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RELEASING MONTAGU'S HARRIER (*Circus pygargus*) BY THE METHOD OF HACKING

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ABSTRACT.—The hacking technique is the method most frequently used for the introduction of birds of prey. The use of this technique in the reintroduction of Montagu's harrier (*Circus pygargus*) is described. Hacking takes place in an enclosure measuring 3–4 m × 2 m × 1 m high. The harriers were between 20 and 30 d of age. After 5–8 d the enclosure was opened. The young birds became independent on average 33.7 d after the first flights (70.5 d of age). Over a 5-yr period 87 birds were introduced with a success rate of 82.7%. Only three birds have been seen returning to the area in subsequent years, but it is still early to be assessing the success of the project.

KEY WORDS: Circus pygargus; *hacking*; *releasing*.

Reintroducción del Aquilucho cenizo por el método hacking

RESUMEN.—El método hacking es el método mas comúnmente utilizado para la reintroducción de rapaces. En el presente artículo se describe la utilización de dicha técnica en la reintroducción del aguilucho cenizo. El hacking se realiza en un cercado de 3–4 m × 2 m × 1 m de alto. Los pollos son situados con edades de 20 a 30 d. Tras 5–8 d el cercado es abierto. Los pollos alcanzan la independencia a los 33.7 d desde el inicio de los primeros vuelos (correspondiendo a 70.5 d de edad). Tras un período de 5 años, 87 pollos han sido reintroducidos con un éxito del 82.7%. Aunque hasta la fecha tan solo tres aguiluchos han sido vistos volver a la zona a los años siguientes, aun es todavía temprano para evaluar el éxito del proyecto. [Traducción Autor]

Montagu's harrier (*Circus pygargus*) has suffered a considerable decline in the last few years (Cramp and Simmons 1980). In Catalonia (northeastern Spain), the population has decreased considerably, dropping from an estimated 40–55 pairs in the early 1980s (Muntaner et al. 1983) to 12 pairs in 1985.

As with most of the Montagu's harrier population on the Iberian peninsula (Garzon 1974, De Juana 1989), in Catalonia the species bred mainly in grain fields and occasionally in wetland areas. The draining of these wetlands, and above all the destruction of nesting sites by combine harvesters, are the main reasons for this serious decline (Muntaner 1981, Muntaner and CRPR 1985, Blanco and Gonzalez 1992). While the percentage of juveniles fledging before harvest time (depending on sites and years) is 40–70% in Italy (Pandolfi and Giacchini 1991), 10–40% in France (Berthemy et al. 1983) and 10–50% in Spain (Perez and Fernandez 1971, Fernandez et al. 1989), in Catalonia the overlap of breeding season and crop harvest is so great that at best only 0–5% fledge.

In 1985 the Servei de Protecció i Gestió de la Fauna (Wildlife Service of Catalonia State) embarked on a program to reestablish the species (Pomarol and Parellada 1989).

For the first few years of the project most of the methods described by Berthemy et al. (1983), used in the protection and management of nests, were unsuccessful. Because harvest time most often coincides with incubation or brooding of recently hatched chicks, the only effective means of nest protection is to leave an extensive area (approximately 0.5 ha) around the nest unharvested (Pomarol and Parellada unpubl. data).

By 1989 only two pairs initiated breeding. At the same time we began a new strategy to introduce the species to areas of short and thick natural vegetation (scrub land, marsh areas, etc.), habitats also frequented by Montagu's harrier in many areas of Europe (Laszlo 1941, Schipper 1978, Cormier 1985).

METHODS

Hacking was the technique selected for the introduction program. Imprinting acquired by juvenile birds on the surroundings from which they start to fly and in which they will eventually be reestablished (Sherrod et al. 1982) is of fundamental importance if introduction is to succeed

Hacking has been utilized to introduce many species of

Table 1. Montagu's harriers released by hacking in Spain (birds seen 10 d after first flights).

YEAR	NUMBER OF BIRDS RELEASED	PERCENT OF BIRDS SUCCESSFULLY RELEASED
1988	8	100
1989	5	100
1990	14	85.7
1991	31	90.3
1992	29	65.5
Total	87	82.7

raptors and has been adapted to the characteristics of each species. However, it has not been described for ground-nesters, like most species of the genus *Circus*.

The 87 harrier chicks used for introduction came from the following sources: 46 from various wildlife recovery centers in Spain (every spring in the center and south of Spain, where harriers are very abundant, the recovery centers receive many harrier chicks found by farmers during crop harvesting); 24 were taken from nests in grain fields in Catalonia; 11 from nests with large broods located in scrub land out of Catalonia, and six had been bred in captivity.

The site chosen for introduction was the Parc Natural dels Aigüamolls de l'Empordà, a wildlife reserve in the province of Girona. Extensive areas of marsh vegetation exist here, and 25 yr ago Montagu's harrier was a resident nesting bird at this location (Wallace and Sague 1969). That the area is currently under protection, combined with adequate management of the habitat, makes the introduction of the species and its long-term survival there feasible. The problems other populations of Montagu's harrier in similar habitats in Europe have experienced or are experiencing, such as loss of habitat, disturbance, etc.

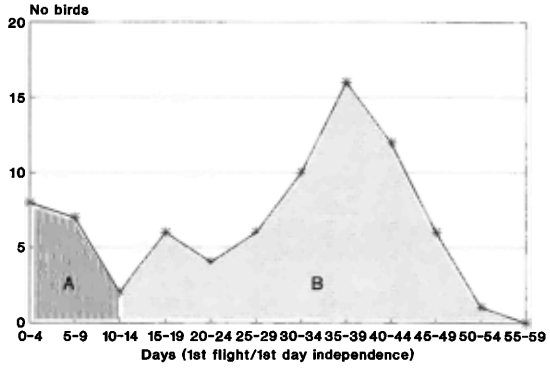

Figure 1. Period of dependence ($N = 79$). A: Birds considered unsuccessfully released. B: Birds seen after first 10 d are considered re-established.

