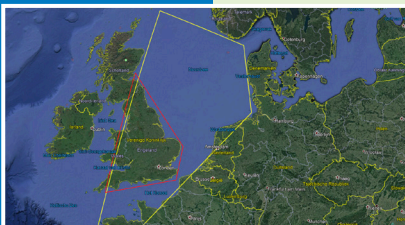


North Sea crossings by Eurasian Curlew

Timing and routes of Curlew migration in relation
to offshore wind developments



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Bureau Waardenburg
Ecology & Landscape

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Preface

In an update to the Dutch framework on ecological effects and cumulative impacts (referred to as *Kader Ecologie en Cumulatie*, KEC 3.0), Curlew was identified as one of the species potentially at risk from the roll out of offshore wind developments. Although Curlews are known to migrate over the North Sea, at the time no information was available on the timing, routes and flight heights of birds during these crossings. RWS commissioned Bureau Waardenburg to further investigate the North Sea crossings of Curlews.

Alongside a review of existing tracking data, Bureau Waardenburg aimed to collect tracking data on Curlews crossing the North Sea. The best chance for obtaining tracking data over the North Sea was identified as coming from Curlews marked in the United Kingdom during the winter. In addition to the tagging of Curlews through collaboration with a UK project, information became available on other projects on this species.

This report describes the processes undertaken in obtaining tracking data for sea crossings of Curlew, the data obtained and on other potential future sources of data on this subject. This project was coordinated by Ruben Fijn and Mark Collier of Bureau Waardenburg and logistics in the UK by Pete Potts and Andrew Hoodless. Curlews were tagged under licence held by Andrew Hoodless and fitted by Pete Potts. We are grateful to all ringers involved with the preparations and catch, particularly members of the Devon and Cornwall Wader Ringing Group, as well as Pete Potts, Ryan Burrell, Lizzie Grayshon, Robin Ward, Tim Frayling, Ellie Rivers, Nik Ward, Kane Brides, Chris Dee, Mike Smart, Samantha Franks, Rachel Taylor, Ros Green and Griet Nijs for their assistance in the field and/or with information on current Curlew projects. We would also like to thank Jos de Visser, Ingeborg van Splunder, Dagmar van Nieuwpoort and Maarten Platteeuw (RWS) for their guidance and support during this project.



Table of contents

Preface	3
Summary	5
1 Introduction	6
1.1 Reviews	6
1.1.1 Existing data	7
1.1.2 Ongoing and planned projects	9
1.2 Tagging	9
1.2.1 Background and planning	10
2 Materials and methods	11
2.1 Tagging and data collection	11
2.2 Contact with current and planned projects	12
3 Results	13
3.1 Tagging data	13
3.2 Current and planned projects	16
4 Conclusions and recommendations	22
4.1 Movements of Curlew across the North Sea	22
4.2 Future sources of information	22
References	24



Summary

In an update to the Dutch framework on ecological effects and cumulative impacts (referred to as *Kader Ecologie en Cumulatie*, KEC 3.0), Eurasian Curlew was highlighted as being potentially vulnerable to collisions with offshore wind energy developments. Part of the reason for this was the lack of information on the precise routes, timing and flight heights of migrations tracks across the Dutch North Sea. In an attempt to gather information of these crossings Curlews were tagged in the UK with the aim of collecting high resolution GPS data on the routes, timing and heights of sea crossings of the (Dutch) North Sea.

The fieldwork to tag Curlews in the UK during the winter was delayed due to Covid-related restrictions and took place in the winter of 2021/2022. Two Curlews were fitted with GPS-GSM tags in Devon in November 2021. These birds failed to yield data on sea crossings as both remained in the UK to during the following breeding season.

In recent years a number of projects have been initiated on Curlew, including many that now tag birds. Data from some of these projects have already yielded information on sea crossings and many others have the potential to do so. Information on sea crossings by Curlew is likely to become available in the next few years as these projects publish this information. An overview of known projects is given. In addition, an ongoing review by Marine Scotland may also provide an overview of the current knowledge on this subject.

An overview of projects likely to yield the required information is given along with a summary of the tagging carried out as part of this project.



1 Introduction

Recent research into the impacts of offshore wind developments in the Dutch North Sea on birds highlighted limitations in current knowledge. Although the Dutch framework on ecological effects and cumulative impacts (referred to as *Kader Ecologie en Cumulatie*, KEC), and several Environmental Impact Assessments (EIAs) revealed the potential vulnerability of several bird species to collisions with offshore wind turbines, sufficient data are lacking for several species in the detail needed for sound assessments of collision risks.

The 'wind at sea ecological programme' (Wozep) initiated by Rijkswaterstaat (RWS) on behalf of the Dutch Ministry of Economic Affairs and Climate (EZK) aims to establish the best practice approach for the cumulative assessment of offshore wind developments through focused monitoring and research projects.

An update to the KEC revealed Curlew as a focus species for the planned roll-out of offshore wind in the Netherlands (Gyimesi *et al.* 2018). Curlews flying between the United Kingdom and the Netherlands, and in some part from the Netherlands to Scandinavia, may cross areas planned for future offshore wind development during part of their annual life cycle. At present, very little is known about the flight behaviour and migration routes of Curlews over the North Sea. Alongside a review of existing and planned projects, tagging was undertaken with the aim of gathering information on the timing and routes of crossings over the North Sea.

1.1 Reviews

In 2019 and early 2020, a review of existing data on Curlew crossings over the North Sea was undertaken. This review was published in a Curlew-themed special issue of *Limosa* (94.1/2), published by the Dutch Ornithological Union (NOU) and the Dutch Centre for Field Ornithology (Sovon), in 2021 (Fijn *et al.* 2021) (figure 1.1).

