

Abstracts

International Hen Harrier and Short-eared Owl meeting 2019

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Preface

Hen Harriers (HH) and Short-eared Owls (SEO) are characteristic birds of prey of open landscapes throughout the northern hemisphere. Besides natural and semi-natural habitats such as moorland and coastal dunes, both species also frequently inhabit agricultural areas. Despite their vast distribution range and apparent flexibility regarding breeding habitats, regional HH and SEO populations are decreasing in large parts of Europe. The suspected reasons for these declines include habitat alteration and, regionally, persecution. Moreover, as ground-breeders, HH and SEO suffer losses due to predation and agricultural activities. However, the exact mechanisms leading to the observed population declines in HH and SEO are poorly understood, calling for efforts to improve our ecological understanding of these two enigmatic species.

As far as we are aware, there had never been a platform where HH and SEO experts and researchers from across Europe met to exchange knowledge and experiences on the ecology and conservation of the two species. Yet, we consider such an exchange of great importance to gain a better understanding of the causes of local and regional population declines and the prospects of conservation measures. Against this background, the Dutch Montagu's Harrier Foundation and BirdLife Netherlands organised an international 3-day expert meeting at the University of Groningen, the Netherlands, on the two species on 20-22 March 2019. The meeting brought together 50 experts from 13 countries, evidencing that our wish for exchanging knowledge on the two species was broadly shared. The goals of the meeting were to:

- 1) exchange and update information on status and trends of HH and SEO in European countries;
- 2) exchange information on research that has been conducted on the summer and winter ecology of both species in past and recent years;
- 3) exchange ideas on effective conservation strategies for both species;
- 4) identify knowledge gaps and explore possibilities for future co-operation in research on and conservation of HH and SEO;
- 5) synthesise a 'future vision' for viable HH and SEO populations in Europe.

In this booklet you can find the abstracts of all the presentations held during the meeting, including a summary of the general discussion held at the end of meeting, synthesising the main outcomes. This booklet thus provides an up to date overview of HH/SEO status and trends, current research on ecology and threats, and conservation approaches.

We have experienced the meeting as a great success and sincerely acknowledge all the contributors and other participants taking part. We hope the meeting and this booklet will serve as a starting point for more international co-operation in the future and will contribute to improved conservation strategies for two enigmatic bird species in Europe.

The meeting organisers,

Jules Bos (BirdLife-NL)

Tonio Schaub (Dutch Montagu's Harrier Foundation)

Marije Kuiper (BirdLife-NL)

Angela Broekhuizen (BirdLife-NL)

Raymond Klaassen (Dutch Montagu's Harrier Foundation & University of Groningen)



Meeting participants (photo: Gerard Westerhuis)

Status and trends



Photo: André Eijkenaar

Farmland breeding Hen Harriers in East Groningen, a new prospect?

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Hen Harriers started to breed in agricultural fields in East Groningen, the core breeding area of Dutch Montagu's Harriers, in 2010, after a first breeding attempt in a cereal field near Lauwersmeer in 2009 (about 60 km further West). This development was encouraging because the breeding population of Hen Harriers in dune habitat on the Dutch Wadden Sea islands was declining since 1995. The population in East Groningen varied during the first years, with as much as six to seven breeding pairs in 2014 (Fig. 1). However, in subsequent years it became clear that this small farmland breeding population is still vulnerable and unstable. Between three and four pairs were confirmed in 2015 to 2018. In 2018, only three pairs were present in the study area and none of these bred successfully. Overall, nests were mainly found in winter wheat (25 out of 28). Half of the confirmed breeding pairs was successful ($N = 13$), most of them thanks to nest protection measures either using electric fences (4) or wire mesh cages (7). In total, 42 chicks fledged between 2010 and 2018. The mean number of fledglings was 1.6 per confirmed pair and 3.2 per successful pair. Reasons for nest failure were unknown in most cases (10), or related to predation (2) and human disturbance (2). Out of 27 confirmed breeding attempts, six were made by the GPS-tagged female *Simone*, originating from the German Krummhörn region near Emden, Lower Saxony. Another four were made by a female originating from the German Wadden Sea island Wangerooge. In all other cases, females were not ringed (6) or it remained unknown (11). Five of the confirmed breeding attempts were made by males born in East Groningen, two by male *Jules* and three by male *Bernard* who bred in all three cases with his mother *Simone* (both males were GPS-tagged). Two more attempts can be assigned to a male ringed and GPS-tagged as adult in East Groningen. In the rest of cases, males were not ringed (10) or it remained unknown (10). In the province of Flevoland in the West of the Netherlands, breeding attempts were also made in cereal fields (one in 2011, two in 2014, and one in 2015), but only the one in 2015 was successful. In addition, breeding in farmland habitat also occurred irregularly in Rheiderland, the region adjacent to East Groningen in Germany, since 2004 ($N = 6$ breeding attempts). The male of a successful nest in 2016 was born in East Groningen in 2014.

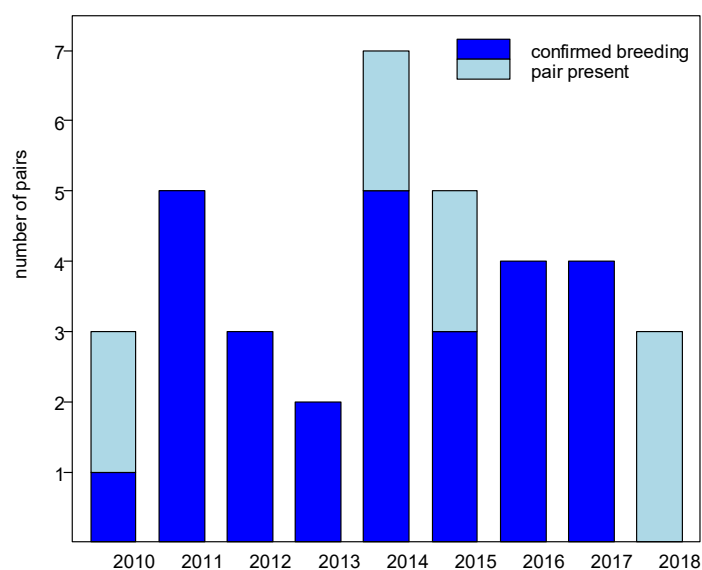


Fig. 1: Development of the Hen Harrier population breeding in farmland in East Groningen.

Status and trends of Hen Harriers in Germany with special focus on the Lower Saxony Wadden Sea National Park

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The Hen Harrier (*Circus cyaneus*) is one of the rarest breeding bird species in Germany and currently threatened with extinction. Until the 20th century breeding Hen Harriers have been albeit rare but widely distributed, concentrating in the vast moor and heathlands in north-western as well as north-eastern Germany. The large-scale degradation of these habitats and transformation into intensively used agricultural land have led to a massive loss of suitable breeding habitats for Hen Harriers.

Today Hen Harriers mainly inhabit coastal habitats in the Lower Saxony Wadden Sea region. Here they breed in dune slacks with low shrubberies dominated by Creeping Willow (*Salix repens*) and other shrub species (i.a. Beach Rose *Rosa rugosa*) at the Wadden Sea islands as well as in Couch Grass (*Elymus repens*) areas in upper mainland salt marshes. Isolated and non-annual breeding occurrences are sparsely distributed in lowland areas throughout Germany. Here breeding sites are located in agricultural areas especially in cereal fields.

Despite a short period (1985–2009) of moderate population increase, the long-term breeding population trend of Hen Harriers in Germany is decreasing. Since the late 1990s population numbers showed a considerably rapid decline.

From 2005-2009 the total German population size ranged from 40-60 breeding pairs, according to the latest German Breeding Bird Atlas. The breeding distribution is highly restricted to the Wadden Sea islands within the World Heritage site and Wadden Sea National Park of Lower Saxony. At present the Eastfrisian islands are the most important breeding site for Hen Harriers and host the only permanent breeding population with 20-30 breeding pairs (2005-2009) representing approx. 75% of the total breeding population.

Although occasional breeding records are reported for the early 20th century for the Lower Saxony Wadden Sea Islands, the colonization of all Eastfrisian islands started from the early 1970s. From 1980 numbers of breeding females increased rapidly to a maximum of 53 in 1997. Since then breeding numbers have dramatically crashed. While in 2001 still 49 breeding females were recorded, numbers decreased to three females until 2017. The Wadden Sea breeding population of Hen Harriers suffered an overall loss of 94% in 20 years (1997-2017). The current Hen Harrier population size of Germany should likely be estimated at less than 20 breeding females.

Status of Hen Harrier and Short-eared Owl in Westphalia (NW Germany)

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In a cereal farmland (area size about 2,000 km²) in central Westphalia, 50 km east of the city Dortmund, breeding sites of harriers have been recorded systematically since 1993. In the event displaying Short-eared Owls were also counted. The study area includes the farmland special protection area (SPA) "Hellwegbörde" (area size about 480 km²) and the grassland-SPA "Lippeaue with Ahsewiesen" (23 km²). The breeding places in winter cereals (mainly barley and wheat), if necessary, were protected to prevent brood losses due to harvesting. Since 2006, I have recorded the number of burrow entrances of the most important rodent species *Microtus arvalis* each summer in over 100 transects (length 400 m, width 2 m) in cereal stubble fields.

Single successful broods of the Hen Harrier occurred 2001 and 2010 in winter wheat fields. Four pairs of Montagu's harriers brooded in the neighbourhood of the Hen Harrier nest in 2001 and two in 2010. In 2007, a pair of Short-eared Owls produced fledglings in a set-aside field. Within a radius of 1.5 km of the nest, 11 nests of Montagu's harriers and 4 nests of Marsh Harriers were recorded and in 2 places I saw nest-building of Hen Harriers (including a one year-old brown male) without brooding. The brooding of both species always appeared in years with rodents peaks (> 140 burrow entrances per 800 m²). Since 2006, the yearly number of Hen Harriers observed in the months of May and June decreased in my study area, the average was 9 in the period 2006- 2009 and only 2 in the period 2015-2018. The yearly number of Hen Harriers observed in May/June was correlated with the rodent index in central Westphalia in the period 2006-2018 (Fig. 1).

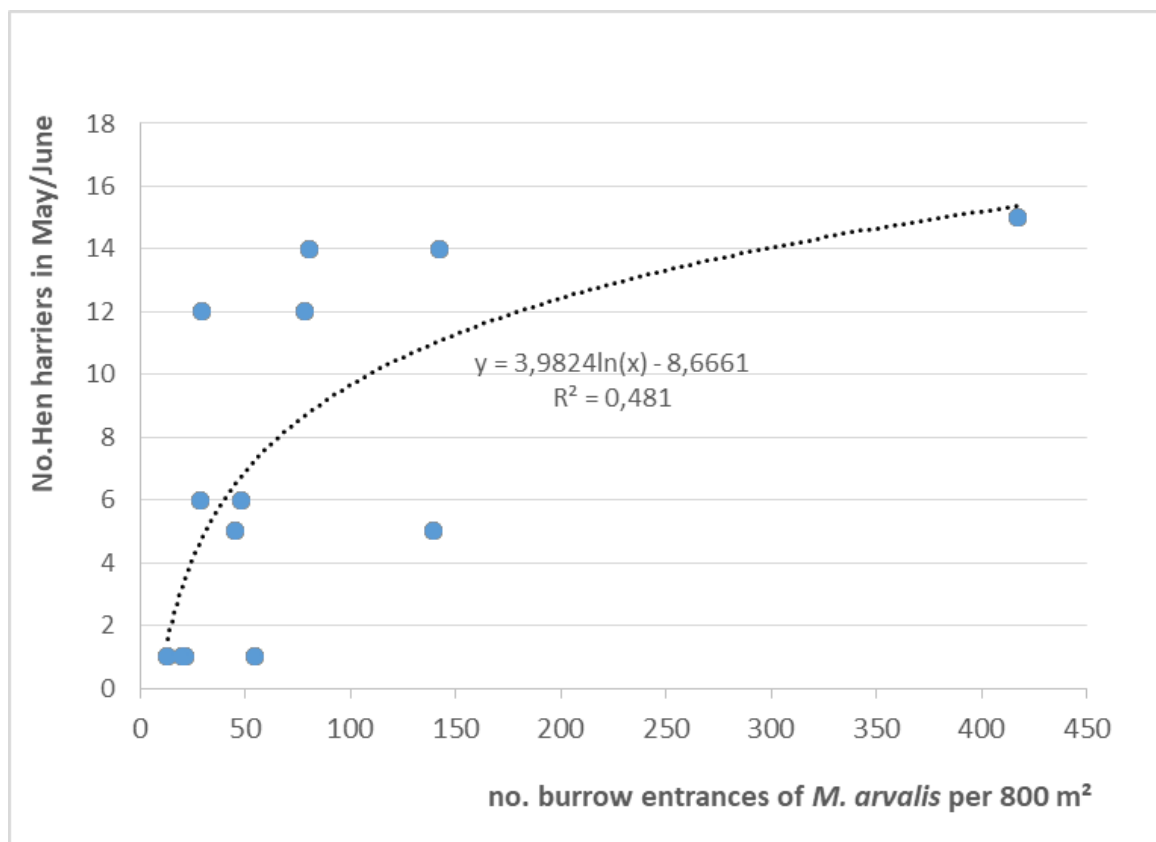


Fig. 1: Number of Hen Harriers observed as a function of vole density in central Westphalia.

In several winters in the last 15 years communal roosts of Hen Harriers (mostly in set-aside, daily maximum 5-8) and Short-eared Owls (mostly in extensified grassland, daily maximum mostly < 10; once about 20 in March 2010, G. Lakmann) were observed in central Westphalia.

In the whole Westphalia part (area size 34,084 km²) of the federal state North-Rhine Westphalia, Hen Harrier and Short-eared Owl are only rare, irregular breeding birds since the 1960s. In the last decade, the Short-eared Owl has become more common as a breeding bird in one large renatured bog area (SPA "Recker Moor") in the north of Westphalia: 1-2 broods or territorial pairs in the years 2009, 2012, 2014, 2015 and 2016. There are also observations without territory hints in the breeding seasons 2007, 2017 and 2018. In some winters communal roosts of Short-eared Owls were also seen there, the daily maximum was 7 in winter 2007/08 (R. Tüllinghoff). In the neighbouring nature protection area "Radewiesen" (Lower Saxony) there was also a breeding record, in 2018.

In the SPA "Recker Moor" there are also regularly larger communal winter roosts of the Hen Harrier, daily maximum was 26 in winter 2015/16 and 19 in winter 2018/19. A higher daily maximum (55) was observed in the neighbouring bog area "Venner Moor" (Lower Saxony) in winter 2018/19 (R. Tüllinghoff, personal communication).

The Hen Harrier in the UK; population status and conservation issues

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The Hen Harrier is a red listed species listed in the UK's Birds of Conservation Concern 4, published in 2016. The species is subject to routine population monitoring every six years. These censuses are supported by the statutory nature conservation agencies in the United Kingdom; delivery is coordinated by the RSPB; and much of the fieldwork is undertaken by the voluntary Raptor Study Groups. Given the large range of the Hen Harrier in the UK, including remote areas (especially in Scotland), this species is surveyed by using a combination of core and randomly selected squares in a stratified sample.

The last national Hen Harrier survey, conducted in 2016, estimated the UK and Isle of Man population of breeding Hen Harriers at 575 territorial pairs (95% confidence limits). Out of this population, 460 territorial pairs are in Scotland; 46 territorial pairs are in Northern Ireland; 35 territorial pairs in Wales; 30 territorial pairs on the Isle of Man; and 4 territorial pairs in England.

