *et al.* 2012), which leads us to suggest that this species is highly polymorphic (Huxley 1955; Roulin 2004). The presence of recurrent patterns of coloration in our population allowed the distinction of several 'types', hence the recognition of the species as polymorphic in addition to sexually dimorphic.

### Are brown males the result of delayed plumage maturity?

Brown males are not just immature birds with delayed plumage maturity, which might seem a logical conclusion given the similarity of their plumage to younger age classes (and females). Instead, these brown males represent a distinct morph, a permanent 'female-like' plumage that is currently known in only one other bird species, the Ruff *Calidris*

*pugnax* (Jukema & Piersma 2006). However, the situation is not quite that simple, since our study population does not consist of just brown and classic grey male morphs. In fact, these two types account for <20% of breeding males, with the remaining 80% exhibiting a wide variety of intermediate plumages. This may suggest that plumage variability in this population results from complete introgression between the two extremes of the range.

### Are brown males present elsewhere?

Although brown males have long been known in this area of France (Bavoux *et al.* 1998), the lack of published records suggests that they are either restricted to west-central France or extremely rare elsewhere. However, based on our personal experience in other areas, and on an internet search (about 3,000 photos checked on Google and Flickr using 'western marsh harrier' and '*Circus aeruginosus*' as keywords), it appears that completely brown males (type 1) and brown males that display only a greyish tint in some of their primary coverts (type 2) are found elsewhere in western Europe (table 1). Such males occur in Spain (pers. obs. and plate 98), as well as the Camargue (southern France: pers. obs.), Italy (A. Corso pers. comm.), eastern Europe and the UK (table 1). In the Balkans, there are some very atypical males that resemble our most extreme plumage types (table 1). However, in all such cases, completely brown and greyish-brown males are apparently quite rare (though possibly overlooked) – in contrast to our study population – and we found no evidence of such birds in Fennoscandia or Germany.

**97.** Variation in coloration with age in wing-tagged male and female Marsh Harriers from west-central France. Age of wing-tagged birds is indicated on images; a red arrow indicates when the same bird is shown in an image sequence of increasing age. To allow better comparisons, some photos have been flipped horizontally, in order to show birds in the same flight direction, meaning that colour marks may not appear consistent, e.g. 7, 12.

**1–3:** Second plumage of three grey males. **4–6:** Variation in coloration with age in grey males between two or three successive plumages. Note that plumage coloration changed between second and third plumage (more grey is apparent in sequences 4 and 5) but not afterwards. **7:** Variation in coloration with age in a brown male between three successive plumages. **8–9:** Known 6CY males displaying a dark trailing edge on the underwing. **10–11:** 6CY and at least 3CY males (respectively) displaying a barred tail. **12–15:** Variation in coloration with age in wing-tagged breeding females between successive plumages. No upperwing colour variation occurred in dark females (12), whereas slight underwing colour variation occurred in pale females (14). No variation in the extent of the lesser wing-covert patch occurred in some females (13), whereas in others, the pale patch became larger with age (15).



98. A brown male Marsh Harrier in central Spain, June 2011.

It is interesting to note that the ornithological literature and field-guide descriptions and photographs are based primarily on birds from northern latitudes. These populations consist of birds that are migratory and that winter in Africa (Klaassen *et al.* 2010) and possibly southern Europe. These birds

seem to exhibit less plumage variability than southwest and eastern European birds. Sedentary and migratory populations may differ in coloration in addition to behaviour.

We currently have no firm explanation for the fact that brown and atypical males are so common in our population. The ‘female-like’

**Table 1.** Some examples of brown or otherwise atypical male Marsh Harriers *Circus aeruginosus*. Many additional males were found but are not listed here because we could not rule out that they were 2CY–3CY birds. Note that in some cases the exact locality is not provided.

Male type	Country	Website
<i>Confirmed brown males</i>	UK	<a href="http://welshbirderindorset.blogspot.com/2011/03/marsh-harrier-madness.html">http://welshbirderindorset.blogspot.com/2011/03/marsh-harrier-madness.html</a>
<i>Putative brown males</i>	Portugal	<a href="http://www.flickr.com/photos/36341545@N08/5546739427/">www.flickr.com/photos/36341545@N08/5546739427/</a>
	Spain	<a href="http://fenetresurgaronne.blogspot.com/2008_11_01_archive.html">http://fenetresurgaronne.blogspot.com/2008_11_01_archive.html</a>
	Spain <sup>1</sup>	<a href="http://www.ibercajalav.net/img/112_MarshHarrierC.aeruginosus.pdf">www.ibercajalav.net/img/112_MarshHarrierC.aeruginosus.pdf</a>
	Turkey	<a href="http://www.flickr.com/photos/donbaloglu/5442084946/in/photostream">www.flickr.com/photos/donbaloglu/5442084946/in/photostream</a>
	Oman	<a href="http://www.patrickdieudonne.com/4images/img3979.htm">www.patrickdieudonne.com/4images/img3979.htm</a>
<i>Putative intermediate males</i>	UK	<a href="http://pewit.blogspot.com/2009/03/3cy-male-marsh-harrier.html">http://pewit.blogspot.com/2009/03/3cy-male-marsh-harrier.html</a>
	France	<a href="http://www.flickr.com/photos/40191328@N03/4793889351/">www.flickr.com/photos/40191328@N03/4793889351/</a>
<i>Atypical males</i>	Eastern Europe	<a href="http://www.flickr.com/photos/63854769@N05/5814833384/sizes/z/in/photostream/">www.flickr.com/photos/63854769@N05/5814833384/sizes/z/in/photostream/</a>
	Germany	<a href="http://www.flickr.com/photos/cis_schut/5107845814/">www.flickr.com/photos/cis_schut/5107845814/</a>
	Unknown	<a href="http://cheshirewildlifetrust.files.wordpress.com/2010/09/marshharrier-male-c-dave-newby-web.jpg">http://cheshirewildlifetrust.files.wordpress.com/2010/09/marshharrier-male-c-dave-newby-web.jpg</a>