This paper outlined the current knowledge on Curlew migration over the North Sea from ringing data (figure 1.2) and highlighted the need for tagging studies to provide further information on the exact routes and timing of migration flights. Several previous or ongoing studies were also mentioned (see 1.1.1)

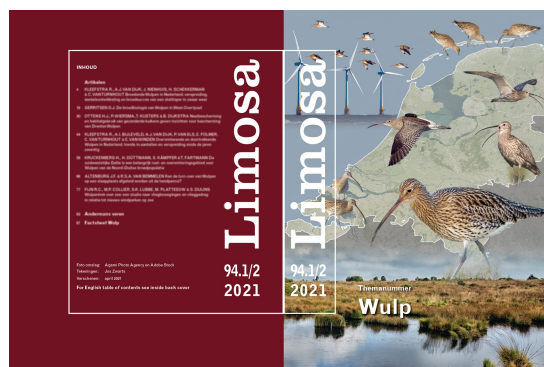


Figure 1.1 Cover image of the *Limosa* 94.1/2 special issue on Curlew published in 2021.

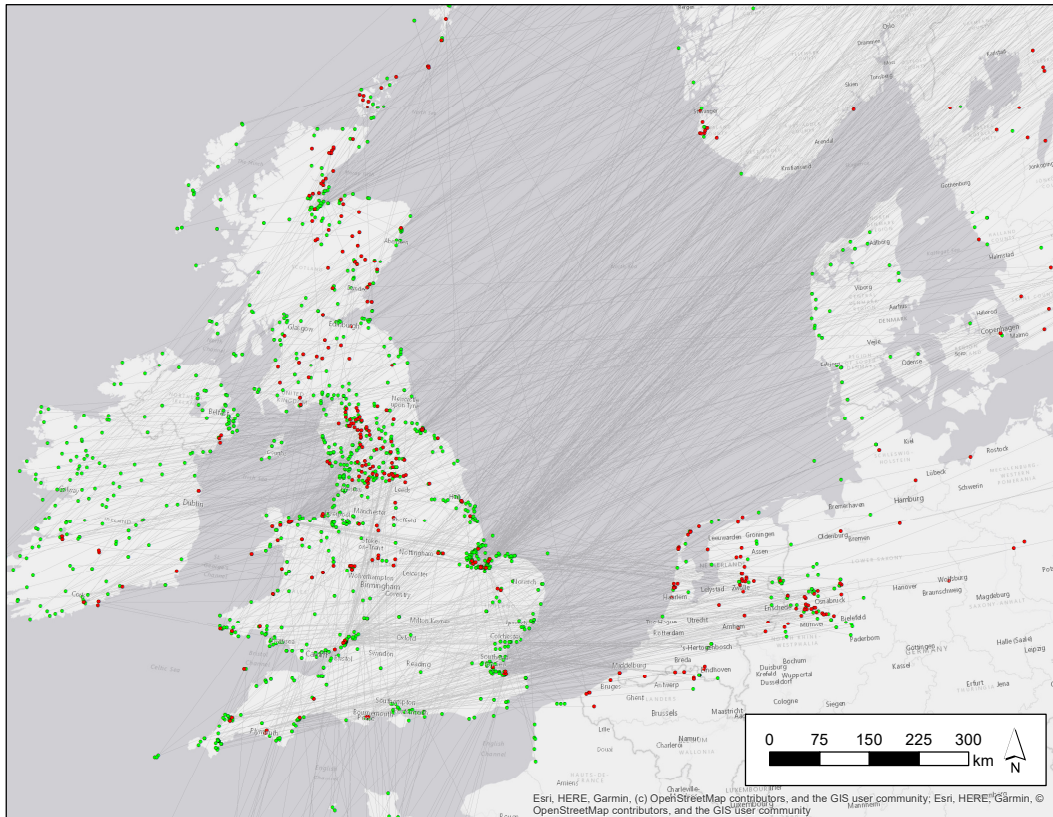


Figure 1.2 Ringing and recovery locations of ringed Curlew until 2019 showing connectivity over the North Sea, although true migration routes remain unknown from ringing data. Source: Fijn *et al.* 2021. Data: BTO - Samantha Franks. See also Spina *et al.* 2022: <https://migrationatlas.org/node/1740>.

1.1.1 Existing data

Ringing data provides evidence of North Sea crossings by Curlew and an overview of current data is available in the online migration atlas (<https://migrationatlas.org/node/1740>, Spina *et al.* 2022). This resource is linked to EURING member databases and the Movebank database (Wikelski *et al.* 2022; Kays *et al.* 2022). This overview provides details of large-scale movements of Curlew but is less relevant for information on the precise routes, timing, and characteristics of sea crossings, for which tracking data are more suited.

Previous and ongoing tracking studies on Curlew over the North Sea are cited in Fijn *et al.* (2021). Besides a satellite-tagged bird making a crossing between Scotland and Norway and then Norway and Scotland in 2009 (Dennis *et al.* 2011), no other crossings from birds marked in the UK were identified. A study on satellite-tagging of Curlews in Germany reported movements between the Dutch Wadden Sea and Delta, and the UK and Ireland (Kruckenberg *et al.* 2021), and a report of a tagged Curlew crossing from the UK to North-Holland in spring has been recorded in a study of Schwemmer (§3.2; Platteeuw pers. comm.)



Two other studies involving the GPS-tagging of Curlew in Europe were ongoing at the time of the review and some of these have since published some results. A German/Estonian/French study had already collected data from Curlews crossing the North Sea (figure 1.3), although at the time data and more detailed information were limited. A second study, on Curlews breeding in Poland, revealed several crossings across the southern North Sea although most remained in mainland Europe (<https://ochronakulika.pl/telemetria>).