The core population of Hen Harriers in Scotland occurs mainly in the southern uplands, and on the west coast. There are particularly important populations on the Western Isles and on Orkney. The Orkney population alone is over 100 territorial pairs or about one fifth of the UK Hen Harrier population.

Formerly, and in the 1600/1700s the Hen Harrier was a widespread breeding bird in the UK. During the 1800s game preservation, egg collecting and taxidermy took their toll, and the Hen Harrier's population was brought to the verge of extinction on mainland UK by the turn of the twentieth century. The only places where continuous breeding throughout the past few centuries occurred are Orkney and the Western Isles. A population recovery began on the Scottish mainland during the World War II period from 1939, and afterwards from 1945, when breeding pairs returned to Tayside, Moray and Sutherland. In the next 20 years regular breeding and population expansion took place in Southern Scotland, Wales, and then England. Population expansion was encouraged by a number of factors; notable amongst these was reduced human persecution with gamekeepers and estate staff involved in the war effort; however also the expansion of new conifer forests provided suitable and safe nesting habitats in many upland areas of the UK.

Between 2004 and 2016 national surveys show that the population of Hen Harriers in the UK (excluding Isle of Man) has declined from 749 territorial pairs to 545 territorial pairs, a decline of 27%. The main explanation for this population decline is continued human persecution, which takes place for the most part on land managed for "driven" grouse shooting, predominantly in the north of England, and the southern uplands, as well as the eastern and central Highlands of Scotland. In 2008, only 5 pairs of Hen Harriers bred in driven grouse moors in the UK despite suitable prey and nest site availability. Several studies have suggested that in the absence of human persecution, the UK population of Hen Harriers has the potential to reach around 2500 breeding pairs.

Hen Harrier status and trend Ireland

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Ireland represents the most westerly location of the Hen Harrier (*Circus cyaneus*) species in the world. At this frontier of its global range, the Hen Harrier is a bird of conservation concern and it appears to have become more and more so, as time has passed. While up to the 20th century, the Hen Harrier in Ireland would have been “generally distributed over the island”, “often met with” and “in considerable numbers”, various changes including persecution and habitat loss would have reduced range and numbers by the time a first population estimate of 250-300 breeding pairs was presented in the 1970s. The first national survey was completed in 2000, with 102 breeding pairs confirmed. This is now considered an underestimate as additional survey coverage in subsequent national surveys found birds where the original survey had not searched. The most recent census undertaken in 2015 confirmed 108 breeding pairs in Ireland. A subset comparison of 10km squares surveyed during all four national surveys to date, reveals a 33.5% decline in 15 years. A long-standing study in County Kerry has been underway since 1955 and has revealed a significant crash in population there. The Irish Hen Harrier Winter Survey has tracked on an annual basis, the national ‘overwinter’ population of Hen Harriers in Ireland for ‘the other 8 months of the year’ and has similarly found declines and loss of Hen Harriers from large areas. Just one in six Hen Harriers reared in Ireland makes it through to the following spring and given very low breeding productivity, Population Viability Analysis suggests the population here will go extinct if things do not change or unless supplemented by immigrant birds. Clearly, the Hen Harrier continues to be a major conservation concern in Ireland. As it is an indicator of overall ecological health, this is also of real concern for wider biodiversity. Species such as Curlew (*Numenius arquata*), Short-eared Owl (*Asio flammeus*), Snipe (*Gallinago gallinago*), Meadow Pipit (*Anthus pratensis*), Skylark (*Alauda arvensis*), Marsh Fritillary (*Euphryas aurinia*) and Red Grouse (*Lagopus lagopus*) share the landscape with Hen Harriers and have all suffered significant declines in range and population in Ireland.

Threats and pressures on the Hen Harrier’s landscape and habitats include direct habitat loss, primarily through afforestation and forestry maturation, loss of High Nature Value farmland, commercial developments including renewable energies, fragmentation of landscape, changes in tillage practices and economic viability and succession of farming enterprises. Predation is considered a serious concern, particularly when Hen Harriers nest in or near forestry. Persecution events in Ireland do happen, but not to the levels seen elsewhere.

Six Special Protection Areas (SPAs) were introduced in late 2007, with “Activities Requiring Consent” notified to landowners and a limited budget agri-environment scheme offered to support farmers to maintain appropriate management practices. At the same time, afforestation of land within the SPAs continued to be funded by the Government and numerous wind farms were developed within the SPAs and of course outside the SPAs also, in other important breeding and wintering areas. The European Commission insisted on ceasing such activities within SPAs unless it could be shown that such activities were in line with keeping the conservation objectives of the SPAs. As a result, a Hen Harrier Threat Response Plan was initiated in 2013, with final recommendations/outcomes awaited.

Under the European Innovation Partnership initiative, Ireland is piloting a new approach to managing the Hen Harrier SPAs, but in the continued context of >50% forestry in these areas, elevated predation rates, a stark socio-economic outlook for the communities that have managed these upland landscapes as High Nature Value farmland for generations and no habitat supports for ‘the other eight months of the year’, including vitally important areas beyond SPAs.

What happens for Hen Harriers in Ireland is not merely an issue for Ireland. If lost from Ireland, the species' global range will have contracted. It is strongly believed that the Irish and British populations in particular are functioning to some extent as a metapopulation, with birds tracked from Ireland to Britain and vice versa. If birds from Britain or elsewhere in Europe are travelling to Ireland to establish breeding territories, Ireland may be acting as a sink population.

Hen Harrier population trends in Spain: comparisons between the 2006 and 2017 national censuses

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The first national coordinated census of Montagu's and Hen Harriers in Spain was carried out in 2006. That year, a total of 1245 10x10 km squares were monitored, of which 403 were within the distribution range of Hen Harriers (located in the northern half of Spain). Results from that year rendered a population estimate of 900-1300 breeding pairs of Hen Harriers in Spain, with highest densities observed in the southern range of the northern mountain range (Cordillera Cantabrica). 53% pairs for which habitat was described (n = 369) bred in crops, and 47% in natural vegetation (mainly scrub habitats). Although previous population estimates were not directly comparable (as methods or survey effort were not detailed), they suggested population stability or a slight increase since the 1990s. Another national census was carried out in 2017. Due to lack of resources, coverage was lower (a total of 611 10x10 km squares monitored, of which 203 within the distribution range of Hen Harriers, and information entirely lacked for 8 of the 50 Spanish provinces). Analysing 2017 data in a comparable way with 2006 data per province indicates, nevertheless, a population decline of 36-45% during this period in the monitored areas. This trend has not been homogeneous throughout the territory, with declines being steepest in the most favourable areas (where census coverage in 2017 has also been greater), whereas densities have remained stable in areas of medium favourability, and have even increased in areas of low favourability (which leads to breeding populations increasing in some provinces). The proportion of pairs in crops in 2017 was similar to that in 2006 (54% of 114 monitored pairs for which habitat was described), which suggests that population declines may not be related to habitat changes, or that they are occurring concomitantly in farmland and shrubland. The fact that declines have been more marked in the most northern areas also weights against climate-driven changes, which were predicted to reduce favourability of more southern areas. These results highlight the urgency of carrying out more frequent monitoring of the population numbers, as well as the need of carrying out more ecological studies of the species in Spain, which are sorely scarce.

Hen Harrier status and trend Belarus

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The Hen Harrier was never numerous in Belarus. In the late 1980s, the species was considered as 'quite scarce, but widely distributed' (Nikiforov *et al.* 1989). In the 1990s the species became clearly rare and to understand the trends of the species, there were declared awards for nests found and, declared vulnerable since 1995, it is included in the National Red Data book (1995, 2005, 2015). For the mid-1990s it was estimated that Belarus had 250-300 nesting pairs (Nikiforov *et al.* 1997). There are two main nesting habitats known: 1) openings and burned areas inside large forests with successions from 1 to 3 km from the forest edge until vegetation becomes 1,5- 2 m high and 2) middle and large peat bogs. Occasionally nests in winter cereals were found. Last estimation was made in the beginning of 2000s, resulting in 600-800 nesting pairs (Dombrovski 2002), but for today it looks overestimated. Modern trends are unknown. Most probably since the 2000s the species has become a wintering species, at the beginning during mild winters only, but at least for the last 10 years the numbers of wintering birds are slowly increasing and birds are registered all over the country every winter.

Hen Harrier as a breeding species in the Czech Republic

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Historical references of Hen Harrier as a supposed breeding species in the area of the present Czech Republic date back as early as 1795. Should these references be accurate, we assume that breeding was very rare. Since the 1850s, Hen Harrier is mentioned in the historical literature as a rare breeder, however, the first breeding was documented in 1921-1924. Since the mid-1960s, the species slowly spread eastwards until the 1980s; a sharp decline followed afterwards. The core breeding areas were situated in the west and central part of the country (Šumava Mountains, South and West Bohemia, Bohemian-Moravian highlands etc.). The first published „official“ breeding population size estimates for the period 1973-1977 (60-100 pairs) was most probably an overestimation. Later estimates range between 50-80 pairs (1985-1989) and 30-50 pairs (2001-2003), but afterwards did not exceed 10-15 pairs; the last estimate for 2014-2016 is only 0-5 pairs, which means that Hen Harrier has nearly disappeared as a breeding species. Breeding is not reported annually (the last confirmed breeding in 2012). Nevertheless, the new breeding population of up to 5 pairs (2012) was found in 2005 ca. 15 km from the Czech border in Lower Austria (Waldviertel) by L. Sachslehner (2016).

Hen Harrier bred in the Czech Republic mainly in small clearings and meadows inside forests, fenced forest plantations and dense young forest stands (mainly conifers but also poplars in floodplains). Also in peatland, heath, wet meadows, rarely cereal fields. In 2012, a rare case of (most probably unsuccessful) nesting in a barley field was proven in N-central Bohemia. One published case of tree-nesting in 1979 (Swietoń & Marek 1979) does not seem to be reliable. From 1943 until the late 1970s, perhaps even 1980s, a small breeding population existed in the border area of the Czech Republic (S Moravia) and W Slovakia (Záhorie) in poplar plantations in floodplain (undergrown by *Carex*, *Urtica dioica*, *Solidago*).

The only published estimate of wintering numbers of Hen Harrier comes from 1982-1985 (700-1000 individuals). Obviously, a significant decline has occurred since then, but there is a lack of exact data. Hen Harrier winters in open landscape – farmland, meadows, surroundings of fishponds. Roosting sites are reedbeds, wetlands, unmown (parts of) meadows and conifer (mainly pine) plantations, but also mature forest stands. Roosts of up to 30-50 birds were found especially in S Moravia and E Bohemia, where also the only Special Protection Area for Hen Harrier (along with Short-eared Owls) as a criteria species has been established (Komárov).

Status and recent occurrence of the Hen Harrier in Slovenia

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The Hen Harrier does not breed and there are no recorded historical data for the species breeding in Slovenia. Most of the observations are from the wintering and migration period. The species is protected through the entire year. The Hen Harrier regularly appears in winter on Slovenian coast, Ljubljansko barje (central Slovenia), Cerknica polje (Southern Slovenia), Vipava valley (western Slovenia) and in lowlands in the eastern part of country. In winter, some birds are vagrants and spend just one or two days at one location, while other Harriers spend whole winter at one place. The most important area for Hen Harrier is Ljubljansko barje (followed by Cerknica polje), where 20-40 individuals overwinter. Observations between 1982-90 indicated that during mild winters the number of overwintering Hen Harriers was lower compared to years with harsh winters. In North-eastern Slovenia several Hen Harriers were recorded in January 1987, when winter was very cold indeed. That year it was estimated that 80-100 individuals wintered in Slovenia. During 82/83, 83/84, 85/86, 87/88, which were relatively mild winters, it was not observed at all. During this period (1982-90), when snow blanket was thick, the species occurred in Slovenia, especially when severe winter affected the entire North-western, Eastern and Central Europe. Since 2000, the species occurs regularly every year, although the past winters (in the last 20 years) were relatively warm and mild with poor snow cover compared to winters in the 1980s. The reason for the increased number of observations in the last two decades could also be an increased number of bird watchers in Slovenia and better sharing of information. In a smaller number the Hen Harrier regularly occurs on migration in autumn (late September and November) and in spring between first half of March and second half of May. In Slovenia the Hen-Harriers have been normally observed in river valleys, beside lakes and ponds. In severe winters the species can be observed also in the vicinity of settlements. During winter and on migration the species can be seen hunting over wetlands and arable lands. We still lack information about the Hen Harrier. Especially habitat use, roosting areas and movements during winter should be studied. Within our new LIFE project we will deal with these issues. The important issue we also should consider are weather patterns and their effect on Hen Harrier abundance/movements on the European scale. For the future it is hard to predict the potential for breeding attempts of the species in Slovenia, since there are many factors (abundance of small mammals, climate change, habitat change...), which effect on presence of the species.

Short-eared Owl status and trend in the Netherlands

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In the first half of the 20th century the Short-eared Owl was locally a common breeding bird in the lowlands of the Netherlands, especially in the province of Friesland. Habitat loss and the decline of vole populations in agricultural land caused the disappearance from almost the entire country. After the reclamation of the province of Flevoland (at least 100 pairs in seventies), numbers of breeding pairs increased briefly. Nowadays breeding is almost completely restricted to the Wadden Sea area, and even on the Wadden Sea islands numbers are still in decline. Nationwide numbers fluctuate between 15-30 pairs. Under exceptionally favourable food conditions, with a vole plague in 2014, dozens of couples bred on the mainland again, mainly in the north of the country. The 2014-population contained about 80-100 pairs. Many young were ringed and resightings came from Denmark and Russia.

Also outside the breeding season numbers can fluctuate strongly due to vole abundance. Local and regional vole peaks can lead to concentrations and high numbers on roosts, in the Wadden Sea region as well as more inland.

Status and trend of the Short-eared Owl in Germany

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During the 20th century there was a strong decline in the distribution and abundance of the Short-eared Owl in Germany. The major driver for this decrease was the conversion of natural and semi-natural open habitats (e.g., bogs, flood plains, wetlands) to intensively used agricultural land. Today, the Short-eared Owl is one of the most threatened bird species in Germany and considered threatened with extinction in the national red data book. In Lower Saxony, the federal state harbouring the largest German population, the owl is listed as a bird species with the highest priority for conservation measures.

The German population is estimated to be 50–180 territories (2005–2009). However, in years without vole outbreaks, owl population size can be assumed to be much smaller. Occurrence of the Short-eared Owl is mainly restricted to the north-west German lowland plain and the adjacent Wadden Sea Islands. Beyond this range, breeding occurs only very irregularly and depends on vole gradations.

The only region where the Short-eared Owl breeds continuously are the German Wadden Sea Islands (NW Germany). At the North Frisian Islands in Schleswig-Holstein and the surrounding coast the species occurs regularly but not constantly. During the last two decades, with the exception of 2003 with 53 territories, the number of breeding Short-eared Owls in this part of Germany ranged between 3 and 16 territories.

The East Frisian Islands within the Lower Saxon Wadden Sea National Park harbour the only constant breeding population in Germany. From 1993 to 2018, the number of territories ranged between 16 and 59 with an average of 36 territories (see Fig. 1). The colonization of the East Frisian Islands by the Short-eared Owl started around 1900 and numbers increased significantly in the 1940s, possibly because of an increase of Common Vole (*Microtus arvalis*) populations due to diking and agricultural use. Despite typical fluctuations, the number of Short-eared Owls breeding on the East Frisian Islands is quite constant compared to the mainland. However, since 2004 a decrease in the size of the breeding population has been observed.

