

See discussions, stats, and author profiles for this publication at: <https://www.researchgate.net/publication/265390916>

# A Review of the Occurrence of Bats (Chiroptera) on Islands in the North East Atlantic and on North Sea Installations

Article in *Acta Chiropterologica* · June 2014

DOI: 10.3161/150811014X683381

CITATIONS

13

READS

589

5 authors, including:



**Aevan Petersen**

161 PUBLICATIONS 1,540 CITATIONS

[SEE PROFILE](#)



**Paulina D Jenkins**

Natural History Museum, London

74 PUBLICATIONS 829 CITATIONS

[SEE PROFILE](#)



**Finnur Ingimarsson**

Natural History museum of Kopavogur

15 PUBLICATIONS 105 CITATIONS

[SEE PROFILE](#)

Some of the authors of this publication are also working on these related projects:



CBird / CAFF [View project](#)



Monitoring of Common Gulls in Iceland [View project](#)

## **A review of the occurrence of bats (Chiroptera) on islands in the North East Atlantic and on North Sea installations**

AEVAR PETERSEN<sup>1</sup>, JENS-KJELD JENSEN<sup>2</sup>, PAULINA JENKINS<sup>3,6</sup>, DORETE BLOCH<sup>4</sup>, and FINNUR INGIMARSSON<sup>5</sup>

<sup>1</sup>*Bráutarland 2, 108 Reykjavík, Iceland*

<sup>2</sup>*Í Geilini 37, FO-270 Nólsoy, Faroe Islands*

<sup>3</sup>*Natural History Museum, Cromwell Road, London SW7 5BD, United Kingdom*

<sup>4</sup>*Føroya Náttúrugripasavn, Fútalág 40, FO-100 Tórshavn, Faroe Islands*

<sup>5</sup>*Natural History Museum of Kópavogur, Hamraborg 6a, 200 Kópavogur, Iceland*

<sup>6</sup>*Corresponding author: E-mail: p.jenkins@nhm.ac.uk*

The bats recorded from Iceland, the Faroe Islands, the Shetland Islands, the Orkney Islands, and North Sea installations are reviewed to the end of 2012. In total 12 species have been positively identified, while a considerable proportion of all records are sightings of unidentified bats. Eight of the species are European in origin and four originate from the New World. The largest number of species (8) has been recorded in Iceland, but the greatest number of individuals (180) has been found in Orkney. The bat invasion on the Faroe Islands in 2010 is without precedence, when 70 observations of a minimum of 45 individuals were noted. Most bat observations in the study area occurred in the autumn, with fewer in the spring. Most observations were of single animals, but there were also sightings of up to 12 individuals. There has been a marked increase in bat records in the past three decades. We discuss whether this is a real increase, or due to improved communications, increased public awareness, increased shipping, changes in weather patterns and/or the effects of climate change. All factors appear to be involved.

*Key words:* Iceland, Faroes, Shetlands, Orkneys, North Sea, vagrancy, ship-assistance, climate change, invasion, identification problems

### INTRODUCTION

The order Chiroptera is widespread through most parts of the World. The greatest proportion of families, genera and species are found in the tropics and sub-tropics, with a lower proportion in temperate zones. Within temperate zones, the number of species decreases with increasing latitude. In temperate zones, insectivorous bats are restricted to those areas with good supplies of food to sustain them through the spring and summer breeding periods and enable them to build up adequate fat reserves in the late summer and autumn ready for hibernation through the winter (Yalden and Morris, 1975; Hill and Smith, 1984; Rolland *et al.*, 2014).

Migratory behaviour and vagrancy are particularly well-known in birds and bats (Ahlén, 1997; Hutterer *et al.*, 2005; Ahlén *et al.*, 2009), in which the ability to fly makes it easier to disperse outside their normal range. Bats employ a variety of strategies to make best use of the available habitats. Some species occupy relatively small territories, travelling

only short distances in search of food and between breeding roosts and winter hibernacula, while other species migrate for medium to long distances, in order to exploit resource-rich areas.

The North East Atlantic islands, comprising Iceland with its fluctuation between subarctic winters and temperate summers and the Faroe, Shetland and Orkney islands with temperate but cool winters and summers, with one exception do not have resident populations of bats. Nor are the islands considered to be on normal migration routes, although stragglers do reach them on occasion. The species involved and the frequency of these occurrences undoubtedly depends on the distance from their normal range, but a number of other factors, such as population numbers, vagrancy, and unintentional transport by humans, are also important. In the long run, global environmental changes such as climate change may also modify traditional distribution patterns.

The present study examines records of bats from the North East Atlantic islands of Iceland and the

Faroe Islands to the end of December 2012, including those reported in previous publications (Koopman and Gudmundsson, 1966; Petersen, 1993, 1994; Baagøe and Bloch, 1994). Comparisons are made with published data on bats recorded from the Shetland Islands and the Orkney Islands, off the north coast of Scotland, as well as oil and gas installations in the North Sea.

Information is provided on all species recorded; the locations of the records are mapped and the species composition, distribution and seasonal occurrence analysed. The possible reasons for the marked increase in occurrence of bats, including the unusual invasion of the Faroe Islands in 2010, are discussed.

## MATERIALS AND METHODS

This study summarizes all available information to the end of 2012, based on specimens of bats preserved mainly in the collections of the Náttúrufræðistofnun Íslands (Icelandic Institute of Natural History [NÍ]), with single specimens respectively at the Natural History Museum of Kópavogur and at Vestmannaeyjar Primary School (Appendix I). Available Faroese specimens are preserved in the scientific collection of the Føroya Náttúrugripasavn (Faroese Museum of Natural History [FN]) (Appendix II). It also includes published records of bats from the Orkney Islands, Shetland Islands, and from oil and gas installations in the North Sea (Appendices III–V). The map (Fig. 1) shows the overall area covered by this study.

The specimens preserved in the collections of NÍ and FN have been acquired opportunistically over many years by interested members of the public. Specimens were identified by the use of literature available at the time of acquisition and by consultation with staff in other European museums containing

international collections of bats. Photographs are available as proof for some bat sightings, although the species could not be established in most cases. Sound recordings using a Pettersson Ultrasound detector D100 have also been used in the Faroe Islands. This detector type may only be used to locate flying bats but not for species identification. In Iceland and the Faroes, sightings were assessed by interviews and requests for photographs because of the problems that exist due to the general public confusing bats with insects and birds. Insects which are especially likely to cause confusion are the larger moths (Jensen and Sivertsen, 2010), while small petrels (seabirds) have an erratic flight similar to that of bats and may be easily misidentified at a distance.

Records of bats from the Orkney and Shetland Islands, and from North Sea installations were obtained by literature searches. Records of bats from the Orkney Islands have been particularly well documented over the last two decades, as a result of observations by members of the very active Orkney Field Club (Booth, 1992–Booth, 2012). Information for the Shetland Islands was initially derived from the website of the Shetland Biological Records Centre [SBRC] (<http://www.nature-shetland.co.uk/brc/bats.htm>) and (<http://www.nature-shetland.co.uk/naturelatest/archives/>), and for North Sea installations from Swift (2004); where possible these records have been traced back to the original references (Appendices III–V).