Data previously collected from tagging studies on Curlew have shown that migration from a wintering area in Scotland to Scandinavia occurred in the second half of April and the return trip across the North Sea in early July (Dennis *et al.* 2011). This individual also used different routes between Scotland and Scandinavia during pre-breeding and post-breeding migrations. Tagging has also revealed that Curlews migrate in large steps and often during night (Jiguet *et al.* 2021a, Jiguet *et al.* 2021b). Flight speeds during migration have been recorded as between 74 km/h at departure and 55km/h on arrival (Schwemmer *et al.* 2021) and with means of between 41 km/h and 81 km/h (Schwemmer, Enners & Garthe 2016). Jiguet *et al.* (2021b) also documented a suspected collision of a tagged Curlew with a coastal wind turbine, after which the Curlew continued its migration a number of hours later.

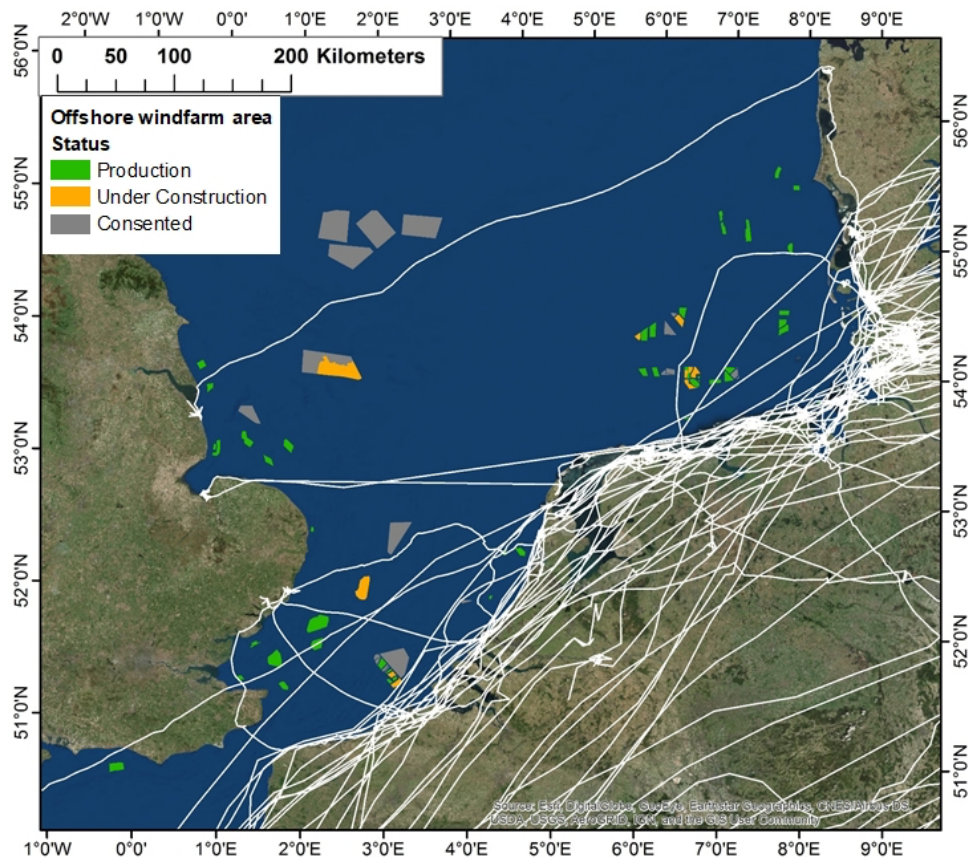


Figure 1.3 Existing GPS data of 41 Curlews captured in France, the German Wadden Sea and Estonia. Coloured areas refer to offshore windfarm areas. Source: P. Schwemmer & S. Garthe - Research and Technology Centre (FTZ), University of Kiel, and P. Bocher - Laboratory Littoral Environnement et Sociétés, University of La Rochelle-CNRS.



1.1.2 Ongoing and planned projects

In 2015, the Curlew's vulnerable conservation status was highlighted and the species was added to the UK Red List (Brown 2015; Brown *et al.* 2015; Stanbury *et al.* 2021). Curlews received additional attention in projects such as 'Wales Single Species Action Plan for the Conservation of Eurasian Curlew' (Gylfinir Cymru/Curlew Wales 2021), following that of previously introduced projects such as the RSPB's Curlew Recovery Programme, The Curlew Conservation Programme and The Curlew Recovery Partnership, as well as predator control and head-starting programmes (Douglas *et al.* 2021).

In the last few years several new tagging projects on Curlew have been initiated, looking at both breeding birds but also movements to and from the UK. Even captive-bred birds have been released and tagged in the UK (e.g. WWT 2022). Most tagging studies focussing on breeding birds in the UK use temporary attachments, where data outside the breeding season would be an exception, although few (e.g. Potts *et al.* 2020, Potts & Hoodless pers comm.), along with some focussing on non-breeding periods (Franks pers comm.) have used permanent harnesses.

Due to this increase in projects on Curlew, an overview of known and planned projects will provide a firm starting position for future sources of data on oversea crossings by Curlew.

1.2 Tagging

Alongside the initial review on information on the timing, routes and flight heights of Curlew over the North Sea, tagging was planned to collect this information directly. The strategy with the greatest chance of collecting data from crossings over the North Sea, particularly over the Dutch part of the North Sea, was deemed to be tagging Curlew wintering in the UK. The UK hosts birds from continental Europe, from Fennoscandia through Germany and the Netherlands (Wernham *et al.* 2002). Curlew numbers in the UK are known to be highest in autumn through to late winter (Frost *et al.* 2021) as numbers are boosted with birds from breeding populations in continental Europe and Scandinavia. These birds begin to leave their UK wintering areas from February onwards with most having departed by mid to late April.