The density peak on the East Frisian Islands was observed in 1972 when 50 pairs were breeding on the 31 km² large island of Borkum. Today, the abundance hotspot is situated on the island of Spiekeroog (area: 18.25 km²), where 10 to 15 pairs breed every year; the maximum was 22 territories in 2005.

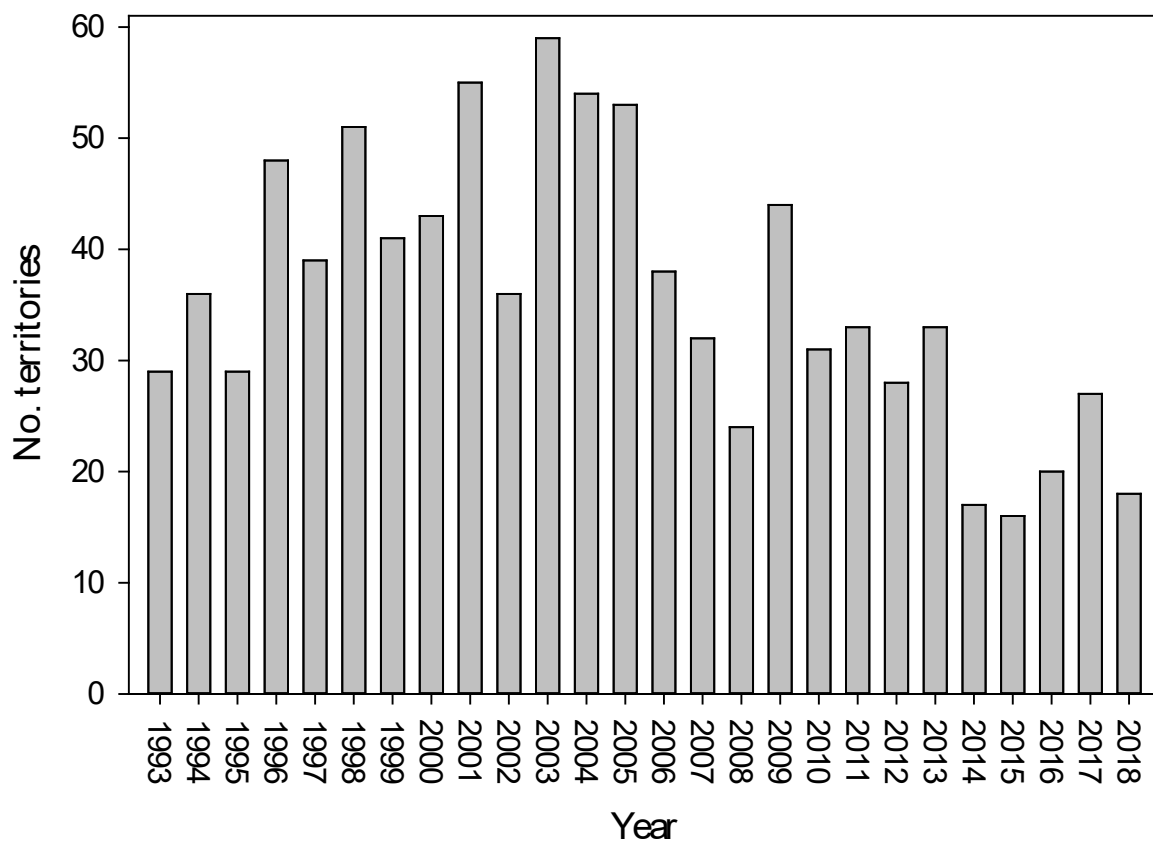


Fig. 1: Population dynamics of the Short-eared Owl on the East-Frisian Islands, the only constant breeding population in Germany. Data source: M. Schulze Dieckhoff, NLWKN 2019.

Short-eared Owl status and trend in Poland

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Short-eared Owl (SEO) is a typical northern tundra species with tendency to invasion to the south and west. The Poland lays close to the West border of the continues geographical area of species.

SEO has vulnerable, highest protected status, higher than in most other European countries, and is actively and strictly protected by Polish law. It is in Polish Red Data Book too. Fortunately the habitats which are suitable for this owl are mainly in protected areas such as national parks and N2000 areas and reserves. Until 2007 every nest and even probable breeding birds had to be accepted by The Polish Rarities Committee. It shows that we are talking about rare bird in Poland.

When we are watching birds in abnormally abundant numbers, we know indirectly that they have enough small mammals as food. Nowadays this phenomenon is much rarer than before. Until the half of 1950s, SEO has been nesting much more frequently than later on until now. It might be related with strong invasions in those years. In the 21st century the only nests have been found in 2008 (one nest) and 2015 (6 nests including 3 loses with eggs taken by predators).

In Poland breeding sites were scattered across lowlands and were occupied irregularly. At the end of the 20th century owls were breeding at river Biebrza and Narew Valley, in swamps Bubnów and Chełm and on the others places in the less number and occasionally. Since 1965 the species has been recorded in 50-60 localities. Estimating the size of the SEO population in Poland is difficult, because of strong fluctuations. To be more clear, authors should use in their information data about period of observation separately for each year, especially that one with or without vole peak. Despite of this data, we have observed a recent regress of this species' numbers, probably as a result of environmental changes. There are no places where SEO breeds regularly.

In 2015 we estimated the number of breeding pairs of SEO in Biebrza Valley at about 50 pairs. On the exactly counted 20 km² study plot, we found about 18 pairs, corresponding to ca. 9 pairs /10 km². It is the highest abundance and density in history, with a minimum distance between nests of 300 meter.

Summarizing, despite huge territory and good condition of some areas, Poland is not a regular breeding country for SEO. The reason is not clear. SEO is very scare breeder in Poland, with 0-10 breeding pairs in poor vole years (years 2000-2018), but with 60-80 pairs during peak vole years. Their broods are mainly recorded in Biebrza Valley, which remains recently the most suitable place for this species in Poland.

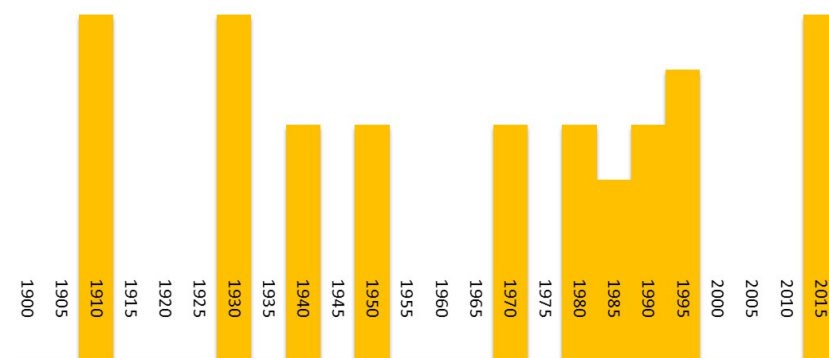


Fig. 1 The years of SEO invasion in Poland since 1900 (height of column corresponds with invasion intensity)

Correlates with the changing status of breeding Short-eared Owls in Britain

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Survey and monitoring of breeding Short-eared Owls are challenging because of a number of factors including: (a) largely nocturnal behaviour¹ that leads to many breeding attempts going undetected, especially those that fail to reach the later stages of chick rearing when demands on provisioning adults can be high and necessitate more frequent daytime activity²; (b) marked fluctuations in breeding numbers in any particular area associated with nomadic tendencies and low tenacity to breeding sites exhibited by at least some individuals^{3,4}; and (c) remoteness of many breeding areas from centres of human population.

While effective monitoring of populations within some areas of limited size is feasible, the best long-term information on trends in Britain is from bird atlases which record breeding evidence and indices of abundance at 10-km square resolution over periods of four to five years⁵. The breeding range of Short-eared Owls contracted from occupancy of 381 ten-km squares with high levels of evidence of breeding in the period 1988-91 to 245 by the period 2008-11. The published population estimate based in part on atlas data is 610 – 2140 breeding pairs in Britain⁶, the range reflecting both variable numbers and also relatively poor knowledge. It is most likely that the current breeding population is very much at the lower end of that estimate and might rarely exceed 1000 pairs.

Modelling (Generalised Additive Models) of owl distribution and changes (from atlas data) with potential environmental determinants identified a number of correlates⁷. Variables included in the models were: semi-natural habitats; forest cover; temperature; rainfall; elevation; slope; young growth stage forests; vole occurrence; indices of moorland management; and measures of predator occurrence. Identified threats to breeding Short-eared Owls included forest expansion and changes in moorland management. Mechanisms for the negative association with forest expansion will be the replacement of preferred semi-natural open moorland and grassland habitats. Mechanisms associated with moorland management are likely associated with changes in predation risk. The latter also has potential implications for the introduction of predators onto islands. Opportunities for restoring breeding populations include restoring areas where predator densities are naturally low, increasing areas where densities of ground predators are maintained at low levels and adapting forest management plans to include open habitat specialists. Although limitations for breeding Short-eared Owls undoubtedly included the distribution of their favoured prey, voles, detection of their significance in models was limited by data on vole distribution and abundance.

¹ Calladine & Morrison (2013) *Bird Study* 60: 44-51.

² Calladine *et al.* (2010) *Bird Study*, 27: 89-99.

³ Newton (2006) *Ardea* 94: 433–460.

⁴ unpublished on ongoing studies.

⁵ Balmer *et al.* (2013) *Bird Atlas 2007–11*. BTO, Thetford.

⁶ Musgrove *et al.* (2013) *British Birds* 106: 64-100.

⁷ Border & Calladine *In prep.*

Hen Harrier and Short-eared Owl status and trends Finland

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Common birds of prey survey started in Finland in 1982. Monitoring relies on volunteers and is coordinated by the Finnish Museum of Natural History Luomus.

Birds of prey are surveyed with several methods. In a Raptor Grid study (1982–), territories and nests of birds of prey are reported from 10 × 10 km study plots. Some 130 study plots of 100 km² participate each year. Long-term trends of Hen Harrier (HH) and Short-eared Owls (SEO) were modelled based on the annual numbers of occupied territories in the Raptor Grid study plots using the program TRIM. Since data are scarce especially on the SEO, observations from line-transect censuses (covering the whole country every 25 km) were also included to complement trend calculations.

A Raptor Questionnaire study (1986–) gathers information on numbers of checked nest types (over 37 000 annually), territories, nests with eggs or chicks, fledged broods and other occupied territories within areas of local ornithological societies of BirdLife Finland. Everyone ringing raptors at nest sites is expected to report their data with Raptor Questionnaires. Approximately 280 ringers or working groups return questionnaires annually. The breeding parameters and geographic distribution of the species are based on the Raptor Questionnaire data.

In addition, population size estimates of raptors are based on enquiries sent to local raptor experts in 1998. Trajectories of population size estimations since 1998 within local ornithological societies were modelled based on trend indices, resulting in overall national population estimates of the species in 2018.

Both HH and SEO are migratory in Finland and their breeding population levels fluctuate considerably due to vole cycles. HH population declines in Finland with an annual rate of –2.5% according to the long-term data (1982–2018). With this rate of moderate decline ($p < 0.01$), the HH population has decreased by –59% since the beginning of monitoring in 1982. In a short-term (2007–2018), the annual rate of decline is even steeper (–6.0%). The estimated population size of HH is 1132 pairs (min–max 824–1464 pairs) in 2018. Based on means of the yearly averages in the long-term data, the breeding parameters of the HH are: clutch size 4.7 eggs/clutch (standard deviation $sd = 0.6$, $N = 183$ nests), 4.1 young/successful nest ($sd = 0.5$, $N = 295$) and 3.3 young/active nest ($sd = 1.1$, $N = 351$). On average, 20.7% of breeding attempts fail.

SEO population declines with an annual rate of –3.2% based on the long-term data (1982–2018). As a result of this moderate decline ($p < 0.01$), the SEO population has decreased by –69% since 1982. In the short term (2007–2018), the annual rate of decline is –7.0%. The estimated population size of SEO is 762 pairs (min–max 39–1485 pairs) in 2018. Breeding parameters of the SEO are: clutch size 6.0 eggs/clutch ($sd = 1.0$, $N = 673$ nests), 4.4 young/successful nest ($sd = 0.8$, $N = 746$) and 3.5 young/active nest ($sd = 1.0$, $N = 945$). On average, 20.7% of breeding attempts are unsuccessful.

Both HH and SEO are most numerous in Northern and Western Finland. No specific conservation plans for the species are implemented.

Short-eared Owl as a breeding species in the Czech Republic

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The historical literature mentions Short-eared Owl (SEO) as a breeding species as early as in the 1850s. However, the first confirmed breeding was published in 1930 (E Bohemia) despite the fact that some promising and reliable data come also from 1874, 1913, 1925 and 1927. All published „official“ breeding population estimates from 1973-1977 until 2001-2003 range between 0-5 (or max 0-10) pairs. SEO breeding in Central Europe always had an invasive or irruptive character. The years of these „breeding invasions“ (breeding of more pairs and/or at more localities) were 1937, 1978, 1981, 1987 and 1998. The first two years were the years with the largest numbers, i.e. 11-25 and minimum 23 pairs, respectively. Breeding of SEO in several consecutive years at the same locality is very rare and happened only in 1966-1967 (?-1968) in S Bohemia and in 1976-1979 and 2014-2015 in S Moravia. Exceptionally, two cases of winter breeding were recorded in N Bohemia during the winter 1936/1937 („vole year“): a nest with a clutch in December 1936 and a nest with chicks in January 1937. Breeding habitat of SEO is mainly wet meadows, wetlands, surroundings of fishponds, farmland – lucerne, cereals etc. but rarely also dry fallow land or almond orchard.

Two published estimates of wintering SEO population are 200-1000 individuals (1982-1985) and 1000-9000 individuals according to the paper from 2005 but the latter is methodically at least problematic. Winter habitat is open landscape such as farmland, meadows and surroundings of fishponds. Roosting sites are unmown (parts of) meadows (sometimes used along with Hen Harrier) or both active and abandoned vineyards. Since 2000, SEO regularly joins Long-eared Owl (LEO) at their communal roosts in conifers in villages and towns (1-12 individuals among tens of LEO). Rarely, a mixed communal roost was found in a forest: January 2011, S Bohemia, 570 m asl, young spruce forest (5-8 m), minimal 2 SEO + LEO. Maximum numbers ever found at one locality were 203 birds in January 1979 and 340 birds in March 1965 (both in central Moravia) and 250 birds in December 1983 - January 1984 in S Moravia. Maximum numbers during the last 20 years are much lower. Two traditional roosting sites are monitored continually: one with maximum 35-60 individuals in winter 2001/2002 (Special Protection Area Komárov, E Bohemia) and one with maximum 55 birds in winter 2004/2005 (S Moravia).

The Short-eared Owl in Hungary

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The Hungarian breeding- and wintering population of Short-eared Owl is fluctuating, highly depending on the common vole fluctuations. The largest breeding numbers were found in the years 1930, 1973, 1976, 1990, 1992, 2002, 2014. While in the year 1992 only 35-40 breeding pairs were recorded, 250-270 pairs were found in 2002, and 337 pairs in 2014. Since then the regular breeding population is 15-30 pairs in Eastern-Hungary, based on new observations in the Szatmár-Bereg region. There are no direct surveys on wintering populations, only sporadic data can be found, but the southern part of the Great Plain is a meaningful wintering area, especially near Túrkeve and Dévaványa. Breeding and wintering is highly affected by several factors:

- Rodent populations, mainly of common vole.
- Conditions of the grassland habitats, specifically the rushy grasslands, adequate habitat management needed.
- Growing predator populations (Red Fox, Badger, Golden Jackal, Hooded Crow, Marsh Harrier, Saker falcon, etc.).
- Weather conditions affecting prey populations and habitats.
- Conditions and SEO population outside the Carpathian-basin.