Coordinates for localities on Iceland were determined using Google Earth (<http://earth.google.com>), while the website <http://www.findlatitudeandlongitude.com> was used for localities on the Faroe Islands. Coordinates for localities on the Shetland and Orkney Islands were principally located by reference to the gazetteer (Ordnance Survey, 1999) supplemented by Google Earth. Coordinates for North Sea Installations not included in original references were determined using maps of North Sea oil and gas fields (<http://www.acorn-ps.com/web/page/oilgas/nsfields/snsmap.htm> and [http://tools.decc.gov.uk/en/content/cms/tools/quad\\_maps/quad\\_maps.aspx](http://tools.decc.gov.uk/en/content/cms/tools/quad_maps/quad_maps.aspx)). Distribution maps were prepared using DMAP (<http://www.dmap.co.uk>).

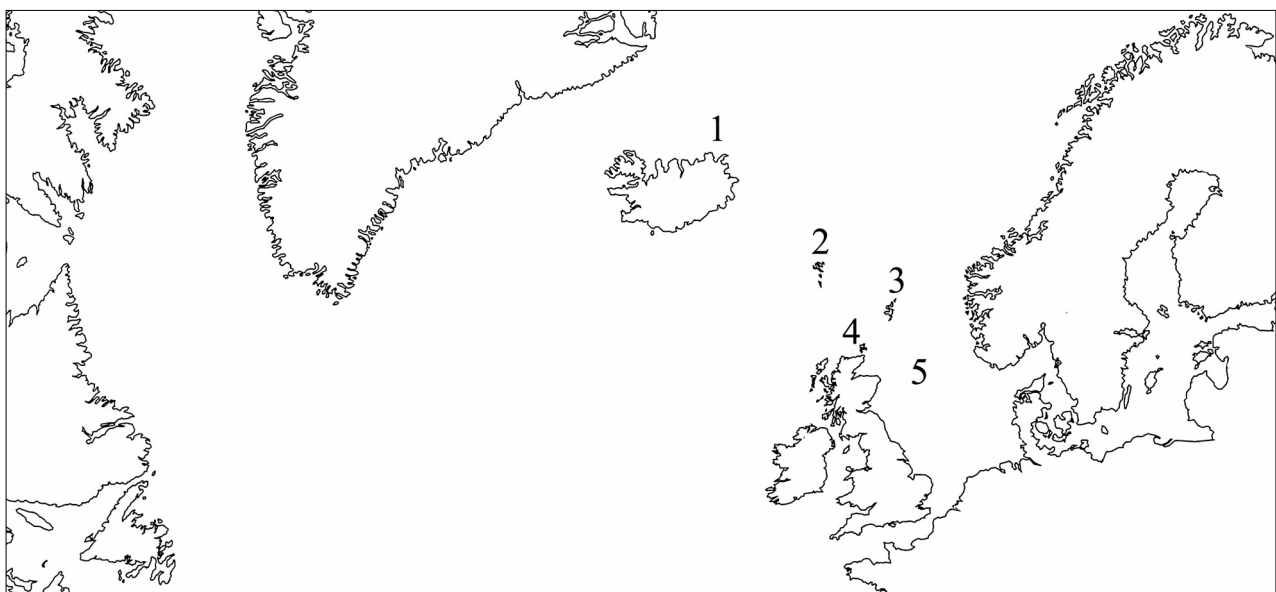


FIG. 1. Map of the study areas relative to the continental landmasses of Europe, Scandinavia, Canada and North America. 1 — Iceland, 2 — the Faroe Islands, 3 — the Shetland Islands, 4 — the Orkney Islands, 5 — North Sea installations

## RESULTS

To the end of December 2012, 12 species of bats all belonging to the family Vespertilionidae have been recorded from the area of study. Four originate from the New World: *Eptesicus fuscus* (Palisot de Beauvois, 1796), *Lasiurus cinereus* (Palisot de Beauvois, 1796), *Myotis lucifugus* (LeConte, 1831), *M. septentrionalis* (Trouessart, 1897); eight are European: *E. nilssonii* (Keyserling and Blasius, 1839), *E. serotinus* (Schreber, 1774), *Nyctalus leisleri* (Kuhl, 1817), *N. noctula* (Schreber, 1774), *Pipistrellus nathusii* (Keyserling and Blasius, 1839), *P. pipistrellus* (Schreber, 1774), *Plecotus auritus* (Linnaeus, 1758) and *Vespertilio murinus* Linnaeus, 1758 (see Appendices I–V and Table 1). A considerable proportion of the individuals are unidentified. This is explained by the variable nature of the records, for while only a third of the bat records from Iceland were sightings, this accounted for the majority (76%) of those in the Faroe Islands. Just over half of the Icelandic records are of bats which were found alive, while this category was 16% for the Faroe Islands. For the Orkney Islands, although only 8% of the records are of identified individuals, 39% of the records are of sightings identified to species with the use of bat detectors and only 11% are sightings. In contrast all of the published records for North Sea installations are identified to species.

All the records for North Sea installations and the Shetland Islands were of single animals. In Iceland

31 of the records (94%) were of single animals, with one instance of two animals and another of six. This differs from the Faroe Islands, where 74 records (77%) were of single animals, 21 of two (10%), three (5%), or four (6%) animals. In the Orkney Islands four of the species were recorded as single animals, but there were multiple sightings of *P. pipistrellus* ranging from three to 12 animals.

*Species Accounts*

Information on each species is given below and those found in each study site are mapped in Figs. 2–6.

*Eptesicus fuscus*

A single individual was found in Iceland in a container of bananas from South America. This species occurs from South Canada to Colombia and North Brazil; Alaska, Greater and Lesser Antilles, Bahamas (Simmons, 2005). There are two records from England of imported specimens (Hutson, 2008a).

*Eptesicus nilssonii*

Two individuals were recorded from the Faroes and North Sea. It is considered to be the most common and widespread species of bat in Norway and Sweden, where it has been recorded north of the Arctic Circle (Rydell *et al.*, 1994; Syvertsen *et al.*, 1995; Ahlén, 2011; Frafjord, 2013). It occurs above

TABLE 1. Summary of records of bats from Iceland, the Faroe Islands, the Orkney Islands, the Shetland Islands, and North Sea installations. The species marked with an \* are North American bats

Species	Iceland		Faroes		Shetland		Orkney		North Sea		Total
	n	%	n	%	n	%	n	%	n	%	
<i>Eptesicus fuscus</i> *	1	3									1
<i>E. nilssonii</i>			1	1					1	3	2
<i>E. serotinus</i>			1	1	1	2					2
<i>Lasiurus cinereus</i> *	4	11					1	1			5
<i>Myotis lucifugus</i> *	2	5									2
<i>M. septentrionalis</i> *	2	5									2
<i>Nyctalus leisleri</i>	1	3	1	1	3	5			1	3	6
<i>N. noctula</i>	1	3			3	5	3	2	2	7	9
<i>N. sp.</i>					2	4	2	1			4
<i>Pipistrellus nathusii</i>	6	16	17	18	12	21	5	3	20	67	60
<i>P. pipistrellus</i>							71	39			71
<i>P. sp.</i>	1	3	1	1	14	24	19	11			35
<i>Plecotus auritus</i>					3	5	4	2			7
<i>Vespertilio murinus</i>	2	5	2	2	7	12			6	20	17
Unidentified	18	47	73	76	13	22	75	42			179
Total records	38		96		58		180		30		402
Number of species	8		5		6		5		5		

64°N in northern Finland (Siivonen and Wermundsen, 2008). There are very few records in England (Hutson, 2008b).