(Jones and Colling 1984, Leroux 1991, Zijlstra and Hustings 1992), are not present at this location.

The hacking cage consisted of a series of net enclosures measured 3–4 m in length, 2 m in breadth and 1 m in height. The enclosures were placed on a small island of 9 ha and surrounded by canals and small lagoons. In this way mammalian predators were avoided.

The ideal age for placing the young harriers in the enclosure is 21–25 d, since from age 21 d they are able to tear their food although they are still unable to fly. Some birds over 30 d old, however, were also used successfully. Five to eight juvenile Montagu's harriers of similar ages were placed in each enclosure.

For identification from a distance, the young harriers were marked with colored bands in addition to official metal bands. Subsequently, this method proved ineffective since bands on birds sitting on ground covered with vegetation were extremely difficult to see. For this reason in 1992 we used wing tags similar to those used by Picozzi (1971) and Village (1982).

The young birds remained shut in the enclosures for a period of 5–8 d in order to accustom them to their surroundings. The birds were released by pulling back ⅔ of the mesh forming the enclosure roof. Initially the enclosures were opened at night, but we later found that they could be opened during the day without any risk.

If the enclosure had been opened at night, the harriers over 30–32 d old began to make their first flights the following morning. These flights were short and straight, and the birds spent most of the day hiding in the grass. At that time the enclosure could be used for a new group of chicks.

From 35 d of age on, real flights could be observed with small ascents and some gliding. At this stage they also began to play together, chasing each other through the air.

The daily food supply for the young birds already flying was left on top of or beside the enclosure. Food was given every day for five days, or until no food was eaten and all harriers had left.

Observations were done with a telescope (20–60×) from a blind located at 80 m from the hacking enclosure. Observations lasted about 6 hr/d, but increased to all day (12 hr) when harriers started to move away more often.

RESULTS AND DISCUSSION

Between 1988 and 1992, 87 juvenile Montagu's harriers were released in this way. In addition, during the first 3 yr, six chicks died before making their first flights. Postmortem analyses did not reveal specific causes. We speculated that transportation of the birds over long distances and possibly bad handling caused a high degree of stress with fatal consequences.

If we assume the minimal learning period for juveniles in the field is 10 d (Cramp and Simmons 1980), and calculate all birds which return to the enclosure after the first 10 d of flight as being successfully reestablished, we obtain an introduction success rate of 82.7% (Table 1). This minimum pe-

Table 2. Correlation between date of release and period of dependence for Montagu's harriers in Spain.

DATE OF RELEASE	NUMBER OF BIRDS	PERIOD OF DEPENDENCE
<15 July	18	39 d
19–25 July	26	32.9 d
30 July–4 August	19	29.9 d

riod seems to be corroborated when we observe the existence of two clearly separated groups (A and B) in Fig. 1.

The average period for attaining self-sufficiency from first flights to independence (when birds stop coming back to the enclosure for feeding) was 33.7 d (N = 63; calculated from birds considered successfully introduced), although this varied greatly in each case (Fig. 1). Independence corresponded to 70.5 d old on average. This seems to be extremely long when compared with observations of young fledging from natural nests (10–17 d). One reason for such differences is the fact that fledglings who received supplementary food dispersed at significantly older age than young from nonexperimental broods (Frumkin in press).

Individuals with slightly damaged plumage are always the last to leave the area, suggesting that they have difficulty catching prey. This emphasizes the importance of birds being in perfect condition when released. Damaged birds were recaptured permanently, and were not included in this analysis.

The periods of dependence appear to decrease when the juveniles are released at later calendar dates (Table 2) (Kruskal-Wallis test H = 9.91, df = 2, $P < 0.01$). This difference may be due to the urge to migrate, as is the case with the black kite (*Milvus migrans*; Bustamante and Hiraldo 1990).

Our results demonstrate that harriers released at a younger age have a longer period of dependence than those freed at an older age (H = 6.77, df = 2, $P < 0.05$), while the age at which they become independent is similar (H = 2.23, df = 2, $P > 0.05$; Table 3).

Laszlo (1941) states that young harriers learn to hunt before becoming independent. Beske (1982), however, having followed several young radio-tagged northern harriers (*Circus cyaneus*), did not observe any hunting activity during the period of dependence. For our part, although hunting was not observed, we were able to confirm that once juvenile harriers reach 40 d of age they carry small prey (birds, particularly young barn swallows (*Hirundo rustica*)) to perches located near the enclosure.

Table 3. Correlation between age of Montagu's harrier (at time of opening the hacking enclosure), period of dependence, and age of independence.

AVERAGE AGE AT RELEASE	NUMBER OF BIRDS	AVERAGE PERIOD OF DEPENDENCE	AVERAGE AGE OF INDEPENDENCE
32.4 d	30	37 d	69.4 d
35.7 d	10	33.8 d	69.5 d
43.2 d	22	29.5 d	73.1 d

In 1989, two of the birds which had been introduced the previous year returned to the area. These joined the immature harriers which had been introduced that year and ate the food provided. This suggests that the birds acquire a certain degree of fixation on the area of release. Despite this initial success, only one more released bird has been recorded as returning to the area, and it could not be confirmed that any pairs had bred in the area.

The low number of individuals released during the first few years (Table 1), and the fact that the species does not usually breed until reaching the age of 2–3 yr (Cramp and Simmons 1980) suggest we should wait a few more years before assessing the result of the introductions in terms of reestablishing a breeding population.

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