The former 10 years cycle of common vole fluctuations is changing based on the latest studies which highly affects SEO appearance. General use of rodenticides in agriculture plays an important role in determining the availability of food for raptors and owls. Intensive management of grasslands endangers nests and changes the diversity of habitats. The growing population of red fox and hooded crow endangers SEO eggs and chicks, while Saker falcon endangers SEOs on the sites where SEO wintering and Saker breeding territories overlap. Extreme dry or wet weather interrupts rodent fluctuations and affects the SEO breeding/wintering sites. Dry weather results in a less diversified habitat, while in wet conditions SEOs lose ground on grasslands and follow Long-eared Owls (LEOs) into settlements. In some years large numbers of SEO are wintering in trees in town centres (the largest flock was 128 SEO in Túrkeve). The most important LEO wintering sites in Hungary can be found in the Nagykunság region, especially in Kisújszállás and Túrkeve. The wintering population is 500-700 LEO in the two towns, very important regular LEO wintering sites are around Túrkeve. The large number of LEOs drive SEOs into towns in numbers. The most regular LEO wintering sites can be found around Túrkeve and Dévaványa, some years they are quite good breeding sites also. We registered an extreme late SEO breeding near Dévaványa, where breeding was started in November 2013 and a three weeks old young bird was found in December.

Current research on ecology and threats



Photo: Harry Kuipers

Breeding Hen Harriers in the German Wadden Sea - long-term research documents steep decline

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Hen Harriers (*Circus cyaneus*) in Germany are threatened with extinction. Although formerly a common breeding bird species in North-Western Germany, the breeding range of Hen Harriers is meanwhile restricted to the East-Frisian islands within the National Park Wadden Sea of Lower Saxony. This remains the only regular breeding occurrence of Hen Harriers in Germany, resulting in a high national responsibility for species conservation and protection. Hen Harriers first colonized the German Wadden Sea islands in the 1980s and showed a rapid population increase. Breeding numbers peaked in 1997 with 53 breeding females. Population decline started in the year 2000, with substantial losses from 2011 onwards. Reasons for the negative population trend have been largely unknown by then. Against this background, we initiated a research project in 2009 in order to study the breeding ecology of Hen Harriers in island habitats and to investigate potential population threats. A main objective of the project was to develop an Integrated Population Model (IPM) for the Hen Harrier Wadden Sea breeding population to identify the responsible parameters affecting population growth rates. A long-term breeding success monitoring of 67 broods over a period of nine years (2009-2017) revealed stable reproductive performance rates concerning laying date, clutch size, numbers of hatched and fledged young. Especially the mean number of 1.7 fledged young per year and female has been relatively high during the study period. Despite single predation events, loss of clutches and young was generally low. Disturbance at nest sites due to recreational activities is largely excluded based on National Park concepts including zoning and a pathway concept. The results of the analysis of more than 500 pellets of Hen Harrier hatchlings showed that parental birds provisioned their young with mammal and bird prey. Both prey groups varied between years (50-65% for mammalian prey). Voles and songbirds are the most frequent prey species groups in the diet of Hen Harrier chicks. In 2011-2016 we conducted a vole population survey using a mark-recapture approach in different island habitats to study annual vole densities. We found no cyclic variation in the islands' vole population. Statistical analyses showed that the reproductive success of Hen Harriers is not significantly depending on annual vole densities. In years with lower vole abundance Hen Harriers switch to other prey groups, mainly songbirds, thereby attaining a constant output of fledged young. In an attempt to look at the German and Dutch Wadden Sea population of Hen Harriers as a whole we merged Dutch and German data on breeding pair numbers, demography and dispersal in order to parameterize an IPM. The IPM revealed that survival rates of both adult and juvenile Hen Harriers outside the breeding period decreased significantly from 1995 onwards. We identify survival outside the breeding season as the potential main driving factor for the steep population decline.

Ecology and demographics of Hen Harriers in the UK

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I review the essentials of Hen Harrier ecology based on studies carried out in mainland Britain, primarily Scotland. Breeding Hen Harriers are associated with open upland areas of moor, bog and young forestry, as shown in a comparison of the species distribution from the latest BTO atlas and a map of the distribution of such habitat. The vast majority (86%) of Hen Harriers choose to nest preferentially on moorland, in areas of vegetation that is primarily 30-60 cm in height. Summer diet (based on items at the nest) comprises mainly small passerines, followed in descending order of abundance by gamebirds, small mammals and lagomorphs. Winter diet is sex-related, with males taking mostly small passerines while the larger females take a higher proportion of lagomorphs and gamebirds. The settling density of males on moorland appears to be related to the density of meadow pipits. Breeding success (measured two ways, as the proportion of successful nests and as the number of fledglings per female), is approximately two-thirds lower on moorland managed for grouse shooting than on other moorland, the difference indicating high levels of illegal destruction of nests and adults on moorland managed for grouse shooting. Breeding success in forestry is intermediate between the two types of moorland. This is probably as a result of predation pressure, because both nest success and the number of young fledged per female are twice as high where densities of generalist predators (e.g. foxes and crows) are low as where they are high. After the chicks have fledged, first-year survival has been estimated at 36%, with no difference between young from grouse moors or from other moors. Thereafter, adult female survival is 40% on grouse moors versus 78% on other moors, linked to illegal killing of breeders. After becoming independent of their parents, young Hen Harriers wander widely before settling; around 75% settle within 50 km of their birth place, though some may settle much further. Breeding birds are strongly philopatric, with 75% of females moving less than 2 km between years. The available evidence suggests that the vast majority of females breed in their second calendar year, whereas fewer than 20% of males do so. The demographic information can be assembled into female-based Leslie matrix population models, which give average rates of population change of -46% on grouse moors, +19% on other moors, and +2% on forestry (assuming a closed population living entirely within each land category). In the course of five national surveys of Hen Harrier abundance between 1989 and 2016, the proportion of Hen Harriers in forestry dropped from 37% to 12%, on grouse moors it fell from 27% to 18%, while on other moorland it rose from 34% to 70% (calculations for mainland Scotland only, to maintain comparability across surveys). Taking into account the distribution of Hen Harriers across the three land categories, the overall rate of population change across mainland Scotland was -6% in 1989, increasing to +6% in 2016.

Juvenile dispersal of Hen Harriers in the UK

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The Hen Harrier *Circus cyaneus* is a rare breeding species in England with an average of 12 breeding attempts per year between 2002 and 2018. Although the source population was low, according to population viability analysis models, productivity and success rates in most years through this period were high enough to underpin a population recovery. This pointed to a lack of annual recruitment to the population through low first winter survivability.

Although a well studied species in the UK, the vast majority of peer reviewed ecological knowledge stems from Scotland and focuses on breeding performance, habitat use in the breeding season and its penchant for predating gamebirds, primarily red grouse *Lagopus lagopus scotica*. Hen Harriers prefer to breed semi-colonially, and can therefore, in high densities, reduce the number of birds available for shooting, this brings Hen Harriers into conflict with game-managers.

Dispersal is one of the least understood facets of avian science. In England, the Hen Harrier is a rare, human averse, ultra-mobile, relatively lightweight, partial migrant that is found mainly in upland remote terrain. Hence it is a particularly difficult species to study from cradle to grave.

Before the advent of lightweight satellite tracking the knowledge into Hen Harrier habitat use outside of the breeding season relied on the old literature, reported sightings, individual marking techniques including patagial wing tags and Darvic colour rings and in the 1990s and early 2000s VHF radio-tracking.

This study is based on 58 satellite tagged juveniles tagged at the nest at c30 days old from various provenances, mostly within England, SW Scotland and The Isle of Man. The data was collected between 2007 and 2018 and consists of 22, 000 separate data points.

Hen Harrier dispersal ecology is complex and ranges from a sedentary existence to a full annual migrant. Significant differences were recorded between sexes for dispersal distances, habitat use and home range size. However, even siblings of the same sex can adopt totally different first year dispersal strategies.

Previous studies were observer biased and this led to the misconception that the Hen Harrier breeds in the uplands of the UK and winters in the lowlands predominantly coastal sites. This is easy to understand as the majority of winter birdwatching/recording is conducted in lowland wetland and coastal areas. There is an influx of wintering Hen Harriers into England's lowlands and estuaries but these are thought to be of Scottish, Welsh, Irish or Fenno-Scandian provenance.

We found that the majority of the females use the mountains and uplands of England and Scotland year round. Some birds use only a small home range (10x5 km) for their entire lives whilst other birds wintered up to 1, 500km from their natal site. We have mapped many previously unrecorded Important Areas for Hen Harriers including breeding sites, dispersal corridors, foraging areas and winter roosts.

Hen Harrier population dynamics on the Orkney Islands, Scotland: insights from over 5 decades of research

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The Hen Harrier is a bird of high conservation importance in the UK. Across the UK the species' numbers and distribution are limited principally by illegal killing on grouse moors. The Orkney Islands in the far north of Scotland hold an important population of Hen Harriers, that are not subject to illegal killing as there are no grouse moors on the island. Most Hen Harriers on Orkney breed in the west of the island of Mainland and this population has been monitored on the same area annually from 1975. A doubling in sheep numbers is believed to have been responsible for a decline in Hen Harriers between the 1970s and 1990s when the numbers of chicks produced each year declined by 73%. The mechanism for this was thought to have been a reduction in rough grassland (the preferred habitat for foraging harriers) and Orkney voles, reducing the amount of prey available to harriers during the critical pre-laying period. The shortage of prey led to a reduction in the levels of polygyny, which confirmed through a supplementary feeding experiment which increased polygyny levels for fed males.

However, since the end of the 1990s the Hen Harrier population on Orkney has recovered. Between 1998 and 2004, the numbers of breeding females on Orkney increased by 118% from 34 to 74, which contributed to an overall population increase for the UK, the Orkney population representing 12% of the Scottish population in 2004. Breeding numbers have remained largely stable since (2010: 75 breeding females; 2016: 82 breeding females).

We describe this population recovery on Orkney up to 2008, and quantify the changes in sheep abundance within their breeding and foraging areas. Secondly, we repeat vegetation and prey surveys first undertaken in the late 1990s and test the hypothesis that a reduction in sheep numbers has allowed the amount of rough grassland and the abundance of key prey species to recover. We also test if Hen Harrier breeding output on Orkney correlates with weather variables because previous work has shown that Hen Harrier breeding success is influenced by the effect of weather on prey delivery and nestling mortality. Lastly, we explore if changes in sheep abundance and/or weather can account for the changes in breeding output of this harrier population over the last 33 years.

Numbers of sheep in Orkney declined by around 20% between 1998 and 2008. Surveys in 1999/2000 and repeated in 2008 showed increases in rough grassland, the preferred harrier foraging habitat, and increases in a key prey species, the Orkney vole *Microtus arvalis orcadensis*. Overall, Hen Harrier breeding output over the last 33 years was significantly negatively correlated to both sheep abundance and spring rainfall. This study provides strong evidence for the consequences of changes in sheep numbers on Hen Harrier.

Fig. 1. Graph showing the total number of young hen harriers fledged from West Mainland Orkney (open circles—the two close circles show the years when a diversionary feeding experiment took place) between 1975 and 2008 together with the 3-year running mean (dashed line). Also shown are the total numbers of sheep (closed squares) recorded between 1975 and 2008 from the June Agricultural Census in the seven parishes with breeding harriers.



Hen Harrier ecology in Ireland: effects of upland afforestation and wind energy development

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Hen Harriers are a species of conservation concern in Ireland due to ongoing population declines and increasing pressures in their upland breeding habitats. Here we review two decades of research which has focused on the general ecology of Hen Harriers and the effects of upland afforestation and wind energy developments.

A study on Hen Harrier breeding biology over a five-year period (2007-2011, $n = 142$ nests) found that breeding output in Ireland was low (1.4 chicks per nesting attempt, 2.4 chicks per successful nest) and region-specific. Low fledging rates suggest that, at least in some parts of the Irish range, breeding output may be a contributing factor to ongoing population declines. During this period, cameras were deployed at 13 nests. Despite the limited sample size, nest cameras recorded two cases of nest predation by red fox, frequent cannibalism (30% of nests) and one siblicide event. The causes and consequences of cannibalism and siblicide at a population level remain unexplored. Nest camera data were also used to study the activity patterns of breeding birds and their implications for monitoring and survey protocols. Findings suggest that female birds reduce nest attendance and may begin foraging earlier during the nesting period than in other parts of the species' range, and that breeding bird activity was highest but variable during the central part of the day. Wing-tagging of fledglings ($n = 170$) and monitoring of breeding sites in subsequent years indicated low recruitment, suggesting that juvenile survival may also play a role in population trends. Additional research on nest visits, wing-tagging, and nest camera deployment indicated no effects of these practices on nest or chick survival.

Upland areas in Ireland inhabited by Hen Harriers have undergone significant changes at a landscape scale, with considerable increases in cover of commercial forest plantations over the last century. A study of nest site selection ($n = 148$ nests) found that Hen Harriers were positively selecting pre-thicket forest plantations in their second-rotation as nesting sites. Although these provide a comparable habitat structure to that of traditional breeding habitats (e.g. heather moorland), analysis of breeding outcome ($n = 140$ nests) showed that nesting in young forest plantations was linked to low breeding success in some areas. This suggests the existence of mismatches between habitat preferences and breeding success. Further research was undertaken in order to understand the mechanisms underlying this variation in breeding success. Predator community studies indicated that pre-thicket forests are used by a range of species which may potentially predate Hen Harrier nests (hooded crow, magpie, red fox, pine marten and stoat). Pre-thicket habitats also had lower bird densities than moorland habitats, suggesting lower prey availability for Hen Harriers. Further to the potential effects of predator and prey communities, it is worth noting that the suitability of these pre-thicket habitats as nest sites is also temporally constrained: as plantation forests grow and the canopy closes over, they can no longer be used by nesting Hen Harriers.

Wind energy is another pressure to upland areas used by breeding Hen Harriers. The development of wind energy has increased substantially in recent decades in response to increasing demands for renewable energy and this has led to a considerable overlap between Hen Harrier breeding distribution and the location of wind farms in Ireland. Investigation of changes in Hen Harrier populations in relation to the presence of wind farms revealed a marginally non-significant negative relationship between wind farm presence and changes in the number of breeding pairs over a 10-year period (2000-2010). To understand the underlying causes of these patterns, Hen Harrier breeding output was evaluated in relation to distances from wind turbines ($n = 84$

nests). Findings from this study suggest that nests within 1 km of turbines had lower success rates than those at greater distances. As prey availability may play a role in nest success, a detailed study of bird communities in upland areas was carried out using an impact-control-gradient design across 12 wind farms (n = 506 bird surveys). Findings revealed that bird species used as prey by Hen Harriers were also affected by wind farm developments, with lower densities recorded within close proximity of turbines. The intensity and scale of differences in bird densities were guild-specific and were linked to land use changes which occurred during wind farm construction.

The research reviewed here highlights some of the pressures faced by Hen Harriers in Ireland. Increasing human activities and development in upland areas are resulting in habitat fragmentation and encroachment of breeding habitats. The survival of the species in the Irish context will require developing species and habitat-focused strategies at meta-population and landscape scales that address multiple pressures and consider their cumulative impacts.