*Eptesicus serotinus*

One of the two individuals was found in timber storage in the Faroes. Occurs throughout Europe as far north as 55°N (Dietz *et al.*, 2009) and also in southern Sweden (Ahlén, 2011). In England it is found mainly in the southeast, but also in central and northwest England and Wales (Entwistle *et al.*, 2001; Hutson, 2008b).

*Lasiurus cinereus*

A single individual was found alive in Orkney (Wolley, 1849, 1850), as were three of the individuals recorded from Iceland. Occurs in Canada, throughout the USA, Mexico, Guatemala, most of

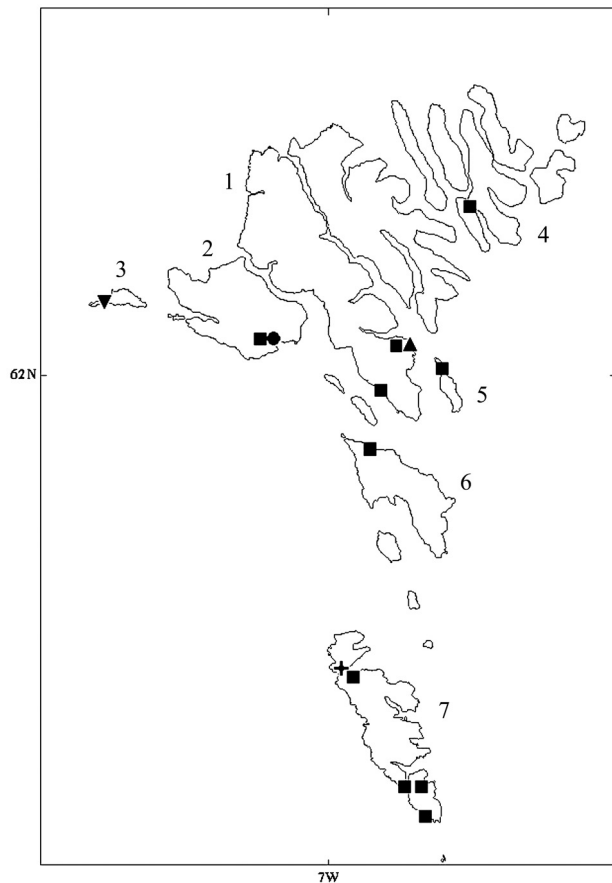


FIG. 2. Map showing distribution of species of bats recorded from the Faroe Islands. *P. nathusii* ■, *V. murinus* ●, *E. serotinus* ▲. The location where both *P. nathusii* and *N. leisleri* have been recorded is indicated by ▼. The location where *P. nathusii*, *V. murinus* and *E. nilsonii* have been recorded is indicated by +. Islands: 1 — Stremoy, 2 — Vágur, 3 — Mykines, 4 — Borðoy, 5 — Nólsoy, 6 — Sandoy, 7 — Suðuroy

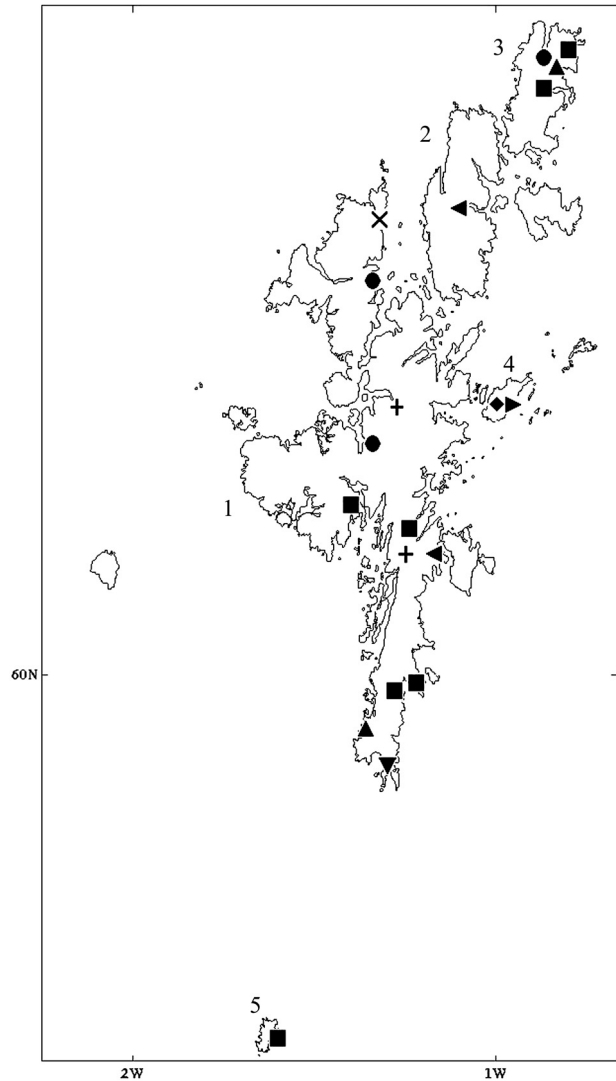


FIG. 3. Map showing distribution of six species of bats recorded from the Shetland Islands. ■ — *P. nathusii*, ● — *N. leisleri*, ▲ — *V. murinus*, + — *N. noctula*, ▼ — *P. auritus*. The location where both *P. nathusii* and *E. serotinus* have been recorded is indicated by ♦, where *P. nathusii* and *N. noctula* have been recorded is indicated by ×, where *P. nathusii* and *V. murinus* have been recorded is indicated by ►, and where *V. murinus* and *P. auritus* have been recorded is indicated by ◄. Islands: 1 — Mainland, 2 — Yell, 3 — Unst, 4 — Whalsay, 5 — Fair Isle

South America, Bermuda and the Galapagos Islands (Simmons, 2005). There is an extralimital record on Southampton Island at 64°20'N (Hitchcock, 1943). Cryan (2003) provided information on distribution patterns throughout the year in North America.

*Myotis lucifugus*

One of the two individuals recorded from Iceland was found on board a ship arriving in Reykjavik harbour from the east coast of the USA. This species

has a broad range to a maximum latitude of 66°34'N in the USA and Canada (Pierson, 1998), occurring from Labrador and Newfoundland in Canada to Alaska, southern California, northern Arizona and northern New Mexico in the USA (Simmons, 2005). There is a single record from England of an imported specimen (Hutson, 2008a).