The exact locations of these migrant Curlews during winter are unknown and they most likely have a broad distribution around UK coasts (Wernham *et al.* 2002). Colour-ringing of wintering birds in the Solent and Devon has shown movements to countries outside the UK, including the Netherlands, Germany, Denmark, Poland and Russia (Potts pers comm., DCWRG 2022). In September 2019, we initiated contact with researchers working on Curlew in the UK. The aim was to work with UK-based ringers for the tagging of Curlew during the winter and early spring with the hope that some of these birds would cross the North Sea, providing information of the timing, routes and flight heights of these sea crossings. Tagging a small number of birds at several locations was hoped to provide the greatest chance that some of these birds were from breeding populations outside of the UK and would therefore migrate across the North Sea. Curlews do not breed in their second calendar year so targeting adult birds were deemed to have the best chance of providing



data on sea crossings as many younger birds are likely to remain in their coastal wintering areas (Wernham *et al.* 2002).

1.2.1 Background and planning

Following initial contact with researchers who have been studying wintering Curlews in the Solent long term, and more recently have been tagging Curlews breeding in the New Forest, an agreement was made to collaborate on tagging Curlews as part of the current project. This would involve working with ringers around the southern coasts of England with the aim of tagging Curlews at several locations including the Solent, Kent and Essex and possibly Devon. The relevant extensions to existing licences and permissions to use permanent harnesses to fit GPS tags on Curlews for this project were applied for in 2019 and were obtained in 2020.

During the winter of 2020/2021 a series of Covid-related restrictions severely limited access outside personal residencies (September, October, November, December and January-March) in the UK, with gatherings of up to six (socially distancing) people permitted only from the end of March 2021. These restrictions, along with the reluctance of organisations to grant access permission during this period, made the prospect of catching (often requiring teams of ca. ten ringers to operate cannon nets) limited. Mild weather in the UK during the latter part of the winter resulted in Curlews remaining scattered on intertidal areas with very few concentrations on wet meadows where catching is most successful.

Plans for catching continued into winter 2021/2022 with a catch targeting Curlew planned in Devon for early November providing the first concrete opportunity to deploy tags. After this no further opportunities arose and plans for tagging more Curlews under the current project were halted.



2 Materials and methods

2.1 Tagging and data collection

On 7 November 2021, two female Curlew were fitted with Milsar GPS GSMRadio Tag-S9 (33 mm x 17 mm x 17 mm: 14 g) tags using permanent leg-mounted harnesses at Skern Beach, Northam Burrows, Devon (51.0559 N, 04.2107 W) (figure 2.1). These birds were also fitted with a BTO metal ring and a unique combination of colour-rings (table 2.1). These birds were captured at 06:45 and released at 08:10 and 08:35 local time.



Figure 2.1. One of the two female Curlew marked in north Devon using Dutch-funded tags on 7 November 2021. Photo: Elli Rivers.

Table 2.1. Ringing details of the two Curlew fitted with GPS tags as part of this project.

Tag ID	Ring number	Colour-ring code*	Bill length (mm)	Wing length (mm)	Weight (g)
85C37F1F	GBT FJ28752	m/B/B/R,L	141	312	854
9CC37F1F	GBT FJ28761	m/B/B/N,N	159	324	909

* m = metal, B = blue, L = light green, N = black, R = red: left above/left below//right above/right below.

Tags were programmed to collect GPS fixes once every 30 minutes and download data via the GSM network every eight hours (base rate). This base rate was changed in early December to a fix every two hours and download every 40 hours to preserve battery life during the winter daylight conditions. Within a fixed geographical area covering the North Sea, fixes would be taken every 10 minutes and relayed every 30 minutes (figure 2.2). Data from the tags are downloaded to an online database managed by Milsar and data can be accessed by Bureau Waardenburg staff.



Figure 2.2. Geofences covering the North Sea and English Channel within which GPS fix interval set to 10 minutes and data download to 30 minutes (yellow) and covering the UK within which GPS fix interval set to a base rate of initially every 30 minutes and download every eight hours and later to a two-hour fix rate and a 40 hour download rate (red). Outside the geofences the base rate is used.

The position and general activity of the two tagged Curlews were checked daily in the week following the catch and there afterwards on a weekly basis. This was to ensure the correct functioning of the tags, to ensure the settings were appropriate for the available battery cycle, as well as to look for indications of birds making movements away from the wintering areas. Once the Curlews had moved away from their wintering areas, it became apparent that both individuals were breeding in the UK and no movements across the North Sea were likely (see 3. Results). Therefore, the positions of birds after that moment were checked less frequently, although the tags and geofences remain active.

2.2 Contact with current and planned projects

Throughout the duration of this project contact with ringers and researchers working on or planning tagging studies on Curlew has successfully been sought. Online searches of scientific literature, websites and social media have been carried out, as well as contact has been established with personal connections within the UK ringing and ornithological community.



3 Results

3.1 Tagging data

In the months after tagging the two Curlews remained around the Taw-Torridge Estuary, using both intertidal and adjacent dune and grassland habitats (figures 3.1 and 3.2).

