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Behaviour of hand-reared orphaned long-eared owls and tawny owls after release in the wild

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ABSTRACT

Two groups of eight long-eared owls, *Asio otus*, and eight tawny owls, *Strix aluco*, which entered a Rehabilitation Centre as nestlings, were studied. When more than 60 days old they were released to the wild. The aim of this study concerns the analysis of their behaviour immediately after release and their adaptation to natural life. The owls were radio-tagged and followed continuously, also with direct observation, until they disappeared from the area or died. The long-eared owls, released in an agricultural area with scattered woods, were reluctant to fly frequently and remained mostly in thick vegetation along stream banks or very close to the release pen itself. Nevertheless, they progressively enlarged their home range in a matter of days. Half of them disappeared from the study area within 11 days; three others died in a few days, apparently from starvation, while the last owl was rescued because it fell into a stream. In contrast, the tawny owls had a much better survival rate, as only one out of the eight died because it was preyed on in the early days. The birds remained in the area for a longer time, constantly within the woods, and flew more often. They, too, enlarged their home range but only until day 10, when there was a contraction in size. Thus, inexperienced hand-reared owlets are able to survive in the wild, but the possibility to cope with the new environment varies greatly between species, possibly due to environmental characteristics.

KEY WORDS: Behaviour - Strigiformes - *Asio otus* - *Strix aluco*.

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INTRODUCTION

Among others, one effect of human interaction with wildlife is the recent concern for birds of prey survival. Nowadays they are seen as environmental indicators (Carson, 1962; Newton & Chancellor, 1985; Cade *et al.*, 1988) and their ecological value is considered very high. Consequently, several Institutions devote many efforts to the rehabilitation of these birds eventual release into the wild.

In the wild state owls are likely no more rare than raptors, but they are found in lower numbers among rehabilitating birds, probably due to their elusive habits and the tendency to remain in woodland. Although several owls admitted to the Rehabilitation Centre of Parma are found injured from collisions with vehicles and structures (mainly wires), an increasing number of them are 'rescued' in Italy by people as nestlings or fledglings (Pesci, pers. comm.; Triossi, pers. comm.). Long-eared owls, *Asio otus*, and tawny owls, *Strix aluco*, are among the species most often present in the Italian rehabilitation centres (Dinetti *et al.*, 1995; Triossi, pers. comm.). Usually these are orphaned birds, veterinary inspection revealing lack of any particular injury. Once in captivity, owlets are hand-reared but efforts are made to avoid imprinting on or habituation to humans. When fully feathered, these birds may then be released into the wild.

Many studies have dealt with the medical and physical rehabilitation during captivity (Llewellyn & Brain, 1983; Giron Pendleton *et al.*, 1987; Redig *et al.*, 1993) or the techniques for successful release (Sherrod *et al.*, 1982; Llewellyn, 1991; Weaver & Cade, 1991). However, little has been done to evaluate the adaptation of the released birds to their natural habitat. Most studies present survival data and data on recovery distances from the release site obtained from ring recovery (e.g., Duke *et al.*, 1981; Larsen *et al.*, 1987; Hamilton *et al.*, 1988; Schulz, 1993; Dinetti, 1996), while little is known about the behaviour and general activity of the individuals immediately after release (Meyers & Miller, 1992; Csermely & Corona, 1994; Dell'Omo *et al.*, 1995). As hand-raised owlets have no experience of the wild, it is important to inspect their behaviour when released and, in particular, in the early period immediately post-release. Such data may additionally be useful for understanding the behaviour of naturally raised fledglings as they begin to explore the environment around their nest.

The goals of the present study were: (1) to describe in detail the behaviour of young owls immediately after their release in the wild; (2) to assess whether owls with no experience of life in the natural environment can adapt to it; (3) to test whether owls reared without parental example can hunt natural prey after fledging, and (4) to determine what kind of interaction they have with the natural population of conspecifics.

