Home range, perching height and reaction to approaching humans by radio-tagged Ural Owls

Área vital, altura dos poisos e reação à aproximação de humanos por parte de corujas dos Urales marcadas com rádio-emissores

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ABSTRACT

Four breeding Ural Owls (*Strix uralensis*) (one pair, one female and one male) were radio-tagged at the nest and tracked on foot with portable equipment in Hedmark county in SE Norway. The owls´ positions were determined by cross-triangulating or by direct observations. A total of 105 plotted locations were obtained. The mated male and female were located 58 and 22 times on 30 and 17 separate days, respectively, in 1989, while the other female was located 18 times on 15 separate days in 1989, and the other male 7 times on 4 separate days in 1990. From October 1989 on, presumably after the young became independent, the first male moved out of his summer range and eastwards into Sweden. Home range areas were treated as summer areas until this date, and winter areas thereafter. Calculated as 100% minimum convex polygon, the summer (May - September) home range for this male was 11 km^2, while his winter (October - December) home range was 63 km^2. The corresponding home ranges for his mate were 7 km^2

and 20 km^2, while for the other female they were 27 km^2 and 32 km^2. Overall home range for the whole tracking period was 112 km^2 for the mated male and 42 km^2 for his mate, and 40 km^2 for the other female. There was negligible overlap between the home ranges of the two females nesting 8 km apart. A kernel analysis of the male´s summer range data showed that he spent half his activity within an area of 5 km^2 around his nest. The owls perched 2.3 - 8 m above ground, with an average of 5.0 m, usually in the lower half of the perch tree. The owls often took off before they were spotted. On the occasions when the owls were seen and flushed, the flight initiation distance ranged 8-35 m, with an average of 20 m. No pellets were found below the perches, and only once was an owl located when ingesting a prey.

Keywords: Home range, perching height, reaction to human approach, *Strix uralensis*, telemetry

RESUMO

Quatro corujas dos Urales (*Strix uralensis*) reprodutoras (um casal, uma fêmea e um macho) foram marcadas com rádio-emissores no ninho e seguidas a pé com equipamento portátil no condado de Hedmark, no sudeste da Noruega. As posições das corujas foram determinadas por triangulação ou por observações diretas. Foram obtidas 105 localizações. O macho e a fêmea acasalados foram localizados 58 e 22 vezes em 30 e 17 dias diferentes, respetivamente, em 1989, enquanto a outra fêmea foi localizada 18 vezes em 15 dias em 1989, e o outro macho 7 vezes em 4 dias em 1990. A partir de outubro de 1989, presumivelmente depois de os juvenis se terem tornado independentes, o primeiro macho abandonou a sua área de verão e deslocou-se para leste, para a Suécia. As áreas vitais foram tratadas como áreas de verão até essa data e, posteriormente, como áreas de inverno. Calculada como polígono convexo mínimo de 100%, a área vital de verão (maio - setembro) desse macho foi de 11 km^2, enquanto a área vital de inverno (outubro - dezembro) foi de 63 km^2. As áreas vitais correspondentes da sua companheira foram de 7 km^2 e 20 km^2, enquanto para a outra fêmea foram de 27 km^2 e 32 km^2. A área vital total para o período de seguimento foi de 112 km^2 para o macho acasalado, 42 km^2 para a sua companheira e 40 km^2 para a outra fêmea. Ocorreu uma sobreposição negligível entre as áreas vitais das duas fêmeas a nidificar a 8 km de distância. A análise *kernel* das localizações do macho durante o verão revelou que este passou metade da sua atividade numa área de 5 km^2 em torno do ninho. As corujas usaram poisos entre 2,3 e 8,0 m acima do solo, com uma média de 5,0 m, geralmente na metade inferior da árvore. As corujas levantavam frequentemente voo antes de serem avistadas. Nas ocasiões em que as corujas foram avistadas e fugiram, a distância de início do voo variou entre 8 e 35 m, com uma média de 20 m. Não foram encontradas regurgitações debaixo dos poisos, e uma coruja foi encontrada a ingerir uma presa apenas uma vez.