#### *Myotis septentrionalis*

The 1981 specimen was found on board a ship that came from the east coast of the USA, on the same occasion as an individual of *M. lucifugus* and four other bats that were discarded before they could be identified. The other Icelandic individual flew into a house and died, but could have arrived by ship at the nearby Hafnarfjörður harbour. Found in Eastern United States and Canada west to British Columbia, E Montana, E Wyoming and south to Alabama, Georgia and Florida Panhandle (Simmons, 2005), to a maximum latitude of 61°25'N (Pierson, 1998).

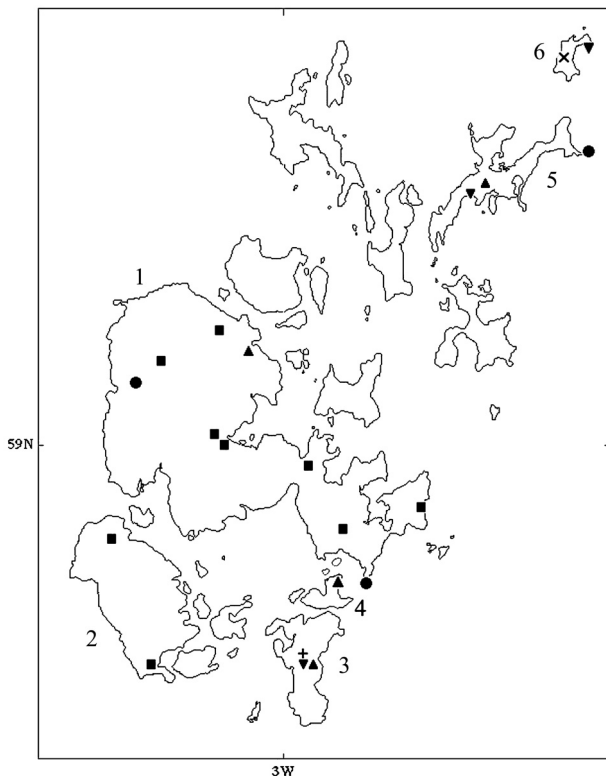


FIG. 4. Map showing distribution of species of bats recorded from the Orkney Islands. ▲ — *P. nathusii*, ■ — *P. pipistrellus*, ● — *P. auritus*, ▼ — *N. noctula*, + — *L. cinereus*. The location where both *P. nathusii* and *P. auritus* have been recorded is indicated by x. Islands: 1 — Mainland, 2 — Hoy, 3 — South Ronaldsay, 4 — Burray, 5 — Sanday, 6 — North Ronaldsay

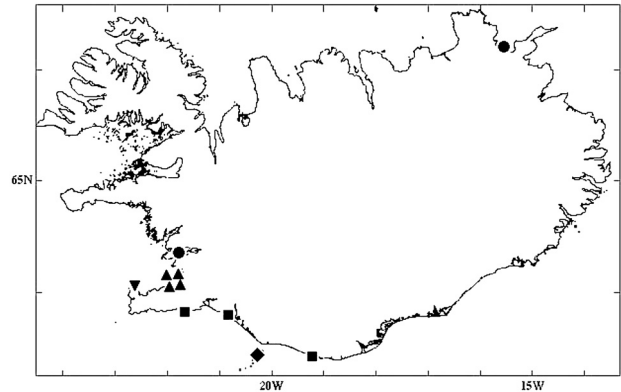


FIG. 5 Map showing distribution of species of bats recorded from Iceland. ▼ — *P. nathusii*, ● — *V. murinus*, ■ — *L. cinereus*. The location on Heimaey, Vestmannaeyjar islands where both *P. nathusii* and *L. cinereus* have been recorded is indicated by ♦. Species found at various locations in the vicinity of Reykjavik: *P. nathusii*, *M. septentrionalis*, *M. lucifugus*, *N. leisleri*, *N. noctula* and *E. fuscus* are indicated by ▲

#### *Nyctalus leisleri*

The individual from Iceland was found in a storage bunker. Occurs throughout western Europe to nearly 57°N, however there are no records from Denmark and Scandinavia, except for southern Sweden (Simmons, 2005; Dietz *et al.*, 2009; Ahlén, 2011). Although rare, this species occurs throughout the British Isles, mainly in central and southern counties of England, also in south western Scotland, a few records from northeast Scotland and it is widespread and common in Ireland (Haddow and Herman, 2000; Entwistle *et al.*, 2001; Sheil *et al.*, 2008).

#### *Nyctalus noctula*

The Icelandic record is of an individual captured on board a cargo vessel. The species is widespread in Europe to the Urals and the Caucasus (Dietz *et al.*, 2009). It has been recorded rarely in southern Norway (Syvertsen *et al.*, 1995) and has an uneven distribution in central and southern Sweden (Ahlén, 2011). The species is widespread in England, Wales and southwest Scotland but is absent from Ireland (Haddow and Herman, 2000; Entwistle *et al.*, 2001; Mackie and Racey, 2008).

#### *Pipistrellus nathusii*

This is the only species of pipistrelle reliably recorded from North Sea installations, Shetland, Faroes and Iceland, where it is also the most commonly recorded species of bat (Table 1; Figs. 2–3, 5–6). It has also been recorded on the Orkneys (Fig. 4), but here it is less frequently encountered than is

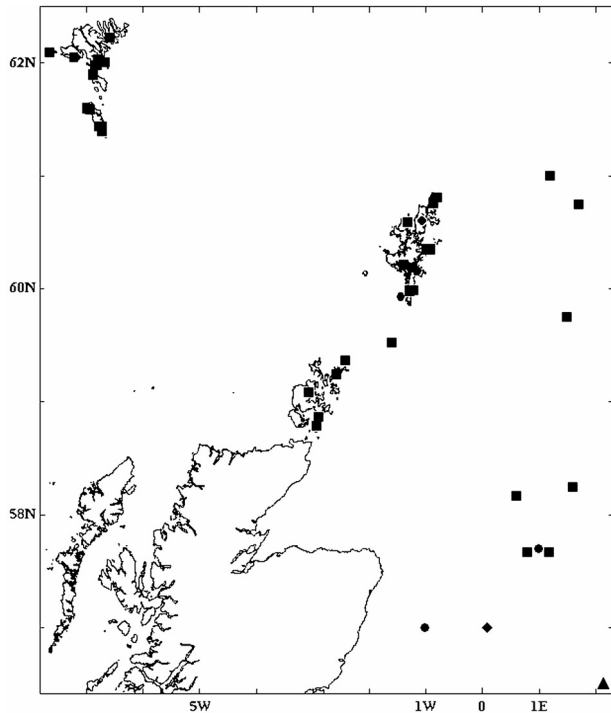


FIG. 6. Map showing distribution of species of bats recorded from North Sea installations. ■ — *P. nathusii*, ● — *V. murinus*, ▲ — *N. noctula*. Location in the North Sea where both *P. nathusii* and *V. murinus* have been recorded is indicated by ♦. Details of the records of species on the Faroes, Shetland and Orkney Islands are shown in Figs. 2–4

*P. pipistrellus* (7% of the total *P. pipistrellus* and *P. nathusii* records). It is possible that some of the earlier unidentified *Pipistrellus* records in all study areas are representatives of this species.