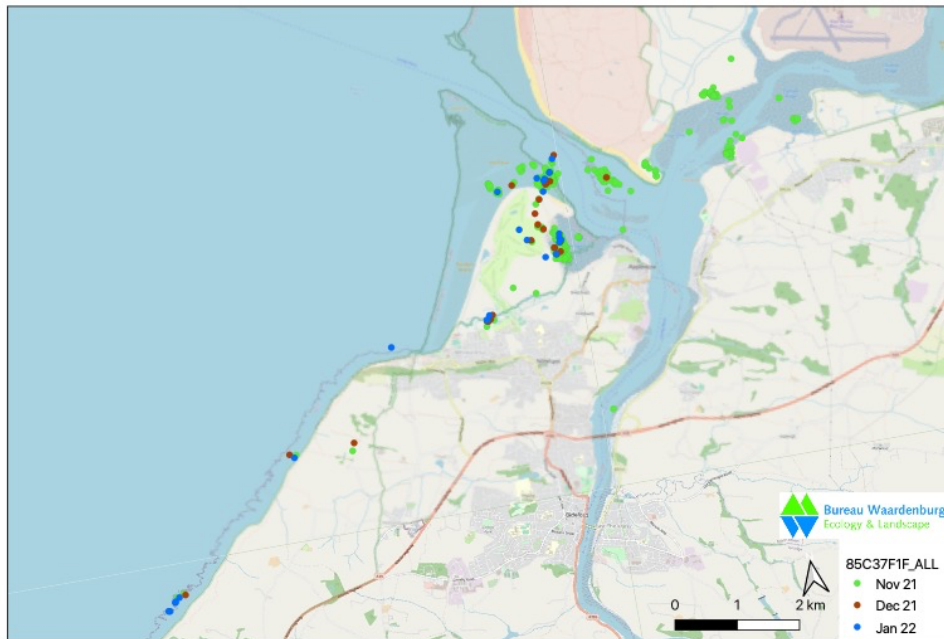


Figure 3.1. Winter habitat use by Curlew 85C37F1F from November 2021 to January 2022.

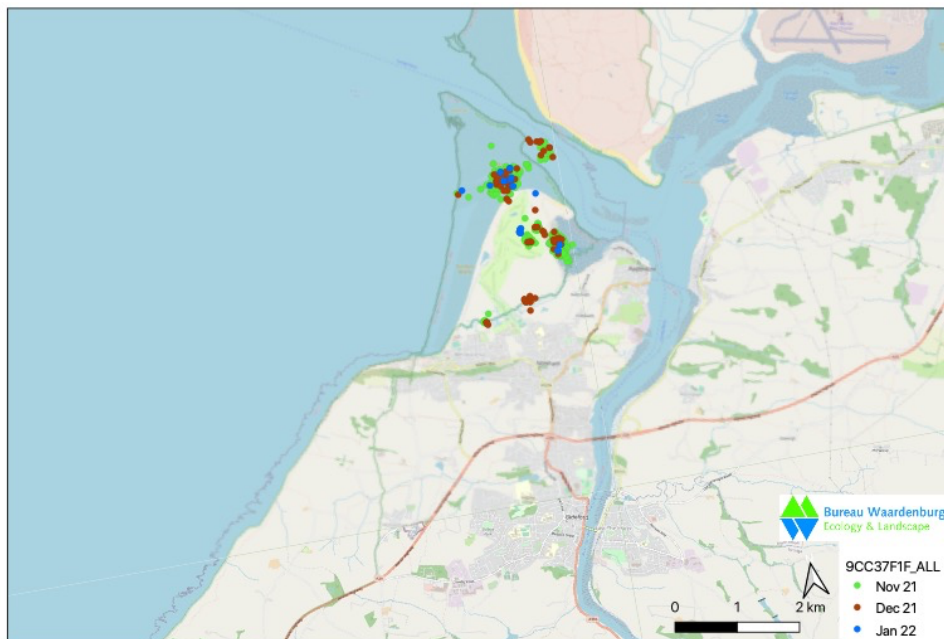


Figure 3.2. Winter habitat use by Curlew 9CC37F1F from November 2021 to January 2022.



Both birds remained on the Taw-Torridge Estuary until the end of February. Curlew 85C37F1F left northwards on 25 February 2022, travelled along the west coast (fixes in Wales, Merseyside and Lancashire) before settling in the Stang Forest in County Durham (figure 3.3 and 3.4). This trip took approximately 24 hours. This bird remains in the Stang Forest and is presumed to be breeding.



Figure 3.3. Route taken by Curlew 85C37F1F between its wintering area and breeding area in County Durham.

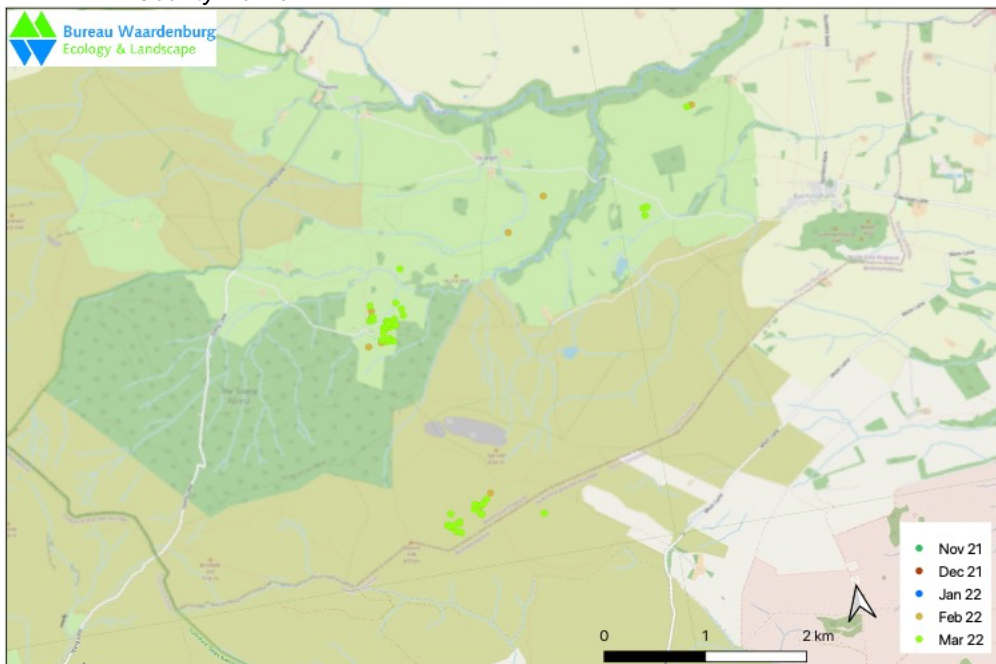


Figure 3.4. The regularity of fixes in the Stang Forest during the end of February and into April indicate that this bird (85C37F1F) has settle on a territory in the UK.