Palavras-chave: altura do poiso, área vital, reação à aproximação de humanos, *Strix uralensis*, telemetria

Introduction

The Ural Owl (*Strix uralensis*) is a cavity-nesting prey generalist that inhabits the northern taiga from Japan across Russia to Fennoscandia, and its westernmost distribution reaches across Sweden into Hedmark county in SE Norway (Mikkola 1983, Cramp 1985). Before 1985 very few nests had been found in Norway (Solheim 1985). In 1979 a nest box study was initiated, and from 1985 a total of 86 nest boxes were available in potential Ural Owl habitat in Hedmark county (Solheim et al. 2009). The sparse data recorded in Norway before 1985 indicated that Ural Owl clutch sizes were smaller than those reported from Sweden and Finland (Solheim & Bjørnstad 1987). We thus suspected that food availability could be a limiting factor resulting in smaller clutch sizes in Norway. In Finland Ural Owls show a functional response to microtine rodents, and otherwise prey on shrews, hares, birds and frogs (Korpimäki & Sulkava 1987). Because Ural Owls in Fennoscandia do not migrate during winter and tend to reside within their established territories, they may be more exposed to poor hunting conditions during harsh winters and low microtine rodent populations. According to Lundberg (1980, 1981), the availability of microtine rodents during winter and early spring is the main regulatory factor for breeding success of Ural Owls in Sweden. Solheim & Bjørnstad (1987) thus proposed to use radio telemetry to follow adult Ural Owls in SE Norway during autumn and winter to study their hunting habits and diet. To this end, three nesting Ural Owls were fitted with radio transmitters in 1989 and one in 1990, and located until the transmitters expired. Here, we present results on home range size and perching behaviour from this study.

Methods

In 1989 two Ural Owl nests situated 8.3 km apart were located at c. 60°46´N, 12°16´E in Hedmark county in SE Norway. One nest was located in a cavity in a partly dead aspen (*Populus tremulus*) (loc. 1), which was first found with nesting Ural owls in 1984. The other nest was in one of the project nest boxes (loc. 2), which had been available but unoccupied since autumn 1979. In each nest, two young fledged c 1 June. We used mist nets to capture the adults on 19 May (male 1; body mass 720 g), 1 June (female 2; body mass 815 g) and 8 June (female 1; body mass 840 g). Male 1 and female 1 were paired, while we did not succeed in capturing the mate of female 2. In 1990, a new male (here denoted as male 3) had occupied loc. 1 and nested with female 1. He was captured on 19 May (body mass 733 g).

The owls were fitted with a transmitter (model Biotrack SR-1) mounted as a backpack and attached by tubular Teflon tape (Bally Ribbon Mills, PA, USA) as harness. The total backpack including harness weighed c. 20 g, thus amounting to less than 2.7 % of the body mass of the lightest owl. The transmitters had a mercury switch which changed the signal to a more rapid pulse when the owls were flying or leaning forward, thus making it easier to cross-triangulate the owls and interpret their behaviour.

The owls were cross-triangulated during day-time to locate roost sites, and tracked during the evening and night hours to locate their hunting grounds and to watch their hunting behaviour. This was done on foot using a portable receiver (model Televilt RX-81) and a hand-held 4-element yagi-antenna. When tracking the owls during daytime and signals indicated that they were roosting, we usually tried to approach the owl at an angle to circle it and avoid flushing it before it could be spotted. Whenever the owls were seen perched, we noted the perching height. Locations of the owls were marked on copies of aerial photos. By using modern digital maps, web-based aerial photos, and Google earth, the locations were recently transferred to Google earth maps. This gave GPS data for each marked location and allowed modern analyses of the owls´ home ranges. Male 1 was located from 20 May until 26 December, while female 1 and female 2 were tracked from 16 June until 26 December, and from 15 June until 9 December, respectively, in 1989. Male 3 was located from 19 May until 15 June in 1990. Young Ural Owls are usually dependent on their parents´ feeding efforts until late August, after which they start dispersing (Valkama et al. 2014). We treated locations during May-September as representing summer home range of the owls, and locations obtained during October-December as representing winter home range. All locations of the females were made after the young had fledged. The transmitters on male 1 and female 1 had expired on 7 January 1990, and that on female 2 on 20 December 1989. The transmitter on male 3 had expired prematurely on 30 June 1990.

We obtained a total of 98 locations in 1989 and 7 locations in 1990. Male 1 and female 1 (the mated pair) were located 58 and 22 times on 30 and 17 separate days, respectively, while female 2 was located 18 times on 15 separate days. Male 3 was located only 7 times on 4 separate days, so home range size was not calculated.

Of the locations of male 1, approximately half were termed diurnal (made when the sun was above the theoretical horizon) and half were termed nocturnal (made when the sun was below the theoretical horizon. Of the locations of the two females, approximately two third were diurnal.

The time interval between successive locations of the same owl varied from 2 minutes to 34 days 22 hours, with a median of 12 hours 29 minutes. Because 98% of the intervals were longer than 5 minutes, and 90% were longer than 21 minutes, we regard the locations as fairly independent.