MATERIALS AND METHODS

The owls used in this study were all wild birds of two species tawny and long eared owl. These birds had been admitted in

singly as orphaned individuals to the Raptor Rehabilitation Centre (RRC) managed by the Italian Society for the Protection of Birds (LIPU), near Parma, Italy. Mostly they had usually been found as nestlings within 200 km of the Centre. During the captivity period the birds were fed day-old chicks by manual feeding until they were to feed autonomously. When released, they all were judged by the RRC's veterinary staff as in perfect physical (i.e., body mass, good pectoral muscle volume etc.) and flying condition and were not imprinted to humans. A few days before release, each owl was individually offered one live laboratory mouse (*Mus musculus domesticus*, C3H strain with agouti pelage) to ascertain its ability in hunting live prey. Needless to say that owls failing to catch effectively the mouse were not released.

The owls entered the RRC at a rather variable age. Nevertheless, the age of the long-eared owls at release ranged from 2 to 4 months, while that of the tawny owls ranged from 3 to 5 months. As the owlets had been admitted to the RRC as nestlings or fledglings, their age was detected with little approximation using their down (and plumage) type (Cramp, 1985; Chiavetta, 1988). The sex was not determined because of the difficulty to ascertain it clearly in young individuals. The owls were released from mid-July to end-September (long-eared) and from mid-July to end-October (tawny) in years 1994/95/96. The long-eared owls were released in an agricultural area near the Po river, about 15 km north of Parma and 50 m a.s.l., containing several, although fragmented, habitats, with most of the trees concentrated along the banks of the frequent streams. This site was chosen because it holds both nesting long-eared owls and winter roosts, and hence was deemed suitable for the species. During spring each year, a count of wild conspecifics was made using the playback method (Fuller & Mosher, 1987).

In contrast, the tawny owls were released within the 'Boschi di Carrega' Regional Park, a *ca.* 900-ha wooded area with several small clearings, located about 15 km south of Parma. The park lies at the foot of the Apennines on Pleistocene stream terraces, whose altitude ranges from 110 to 316 m a.s.l. This area was chosen because of its environmental protection, the constant presence of wild tawny owls and of several prey species and the general structure of the habitat which appears optimal for this owl (Redpath, 1995).

At about 10 days before release, the owls were treated against both ecto- and endo-parasites using commercial veterinary products: PBK (Copyr) and Ivomec (Merck Sharp & Dohome), respectively. Seven days later they were transported to a small (1 × 1 × 1 m) release outdoor pen, where they remained until release, to habituate them to the surroundings. The owls were then weighed and a false radio-tag was attached for habituation. A true backpack radio-tag (4 g two-stage by Biotrack, Wareham, U.K.) was mounted the day before release (Kenward, 1987; White & Garrott, 1990). The release occurred by opening the pen one hour before sunset on days without precipitation. To ascertain the possibility of owls to adapt and survive and in contrast to the hacking releasing method (Sherrod *et al.*, 1982), no food was offered after release.

Weather conditions permitting the birds were followed virtually continuously from dusk to dawn each night, for the first three nights after release. If a bird did not leave the study area, it was also monitored intermittently until its disappearance with the same schedule on alternate nights for the first week after night-3 and with 3-night intervals from then on. The observations were carried out using 10 × 42 binoculars (Konus) and a 3× nightscope (model NPN 30 K, Moonlight). Radio tracking was used as a tool to know precisely the owls' positions and to follow their movements. The fixes, obtained when the bird was perched, were calculated by triangulation or direct observation and were drawn onto a 1:25 000 (long-eared owls) or 1:5 000 (tawny owls) map. Flight length was calculated from the map after plotting the flight starting and ending site. Flight altitude above ground, whenever it was observed, was instead calculated subjectively making a comparison with the known height of tree branches.