Occurs in western Europe, from southern Scandinavia southwards to France and northern Spain and eastwards to the Urals and Caucasus (Dietz *et al.*, 2009). It has been recorded in Norway (Syvertsen *et al.*, 1995; Swenson *et al.*, 2010) and is found in central and southern Sweden as far north as 61°21'N (Ahlén, 2011). Occurs in southern and eastern Scotland, most of England and Wales, and eastern and central Ireland (Russ *et al.*, 2001; Russ, 2008).

#### *Pipistrellus pipistrellus*

Reliable records of *P. pipistrellus*, based on professionally identified specimens and sound recordings of bats with echolocation calls at 45 kHz, have only been obtained from the Orkney Islands (Table 1 and Fig. 4), where it is by far the most commonly recorded species (75% of the total records of *Pipistrellus*). Although the Orkney Islands may be considered marginal for the existence of resident

bats, there is evidence of summer roosts of *P. pipistrellus* from various locations from 1994 onwards (Holmes, 1994; Holmes *et al.*, 1995; Booth, 1995–2011; see Fig. 7).

Widespread in Europe, more common than *Pipistrellus pygmaeus* (Leach, 1825) in central Europe, but rare or absent in the Netherlands and Scandinavia (Jones and Racey, 2008; Ahlén, 2011). Details of distribution remain uncertain on mainland Europe. Occurs throughout the British Isles (Barlow and Jones, 1999; Jones and Racey, 2008).

#### *Plecotus auritus*

Records from Shetland and Orkney, including one individual observed over a period of eight days (Booth, 1989). Occurs throughout Europe (Dietz *et al.*, 2009). In Scandinavia it is found throughout the lowlands of southern Norway as far north as 63°25'N (Syvertsen *et al.*, 1995), is common in southern and central Sweden (Ahlén, 2011) and occurs above 64°N in northern Finland (Siivonen and Wermundsen, 2008). Widespread in the British Isles, except for the far north of Scotland (Haddow and Herman, 2000; Entwistle *et al.*, 2001; Entwistle and Swift, 2008).

#### *Vespertilio murinus*

There are more records of this species than of other European bats, apart from *Pipistrellus*. Both of the Icelandic records were of live animals, one of which flew into the bridge of a cargo vessel. Occurs in Europe eastwards and northwards from eastern France (Dietz *et al.*, 2009). It occurs in scattered coastal localities in southern Norway as far north as c. 61°56'N (Syvertsen *et al.*, 1995) and also has an uneven distribution in southern Sweden (Ahlén, 2011). Occasional records from the British Isles are considered to be of vagrants and migrants (Racey *et al.*, 2008).

#### *The Invasion in 2010*

The unprecedented bat invasion in the Faroe Islands occurred from September to the beginning of November 2010 (Fig. 8). Over a period of seven weeks, 70 observations were recorded and, although some of these observations were possibly of the same individuals, a minimum of 45 individual animals were involved. Two bats were identified respectively as *V. murinus* and *Pipistrellus nathusii*, but no further bats were identified to species.

During the invasion period, two unidentified bats were recorded in Iceland and three in Shetland,

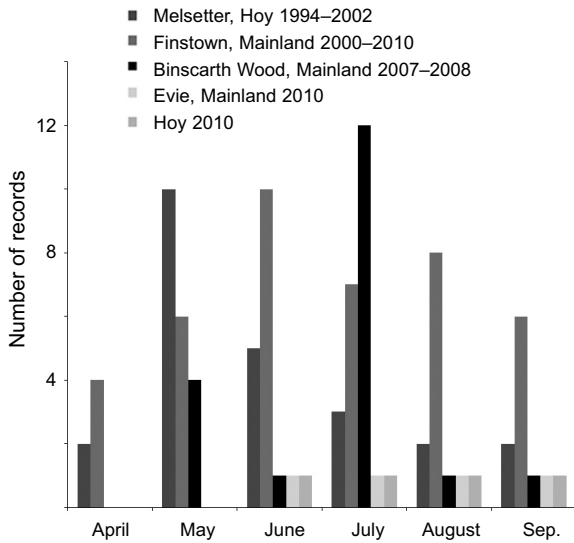


FIG. 7. Seasonal occurrence of records of *P. pipistrellus* from selected localities in Orkney, showing changes in location over the years from 1994 to 2010. The vertical axis represents the number of records for each month from April to September

which may signify a connection with the phenomenon in the Faroes. None were recorded on North Sea installations at this time.

#### Seasonal and Frequency Data

The majority of *P. nathusii* records occur in the autumn and winter in marked contrast to the occurrence of *P. pipistrellus* mainly in late spring to early autumn (Fig. 9). For all other species of bats (Fig. 10), a similar pattern may be seen to that of *P. nathusii*, with the majority of records occurring in the autumn. The frequency of occurrence of bats in all study areas is given in Table 2, which shows a marked contrast between the low number of records in the first two decades and those in the three succeeding decades.

#### DISCUSSION

Monitoring of all wildlife may be considered the duty of any independent nation and the incursion of any non-native species is a matter of interest for a variety of reasons. Bats are very rare vagrants on the north east Atlantic islands and North Sea installations. Further north and west, bats have also occasionally been observed on Greenland, and are understood to have been blown over from North America according to Møbjerg and Rosing (2001). These authors state that the bats have both an East Greenlandic name “Avangiarlik” (the one which

resembles a lemming) and in West Greenland, “Imangartaq” (the one which has been silenced). This indicates that bats have been recorded on both sides of the huge Greenland ice-shield, although individual records with locality and date do not seem to be available.

Most of the bats found in Iceland were recorded in the south and southwest. The largest number has been found in the capital city of Reykjavik, where most of the population lives and where most of the international shipping and air traffic is received. Many of the bats were recorded under such situations that point to assisted passage, either with imported goods, on board ship or in storage containers. Others found inside houses, or alive outside may also have been assisted rather than arriving independently.