Home ranges were calculated by use of two methods in the package “adehabitatHR” in the statistical software R (R Development Core Team 2017); minimum convex polygon (MCP) and kernel (Wolton 1989). The former was used to enable comparison with a previous study. Means are presented with standard error (SE).

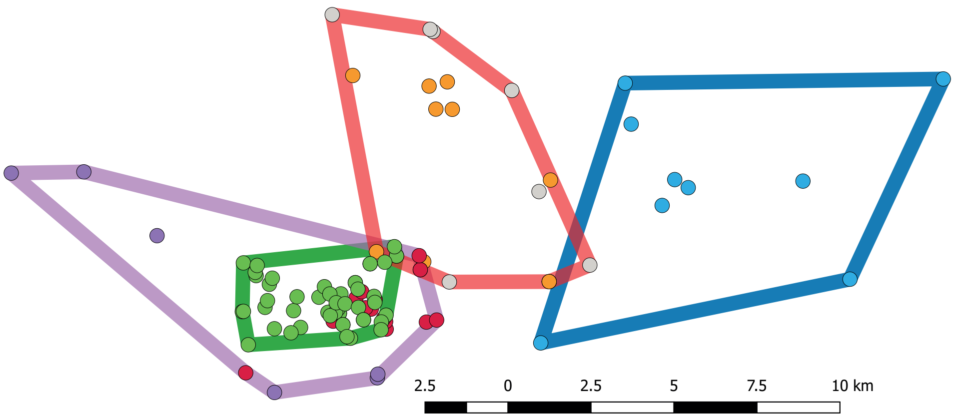
Results

When home range was calculated as 100% MCP it covered 41.9 km^2 for female 1 and 39.7 km^2 for female 2, with hardly any overlap between these two neighbours, and 112.0 km^2 for male 1 overall (Fig. 1). When it was calculated as separate 100% MCP ranges for the offspring dependence period (May - September) and the ensuing non-breeding period (October - December). it covered 11.2 km^2 (49 locations) and 62.8 km^2 (9 locations), respectively, for male 1, with no overlap (Fig. 1). The male had moved 9 km between the last location in the offspring-dependence period (25 September) and the first location in the non-breeding period (2 October). For female 1 the corresponding ranges were 7.3 km^2 (16 locations) and 19.5 km^2 (6 locations), while for female 2 they were 26.7 km^2 (11 locations) and 31.7 km^2 (7 locations), respectively.

The number of locations of the females was too small to calculate home range as kernel. The same was the case for the male in the non-breeding period. For the male during the offspring dependence period (May - Septem-

Figure 1 - Home ranges of the three Ural owls radio-tracked in 1989, expressed as 100% MCP, with each plotted location shown. Green colour denotes the range of the male during May - September, and blue colour his range during October - December. The overall range of his mate (female 1) is denoted by purple colour, with locations from June - September in red colour and locations from October - December in purple colour. The overall range of the other female (female 2) is denoted by orange colour, with locations from June - September in orange colour and locations from October - December in grey colour.

Figura 1 - Áreas vitais das três corujas dos Urales seguidas por rádio-telemetria em 1989, expressas como 100% MCP, com cada localização representada. A cor verde indica a área ocupada pelo macho entre maio e setembro, e a cor azul a área ocupada entre outubro e dezembro. A área ocupada pela sua companheira (fêmea 1) é indicada pela cor roxa, com as localizações de junho a setembro a vermelho, e as localizações de outubro a dezembro a roxo. A área ocupada pela outra fêmea (fêmea 2) é indicada pela cor laranja, com as localizações de junho a setembro a laranja e as localizações de outubro a dezembro a cinza.



ber) 95%, 75%, 50%, 25% and 10% kernel range covered 21.8, 11.2, 5.4, 1.9 and 0.6 km^2, respectively (Fig. 2). His nest was located within the 25% (and higher) kernel range, but outside the 10% kernel range (Fig. 2).