The night (sunset to sunrise) was equally divided into three sub-periods whose duration, being based on the photoperiod, was variable during the year. The nights after release were numbered progressively (night of release = 1). Air temperature was ascertained at the beginning and at the end of each sub-period using a pocket digital thermometer, with 0.1° C approximation.

The Spearman rank correlation coefficient and the Kruskal-Wallis one-way ANOVA (Siegel & Castellan, 1988) were used for comparisons of continuous measures and correlation. The means are given ± SE and the probability is always two-tailed.

RESULTS

Long-eared owls

The eight owls used were followed for a total of 235 h. The captivity period mean duration was 72.8 ± 10.8 days (range 7 to 99 days), the earliest entering the CRR in April. The mean mass of the owls at release was 266.9 ± 12.4 g (range 210 to 315 g). The air temperature during the whole study was rather constant (mean 24.1° ± 0.4° C, range 15° to 30° C) and the wind speed never exceeded the Beaufort scale value 4 (7 $m \cdot s^{-1}$).

The owls usually disappeared from the release site after 5.3 ± 1.1 days (range 2 to 11 days). Three owls disappeared from the study area, apparently leaving it spontaneously. Three others died, likely from starvation, within one week of release. They had shown no odd behaviour patterns until the last observation session before being found dead. In addition, one bird was recaptured on the third night, because it was found drowning in a pond. The last owl lost its tag (later retrieved) one week after release, likely because the backpack attachment broke.

It was assumed that the data from a specific bird concerning resting, perching and flying activity are independent from each other, i.e. are not influenced by the preceding activity of the bird. The several habitats were equally available, as their distribution was subjectively judged as almost regular, but owls were recorded perching mostly on trees along stream banks. However, the longest mean perching duration (674.0 ± 55.1 min) was recorded when owls were very close to or on the release pen, although this occurred in two birds only (three times in total).

Air temperature affected the duration of perching negatively (r_s = -0.279; n = 76; $P < 0.02$). Owls perched low down (1.2 ± 0.2 m, range 0 to 5 m), but perch height was unaffected by habitat. The perches were usually located in the thickest part of the tree or close to the trunk. Among the several tree species in the area, those most often used were poplars (*Populus* spp.), willows (*Salix alba*), English oaks (*Quercus* spp.), or false acacias (*Robinia pseudoacacia*). The perch height was higher in nights with clear or partly clouded sky than under fully clouded sky (H = 13.279; n = 65; $P < 0.01$).

Although able to fly very well, the owls were reluctant to abandon the release pen, making only very few flights during the night of release, with no changes in subsequent nights. The maximum distance reached from the release site was 1750 m; however, the starting location of each flight was steadily farther with the passing of nights (r_s = 0.835; n = 74; $P < 0.001$, Fig. 1).

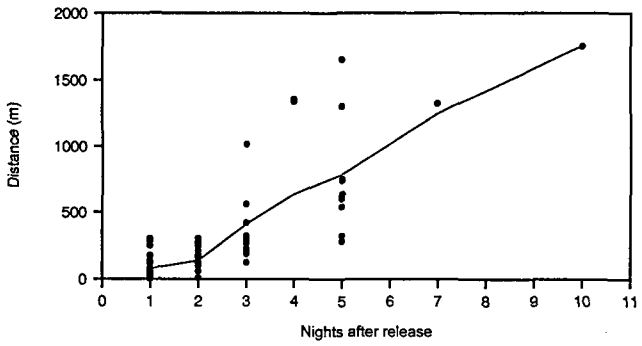

Fig. 1 - Distance in metres from the release site reached by the long-eared owls during this study. The curved line shows the best data fitting curve.

The mean interval between two successive flights was shorter during the early part of the night (H = 10.862; n = 58; P < 0.01).

The length of each flight also increased both with nights since release (r_s = 0.503; n = 74; P < 0.001) and the distance from the release pen (r_s = 0.659; n = 74; P < 0.001) (Fig. 2). Due to the difficulty in following the bird visually in darkness flight altitude could only rarely be ascertained. The mean value for observed flights was similar to perch height (2.3 ± 0.3 m, range 0.5 to 4 m) and increased as the owls moved farther from the release site (r_s = 0.723; n = 74; P < 0.01), but was independent of flight length.