<sup>1</sup> The adult female (18–11) on page 3 is claimed to be a female, but it was not sexed genetically (A. Zuberogoita pers. comm.) and we believe that it is actually a brown male, based on head shape and tarsus size shown in the photo.

morph may result from very intense competition within the sexes at high breeding densities and may have evolved to lessen competition among males and allow brown males to breed (Sternalski & Bretagnolle 2010; Sternalski *et al.* 2012). Such differences in colour between populations must also have consequences on mating (which in turn may help to maintain such plumage variability), as well as on mechanisms of plumage transmittance and heritability. Schreiber *et al.* (2001) showed extreme plumage variability in a population of Common Buzzards *Buteo buteo*, despite very low levels of molecular divergence, suggesting that plumage variability in our harrier population may be a consequence of historical population bottlenecks having an effect on allele frequencies on genes, in turn affecting plumage pattern. However, further research on both the level of genetic variation and the evolution of conditional alternative mating strategies such as female mimicry (Sternalski *et al.* 2012) is needed to improve our understanding of the evolution and maintenance of such extensive plumage variability and the existence of different morphs.

### **Is sexing of Marsh Harriers in such populations feasible and reliable?**

Since we also found that there are two distinct female morphs, the darkest one characterised by the absence of light patches (crown, throat, and upperwing-coverts), and since there is so much variability in male plumages, a key question is whether birds can be sexed reliably in the field in such populations. For instance, upperwing pattern appears as a good criterion for sexing birds, apart from brown males (type 1 & 2). Only males possess grey feathers, but beware that up to 6% of females may have some grey tint on the primary coverts. Brown males and females, irrespective of age, may thus be difficult to separate, but a grey or greyish hue in the tail is diagnostic of males. Furthermore, many brown males show black wing-tips, and also a large, whitish area at the base of the primaries, although these criteria are not always easy to note in the field (plate 96, 14 & 16, plate 97, 7). Apart from diagnostic behaviour during the breeding season (food pass and copulation behaviour only, since both males and females will carry nest material;

Simmons 2000), there are some subtle differences in silhouette between two members of a pair. Females are heavier than males and their silhouette, as well as their type of flight, more closely resembles a buzzard than a harrier – females are more ‘stubby’ than males, with a wider base to the wing and a shorter tail.

### **What about criteria for ageing Marsh Harriers?**

Ageing birds solely by plumage colour and pattern is probably impossible (even if the sex of the bird is known) – at least at our study site – because of the wide plumage variability within and between age classes and the large overlap between these classes. For instance, the upperwing-covert pattern of older birds may be apparent in juvenile plumage or appear only after the first moult. Similarly, grey males from any given age class can show great variety in the extent of grey. At least in our population of wing-tagged, known-age individuals, there is no trend with age in the extent of light patches, the extent of grey in the upperwing or how pale the underwing appears. However, 1CY and early 2CY birds are identifiable as such from their uniformly fresh/worn plumage (lacking moult contrast); while males with grey feathers (in the tail and/or upperwing) and females with clean pale underwing-coverts are undoubtedly 2CY or older. Ageing criteria such as a barred tail or a dark trailing edge to the wing (both said to be typical of 2CY–3CY males) are found in much older males in our population.

### **Conclusions and future prospects**

Our findings may come to a surprise to many, even those familiar with Marsh Harriers – that in a large breeding population in western Europe, only 10% of breeding males look like ‘typical field-guide males’, and almost a third of males show a previously undescribed ‘female-like’ plumage. Until now, this is the only population of Marsh Harriers in the region with such a high proportion of atypical plumages, especially in males, though such individuals apparently occur in other areas and may have been overlooked. This raises the question of the validity of sex and age attributions over most of the breeding range, at least with certainty.

Although we admit that this population may appear as an outlier, we hope that our findings will alert ornithologists to the existence of such birds, which may prove to be less rare than currently thought. We encourage further research based on our findings that both male and female Marsh Harriers are polymorphic.

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