The information reviewed here is available in the following publications: Wilson et al. 2009 Ibis; Irwin et al. 2011 Irish Birds; Wilson et al. 2012 Ibis; Fernández-Bellon et al. 2015 Irish Birds; Fernández-Bellon et al. 2017 Bird Study; Wilson et al. 2017 Bird Study; Wilson et al. 2017 Irish Birds; Fernández-Bellon et al. 2018 Journal of Raptor Research; Fernández-Bellon et al. 2019 Conservation Biology; Caravaggi et al. 2019 in prep; McCarthy et al. 2019 in prep.

Patterns of satellite tagged Hen Harrier disappearances suggest widespread illegal killing on British grouse moors

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Wildlife crime represents a major threat to global biodiversity. One of the challenges in tackling this threat lies in identifying the true extent and patterns of these inherently secretive crimes. We bring together data from satellite-tracking devices and remotely sensed habitat data to understand the extent and pattern of deaths and disappearances of a protected species, the Hen Harrier *Circus cyaneus*. The species is nearly extinct as a breeding bird in England, and it has been argued that this is primarily due to illegal killing on grouse moors, which are areas managed for the production of red grouse surpluses for recreational shooting. Quantifying the extent and patterns of illegal killing is key to the development of long-term sustainable solutions to this problem. Using data from 58 satellite tracked Hen Harriers we show high rates of unexpected tag failure (66%) and low first year survival (17%) compared to other harrier populations. Unexpected tag failure is indicative of illegal killing, whereby the tag suddenly stopped transmitting without any prior evidence of tag malfunction, no remains could be found and the birds were not seen again. The first year survival rate of 17% was less than half of any equivalent estimate from harriers elsewhere. Furthermore, we found an association between the death or disappearance of tracked Hen Harriers and the use of grouse moors both at the individual level and at the landscape level. At the individual level, harriers used grouse moors more than usual during the week preceding their death or disappearance compared to other weeks (i.e. the probability of a bird dying or disappearing increased with the proportion of fixes on grouse moors). At the landscape level analyses, locational fixes during the week preceding death or disappearance (terminal week) were distributed disproportionately on grouse moors compared to fixes from other weeks (i.e. the proportion of fixes that were from the terminal week of life was significantly associated with the percentage of each 20 x 20 km grid square with grouse moor). This pattern was also apparent in protected areas (PAs) in northern England, where satellite fixes from the last week of life were distributed disproportionately in PAs with more grouse moors in comparison to the overall use of such areas (i.e. as the percentage area of grouse moor within a PA increased, there was an increase in the proportion of terminal fixes per PA). We conclude that Hen Harriers in Britain suffer elevated levels of mortality on grouse moors and the most parsimonious explanation for the fate of these birds is illegal killing.

Insights from year-round GPS tracking of Hen Harriers breeding in Dutch farmland

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A small breeding population (3-5 pairs) of Hen Harriers recently established in the east of the province of Groningen, the Netherlands, in large scale arable farmland. We equipped four adults, three males and one female, with UvA-BiTS GPS loggers to study home ranges and habitat use throughout the year.

Habitat use by breeding birds was dominated by (winter) cereals (60%) and grassland (22%), two common crops in the study area (availability is 42 and 24%, respectively). Moreover, set-aside habitats, which are especially created and managed for breeding harriers, were preferred, although the overall absolute use was surprisingly limited (4% used, 1% available). Non-breeding birds occupied smaller home ranges during summer. In addition, they used set-aside habitat to a much larger extent (up to 22%).

Tracking also revealed a number of intriguing round trips to Northwest Germany, Sweden and the UK. These were considered exploratory movements rather than migrations. One male spent the winter in Spain, in an agricultural area near Olivenza. The other individuals (two males and one female) spent the winter near the breeding area. Loggers failed to record positions during mid-winter as solar panels could not keep the batteries charged. Habitat use in winter was dominated by grassland (62%). Set-aside was also preferred (5%).

Differences in hunting between wintering males and females of Hen Harrier in Belarus

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Since the 2000s Hen Harrier became a regular wintering species in Belarus. By direct observations in West Belarus we determined choice of hunting habitats, type and height of vegetation; height of hunting flights, use of wind during hunting, type of attacks and their success by males and females. The most popular hunting habitat – both for males (in 72%) and females (in 73%) - was perennial grass with the height not more than 50 cm. Proportion of using other habitats and heights of vegetation used for hunting were different between sexes and looked to be more equally used by males. Both sexes during hunting prefer to fly on the heights 1-3 and 1-5 m above the ground (in 49 and 36% cases by females and 50 and 29% by males respectively) and differences in using other heights were also NS. Most probably such heights allow harriers to use both sight and hearing and increasing chances to surprise the prey. We had impressions that males much more often used manoeuvrable flights over different types of vegetation trying to hunt passerines, females usually hunt for ground prey (voles).

Males (in 47% of all hunts during windy weather) as well as females (in 70%) hunt against the wind direction and under some angle to it (in 20 and 12% respectively). But proportions of such choices were different between the sexes. We believe that such hunting conditions also help harriers to use hearing and be prepared for attack before they will see possible prey.

Both sexes used direct attacks of the prey from air, but with different frequency: males did it in 82% of all attacks and females in 97%. Chasing of the prey on the ground was used more often by males than by females: in 18 and 2% respectively. Success of attacks was quite high: 39% of all attacks by males and 23% by females were successful, but difference between sexes was NS.

Winter habitat use and migration of Hen Harriers based on GPS-tracking

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On 9 February 2018, two female Hen Harriers (1 adult, 1 immature) were caught on a common roosting place in north-eastern Bohemia with the use of a dummy Eagle Owl. Both females were radio tracked with a 15 g GPS/GSM radio-transmitter produced in the Lithuanian company Ornitela. The transmitters were set for 20 minutes period of collecting data. The period changed to 1 hour in case of low capacity of the batteries.

During winter, we monitored the selection of the type of foraging areas and their size and the distance from the roosting place. The sizes of the day foraging areas was often very small - 0,2-1,0 km² - and the distance from the roosting place ranged 1 to 2 km. The birds preferred meadows and pastures with horses, less often arable fields with winter crops, for catching prey. The immature female roosted always on the ground in areas with dry grasses, reeds or on non-harvested white mustard fields. The adult female roosted almost always in the tree tops, mostly pines.

The spring migration of the adult female started on 30 March 2018, the immature female started the migration two weeks later on 15 April 2018. Both birds flew straight to the north through Poland, the Baltic states to Russian Karelia. The immature female's transmitter sent its last location from the shores of the White Sea (64° N) on 10 May 2018. Further whereabouts of this female are not known. The adult female flew to the southern coast of the Kola Peninsula on 14 May 2018 (66° 50'N). Then she returned south to the vicinity of the town Ladva (61° N) where she spent the whole breeding season (from 4 June) on the farmed meadows. However, according to the data sent by the transmitters, she did not even attempt breeding.

The autumn migration started on 7 September 2018 and after more than two months - on 18 November 2018 – she returned to the wintering grounds in the Czech Republic. She is currently staying in south Moravia/west Slovakia (flood-plain of Morava River) since her return.

Diet and foraging ecology of Hen Harriers wintering in the Northern Netherlands

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In winter, Hen Harriers are widespread but occur in low numbers. The population of wintering birds is believed to be a mixture between local breeding birds and migrants with a northern and eastern origin. We studied the diet of wintering harriers by analysing pellets collected on communal roosts. The great majority of prey were voles (93% of >750 prey items), but the proportion of voles varied over space and time. Observations on foraging birds revealed differences in foraging efficiency between habitats, which could be contributed to differences in vegetation structure. Certain grasslands contain high vole densities, and here harriers achieve relatively high feeding rates. Foraging on grasslands often is more successful compared to set-aside habitats, despite the fact that voles are abundant in set-aside, possibly because the high set-aside vegetation makes it difficult to capture prey.

Habitat use and movements by Short-eared Owls: initial results from GPS-satellite tracking and a review of European ring recoveries

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Assessing habitat use by Short-eared Owls by direct observation is limited by their mostly nocturnal behaviour and potentially introduces biases should there be any differences in areas used during daylight and at night. Radio-tracking and other telemetry that requires in-field collection or uploads of data remains limited by inability to follow tagged birds if they leave the study area and for some approaches, relative imprecision of locational data. Since 2017 we have started using GPS-satellite tags to give accurate fixes and capability to monitor birds when they leave the areas of capture. To date seven birds have been tagged in Scotland. Noting the restricted sample sizes, some initial findings suggest:

- Home ranges, including when breeding, tend to be about 200 ha and can be occupied for periods of a few days or several months. They can make exploratory visits to other areas from home ranges being absent for up to 10 days. When not occupying a 'home range', they can range more widely. Marked variation in movements between individuals and by the same individuals between years and seasons is likely related to availability of prey;
- Most activity is concentrated during darkness when Short-eared Owls also tend to range further and also to higher elevations than during daylight. Such diurnal differences could be related to availability of prey and also risk and competition from other predators;
- On moorland, the broad habitat-type used by most breeding Short-eared Owls in Britain, birds preferentially select areas of grassland for hunting within the heather-grass mosaics and generally avoid extensive areas dominated by heather. The grasslands likely support highest densities of small mammal prey, especially voles;
- Females can leave their young before they are fully independent (within 3 – 6 weeks after hatching) with the males remaining to rear the young. This also coincides with when most tags cease transmitting, potentially indicating a period of high mortality risk;
- Sequential breeding attempts can be distant and occur even within the same season. One female likely bred twice in a single season at sites 1000 km apart (in Scotland and Norway);
- Movements outside of the breeding season differ markedly between individuals and also by the same individuals between seasons. For example, a bird that remained close to its breeding area in Scotland throughout 2017, spent part of summer 2018 in Norway and the following winter in the south of Ireland and in south-west England.

An analysis of ring recovery data for Short-eared Owls spanning 1912–2007 identified spatial and temporal differences in migration patterns¹. Recovery distances showed a marked quadratic relationship with time, generally increasing through to the 1960s and 1970s and then subsequently declining, with the apparent turning point being latest for birds from the Boreal region and upland Britain (areas that retain the strongest populations). Temporal changes in recovery distances could have been positively associated with breeding population density (at least in some areas), but vagaries associated with knowledge of the past and current status of Short-eared Owls in many areas adds difficulty to assessing the validity of such an association. Ongoing tracking of individual birds possibly adds some further support for density-dependent relationships on migration and dispersal operating outside of the breeding season.

Future plans are to deploy tags on owls across areas with contrasting prey, predator and competitor bases. This will increase the sample sizes to assess the generality of the initial findings and generate sufficient and robust data on behaviour, habitat and landscape use to inform a conservation strategy for the species.

¹ Calladine *et al.* (2012) *Journal of Ornithology* 153: 691-698.

Breeding and feeding ecology of the Short-eared Owl on the East Frisian Islands (NW Germany)

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The Short-eared Owl ranks among the rarest breeding bird species in Germany. Today, the remaining breeding population is almost exclusively restricted to the coastal areas of Schleswig-Holstein and Lower Saxony. Besides a few breeding pairs located on the North Frisian Islands, the East Frisian Islands (Wadden Sea National Park of Lower Saxony) are the only region where the species continuously breeds in Germany. During recent decades, on the West Frisian Islands in the Netherlands a decrease of the Short-eared Owl breeding population has been observed. Since the Dutch breeding habitats are rather similar to those on the German Wadden Sea Islands, there is concern that the German breeding population might also decrease. In line with this, for the East Frisian Islands a decline of the breeding population has been detected since 2004. However, until now it is unknown if this pattern possibly only reflects a normal fluctuation. Consequently, for the long-term survival of the species there is urgent need for a better understanding of the ecology of the species. Accordingly, we studied the breeding and feeding ecology as well as habitat preferences of the Short-eared Owl on the East Frisian Islands.

During the breeding seasons 2011, 2017 and 2018 we examined nest-site selection by comparing biotope type and vegetation structure at nests with those of randomly selected control samples. To evaluate foraging habitats we conducted more than 200 hours of fixed point surveys. To gather data about feeding ecology and activity patterns of breeding Short-eared Owls we used camera traps which were placed at nest sites. Additionally, we studied food availability in different biotopes used for foraging by live trapping of small mammals. Furthermore, we conducted nest monitoring to determine hatching success and radio-tracked fledglings to gather information about breeding success.

Dense and relatively high vegetation was preferred for nesting. Nests were mainly located within dune grasslands, high marshes and salty dunes, which were also the main feeding habitats. According to the analysis of camera traps young birds were almost exclusively fed with voles (*Microtus* spp.). Additionally, single European White-toothed Shrews (*Crocidura russula*) and one young European Hare (*Lepus europeaus*) were fed. Several observations of feathers of species like Bluethroat (*Luscinia svecica*) and Meadow Pipit (*Anthus pratensis*) in owl nests suggest that songbirds were also hunted as prey. Abundance of small mammals was generally low, although it increased from April to August. The Common Vole (*Microtus arvalis*) was the dominant species in all studied habitat types – except for dune heath – and exhibited its highest abundance in salty dunes and dune grasslands. Consequently, the habitats with the highest prey density were also preferred for foraging. On contrast to the very high hatching success (ø 87 %), radio tracking revealed that only 25% of the young birds fledged successfully. For some fledglings, food shortage was identified as cause of death. A very high loss was observed after several days of bad weather (heavy rain and strong wind [6–9 Beaufort]) in June, when most of the fledglings were still young.

Breeding biology of Short-eared Owl in an invasion year 2015 in the Biebrza Marshes

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Short-eared Owl is a visual predator, silent and difficult to detect in the field. In my presentation I have chosen some, and in my opinion most interesting aspects of our study: food in relation to trap line study of small mammals and secondly I tried to answer the question whether Short-eared Owl (SEO) builds the nest on its own.

Our research started after the observation of unusually high numbers of owls in Biebrza Valley in May 2015. We have used trees and shelter for direct observations, and we systematically searched the whole area. We also used trail cameras mounted by the nests. We've also tried to find as many pellets as we could, to study owl diet compared with vole trap lines (K. Zub, unpublished).

We found ca. 200 pellets under bushes, solitary trees and poles. We collected some pellets in the day-roosting places near nests, under the roof of grasses. Some of them have been used by birds only once and two others used much more frequently (more pellets gathered together), 20 and 22 meters from nests. In 2015 the diet composition was not very rich, compared with 2012 (the year after vole peak in autumn, but with low number of owls). In both periods the main prey were voles, with tundra voles *Microtus oeconomus* as the most common prey.

The bottom of nests remains clean. Young owls eject faeces on the bank of a nest. Some of them females ate systematically. She did the same with pellets, regurgitated them far from the nest.

We can find in some papers and books that SEO is the only owl that builds a nest. In our film recordings we can see females on the nest preparing the nest sitting inside. They cut, curves, tear off, sometimes eats pieces of plants which can reach only from the nearest vicinity. The material inside the nest contains cut fragments of dry and fresh grasses, mosses and ferns. It seems that this owl only adopts the nest for breeding and it is not a typical constructor (*'Making a nest is making bits of material stay together in a certain spatial relationship'* – M. Hansell 2005. Bird, nests and construction behaviour. Univ. of Glasgow). The observations of owls carrying materials could refer to individuals with prey with accidental grasses attached to it.