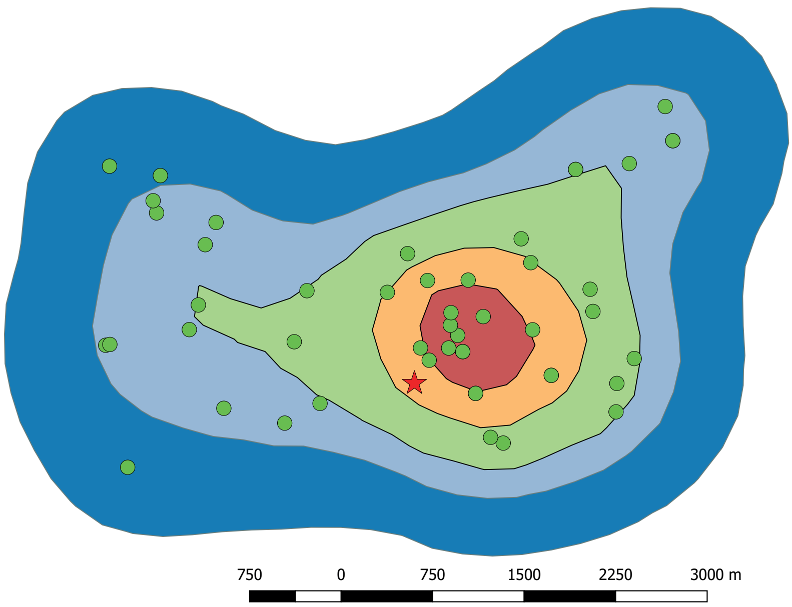
When we approached perched owls during daytime, they either took off before we could see them or at the moment we spotted them, or they stretched out in camouflage posture trying to avoid detection. On 24 occasions the owls were observed before they took off, and their perching height could be measured. The owls were usually perching in the lower half of the tree, typically on the lowest thick branches of a pine, and were never seen perching in the top of a tree. Perching height was on average 5.0 ± 0.3 m and ranged 2.3 - 8 m, with no significant variation between the four individuals ($F_{3,20} = 0.29$, $p = 0.83$). In seven of these cases we measured the height of the perch tree, and it ranged 6 - 15 m, with an average of 10.8 ± 1.4 m. The perching height relative to the tree height ranged 0.30 – 0.83, with an average of 0.48 ± 0.06.

On the 14 occasions when the owls were seen and flushed, the flight initiation distance ranged 8-35 m, and was on average 19.7 ± 2.4 m, with no significant variation between the four individuals ($F_{3,10} = 1.72$, $p = 0.23$). This flight initiation distance was not significantly related to perching height ($F_{1,12} = 0.37$, $p = 0.55$).

We did not attempt to measure the owls´ habitat preferences, i.e. habitat use against available habitat types. During the seven months we were able to follow the Ural Owls, we did however get a good impression of where the owls moved while hunting. They were often found in swampy pine or mixed coniferous forest, and never seen perching in open areas like bogs or clear-cuts. When the male of the mated pair was flying towards the nest, he crossed some clear-cuts usually in tree-top height. When the owls were flying

Figure 2 - Home range of the Ural owl male during May - September, expressed as kernel utilization distributions, with each plotted location shown in green colour. Brown colour denotes 10%, yellow 25%, green 50%, light blue 75%, and dark blue 95% utilization. The red star denotes the position of the nest.

Figura 2 - Área do macho de coruja dos Urales durante os meses de maio a setembro, expressa em distribuições de utilização de kernel, com cada localização estimada na cor verde. A cor castanha indica 10%, amarelo 25%, verde 50%, azul claro 75% e azul escuro 95% de utilização. A estrela vermelha indica a posição do ninho.



in forest, they often flew close to the ground (0.5-1.5 m).

We did not find any pellets at the sites where owls were located perching during daytime. The movements of the owls indicated that they did not establish specific roost sites after the chicks had left the nest, and ended up resting wherever their nightly hunting had brought them at the dawn of day. On the very last tracking day we located female 1 with prey. When we triangulated her after 11.30 pm in the dark in snowy weather on 26 December, the transmitter signals indicated that she was eating (alternating quick and slow pulse of signals from a stationary position). The owl was flushed from a carcass of a female Capercaillie (*Tetrao urogallus*) on the ground. The bulging eyes of the carcass indicated that the prey was recently killed, and thus most likely killed by the Ural Owl herself.

Discussion

Home range

During May – September 1989, when providing for offspring, the Ural Owl male had a home range covering 11 km^2 when calculated as 100% MCP. In comparison, a Ural Owl male radio-tracked for 9 weeks during May - July in 1991 in Värmland county in Sweden, in the same boreal forest region as our study area and less than 100 km towards southeast, had a 100% MCP home range covering 21 km^2 (Bolin et al. 1992). These areas were 5-10 times larger than those found for 100% MCP home ranges of providing males of the Boreal Owl (*Aegolius funereus*) and the Northern Hawk Owl (*Surnia ulula*) in boreal forests c. 100 km northwest of our study area in 1983-85 (Sonerud et al. 1986, Bækken et al. 1987, Jacobsen & Sonerud 1987). The two latter species are smaller than the Ural Owl, so would be expected to need smaller ranges, given the same access to prey. Moreover, the Boreal Owl and the Northern Hawk Owl are more specialized on small mammals as prey than is the Ural Owl (Mikkola 1983, Cramp 1985), and therefore depend on higher small mammal abundance to nest. Thus, the home range estimates obtained for Boreal Owls and Hawk Owls were probably on average representing higher small mammal abundances than were those obtained for the Ural Owl. In the low vole year 1993, Eurasian Pygmy-owl (*Glaucidium passerinum*) males in a mixed boreal forest-farmland area c. 100 km northwest of our study area had 100% MCP home ranges averaging 3 km^2 (Strøm & Sonerud 2001).