Home range was calculated using the minimum convex polygon method. Although obtained during the night, the fixes were very accurate because the perched owls could be approached to within a few dozen metres. Unfortunately, the strong reluctance of the owls to fly frequently in some cases made it impossible to obtain at least three fixes per night. Because of this, all fixes were used in the analysis of home range size, discarding the usual 0.95 approximation.

The home range barycentre shifted progressively away from the release site (35.9 ± 8.5 m in night-1, 95.1 ± 28.0 m in night-2, 190.7 ± 56.3 m in night-3 and 486.7 ± 144.0 m in the subsequent nights) (H = 8.458, n = 27, P < 0.05). At the same time, the home range area enlarged, although, likely due to the small sample and the very high individual variability not significantly so.

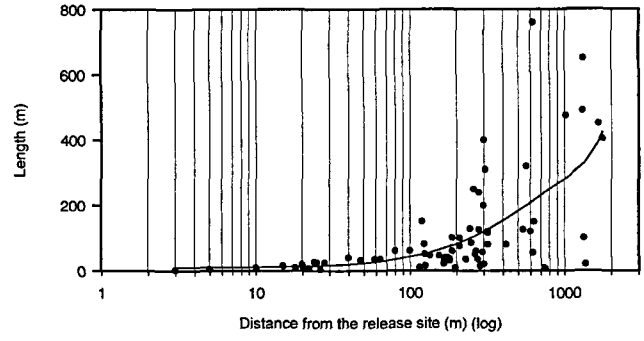

Fig. 2 - Length of each flight by long-eared owls plotted against distance from the release site of the place where the flight started. The abscissa axis is drawn in logarithmic scale for better data distribution. The curved line shows the best data fitting curve.

Hunting activity was difficult to observe. Nonetheless, several strikes were recorded, but it was impossible to identify the potential prey type and whether the attempts were successful. Only two pellets, definitely produced by the released owls, were recovered. These contained two common voles *Microtus arvalis*, one ground vole *Arvicola terrestris* and one wood mouse *Apodemus sylvaticus*.

Two owls only once each had some interaction with conspecifics. There was a vocal interaction and one attack, but the released owl reacted in neither case. Moreover, both the vocal interaction by three little owls (*Athene noctua*) and one short mobbing episode by a sandpiper (*Tringa* sp.) caused the same lack of reaction.

Tawny owls

The eight owls were followed for a total of 383.7 h. The mean duration of the captivity period was 84.9 ± 14.2 days (range 41 to 118 days) and the mean mass of the owls was 419.3 ± 20.0 g (range 353 to 512 g). Although the average air temperature was rather constant (21.0° ± 0.4° C), there was a high temperature variation (range 1 to 27° C), due to the longer stay in the study area and consequent arrival of winter for a few released birds. The wind speed never exceeded the Beaufort scale value 2 (4 $m \cdot s^{-1}$).

As a whole, these owls left the release site later than did the long-eared owls, i.e. after 18.3 ± 8.8 days (range 7 to 79 days). Seven owls disappeared from the study area, apparently leaving spontaneously and without problems, while only one was found dead, three days after release. The inspection revealed a wound on one leg and small symmetrical holes on the pectoral muscles, and these associated to an internal haemorrhage beneath. This owl did not likely starve, as the stomach contained remains of grasshoppers (Acrididae) and earthworms (Lumbricidae). Radiography revealed absence of gun shots, but showed a few radio-opaque dots that were interpreted as earth particles. It can be concluded that the cause of death was likely predation, maybe by an *Accipiter* sp., which are frequently seen in the park; the puncture wounds were caused by its talons and the leg wound by the beak.