Movements and diet of Short-eared Owls in the Netherlands

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Both as breeding birds and winter visitors, Short-eared Owl (SEO) numbers have declined during the past decades in the Netherlands. At the same time, knowledge on SEO ecology is still limited, mainly due to their inconspicuous behaviour and nomadic movements. To enhance our understanding of this species, the Dutch Montagu's Harrier Foundation has been monitoring the diet of SEO by collecting pellets across the country since 1990. Furthermore, a tracking study using GPS loggers was recently initiated.

A total of 7,704 prey items were collected between 1990 and 2018, mainly from pellets at roost sites. 89.8% of these were voles, 6.0% birds (mainly waders and songbirds), 3.7% other mammals (mainly mice and shrews) and 0.4% insects (beetles). The range of prey species included noteworthy oddities such as larger birds (doves and ducks), water beetles and a bat. Variation between sites was large. At a number of (mainland) sites, SEO diet was extremely dominated by Common Voles (up to 99.9%). At other sites, especially on islands in the Dutch Wadden Sea where voles are absent, the diet featured important proportions of birds (up to 89.7%) and/or mice (up to 41.7%).

Two SEOs were tagged with *Milsar* GPS-GSM loggers in the late summer of 2017 in the Dollard area in the northeast of the Netherlands. The first individual (1st cy male, "SEO 1") showed pronounced exploratory behaviour across the entire Dutch coastal region within three weeks after tagging in September, travelling from East Groningen to Southwest Friesland passing by the Dutch Wadden Sea islands, then back to North Groningen and finally to the Rhine-Meuse-Scheldt delta region in the Southwest of the country (Fig. 1). The total travelled distance was at least 509 km in 19 days, with an average distance between subsequent noon positions of 34 km (range: 0-194 km). Due to insufficient battery charging, possibly because feathers covered the solar panels, the logger ceased transmitting by the end of September. The second individual (1st cy female, "SEO 2") also quickly left the Dutch Dollard area after tagging and settled in Rheiderland, about 20 km further east in Germany (Fig. 1). She stayed in this area characterised by managed grasslands during at least three weeks until the battery was drained temporarily by the end of October, occupying a restricted home range of about 247 ha (90% kernel). During most of this period, she used the exact same roost site during the day. In February the logger became active again; at that time, SEO 2 was already in another wintering site in northern Friesland (about 100 km away from the first site; Fig. 1), a protected area with extensive grassland managed for meadowbirds. She stayed in this area until mid-April, when she started to migrate eastwards. The last transmitted GPS position on 25 April 2018 came from northeastern Poland (at least 1017 km travelled in 10-13 days). While roosting on the ground during daytime, roosting in trees close to farm buildings or inside villages for shorter periods occurred regularly during nighttime in both tracked individuals.

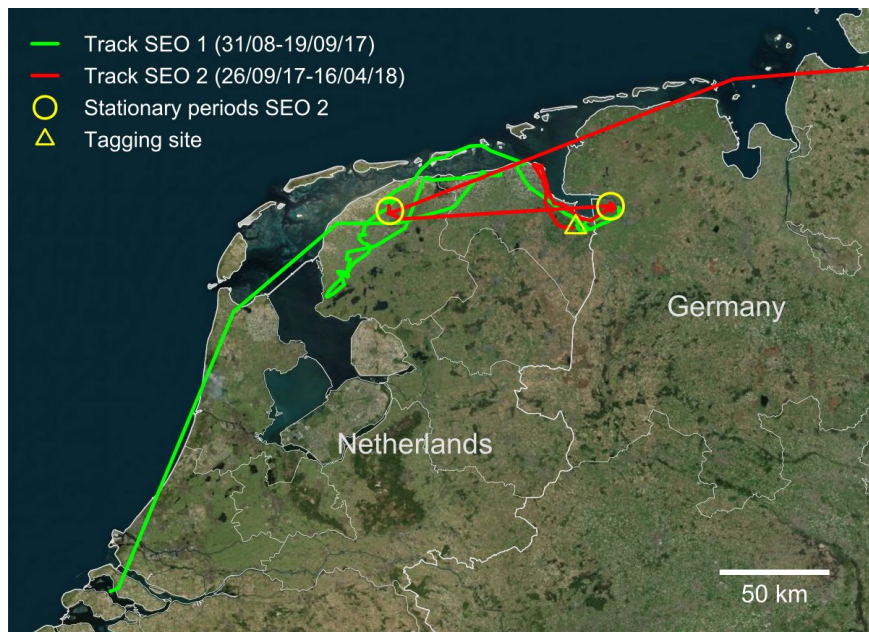


Fig. 1: Map indicating the movements of two Short-eared Owls tracked with GPS-GSM loggers.

Conservation approaches



Photo: Gerard Westerhuis

Hen Harrier LIFE: UK

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The Hen Harrier (*Circus cyaneus*) is one of the rarest birds in the UK, and populations continue to decline across the country. The latest national survey, conducted in 2016, estimated there are 575 pairs of Hen Harrier across the UK and Isle of Man – just a fifth of the 2,653 pairs that habitat surveys estimate should be present.

Hen Harriers live and breed in moorland. This habitat is rarer than rainforest and 75% of it occurs in the UK. Over 50% of UK moorland is used for grouse shooting. It is widely accepted, and supported by a growing body of scientific evidence, that the main cause of the decline of Hen Harriers is illegal killing associated with intensive management of moors in the British uplands to produce high numbers of grouse for shooting. Hen Harriers are the most intensively persecuted of all the UK's birds of prey, despite the bird having legal protection under the Wildlife and Countryside Act, 1981.

Hen Harrier LIFE is a 5 year project running from 2014 to 2019, jointly funded by the RSPB and the European Commission's LIFE programme, which is the EU's funding instrument for environment and climate action. The aim of the project is 'to provide the conditions in which Hen Harrier range and population recovery can occur, particularly in parts of the UK where this species is most threatened'.

Our focus is on five Special Protection Areas, designated for Hen Harriers, in northern England and southern and eastern Scotland: Glen Tanar, Forest of Clunie, Muirkirk and North Lowther Uplands, Glen App and Galloway Moors, and the Langholm – Newcastleton hills in Scotland, and the North Pennine Moors and Bowland Fells in England. The project has five main actions:

1. Improve understanding of movements of Hen Harriers in the core project area and improve understanding of intensity and nature of persecution

We have tagged over 80 Hen Harriers to date, and their movements are widespread across England, Wales, Scotland, Isle of Man, Northern Ireland, Republic of Ireland, France, Spain and perhaps Norway. To date, we have lost around a third of our birds to confirmed or suspected illegal persecution in the UK. Therefore, to protect Hen Harriers across their range, we need cross-country conservation, working with governments, law enforcement, landowners and local communities.

2. Protect Hen Harriers at breeding and wintering sites

Tagged birds are monitored daily, and to date we have identified, protected and monitored over 60 nest sites and over 150 winter roost sites. We work alongside local raptor workers, who have contributed over 10,000 hours to the project to date. Protection and monitoring measures help to deter persecution and allow us to understand reasons for nest failures and how the birds are using the habitat throughout the year.

3. Ensure habitat availability does not limit population recovery

At our RSPB Geltsdale reserve, the moorland habitat is carefully managed including an annual cutting regime and is grazed by populations of ponies, sheep and cows. The diverse habitat that has resulted is often used in advocacy work for land management practices in the uplands.

4. Raise public awareness of Hen Harriers, threats and conservation efforts

We have three main channels of communication: the Hen Harrier LIFE website, @RSPB_Skydancer twitter account and the RSPB Skydancer blog. Each year we add 12 Hen Harriers to our website, whose journeys are updated based on the tagging data, to allow the public to see where the birds

are travelling. Regular tweets and blog posts allow us to keep people involved in Hen Harrier-related news.

5. Engage local communities and land managers and increase support for Hen Harrier protection
Our successful community engagement programme has allowed us to work with over 12,000 people, to engage them with Hen Harriers and understand the issues faced by these birds. To date, we have installed five Hen Harrier interpretation panels on reserves, visited 148 schools and 14 colleges, delivered 87 community talks and 32 public events, put out 97 press releases with regular pick up from print and online media, television and radio producers. Each new release allows us to reach more and more people.

Project delivery is due to finish in December 2019, and we have a lot more planned, including scientific analysis of the satellite tag data to understand where the birds live and die, advocacy work with Scottish and English parliaments, a podcast series, short film about the project and a layman's report incorporating the stories of the tagged birds. Watch this space!

A novel results-based approach to farming for Hen Harriers in Ireland

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In 2017, a new innovative Locally Led Agri-Environment Scheme (Hen Harrier Project) was funded through the Environmental Innovation Partnership (EIP) as part of Ireland's Rural Development Programme. The Hen Harrier Project represents a €25 million investment in a new results based approach to upland pastoral farming partnerships in Special Protection Areas (SPAs) designated for breeding Hen Harrier. This pilot programme will run between 2018 and 2022. Six areas comprising a combined area of 167,297 hectares have been designated as SPA for breeding Hen Harrier in the Republic of Ireland. There is accurate contemporary quantitative data on habitat composition in these areas. There are approximately 3,760 farmers in the SPA network managing a total of 56,000 hectares of designated farmland.

The Hen Harrier Project is a locally targeted conservation programme building strong partnerships with farmers to deliver sustainable benefits for biodiversity, upland ecosystems and a vibrant local rural economy. The objectives of the Hen Harrier Project are:

1. to ensure the sustainable management of High Nature Value (HNV) farmland in the most important areas for breeding Hen Harrier in Ireland, with special emphasis on providing quality habitat for the Hen Harrier.
2. to promote a stronger socio-economic outlook for what are generally areas with difficult to manage marginally agriculturally productive upland areas. These challenges have led to low farm viability and reduced farm succession.
3. to develop an effective model for future sustainable management of Hen Harrier areas.
4. to foster continued positive relations through locally-led solutions between the people who have managed this landscape for generations, the relevant Government Departments and the special biodiversity that exists on the land.

The project supports and encourages farmers and farming communities to farm for conservation. The project works for and with farmers to help ensure that upland management is rewarded and valued for the delivery of vital ecosystem services. The Hen Harrier Project uses a novel 'hybrid' approach to farming for conservation which sees farmers paid for both work undertaken and, most importantly, for the delivery of defined environmental objectives. The Hen Harrier Programme consists of three payments:

1. A points-based habitat payment – this pays for the quality of the habitat delivered at the end of each breeding season.
2. A Hen Harrier payment – this represents local recognition of local success in terms of supporting breeding Hen Harrier.
3. A supporting actions payment – this is an investment with the farmer in actions that improve the farmers capacity to benefit from the other two payments.

As part of the Hen Harrier Project, dedicated ornithologists from the Golden Eagle Trust Ltd undertake intensive monitoring of breeding and wintering Hen Harrier within the SPAs to inform the scope and extent of annual incentivised payments for participants. This allows a unique opportunity to link agri-environment payments to nesting success and population level performance, adding a direct value to the Hen Harrier itself.

The Hen Harrier Project represents a high profile and unique opportunity to both research further the ecological requirements of Hen Harrier in Ireland while using data collected from the project to study the effectiveness of the results based approach in delivering real improvements to agricultural and

environmental sustainability in a HNV farming landscape. The project aims to provide the first proof-of-concept for targeted results-based agri-environment scheme impacts on a specialist declining apex avian predator, underlining the importance of targeting measures towards population-limiting factors, habitat availability and habitat quality for bird conservation.

Hen Harrier Reintroduction Project in Southern England

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Hen Harriers historically bred in suitable habitat throughout the UK, but the population declined significantly from c.1830 due to land use changes and human persecution. Despite a gradual recovery across Scotland and Wales in recent decades, Hen Harriers have not returned as a breeding bird to southern England. In 2016, a full survey estimated a total of 545 territorial pairs in the UK; a down-turn of 14% since the last census in 2010. Of this figure, only 4 pairs bred in England, solely in the north. This parlous situation has been a driver for the development of the Department for Environment, Food and Rural Affairs (Defra) Joint Action Plan to increase the English Hen Harrier population. The southern reintroduction project is key to delivering the ambitions of that plan.

The reintroduction will focus on establishing a farmland nesting population, aiming to release c.100 juvenile harriers over a 5-6 year period, starting with a smaller number (6-10) this summer. The release aviaries will be located at Parsonage Down National Nature Reserve (NNR) in Wiltshire, which is owned and managed by Natural England. The NNR borders the extensive foraging grounds of Salisbury Plain Special Protection Area, where Hen Harriers were known to breed and now over-winter in good numbers. Crucially, the reasons for historic decline have long since disappeared with contemporary cultural attitudes and land management in southern England. Therefore we are confident that the threat of targeted persecution locally is extremely low and that extensive suitable farmland and supporting semi-natural habitats will sustain a large, healthy population of Hen Harriers.

The project hopes to source harriers from thriving populations in similar farmland landscapes in Europe as they are likely to be culturally adapted to such habitats. Expert advice and the scientific literature tells us that harriers frequently lay 4-5 eggs but rarely raise more than 3 fledglings, even when food is abundant. Chicks would be collected at c.28-30 days of age from larger clutches, leaving at least 2 viable chicks in each nest. Taking strong, healthy chicks at a late stage in their development (directly from the nest) will minimise human imprinting and help ensure they have the best possible chance of long-term survival. Importantly though, this method will have no demographic effect on the donor harrier population, and indeed may well improve fledging success of the remaining chicks through reduced sibling competition.

Given the species' range and mobility, we are keen that harrier conservation and research in the UK is framed and actioned at a European level. In this context, a farmland breeding population in southern England could facilitate an expansion of the European crop-nesting range. And this may help mitigate current and predicted negative effects of climate change and agricultural harvesting operations. The project will be supported by a rigorous monitoring and research programme, with oversight from a scientific advisory panel made up of international experts. The project is therefore likely to forge links with academic institutions in Europe, particularly in the research areas of movement ecology and farmland habitat use and enhancement.

Birdfields for Hen Harriers and Short-eared Owls

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Trends of breeding Hen Harrier and Short-eared Owl on the Dutch Wadden Sea islands have been going steeply downward since the mid-1990s. Once a stronghold for the species, now they only appear there in single digit numbers. A possible cause for their decline is the changed dune vegetation. In the last decade, Hen Harriers appears more often as a breeding bird in arable farmland on the main land in the eastern part of Groningen province. Also Short-eared Owls find breeding opportunities in this region. Numbers of breeding pairs for both species, however, are still very low. In an effort to improve numbers of both species, a project was started called 'Wadvogels van Allure'. One goal of this project was to improve feeding conditions for Hen Harrier and Short-eared Owl by increasing densities of voles in agricultural settings, using methods that could be easily implemented by nature management organisations and farmers.

The birdfield concept was conceived by Ben Koks from a combination of several observations. First, vole densities are high in set-aside, but availability for vole eating predators is often low due to high and dense vegetation. Second, vole densities are often elevated in crops bordering set aside. Third, lucerne, when not too high, is profitable foraging habitat for Montagu's harriers. Clover can be an alternative for lucerne, or can be mixed in. Because lucerne is harvested 3-4 times per year, the vegetation is repeatedly reset to a short state, and because it is a perennial crop, voles in lucerne can develop steady populations. The harvested lucerne can be sold as cattle feed. By combining these elements – lucerne fields intersected with strips of set-aside – a field is formed that could greatly benefit food availability for vole eating predators, including Hen Harriers and Short-eared Owls, while producing a crop for the farmer. As an extra, skylarks are very much attracted to lucerne fields, and can have a high reproductive output there. In addition, in larger fields, winter food strips can be added, to offer seeds for overwintering seed eating birds.