Bird 9CC37F1F left northeast on 22 February and quickly settled on flood meadows along the River Avon near Bredon on the border of Worcestershire and Gloucestershire (figures 3.5 and 3.6). This trip was undertaken within a matter of hours and seemingly in a single flight. Local ornithologists were able to locate the bird based on GPS data and determined that this bird had paired and in late April its nest was located. This nest was suspected to have failed in early May although the bird was still present and re-captured on 19 May (figure 3.7).



Figure 3.5. Route taken by Curlew 9CC37F1F between its wintering area and breeding area in Gloucestershire.

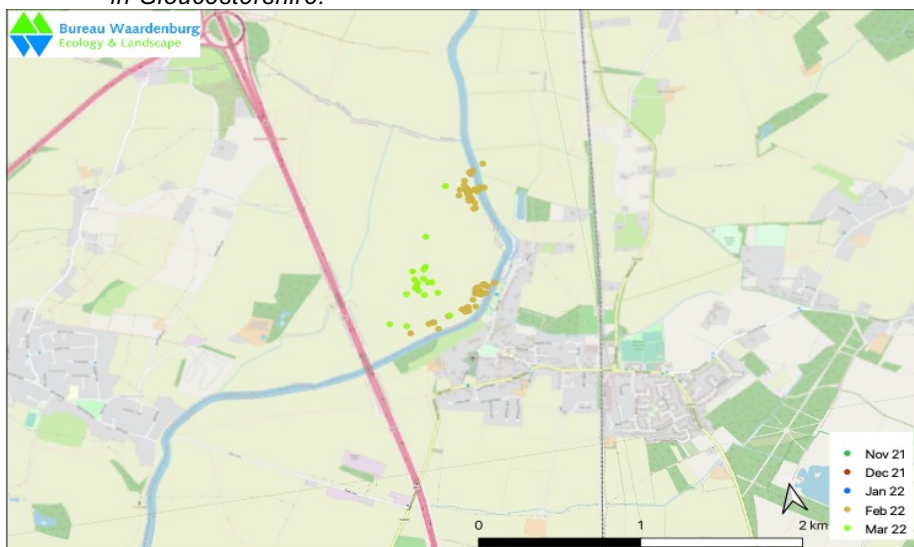


Figure 3.6. The regularity of fixes around the flood meadows along the Avon during the end of February and into April indicate that this bird (9CC37F1F) has settle on a territory in the UK. This bird was confirmed as having a nest in the area in April 2022.



Figure 3.7. Tagged Curlew re-captured on its breeding grounds in Avon on 19 May 2022.

The GPS loggers of these two birds continue to collect data at the base rate and the geofences, within which higher resolution data will be collected, remain active. Although it is expected that these birds will remain in the UK, data will be monitored to verify any possible movements over the North Sea.

3.2 Current and planned projects

In recent years a number of projects involving the tagging of Curlew have been initiated or continue to run. Known projects are listed below and details are given on the area, contact and aims of the project, as well as the likelihood that data on sea crossings may be collected. The list focusses on those projects using remote download GPS tags on Curlew. Although many projects focussing on the breeding season and chick survival have used radio tags, these have generally not been listed as these tags would not collect data suitable for assessing the timing and flight heights of sea crossings. Some ongoing projects using radio tags have been mentioned where it is thought possible that these may use GPS tags in the future. The focus was on projects in the UK and Ireland as these are thought to provide the best chance of crossing over the North Sea but other projects are included where known.

The 14 known projects of relevance are listed below.

Project 1:

Area: The Wash, UK

Contact: Samantha Franks (Wash Wader Research Group)

Years: 2021 onwards

Aim: Non-breeding season habitat use of terrestrial habitat around The Wash SPA; spring and autumn migration characteristics including routes, flight heights, flight speeds and timing.



Website: <https://wwrg.org.uk/ten-years-of-colour-marking-Curlew-on-the-wash-what-have-we-learnt#more-7774>

Type of tags: GPS-GSM

Possible data on sea crossings: Yes, already North Sea crossings recorded but currently no analysis of migration crossings of North Sea undertaken. These crossings will be analysed later as part of an ongoing PhD study.

Publications: none found yet.

Project 2:

Area: Devon, UK

Contact: Tim Frayling (Natural England), Ryan Burrell (Devon and Cornwall Wader Ringing Group)

Years: 2021 onwards

Aim: Assess non-breeding season habitat use and the importance of functionally linked land outside of protected areas around the Taw-Torridge SSSI and Exe Estuary SSSI/SPA. Also subsequently interested in migration movements.

Website: <https://www.dcwrg.org.uk>

Type of tags: GPS-GSM

Possible data on sea crossings: Yes (but low temporal resolution) and likely to be analysed as part of the Wash study.

Publications: none found yet.

Project 3:

Area: Hampshire, UK

Contact: Andrew Hoodless (Game and Wildlife Conservation Trust), Pete Potts.