Although visiting several habitats around the release site, the owls remained almost constantly in the wooded areas during both daylight and night. The individual owls perched at similar height (general average 4.2 ± 0.1 m, range 0 to 10 m, n = 233) and, similarly to long-eared owls and to observations by Dell'Omo *et al.* (1995) and Overskaug *et al.* (1999), all of them preferred to perch in thick vegetation and close to the trunk. Conversely, there was strong individual variability in perching duration (H = 32.715; n = 161; P < 0.001), which averaged 75.7 ± 6.7 min. The duration was negatively correlated with air temperature (r_s =

-0.303; n = 161; P < 0.001). Moreover, the owls were more active in the early part of night than close to dawn, as the duration of perching increased from dusk to dawn (H = 7.736; n = 161; P < 0.025).

Similarly to long-eared owls, tawny owls tended to fly most often early at night (H = 27.191; n = 166; P < 0.025) and more shortly (H = 10.821; n = 208; P < 0.001; average 51.9 ± 2.2 m) than before dawn. The length of their flights was correlated to the number of days post-release (r_s = 0.478; n = 208; P < 0.001) as well as to the distance from the release site (r_s = 0.637; n = 207; P < 0.001). Flight length was also affected by sky clarity, the flights being shorter when the sky was either clear or fully clouded (H = 17.558; n = 208; P < 0.001).

Flight altitude was detected with difficulty; in fact, only sometimes it could be ascertained with sufficient confidence. In these instances, the owls maintained constant and rather low flight altitude, averaging 3.0 ± 0.1 m (range 1.5 to 4.0 m). Although able to fly well, they did not move far from the release site, reaching a maximum distance of 1560 m (average 309.9 ± 19.8 m). This distance increased constantly until night 10 post-release (r_s = 0.476; n = 207; P < 0.001), but, in contrast to long-eared owls, it shortened on subsequent nights (Fig. 3).

Home range area was calculated using the minimum convex polygon method. Although obtained during the night, because the perched owls could be approached to within a few dozen metres the fixes were very accurate. The home range area enlarged steadily (r_s = 0.587; n = 26; P < 0.01) and, additionally the home range barycentre increased its distance from the release site (r_s = 0.717; n = 30; P < 0.001).

Some predatory strikes were recorded, but, again, it was impossible to identify the potential prey and whether the attempts were successful. A search was made daily beneath the perches used during the daylight to recover the pellets released by the owlets but without success.

Resident conspecifics interacted with three tawny owls only, once each, on night 1, 2 and 3, respectively. The interactions were simply vocal, lasted 60 to 180 s and the released bird did not react at all. The owlet of the above night 1 was also mobbed by two little owls on the same night (duration 120 s) but, once again, there was no reaction.

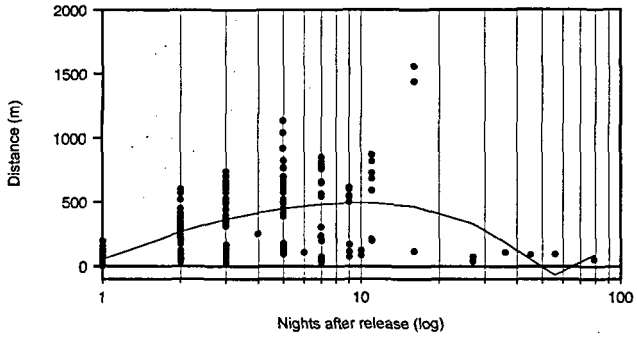

Fig. 3 - Distance in metres from the release site reached by the tawny owls during this study. The abscissa axis is drawn in logarithmic scale for better data distribution. The curved line shows the best data fitting curve.

DISCUSSION

Despite having no previous experience of it the birds studied seemed to be readily able to cope with life in a natural habitat immediately after release. This might be related to the rearing conditions they experienced, the lack of social attachment to humans, the training to fly in large outdoor aviaries during the period preceding the release and, particularly, to the hunting ability of owls, which were tested in specific predation tests with live prey.