Birdfields were first introduced in 2009 in the Flevoland polder, followed by a CAP pilot in Groningen in 2013. This pilot led to the first test of the birdfield concept using GPS-tagged Montagu's harriers. The test showed that birdfields are effective agri-environment schemes for Montagu's harriers due to increased prey accessibility.

As part of the Wadvogels van Allure project, almost twenty bird fields were realised, located in East- and North-Groningen, Friesland and the island of Texel. As part of another project three more were created.

Monitoring of the birdfields showed that vole densities were indeed higher than in crops. Only in extensively managed grass fields, occasionally, comparable numbers could be found. Densities were highest in set-aside, but in lucerne densities were most of the time surpassing those in crops. Wintering seed-eaters, such as yellowhammers, greenfinches, common linnets and tree sparrows, appeared in higher densities in birdfields than in conventional agricultural fields. Breeding densities of skylark were measured only in one birdfield, and there densities were two to three times higher than in conventional fields. Outside the breeding season, foraging raptors (Hen Harrier, marsh harrier, rough-legged buzzard, common buzzard, kestrel and Short-eared Owl) were present in higher densities in birdfields than in conventional fields. Increases could be up to ten-fold. This was also the case for Hen Harrier and Short-eared Owl separately (Figure 1). At one bird field in Groningen, nightly catches with mist nets revealed the use of birdfields for hunting by Short-eared Owls, Long-eared Owls and barn owls. In the breeding season, numbers of vole eating raptors varied per location. In one birdfield in Groningen, densities were comparable to those in conventional fields, but on

Texel densities were more than two times higher. Nevertheless, the use of birdfields by raptors was most pronounced in winter.

In conclusion, birdfields increase the number of voles, and Hen Harriers and Short-eared Owls, among other species, make use of these fields for foraging in winter and in the breeding season. In this sense birdfields can be considered a success. Nevertheless, use of the fields in the breeding season is limited and there can be considerable variation in use, depending on the locality of the birdfields. For Short-eared Owls, their impact is harder to determine. Birdfields can be an instrument in improving the foraging habitat for Hen Harriers and Short-eared Owls. Whether they can stop their declining trend, however, remains to be seen, and may depend on the generous application of this agri-environment scheme.

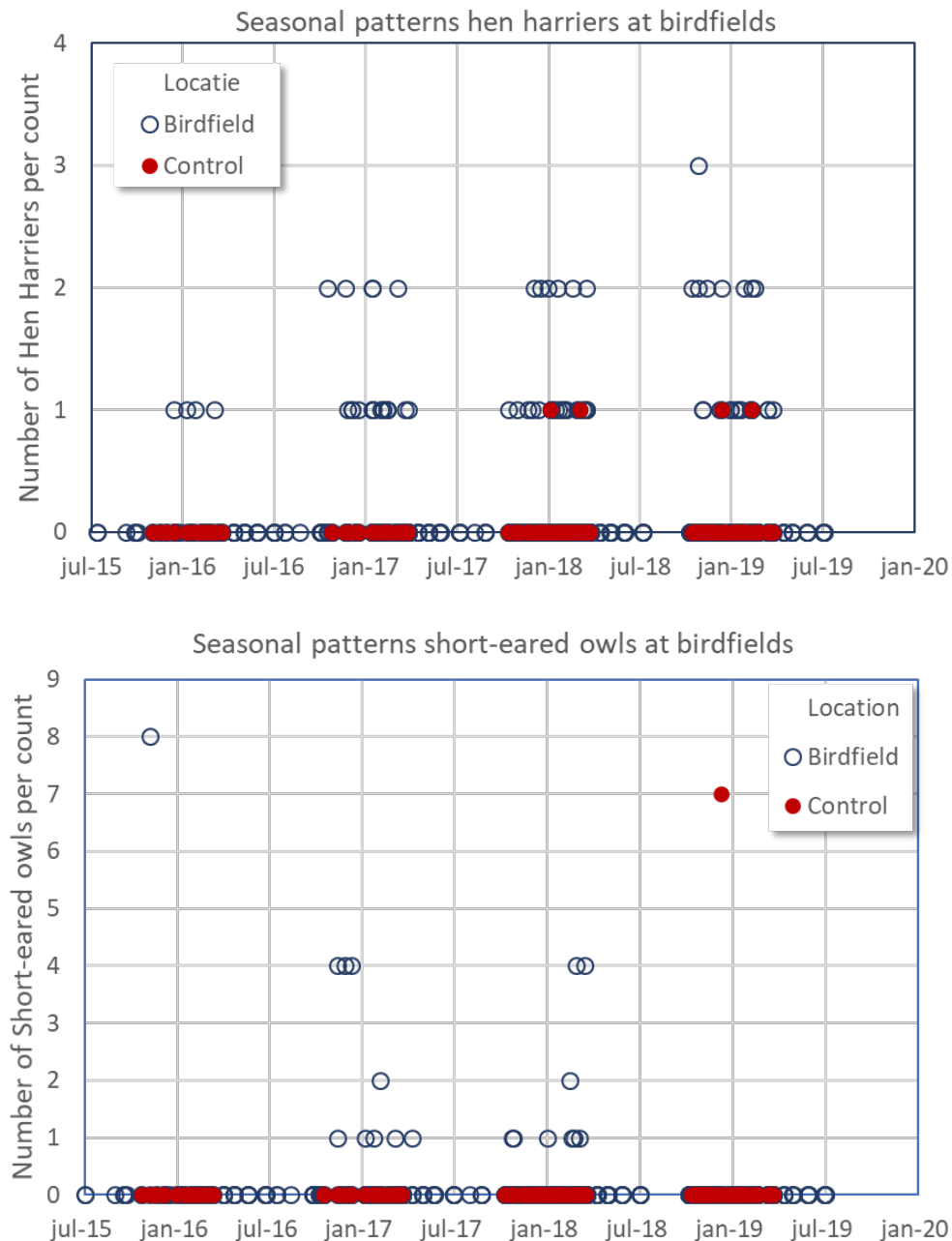


Figure 1. Seasonal patterns in numbers of observed Hen Harriers (upper panel) and Short-eared Owls (lower panel) on 'Wadvogels van Allure' birdfields and on nearby conventional arable fields as controls.

Plenary session



Photo: Gerard Westerhuis

Summary of plenary discussion

The plenary discussion was started with an interactive 'take a stand' session, in which participants had to respond 'yes' or 'no' (by standing in the left or right corner of the meeting room) to three statements prepared by the workshop organisers. After this 'take a stand' session, there was a plenary discussion about specific themes. Both parts were led by Raymond Klaassen.

1. Take a stand

Statement 1: In my country, there is sufficient knowledge to protect HH effectively.

Result: 9 persons, mostly from the UK, choose 'yes', large majority choose 'no'. A Dutch participant chose "yes". "It is time to act now. HH might be gone if we wait for new knowledge. Use existing knowledge to design an action plan. Meanwhile research can continue". Another Dutch participant chose "no". "Breeding success on the Wadden Sea islands seems sufficient for a stable population, but population decline is 10% per year. We do not know where juveniles go and where they die. This knowledge gap needs to be resolved before we can act effectively". A Spanish participant chose "no". "At least for Spain, we do not have enough information about *effective* strategies. We need to act now based on available knowledge, but we have to thoroughly monitor the effects of actions in search for strategies that are truly effective". A UK participant chose "yes". "Sufficient knowledge is available. The problem in the UK is the rather polarised views and a lack of discussion on what to do about the specific problems in the UK."

Statement 2: I am positive about the future of HH in my country.

Result: 8 persons choose "yes", again mostly from the UK, large majority choose "no". The large group choosing "no" suggests pessimism to prevail among participants. A UK participant chose "no" because she thinks that the state of politics is such that illegal persecution in the UK will be hard to eliminate. A Dutch participant chose "no" as he just thinks that the species will go extinct as a breeding bird. A German participant chose "no" because he has no idea what actions to take to preserve HH in the Wadden Sea. Breeding success is good, but nevertheless the HHs decline. A UK participant chose "yes". Overall, there is a population decline in the UK, but in sizeable, more natural areas, mainly on islands and away from moors, populations have increased and seem secured. Another UK participant warns, however, that small and subtle changes in agriculture might cause also decreases in apparently stable populations. Nevertheless, these secure populations in parts of the UK contrast with the gloomy situation on the European continent and offer a spark of hope.

Statement 3: International collaboration is necessary to protect HH and SEO.

Result: all participants choose "yes". An Irish participant chose "yes". "For Ireland enough information is available to start securing HH and SEO populations. However, during this meeting we have seen numerous examples of HHs and SEOs covering large distances during their annual or life cycle, visiting and even breeding in more than one country. So, in both species, populations are connected". Another reason why we need international collaboration is that the issues that need to be addressed, such as changes in agriculture and forestry, transcend national borders. Single countries will not act if others do not. Problems are often similar in each country, so solutions have to be taken up jointly.

2. Plenary discussion

Opening words by Fred Wouters, director BirdLife Netherlands

"If we, motivated and dedicated people, do not act for HH and SEO, then no-one else will in Europe. Therefore the research community and BirdLife partners should unite forces. Both species spend their life partly or fully outside nature reserves (Natura 2000 areas), which makes their conservation very complicated. The results of the questionnaire circulated before the meeting already contain a lot of useful information. I would appreciate if we could use these results, together with all other information presented during this meeting, to work towards a European wide action plan. I am convinced that if we unite, we can make a difference at the European level and at the level of national states."

Numbers and trends

One rather unexpected general outcome of this meeting is that HH and SEO numbers appear to be declining almost everywhere. Even in France, a key country for HH, numbers seem to be declining. This raises the question whether their IUCN conservation status should be reconsidered. For HH the current status is 'near threatened' for Europe (BirdLife International, 2015) and 'least concern' globally (BirdLife International, 2020). The status for SEO is 'least concern' both for Europe and globally. Major problem is that we do not know much about the size of Russian HH populations, which is supposed to run into the 1000s, let alone about trends. However, declining numbers in the entire European range, possibly except Russia, provides in itself enough argumentation for a reconsideration of the IUCN conservation status. Missing data for Russia might be overcome by calculating a population trend based on trends of sub-populations for which data are available.

Suggestions to reconsider the IUCN conservation statuses of birds have to be addressed to a 'chat group' within BirdLife International. In this chat group, experts from each country have to report numbers and trends. Based on subsequent discussion within the forum of the chat group, decisions about changes in conservation statuses are made. We decide that we will inform BirdLife International about this meeting, with one of the outcomes being the need to check if reconsideration of the IUCN conservation status of HH is appropriate. BirdLife-NL will take the lead.

How well are SEO populations monitored?

SEO data presented during this meeting all point in the direction of population declines. However, we do not know how well SEO populations are monitored and what the overall trend of this difficult species is. Do we therefore need a specific monitoring strategy or program for SEO?

A participating SEO specialist suggests that we need to develop a method, but it will not be possible to get SEO estimates for whole countries when numbers are in the 100s or 1000s. What can be done is monitoring of SEOs in distinct areas as long as the unit is "pairs that bred successfully". Such area-based monitoring of successful pairs can be done in an international network setting. The BTO is willing to elaborate a method for area-based monitoring of successful breeding pairs in a network context. Already sharing an idea about a monitoring program would be very useful.

SEO is declining everywhere where there has been monitoring, including the US. The current IUCN status is 'least concern'. This status is probably due to a lack of information rather than the result of coordinated information. BirdLife-NL will also look at the need to reconsider the IUCN status of SEO.

Threats

Shortly before this meeting Darío Fernández-Bellon circulated a questionnaire among meeting attendees to collate information on threats and effectiveness of conservation strategies for HH and SEO. The questionnaire revealed that besides more general, overlapping threats (e.g., chemicals, windfarms), threats for HH and SEO in the various countries are very specific (e.g. illegal persecution in the UK, large scale habitat loss through afforestation in Ireland; habitat degradation in The Netherlands; see table 1). A threat not covered in the questionnaire nor in the presentations is climate change. It affects vole cycles.

Table 1: HH and SEO threats in different countries as identified by species experts present at this meeting. (Source: Fernández-Bellon et al., 2020)

<i>Hen Harrier</i>	
Netherlands	Prey availability; Agricultural intensification.
UK	Shooting; Nest destruction; Predation.
Ireland	Habitat loss; Afforestation.
France	Accidental nest destruction; Prey availability; Agricultural intensification.
Spain	Habitat loss; Accidental nest destruction.
Finland	Habitat loss; Afforestation.
Germany	Habitat loss; Agricultural intensification.
Czech Republic	Habitat loss; Agricultural intensification.
<i>Short-eared Owl</i>	
Netherlands	Prey availability; Agricultural intensification.
UK	Prey availability; Predation; Habitat loss; Shooting; Afforestation; Extreme weather.
Spain	Shooting.
Finland	Habitat loss; Agricultural intensification; Predation; Car / train strike.
Germany	Extreme weather; Prey availability.
Czech Republic	Habitat loss; Agricultural intensification; Accidental nest destruction.

SEO is in many ways a difficult species. How well do we know the threats for SEO? From the presentations held at this meeting it seems that SEO trends follow HH trends (Wadden Sea islands, Orkneys), so threats might also be similar. The fact that we know so little about SEO is a threat in itself. We can only guess what is driving SEO declines. It would be a useful exercise to synthesise the information that we need to identify the threats for SEO, possibly as part of an action plan.

Knowledge gaps

The following knowledge gaps have been identified for HH during this meeting:

1. Are HH populations limited by reproduction or survival? Is the cause of decline in the breeding or wintering areas?
 - a. When comparing breeding success across regions, it is important to consider reproduction per breeding attempt (rather than per successful attempt);
 - b. What are first year movements and survival in relation to body condition? Might winter mortality be the result of carry-over effects from the breeding season?

- c. How do skewed sex ratio's arise in the population? Why are male ringtails underrepresented in the population? Are there differential survival rates between the sexes?
2. Are there sex-specific movements, dispersal and wintering strategies (natal & breeding dispersal)?
3. The percentage of passerines in diets differs strikingly between UK and mainland. Can we explain this variation? What is the link with food availability? Do we need an European synthesis?
4. What is the variation in foraging behaviour and capture rates between age classes and sexes? Can we explain variation between populations? Do we need an European synthesis?

For SEO we still have so little knowledge, that every study is valuable. SEO tracks presented during this meeting show important first glimpses, such as the suspected breeding in two widely separated countries in one breeding season. Other remaining SEO questions are how high reproduction should be for population stability, if and how populations are connected, how SEOs are able to locate areas with high vole abundances and when and where natural mortality occurs.

Wadden Sea islands

On both the Dutch and German Wadden Sea island HHs are in decline. There are different views on whether the problems are most apparent in the breeding season or in the wintering period. Dutch HHs are believed to face problems in both periods, HHs on the German Wadden Sea islands seem not to have problems in the breeding area, but mainly in the wintering period due to a shortage of food.

An important question is how to improve management of the dunes for HH. Dunes in NL suffer from high nitrogen deposition and part of the Dutch Wadden Sea islands are used for intensive agriculture. On the German Wadden Sea islands there is no intensive agriculture, and N deposition seems less of a problem, although locally HH habitat is overgrown with shrubs and trees; there are polders, but these consist of extensively managed grasslands for meadow birds. A comparison between dune / island management in NL and DE would be valuable. We agree that a visit to one of the German Wadden Sea islands will be made to discuss dune management issues.