Years: 2018 onwards

Aim: Habitat use and movements of UK breeding birds.

Website: <https://www.gwct.org.uk/blogs/news/2021/april/landscape-use-by-breeding-Curlews/> / https://www.Curlewcall.org/wp-content/uploads/2020/01/HBR-2018_Movements-of-GPS-tracked-Curlews.pdf

Type of tags: GPS-GSM

Possible data on sea crossings: Possible but unlikely as UK breeding birds tagged.

Publications: none found yet.

Project 4:

Area: Severn and Avon Vales, UK

Contact: Kane Brides (The Wildfowl and Wetland Trust)

Years: 2022 onwards

Aim: To assist with locating nests, document habitat use by breeding birds and breeding success.

Website: <https://www.wwt.org.uk/our-work/projects/eurasian-Curlew-recovery/>

Type of tags: GPS-GSM

Possible data on sea crossings: Possible but unlikely as UK breeding birds tagged.

Publications: none found yet.



Project 5:

Area: Shropshire, UK

Contact: Leo Smith (Shropshire Ornithological Society, Save our Curlews Campaign)

Years: 2020 onwards

Aim: Breeding success through tagging chicks and effects of predator control measures.

Website: <http://www.shropshirebirds.com/index/bird-conservation/save-our-Curlews/>

Type of tags: Radio tags

Possible data on sea crossings: No.

Publications: none found yet.

Project 6:

Area: Shropshire and Powys Borders, UK

Contact: Curlew Country (via Game and Wildlife Conservation Trust and Natural England) and Tony Cross (unconfirmed)

Years: 2015 onwards

Aim: To improve breeding success through pioneering techniques and community involvement.

Website: <https://Curlewcountry.org/project-background/colour-ringing-and-tagging/>

Type of tags: GPS-satellite

Possible data on sea crossings: Possible but unlikely as only two birds fitted with tags during the 2019 breeding season.

Publications: none found yet.

Project 7:

Area: Wales and Ireland

Contact: Rachel Taylor (British Trust for Ornithology)

Years: 2022 onwards

Aim: ECHOES project looking at effects of climate change and specifically habitat use of Curlew.

Website: <https://echoesproj.eu>

Type of tags: GPS-UHF/GPS-GSM

Possible data on sea crossings: Yes and will be analysed as part of Wash study.

Publications: none found yet.

Project 8:

Area: Northern Ireland

Contact: Kendrew Calhoun

Years: Recently but exact details unknown

Aim: Exact details unknown at present

Website:

Type of tags: GPS-GSM (glue-mounted)

Possible data on sea crossings: Possible but short-term tags will be lost when bird moults (from August onwards).

Publications: none as yet



Project 9:

Area: Drenthe, Netherlands

Contact: Henk Jan Ottens (Grauwe Kiekendief Kenniscentrum Akkervogels)

Years: 2021 (onwards?)

Aim: Breeding success, habitat use chicks, electric fencing of nests, (color)ringing, tracking information by gps-gsm loggers

Website: https://grauwekiekendief.nl/news_posts/gezenderde-nederlandse-wulp-naar-ierland/

Type of tags: GPS-GSM

Possible data on sea crossings: Yes

Publications: none as yet

Project 10:

Area: Belgium

Contact: Griet Nijs (Natuurpunt), Hilbran Verstraete (Instituut voor Natuur- en Bosonderzoek)

Years: 2020 - 2022

Aim: Habitat use and breeding success.

Website: Birds can be followed using the Animal Tracker app and Movebank: <https://lifewatch.be/en/gps-tracking-network-large-birds>, https://www.movebank.org/cms/webapp?gwt_fragment=page=studies.path=study1841091905

Type of tags: GPS-GSM

Possible data on sea crossings: Yes possible. Birds from this project overwinter along the French, Spanish and Portuguese coasts.

Publications: Summary of project to be completed end of 2022.

Project 11:

Area: Poland

Contact: Dominik Krupiński

Years: 2017 onwards

Aim: Breeding ecology and movements of Curlew

Website: <https://www.ochronakulika.pl>

Type of tags: GPS-GSM

Possible data on sea crossings: Yes, and marked birds known to have been recorded in the UK.

Publications:

Pederson, R., Bocher, P., Garthe, S., Fort, J., Mercker, M., Auernhammer, V., Boschert, M., Delaporte, P., Elts, J., Fiedler, W., Korniluk, M., Krupiński, D., Marja, R., Rousseau, P., Thiess, L. & Schwemmer, P. 2022. Bird migration in space and time: chain migration by Eurasian curlew *Numenius arquata* along the East Atlantic Flyway. *Journal of Avian Biology*. 10.1111/jav.02924.



Project 12:

Area: France (Netherlands)

Contact: Frédéric Jiguet (Centre de Recherches sur la Biologie des Populations d'Oiseaux), Pierrick Bocher (Université de La Rochelle), in the Netherlands via Henk-Jan Ottens (Grauwe Kiekendief - Kenniscentrum Akkervogels).

Years: 2015 onwards

Aim: Migratory connectivity patterns of Curlew.

Website: <https://limitrack.univ-lr.fr>, <https://limitrack.univ-lr.fr/courlis/>

Type of tags: GPS-GSM

Possible data on sea crossings: Yes and is one of the main aims of this project.

Publications:

Pederson, R., Bocher, P., Garthe, S., Fort, J., Mercker, M., Auernhammer, V., Boschert, M., Delaporte, P., Elts, J., Fiedler, W., Korniluk, M., Krupiński, D., Marja, R., Rousseau, P., Thiess, L. & Schwemmer, P. 2022. Bird migration in space and time: chain migration by Eurasian curlew *Numenius arquata* along the East Atlantic Flyway. *Journal of Avian Biology*. 10.1111/jav.02924.