As far as the other island groups are concerned, the inadvertent transport of bats by humans is apparently of less importance. In the Faroe Islands most bats have been observed when catching insects attracted to the street lights in the small settlements around the entire Faroe Islands. While there are four records of bats on Mainland, Shetland from the port

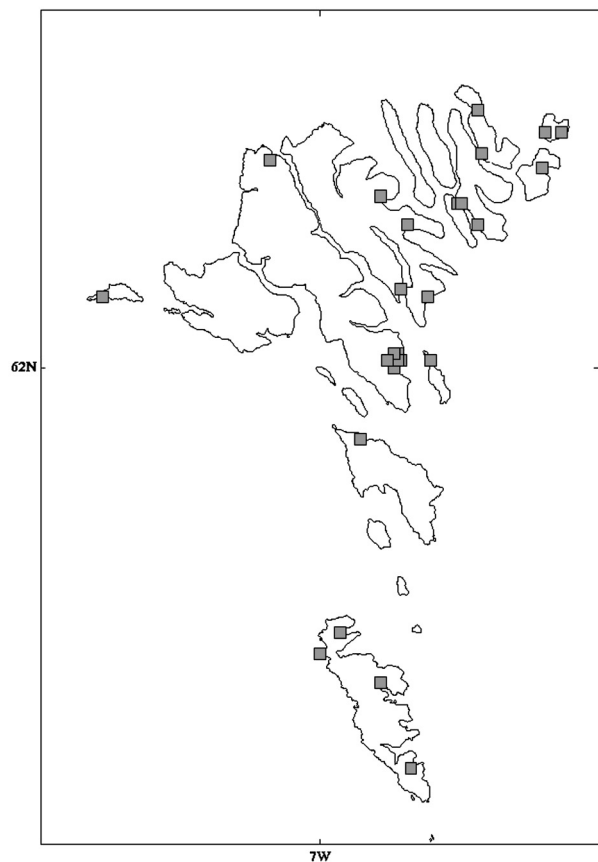


FIG. 8. Map showing the inundation of bats on the Faroes during September to November 2010



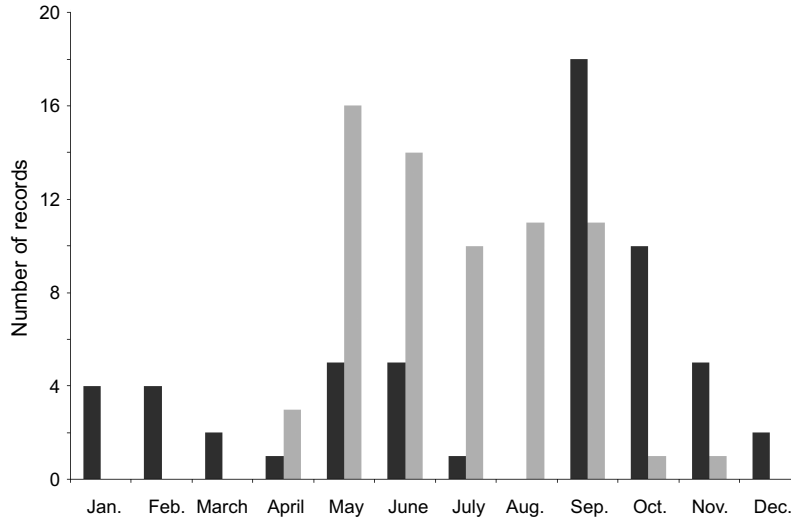


FIG. 9. Comparison of the seasonal occurrence of records of *P. nathusii* (■) from the combined study areas, with those of *P. pipistrellus* (■) from Orkney. The vertical axis represents the number of records each month

and capital and two from the main airfield, other records are more or less randomly distributed in the islands. Similarly while there are records of three species on South Ronaldsay, the closest island to the Scottish mainland, there are no obvious connections in Orkney to the inadvertent transport of bats by humans.

*Movements*

The bats recorded from the study areas may be broadly divided into sedentary or migratory species. The tendency to vagrancy and migratory behaviour, which greatly varies between bat species, no doubt

has much bearing on whether bats reach the islands without assistance.

*Sedentary Bats*

All three species of *Eptesicus*, *P. pipistrellus*, *P. auritus* and *M. septentrionalis* are regarded as largely sedentary species of bats. Both *E. nilsonii* and *E. serotinus* have small home ranges, moving only short distances between roosts, but with occasional longer distance dispersal flights in Europe (Hutterer *et al.*, 2005; Hutson, 2008b). *Eptesicus fuscus* is a more or less sedentary species according to Hutson (2008a). *Plecotus auritus* is considered to

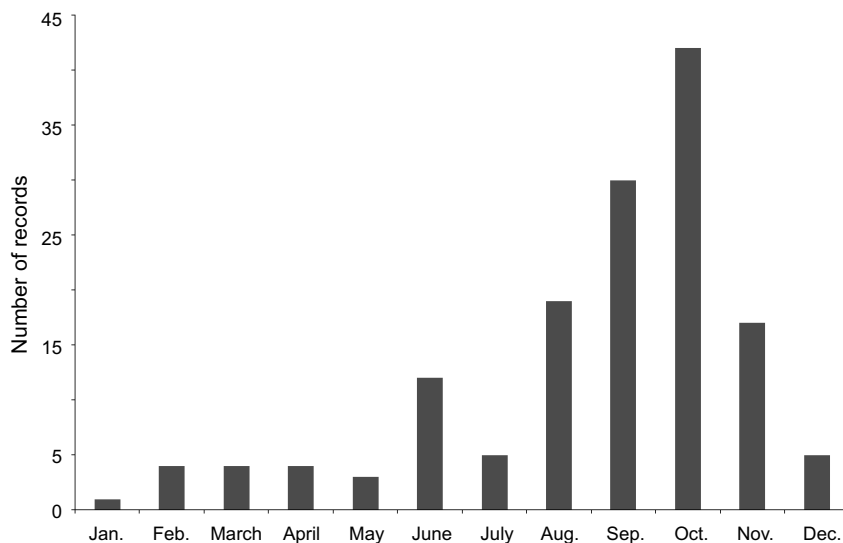


FIG. 10. Comparison of the seasonal occurrence of all records of bats, other than *Pipistrellus*, from the combined study areas. The vertical axis represents the number of records each month

TABLE 2. Frequency of occurrences in all study areas from 1960 to 2009, grouped into ten year periods, and for three years from 2010 to 2012. Figures in bold indicate the peak records for each of the study areas

Area	Records	1960–69	1970–79	1980–89	1990–99	2000–09	2010–12
North Sea	All records	1	0	6	<b>15</b>	6	0
	<i>P. nathusii</i>	0	0	4	<b>14</b>	2	0
Orkney	All records	0	3	2	60	<b>74</b>	37
	<i>P. nathusii</i>	0	0	0	1	<b>2</b>	2
	<i>P. pipistrellus</i>	0	0	0	15	<b>39</b>	16
Shetland	All records	1	2	<b>13</b>	12	11	<b>13</b>
	<i>P. nathusii</i>	0	0	4	<b>7</b>	0	0
Faroes	All records	0	0	2	10	25	<b>79</b>
	<i>P. nathusii</i>	0	0	2	3	<b>7</b>	5
Iceland	All records	2	2	2	2	<b>12</b>	5
	<i>P. nathusii</i>	0	1	1	0	<b>3</b>	1

be a relatively sedentary species (Hutterer *et al.*, 2005; Baagøe, 2007; Entwistle and Swift, 2008). Corbet (1970) commented that a specimen found in the autumn on a lightship about 48 km east of Norfolk, UK may have originated from the continent, as this coincided with a massive fall of birds from Scandinavia. Although recorded rarely in the study areas and then at long intervals, there are more records of this species than of other sedentary species. The New World *M. septentrionalis* is a short-range migrant reported to travel a distance of up to 56 km between the summer habitat and winter hibernacula (Caceres and Barclay, 2000). There are very few records from the study areas of any of these sedentary species and only *E. nilsonii* has been recorded from an oil rig. Most of these are believed to be vagrants, whose presence may be attributed to inadvertent transportation by humans.