The kernel analysis of the locations obtained for the Ural Owl male suggests that during the provisioning period he was as likely to be located within an area of 5 km^2 around the nest as further away. Thus, a substantial part of his movement seemed to be concentrated on a rather small area.

The overall home ranges of the two Ural Owl females (100% MCP) had strikingly similar size (40 km^2 and 42 km^2). It is also striking that these neighbours, nesting 8 km apart, had 100% MCP home ranges just touching each other, with minimal overlap. Ural Owl males are strongly territorial (Mikkola 1983, Cramp 1985), and our data suggest that this applies to the females as well. While one of the females had a smaller 100% MCP home range in the offspring-dependence period (7 km^2) than in the non-breeding season (19 km^2), this was not the case for the other female (27 km^2 and 32 km^2, respectively). The former female had a similar home range size in the offspring-dependence period as her mate (7 km^2 and 11 km^2, respectively).

Young Ural Owls depend on their parents for food until late August (Valkama et al. 2014). This may explain why the male Ural Owl did not start expanding his home range until October, and thereafter moved 20 km towards the east into Sweden. His mate nested in the same cavity in the aspen tree with a new male (male 3) in 1990, but thereafter she relocated 1 km eastwards to a nest box, which she used for breeding in later years. Thus, the male may have been evicted from his territory by the new male in fall 1989.

Perching height

The Ural Owls did not tolerate humans at close distance. We were thus unable to closely follow the Ural Owls and observe their hunting behaviour, as is possible for Boreal Owls (see Bye et al. 1992). On average, the Ural Owls perched 5 m above ground when located. In comparison, radio-tagged Boreal Owls on average perched 3 m above ground when hunting at night, and 4 m above ground when roosting during daytime (Bye et al. 1992). We did not discriminate perches used for hunting from perches used for roosting by the Ural Owls, but apparently they perched higher than Boreal Owls when hunting. Although the Ural Owl is less constrained to nocturnal hunting than is the Boreal Owl, both use auditorial cues to locate prey (Cramp 1985). Because Ural Owl males are twice as large as Boreal Owl males by linear body measures (Cramp 1985), the distance between their ears is larger, so they would be able to determine the exact position of a ground-dwelling prey by acoustic cues at a larger distance (cf. Norberg 1970, 1978).

Prey

Unfortunately, we were unable to document prey taken by the radio-tagged Ural Owls to reveal their diet during fall and winter, with one exception (see below). The owls obviously did not use permanent roost sites outside the breeding season, and pellets were thus very hard to find. The way Ural Owls seemed to avoid close contact by humans made it even more difficult to locate roosts sites and pellets. This shy behaviour was quite similar to that found in radio-tagged individuals of the closely related Tawny Owl (*Strix aluco*) and Great Grey Owl (*Strix nebulosa*) (pers. obs.).

The only prey item we were able to record was a female Capercaillie being ingested by female 1 close to midnight in late December. This prey weighs c. 2 kg, which is 2-3 times as much as a female Ural owl (c. 800 g). By feeding mammalian and avian prey to owls in temporal captivity, and video recording the owls´ prey handling, Slagsvold & Sonerud (2007) and Slagsvold et al. (2010) found that ingestion rate decreased with prey size, and was higher for mammalian than for avian prey. From figs. 2 and 3 in Slagsvold & Sonerud (2007), we estimated that a microtine rodent weighing 20 g, thus c. 2.5% of a female Ural Owl (800 g), would be ingested at a rate of 30 g/min, thus in 40 s, whereas an avian prey weighing more than twice as much as the owl would be ingested at a rate of less than 1g/min. Although only c. 70% of the body mass of the latter prey would be consumed (fig. 1 in Slagsvold et al. 2010), it would still take the owl c. 24 hours or more to consume the prey. Thus, the probability of locating a Ural Owl while it is consuming a microtine rodent is negligible compared to the probability of locating it when it is consuming a female Capercaillie. This would explain why the only prey we recorded was a female Capercaillie, and why we never found the owls while they were consuming smaller prey.

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