Bocher, P. 2022. Limitrack research project. <https://limitrack.univ-lr.fr/courlis/>.

Jiguet, F., Bocher, P., Kruckenberg, H., Kämpfer, S., Debenest, E., Lorrillière, R., Rousseau, P., Szajda, M. & Düttmann, H. 2021a. Joint flight bouts but short-term association in migrating Eurasian Curlews *Numenius arquata*, *Bird Study*, 68:1, 38-46, DOI: 10.1080/00063657.2021.1962805

Jiguet, F., Schwemmer, P., Rousseau, P. & Bocher, P. 2021b. GPS tracking data can document wind turbine interactions: Evidence from a GPS-tagged Eurasian Curlew. *Forensic Science International: Animals and Environments*. <https://doi.org/10.1016/j.fsiae.2021.100036>.

Jiguet, F., Duby, D., Bourgeois, A., Robin, F., Rousseau, P., Nijs, G., Fuchs, J., Lorrilliere, R. Bocher, P. 2021c. Investigation into the illegal killing of a tagged Eurasian Curlew. *Forensic Science International: Animals and Environments*. DOI: 100005. 10.1016/j.fsiae.2021.100005.

Project 13:

Area: France (possibly same project as above but exact details unclear)

Contact: Institut Scientifique Nord Est Atlantique (ISNEA)

Years: At least from 2017 onwards

Aim: Migratory connectivity patterns and survival of Curlew.

Website: <http://www.isnea.eu/programmes-scientifiques/>

Type of tags: GPS-GSM

Possible data on sea crossings: Yes, already maps published on ISNEA websites and on social media sites.

Publications: Mostly short news items on websites e.g. <http://www.isnea.eu/un-sens-de-orientation-remarquable/>, <http://www.isnea.eu/la-migration-des-courlis-se-poursuit/>.



Project 14:

Area: Germany, Denmark and Estonia

Contact: Philipp Schwemmer (Kiel University), Helmut Kruckenberg (Institute for Waterbird and Wetlands Research)

Years: 2014 onwards

Aim: Movements of Curlew

Website: <https://www.datarepository.movebank.org/handle/10255/move.1285>,
<https://www.blessgans.de>

Type of tags: GPS-GSM

Possible data on sea crossings: Yes and data on flight speeds during migration already published.

Publications:

Pederson, R., Bocher, P., Garthe, S., Fort, J., Mercker, M., Auernhammer, V., Boschert, M., Delaporte, P., Elts, J., Fiedler, W., Korniluk, M., Krupiński, D., Marja, R., Rousseau, P., Thiess, L. & Schwemmer, P. 2022. Bird migration in space and time: chain migration by Eurasian curlew *Numenius arquata* along the East Atlantic Flyway. *Journal of Avian Biology*. 10.1111/jav.02924.

Schwemmer, P., Mercker, M., Vanselow, K.H., Bocher, P. & Garthe, S. 2021. Migrating Curlews on schedule: departure and arrival patterns of a long-distance migrant depend on time and breeding location rather than on wind conditions. *Movement Ecology* 9:1. DOI:10.1186/s40462-021-00252-y.

Schwemmer, P., Enners, L. & Garthe, S. 2016. Migration routes of Eurasian Curlews (*Numenius arquata*) resting in the eastern Wadden Sea based on GPS telemetry. *Journal of Ornithology*. 157. 10.1007/s10336-016-1338-2.



4 Conclusions and recommendations

4.1 Movements of Curlew across the North Sea

In an attempt to collect data on the movements of Curlew across the North Sea, birds were marked using GPS tags in southern England. Unfortunately, due to a series of Covid-related restrictions, site permissions not being granted, mild weather and a suspension of the tagging permission, only two birds were only marked at a single site in the winter of 2021/2022.

Data collected on the two Curlews tagged as part of this study revealed movements towards the breeding areas were quick, with few or no stops, and occurred mostly during night, which reflects data collected in other studies.

To increase the chance of collecting data on sea crossing of Curlew, birds at multiple sites around the southern and eastern UK could be tagged to give the best chance of birds from breeding populations outside the UK being marked and crossings of the North Sea during pre- and post-breeding migration occurring. Working with established ringing groups in the local area would increase the chance of catching this species and for obtaining the relevant permissions and licences. Various catching methods are available for full-grown Curlew, including mist-netting and cannon-netting, the local conditions and behaviour of birds in the area determining the most appropriate.

As a number of projects tagging Curlew have been initiated only in the past few years data on sea crossings are likely to become available over the next few years as these projects progress and findings will be published. Even projects focussing on breeding success may collect data on sea crossings where these birds migrate to other areas, such as has been demonstrated for birds tagged in the UK, the Netherlands, Germany and Belgium.

4.2 Future sources of information

The issue of offshore wind farms and migrant birds has been to focus of two Marine Scotland studies since 2019. The latest is a project called “Strategic study of collision risk for birds on migration and further development of the stochastic Collision Risk Modelling tool”, which summarises collision risk during migration for UK SPA focal species, including Curlew, and is due to be published towards the end of 2022 (Franks pers comm.).

A recently published article summarizing data collected from Curlews tagged in several European countries illustrated sea crossings during both spring and autumn migration, broad front migration patterns and possible differences in the timing of autumn migration between males and females (Pedersen *et al.* 2022), yet details on flights across the North Sea that can be used to improve estimates of collision risk with offshore wind turbines remain scarce.



Although there remains as yet little published on the details of Curlew flights over sea (e.g. height, speed, diurnal timing, duration), an emergence of recent projects is likely to generate this type of information in the (near) future.



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