Most populations of *P. pipistrellus* in central Europe are sedentary, travelling only short distances between winter and summer roosts, although this species may be more migratory in eastern Europe (Hutterer *et al.*, 2005; Jones and Racey, 2008). This is the only species with apparent breeding roosts so far North in Britain, although it has only been recorded on Mainland and Hoy, the largest of the Orkney Islands. The locations of summer roosts have changed over time, sometimes two roosts co-existing for several years, suggesting that there may be sufficient bats for the formation of splinter groups, which may or may not be sustainable depending on conditions. While the status of this species on the Orkneys may be accepted as that of a resident, populations here may be vulnerable, as they are at the northern boundary of their distributional range in the British Isles.

There is little available information on *P. pygmaeus*, because most predates the taxonomic

separation from *P. pipistrellus*, however Sztencel-Jablonka and Bogdanowicz (2012) observed that *P. pygmaeus* was more migratory than *P. pipistrellus*. Details of the distribution of this species remain uncertain but it is widespread in Europe and southern Scandinavia and, while both species are sympatric over most of their range, *P. pygmaeus* may be the more common of the two on the margins of continental Europe (Racey *et al.*, 2007). It occurs throughout the British Isles but is apparently less common than *P. pipistrellus* in northern mainland Scotland (Barlow and Jones, 1999; Jones and Racey, 2008). To date this species has not been recorded from any of the study areas but could conceivably be included amongst the records of unidentified *Pipistrellus*. There is one equivocal reference to a bat detector recording in Orkney of a pipistrelle calling in the 50–55 kHz range which was attributed to *P. pipistrellus* (Booth, 2010), although calls above 52 kHz are in the range of *P. pygmaeus*. In this study it has been included as an unspecified *Pipistrellus*, while the early record of *P. pipistrellus* (Spence, 1909) could represent either species. The situation becomes even more complicated in light of the recent evidence of hybridisation between the two species in continental Europe (Sztencel-Jablonka and Bogdanowicz, 2012).

#### *Migratory species*

*Nyctalus leisleri* is considered to be a long-distance migrant, showing regular seasonal NE to SW movements between the summer and winter habitats in Europe (Hutterer *et al.*, 2005; Sheil *et al.*, 2008). It seems unlikely that migration was a factor in most of the records in the study areas which are mainly in the summer. However strong winds may have affected dispersal in some instances (Corbet, 1970).

In contrast *N. noctula* is not considered to be such a long range migrant; it is migratory in eastern Europe, but probably less so in western Europe (Strelkov, 1969; Hutterer *et al.*, 2005). Information on migratory activity in Scandinavia has been recorded by Ahlén (1997), Baagøe (2007) and Ahlén *et al.* (2009). Populations are not known to migrate from England in the winter and records from the Orkneys, Shetlands and North Sea installations are regarded as vagrants from Europe (Mackie and Racey, 2008), some perhaps originating from Scandinavia.

*Pipistrellus nathusii* is known to be a seasonal long-distance migrant in Europe (Strelkov, 1969; Ahlén, 1997, 2011; Pētersons, 2004; Hutterer *et al.*, 2005; Ahlén *et al.*, 2009). Ahlén (1997) reported dispersal and migratory behaviour in this species in late August and early September. Some of these bats were observed to fly out over the open sea in a southern or south-westerly direction and specimens marked in Sweden have been recorded in Germany and Belgium.

*Pipistrellus nathusii* was first recorded from the British Isles by Stebbings (1970) and for the next two decades it was considered to occur only as an occasional vagrant in Britain. With an increase in the number of records in the late 1980s, it was subsequently considered to be a winter migrant (Speakman *et al.*, 1991; Hutson, 1993). More recently the discovery of three summer maternity colonies in England and Northern Ireland (Hutson, 1997; Russ *et al.*, 1998, 2001) means that this species in Britain and Ireland is now considered to consist of both a resident breeding population present throughout the year, and a migratory population present during autumn, winter and spring (Russ, 2008). The increasing number of records in the study areas over the same period mirrors the situation in mainland Britain, with similar seasonal peaks for sightings and records in September and October, coinciding with autumn migratory behaviour. Therefore, although in these areas the records are more likely to be of vagrants, it is conceivable that some could be migrants. Most of the specimens recorded from Iceland were probably ship-assisted, although the specimen from the island of Heimaey could have been a storm-borne migrant.

*Vespertilio murinus* is a long-distance migrant normally spending the summer in northern, central and eastern Europe and flying generally in a south-westerly direction to southern Europe to hibernate (Hutterer *et al.*, 2005; Stebbings *et al.*, 2007). In southern Sweden a few individuals were recorded in

the autumn leaving land and flying out over the sea (Ahlén, 1997). There has been an increase in records in the British Isles since 1980, predominantly in the autumn and spring suggesting that migrants are sometimes deflected from continental Europe (Racey *et al.*, 2008). This is also possible for records from Shetland and North Sea installations, even for records from the Faroes. The specimen recorded from NE Iceland could possibly be a storm-assisted migrant.

*Lasiurus cinereus* is a fast flying, highly migratory species that has been recorded in Orkney and Iceland in autumn and winter (Stebbing, 1986; Stebbings *et al.*, 2007). Three of the specimen records from Iceland were from small, remote locations on the southern coast of Iceland, so ship-assisted passage was considered unlikely (Koopman and Gudmundsson, 1966). These authors also mentioned that meteorological records of storm tracks just prior to the October records of 1957 and 1964 indicated winds suitable to carry bats from eastern Canada to south western Iceland, which was further substantiated by a meteorologist (Jakobsson, 1967).

Although Wolley (1849, 1850) was of the opinion that the Orkney record was of a ship-assisted individual, Hill and Yalden (1990) and Yalden (2008) pointed out that at least two American land-birds were also recorded in western Europe in the autumn of 1847. It seems highly likely therefore that the Orkney and Iceland records are of bats storm-carried whilst migrating, although, in the case of the Orkney record, at least partial ship-assisted passage may not be excluded.

*Myotis lucifugus* is a medium-range migrant with movements of more than 300 km to hibernation sites (Hutson, 2008a). The record in August could be of a stray migrant, although Koopman and Gudmundsson (1966) concluded that it was more probable that this immature bat was ship-assisted to Reykjavik harbour.

#### *Frequency of Occurrence*

The apparent increase in the occurrence of bats, raises the following questions that need to be addressed.

(a) Is there a real increase in records? The results show (Table 2) that there has been a measurable increase in records for four of the five study areas (Iceland, Faroes, Shetland and Orkney).