The behaviour displayed by both species was basically similar. They both flew more frequently in the early part of the night, with a progressive decrease of activity as the night progressed. Both also increased their flying activity with the passing of days, showing progressive endurance of their pectoral muscles, likely not yet perfectly achieved, even if trained in captivity in large aviaries. However, it is unlikely that low muscle endurance is a major cause for released birds' vulnerability, as Duke *et al.* (1981) claimed. In fact, since released birds undertook long flights soon after release and the constant enlargement of the home range is an indication of the progressive exploration of the release site surroundings. On the other hand, the long periods of inactivity can suggest great attention paid by the birds to their own metabolic balance. This may result from the flying energy expenditure not compensated by the low energy intake in the early period after release, which seems to be one major limiting factor for the owls' activity.

The preference of owls to perch close to tree trunks as also recorded in wild owls is likely an antipredatory strategy (Overskaug *et al.*, 1999). Both species reacted similarly to air temperature, perching longer with low temperature. Conversely, sky cover had different effects: while tawny owls flew longer with partly clouded sky, long-eared owls' flight activity appeared unaffected by sky cover.

Although hand-reared, both species did not approach human beings, but, conversely, avoided perching in locations with evident human presence. This is particularly evident in the long-eared owls, released in an agricultural area. On the other hand, the tendency of long-eared owls to stay close to the pen immediately after release likely shows habituation to the captivity context, rather than to human beings. The release pen could be considered as a suitable perching site because it is a known environment, in contrast to the natural environment. This is another difference between the two species: in fact, although reared in the same context, tawny owls were apparently less influenced, moving around in the habitat with less consideration for the release pen. The relatively short flight distance shown by the owls in front of hu-

mans is possibly due to their habituation to see human beings moving around during the captivity period.

The released owls were very elusive and the invariable lack of response during the few interactions, even to mobbing (Flasskamp, 1994), suggest that unfamiliar juvenile owls can enter the home ranges of a wild individual without interfering greatly with it, nor causing strong reaction.

The two species differed in the dispersal time and in the distance reached from the release site. In fact, while long-eared owls moved constantly away from the release site, tawny owls had the same trend only for the first ten days, when the maximum distance was reached. This distance is the same as that recorded by Dell'Omo *et al.* (1995) in released conspecifics. Tawny owls remained longer in the study area, proving to be greatly able to cope with the ecological conditions, with consequent higher survival rate than recorded by Overskaug *et al.* (1999). Moreover, as both species were released without supplementary feeding method, the relatively long duration of tawny owls in the area indicates they were skilled hunters, being able to recognize and hunt live prey although without previous experience.

The survival of long-eared owls was lower, likely because of their inability to adapt readily to the natural context. This was probably not caused by poor predatory ability, as their hunting ability was ascertained just before release. In this species 60 days seems to be the age when fledglings begin to show spontaneous predatory attempts (Mikkola, 1983; Cramp, 1985). Their age at release was beyond this threshold. Prey remains in the few pellets recovered show that the owls hunted the same prey typically caught by wild long-eared owls in that part of Italy (Malavasi, 1995). Death was therefore more likely caused by the low ability to recognize the suitable potential prey. This can be due to the absence of prey presentation to nestlings and fledglings by parents. It seems very important to be a skilled predator in the early days after release to prevent a critically low mass being quickly reached (cf., Kirkwood, 1981).

In conclusion, this paper shows that young Strigiformes can almost readily adapt to life in the natural context even if orphaned and hand-reared. However, while flying ability seems to be acquired almost correctly in captivity, one difficulty can be identified in the correct develpment of the predatory behaviour. Although this likely develops without necessity of a specific learning process (cf., Meyer-Holzapfel & Räber, 1976; Csermely & Sponza, 1995), it seems important to stress to release birds after having trained them to both hunt and recognize a variety of suitable prey during the captivity period.

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