The question whether or not HHs on the Wadden Sea islands actually face food shortage has not been explicitly addressed. One possible way to study this would be to conduct a supplementary feeding experiment, but this method has caveats. A simpler way forward would be to collate data on chick condition for different breeding populations, including populations that show no decline. With much chick condition data available, this exercise could start 'tomorrow'. Insights gained during the meeting are that reproduction on the islands is not very high and condition of the young at the end of the breeding season rather poor. When analysing breeding success it would be valuable to also compare productivity per breeding attempt, even though this requires high quality data from intensively monitored breeding populations.

A population model for Dutch HH indicated that a decreased adult and especially juvenile survival during the non-breeding season is the main cause for the population decline. As we know little about this phase in the annual cycle a larger tracking study including especially juveniles would be valuable. Reduced survival may also be a carry-over effect from poor body conditions upon fledging.

Sex-specific movements

Despite extensive tracking studies in HH, we have limited knowledge on sex-specific movements and natal and breeding dispersal strategies. These are important issues as they impact essential population parameters such as differential survival of sexes. We would need an international tracking program to tackle these issues, with a focus on tracking in countries with low levels of illegal persecution to obtain lifelong tracks.

Diet

HH diets differ notably between countries, with high proportions of passerines in UK and Spain, and vole-dominated diets in NL. We cannot yet fully explain these differences and what a certain diet indicates about the state of the population. The general impression is that HHs prefer voles if these are available, but we do not know the ecological significance of this. If voles or passerines in the diet does matter for HHs, then the preference for voles has conservation implications, e.g. by affecting the type of conservation measures that will be effective. We agree that it would be worthwhile to produce an European synthesis on HH diets, i.e. comparing diets between countries and relating regional diet to regional prey availability.

Foraging behaviour and capture rates

Across Europe, different groups have collected data on foraging behaviour (e.g. prey capture rates), but not always the same methods were used. In order to establish a homogeneous European wide dataset it is suggested to adhere to the same protocol (see Redpath et al., 2002). It would be interesting to relate prey capture rates during breeding and non-breeding season to population trends.

Action plans for HH and SEO?

An action plan describes the current situation and proposes solutions. Would this be useful for HH and/or SEO? A multi-species action plan for African vultures was recently published under the umbrella of the Convention on Migratory Species (CMS). There is also a Memorandum of Understanding (MoU) on Raptors (formally: Memorandum of Understanding on the Conservation of Migratory Birds of Prey in Africa and Eurasia, administered by a Coordinating Unit based in Abu Dhabi, UAE). Both HH and SEO are on the species list of this MoU. Given the signatures of governments under CMS and MoU on Raptors agreements, it is very important that HH and SEO action plans are brought under CMS umbrella. Both CMS and MoU Raptors have funds available to develop action plans.

During the meeting an update from BirdLife International was received. HH was assessed 'near threatened' in the 2015 assessment, based on reports on a 5-30% decline during 2000-12 in non-European Russia. In case a 30% decline is genuine, a status of 'near-threatened' would be justified. However, reliable trend data from Russia is still missing. A new assessment is scheduled for 2020-2021. We conclude that it is urgent to update outdated population data (for e.g. F, FIN, DE, NL).

What would be the next steps? Should we contact CMS and/or MoU Raptors about this? We need to further explore this. BirdLife-NL is willing to play a role, but more partners are needed, especially if action plans will be written. The participants of this meeting are prepared to contribute.

International collaboration

We agree that it would be useful to have a second HH and SEO meeting. It could be held in Spain, connected to an already scheduled vole meeting. However, to increase involvement of experts from Russia, Ukraine and other eastern countries, an eastern venue (e.g. Belarus) would be better.

We agreed to initiate mailing lists for HH and SEO researchers for sharing information and discussing field methods, conservation actions etc (see Annex 2). It was noted that regarding SEO, collaboration with researchers in North America would be valuable in view of the small number of studies carried out in Europe.

Public outreach

Satellite tracking and webcams on nests are powerful tools for public engagement. We should consider applying for funds together, for example for a European wide tracking study. The international HH and SEO network, as established by this meeting, could be used to show that national work is part of a larger, international project. The book of abstracts with agreed main conclusions and knowledge gaps could form a basis for this. It would also help to write a short research paper about trends of HH in different countries. Such a paper would help in raising awareness. Many conservationists are unaware of the current negative HH and SEO trends.

Actions accorded

- Check whether reconsideration of IUCN status of HH and SEO is necessary
- Establish e-mail networks for SEO and HH researchers
- Dutch-German field trip to Wadden Sea islands for discussing issues of dune management

Actions proposed

- International tracking program on HH
- Research paper about trends of HH in different countries
- Synthesis of HH diets across Europe
- Comparative study on HH prey capture rates across Europe
- Continuation of HH/SEO meetings with biennial rhythm
- Exchange with SEO researchers in North America

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Annexes



Photo: André Eijkenaar

Annex 1: Expert meeting program

Wednesday, 20 March 2019

Time	Species	Name & institution	Presentation title
9.00			Opening and introduction
An update on status & trends (I)			
9.30	HH	Peter de Boer Sovon, Dutch Centre for Field Ornithology, Netherlands	HH status & trend Netherlands (Wadden Sea islands)
9.38	HH	Almut Schlaich Dutch Montagu's Harrier Foundation, Netherlands	HH status & trend Netherlands (Groningen): Farmland breeding Hen Harriers in East Groningen, a new prospect?
9.46	HH	Nadine Knipping University of Oldenburg, Germany	HH status & trend Germany: Status and trends of Hen Harriers in Germany with special focus on the Lower Saxony Wadden Sea National Park
9.54	SEO	Romke Kleefstra Sovon, Dutch Centre for Field Ornithology, Netherlands	SEO status & trend Netherlands
10.02	SEO	Steffen Kämpfer Osnabrück University, Germany	SEO status & trend Germany
10.10	SEO	Romuald Mikusek Stolowe Mts. National Park, Poland	SEO status & trend Poland
10.18			Coffee break
Current research on ecology & threats (I)			
10.40	HH	Nadine Knipping University of Oldenburg, Germany	The rise and fall of the Hen Harrier in the Wadden Sea - outcomes of a research project on reproduction, food and population dynamics
11.10	HH	Peter de Boer Sovon, Dutch Centre for Field Ornithology, Netherlands	Breeding success, survival and diet of Hen Harrier in the Dutch Wadden Sea area
11.40			Coffee break
An update on status & trends (II)			
12.00	HH	Alexandre Millon (presented by Almut Schlaich) Aix Marseille University, France	HH status & trend France
12.08	HH	Beatriz Arroyo Institute for Game and Wildlife Research, Spain	HH status and trend Spain: Population trends of Hen Harriers in Spain: comparisons between the 2006 and 2017 national censuses
12.16	HH	Duncan Orr-Ewing RSPB, UK	HH status & trend UK
12.24	HH	Barry O'Donoghue Ireland	HH status & trend Ireland
12.32	SEO	John Calladine British Trust for Ornithology, UK	SEO status & trend UK: Correlates with the changing status of breeding Short-eared Owls in Britain
12.40			Lunch break
Current research on ecology & threats (II)			
13.55	HH	Nicholas Aebischer Game & Wildlife Conservation Trust, UK	Ecology and demographics of Hen Harriers in the UK
14.15	HH	Stephen Murphy Natural England, UK	Juvenile dispersal of Hen Harriers in the UK
14.35	HH	Arjun Amar FitzPatrick Institute of African Ornithology, South Africa	Hen Harrier population dynamics on the Orkney Islands, Scotland: insights from over 5 decades of research
15.05			Coffee break
An update on status & trends (III)			
15.25	HH	Dzmitry Vincheuski APB - BirdLife, Belarus	HH status & trend Belarus
15.33	HH	Tomáš Bělka CSO - BirdLife, Czech Republic	HH status & trend Czech Republic
15.41	HH/SEO	Heidi Björklund Finnish Museum of Natural History LUOMUS, Finland	HH & SEO status & trend Finland
15.56	HH/SEO	Stiven Kocijancic National Institute of Biology, Slovenia	HH & SEO status & trend Slovenia
16.11	SEO	David Horal CSO-BirdLife / Nature Conservation Agency, Czech Republic	SEO status & trend Czech Republic
16.19	SEO	Ákos Monoki Hortobágy National Park Directorate, Hungary	SEO status & trend Hungary
16.27			Coffee break
Current research on ecology & threats (III)			
16.45	HH	Megan Murgatroyd FitzPatrick Institute of African Ornithology, South Africa	Association between grouse moors and Hen Harrier disappearances suggests widespread persecution in the British uplands
17.05	HH	Dario Fernandez-Bellon University College Cork, Ireland	Hen Harrier ecology in Ireland: effects of upland afforestation and wind energy development
17.35	HH	Raymond Klaassen Dutch Montagu's Harrier Foundation, Netherlands	Insights from year-round GPS tracking of Hen Harriers breeding in Dutch farmland
17.55	HH	Dzmitry Vincheuski APB - BirdLife, Belarus	Winter hunting of Hen harrier in Belarus: some differences between males and females
18.15			End of programme Wednesday

Thursday, 21 March 2019

Time	Species	Name & Institution	Presentation title
9.00			Opening
Current research on ecology & threats (IV)			
9.05	HH	Tomáš Bělka CSO-BirdLife, Czech Republic	Winter habitat use and migration of Hen Harriers based on GPS-tracking
9.25	HH	Raymond Klaassen Dutch Montagu's Harrier Foundation, Netherlands	Diet and foraging ecology of Hen Harriers wintering in the Northern Netherlands
9.45	SEO	John Calladine British Trust for Ornithology, UK	Habitat use and movements by Short-eared Owls: initial results from GPS-satellite tracking and a review of European ring recoveries
10.15			Coffee break
Current research on ecology & threats (V)			
10.35	SEO	Steffen Kämpfer Osnabrück University, Germany	Breeding and feeding ecology of the Short-eared Owl on the Wadden Sea Islands of North West Germany
11.05	SEO	Romuald Mikusek Stolowe Mts. National Park, Poland	Breeding biology of Short-eared Owl in an invasion year 2015 in the Biebrza Marshes
11.25	SEO	Tonio Schaub Dutch Montagu's Harrier Foundation, Netherlands	Movements and diet of Short-eared Owls in the Netherlands
11.45			Coffee break
Conservation approaches (I)			
12.05	HH	Cathleen Thomas RSPB, UK	Hen Harrier LIFE: UK
12.35			Lunch break
Conservation approaches (II)			
13.50	HH	Ryan Wilson-Parr Hen Harrier Project, Ireland	A novel results-based approach to farming for Hen Harrier in Ireland
14.20	HH/SEO	Popko Wiersma & Jules Bos Dutch Montagu's Harrier Foundation & BirdLife Netherlands	"Birdfields" for Hen Harriers and Short-eared Owls
14.50	HH	Simon Lee Natural England, UK	Hen Harrier Reintroduction Project in Southern England
15.10			Coffee break
General discussion & synthesis (I)			
15.30	HH/SEO	Chair	"Take a stand"
15.50	HH/SEO	Dario Fernandez-Bellon University College Cork, Ireland	Threats and conservation measures for HH/SEO in Europe: Results from questionnaires
16.20			Coffee break
General discussion & synthesis (II)			
16.40	HH/SEO	Chair	General discussion
18.10			End of programme Thursday

Friday, 22 March 2019 - Field excursion

- 07.30 Departure by bus from Martini hotel
- 09.30 Coffee/tea break at Groninger Kroon, Finsterwolde
- 12.30 Drop-off at Groningen railway station



Photo: Jelle de Jong
Photo: cover/back: Rein Hofman

Annex 2: Contact details Hen Harrier and Short-eared Owl networks

During the meeting it was decided to start separate Hen Harrier and Short-eared Owl (e-mail) networks. These networks allow to share information about ongoing Hen Harrier and Short-eared Owl research projects, conservation schemes, etc. New findings and publications can easily be shared and discussed. Invitations for collaborations and meetings can easily be spread.

International Hen Harrier network

Network co-ordinator is Almut Schlaich (Dutch Montagu's Harrier Foundation). To join the International Hen Harrier network, send an email to almut.schlaich@grauwekiekendief.nl.

International Short-eared Owl network

Network co-ordinator is Kjell Janssens. To join the International Short-eared Owl network, send an email to kjell_asio_otus@hotmail.com.

Annex 3: Meeting participants

Name	Organisation	Country
Dzmitry Vincheuski	APB-BirdLife Belarus	Belarus
Remar Erens	Werkgroep Grauwe Gors	Belgium
Robin Guelinckx	Werkgroep Grauwe Gors	Belgium
Kjell Janssen	Werkgroep Grauwe Gors	Belgium
Tomáš Bělka	Czech Society for Ornithology	Czech Republic
David Horal	Czech Society for Ornithology / Nature Conservation Agency of the Czech Republic	Czech Republic
Stephen Murphy	Natural England	England
Simon Lee	Natural England	England
Matthew Geary	University of Chester	England
Cathleen Thomas	Royal Society for the Protection of Birds	England
Nicholas Aebischer	Game & Wildlife Conservation Trust	England
Heidi Bjorklund	Finnish Museum of Natural History LUOMUS, University of Helsinki	Finland
Nadine Knipping	University of Oldenburg	Germany
Steffen Kämpfer	Osnabrück University	Germany
Hubertus Illner	Arbeitsgemeinschaft Biologischer Umweltschutz im Kreis Soest	Germany
Gundolf Reichert	Wadden Sea National Park Authority of Lower Saxony	Germany
Ákos Monoki	Hortobágy National Park Directorate	Hungary
Zsuzsanna Székely	Independent	Hungary
Barry O'Donoghue	Independent	Ireland
Darío Fernández-Bellón	University College Cork	Ireland
Ryan Wilson - Parr	Hen Harrier Project	Ireland
Peter de Boer	Sovon, Dutch Centre for Field Ornithology	Netherlands
Perry Cornelissen	Staatsbosbeheer	Netherlands
Lieuwe Dijkse	Independent	Netherlands
Romke Kleefstra	Sovon, Dutch Centre for Field Ornithology	Netherlands
Johan Krol	Natuurcentrum Ameland	Netherlands
Raymond Klaassen	Dutch Montagu's Harrier Foundation / University of Groningen	Netherlands
Almut Schlaich	Dutch Montagu's Harrier Foundation / University of Groningen	Netherlands
Tonio Schaub	Dutch Montagu's Harrier Foundation	Netherlands
Popko Wiersma	Dutch Montagu's Harrier Foundation	Netherlands
Madeleine Postma	Dutch Montagu's Harrier Foundation	Netherlands
Jitty Hakkert	Dutch Montagu's Harrier Foundation	Netherlands
Willem-Pier Vellinga	Dutch Montagu's Harrier Foundation	Netherlands
Oike Vlaanderen	Dutch Montagu's Harrier Foundation	Netherlands
Gerard Westerhuis	Dutch Montagu's Harrier Foundation	Netherlands
Jules Bos	BirdLife Netherlands	Netherlands
Marije Kuiper	BirdLife Netherlands	Netherlands
Frans van Alebeek	BirdLife Netherlands	Netherlands
Fred Wouters	BirdLife Netherlands	Netherlands
Nico Beemster	Altenburg & Wymenga	Netherlands

Frank Haven	Independent	Netherlands
Jan van 't Hoff	Province of Groningen	Netherlands
Romuald Mikusek	Stołowe Mountains National Park	Poland
John Calladine	British Trust for Ornithology	Scotland
Stiven Kocijancic	National Institute of Biology	Slovenia
Arjun Amar	FitzPatrick Institute of African Ornithology	South-Africa
Megan Murgatroyd	FitzPatrick Institute of African Ornithology	South-Africa
Beatriz Arroyo	Institute for Game and Wildlife Research	Spain



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