(b) Is the increase due to improved communication? In such isolated regions as most of the study areas, until relatively recently internal communication was limited and communication with the

external world restricted, which may have hampered the notification of rare animals like bats to the scientific world. This does not apply to the situation in Iceland however, which has had good internal communication for considerably longer and regular external communication for up to a century.

(c) Is there an increased awareness? There has always been an interest in the news of unusual sightings of animals, witness the early records of bats in Shetland in 1774 (Low, 1879), 1815 (Laing, 1815), and 1904 (Tulloch, 1904); in Orkney in 1847 (Wolley, 1849) and 1908 (Spence, 1909); and in Iceland in the 18th century (Pennant, 1784), circa 1817 (F. Faber, unpublished diary held in the Archives of the Kongelig Bibliotek, Copenhagen) and 1936 (Petersen, 1994). There are no similar early records in the Faroese literature and indeed Degerbøl (1940) makes no mention of them.

It appears that bats have become more common over the last decades. For example amateur naturalists have lived on Nólsoy in the Faroe Islands for the last 150 years, yet the first bats were not observed there until 1987, increasing to 25 records in the period from 2000 to 2009. The dramatic increase in records for Orkney from the few in the 1970s and 1980s to much greater numbers in the 1990s and 2000s, may be due in part to greater awareness and involvement of local naturalists and others inspired by a very keen recorder (Booth, 1979, 1980, 1989, 1992–2012), but is also likely to be a true reflection of the increase since Orkney Field Club publications date from 1968. Similarly researchers at NÍ have taken an interest in recording bats in Iceland, probably from as early as 1889 when the Icelandic Natural History Society with its natural history museum was established. However the records remained steadily at two per decade from the 1960s to the 1990s, with a marked increase from 2000 to 2012.

(d) Is there an increase in shipping traffic? Shipping traffic into Iceland, and more recently the use of containers to transport all manner of goods has increased considerably over the last few decades. Air traffic has also increased and is an important source of goods transport for all study areas. At least ten of the records from Iceland are believed to have been associated with shipping, and one possibly with air transport. In the Faroe Islands only one bat is presumed to have been imported with timber and there are no other Faroese observations to suggest that bats have arrived with either aircraft or ship.

(e) Is the apparent increase due to changes in weather patterns and the effects of climate change? Unusual weather patterns have been invoked in the

past to account for the occurrence of vagrants, such as that of the specimen of *L. cinereus* in Orkney, which coincided with that of North American land birds in western Europe. The relationship between bat occurrences and weather patterns was identified in Iceland in the 1960s (Koopman and Gudmundsson, 1966; Jakobsson, 1967). The 2010 invasion of the Faroes also included birds from the USA, Europe and the Far East, and European Lepidoptera. During the same period, a number of European Lepidoptera reached south east Iceland, borne there on a warm south-easterly wind (Erling Ólafsson, personal communication). It is difficult to reach any conclusions concerning the possibility of changes in environmental factors affecting the situation in the Faroes at this time, for although September and October were amongst the seven months that were warmer than normal that year (Cappelen, 2011) weather maps for the Faroes showed no unusual wind conditions at that time (<http://www.dmi.dk/faeroerne/arkiver/vejrarkiv/>). An analysis of the occurrence of bats, insects and vagrant birds and weather patterns is much needed.

It is important to distinguish the influence of occasional unusual weather patterns from overall trends in climate. The evidence about long term changes in weather patterns linked to global environmental change is still fragmentary but nevertheless strongly indicated, and evidence to demonstrate the ecological response of species to climate change is accruing in many taxa (Thomas and Lennon, 1999; Parmesan *et al.*, 1999; Visser and Holleman, 2001; Walther *et al.*, 2002; Parmesan and Yohe, 2003; Sherwin *et al.*, 2013). As far as the study areas are concerned, Cappelen (2011) reported that the decade from 2001–2010 was the warmest in the Faroes since measurements began in 1890.

The status of *P. nathusii* in the British Isles has changed over more than four decades from vagrant to that of a resident and winter migrant. This may represent a range extension which could conceivably be linked to climate change, but may just be a question of mistaken identity in the past and an increase in skilled recorders since the mid-1980s (Russ *et al.*, 2001). The increase in records of *P. nathusii* in the study areas however, suggests that migrating bats are more often in areas where they are more prone to being swept off-course. In a recent study, this species has been used to demonstrate range expansion linked to climate change in the UK (Lundy *et al.*, 2010). These authors mapped the change in habitat suitability for this species from 1980 to 2000 based on UK Meteorological Office

data and modelled the projected change in habitat suitability from 2020 to 2080. The presence of resident *P. pipistrellus* on Orkney may also be regarded as a range extension, implying that overall conditions have improved sufficiently to support breeding and overwintering bats.

Other recent studies that examined the predicted impact of climate change on bats include Rebelo *et al.* (2010), Prydatko *et al.* (2011) and Sherwin *et al.* (2013). Rebelo *et al.* (2010) modelled the potential distribution of bat diversity for three biogeographic groups: temperate, boreal and Mediterranean. Four of the ten species in their temperate group, included species reported in the current study: *P. nathusii*, *N. leisleri*, *E. serotinus* and *P. auritus*, while *N. noctula* was one of four species in their boreal group.

The measurable increased frequency of the occurrence of bats in Iceland, the Faroes, Shetland and Orkney suggests that all the above factors are important but it is difficult to distinguish between them. The importance of different factors appears to be variable depending on the study area. Overall the European migratory species are probably more likely to reach Shetland and Orkney and North Sea installations. The North American bat species seem more prone to appear in Iceland than in the other study areas. However although further away from sources of bats, whether in Europe or North America, migratory bats may well reach the Faroe Islands and Iceland as do vagrant birds (Pétursson and Skarphéðinsson, 1978) and insects (Kaaber *et al.*, 1994; Jensen, 2001).

#### ACKNOWLEDGEMENTS

We thank all observers for reporting their findings of bats. In Iceland Þorvaldur Björnsson has been particularly helpful in preparing and curating specimens. Thanks to Janus Hansen, FN for the loan of specimens in his care and for assistance with Fig. 1. Jerry Herman provided helpful information on specimens in the collections of the National Museums of Scotland. PJ is particularly grateful to Louise Tomsett and Roberto Portelo Miguez, Mammal Group, for preparation of skulls and for their helpful support, and to staff of the General Library for assistance in tracing obscure references. We thank reviewers for their constructive criticism of the manuscript.

#### LITERATURE CITED

- AHLÉN, I. 1997. Migratory behaviour of bats at south Swedish coasts. *Zeitschrift für Säugetierkunde*, 62: 375–380.
- AHLÉN, I. 2011. Fladdermusfaunan i Sverige. Arternas utbredning och status. *Kunskapsläget 2011*. [The bat fauna of Sweden. Present knowledge on distribution and status.] *Fauna och Flora*, 106: 2–19. [In Swedish].
- AHLÉN, I., H. BAAGØE, and L. BACH. 2009. Behavior of Scandinavian bats during migration and foraging at sea. *Journal of Mammalogy*, 90: 1318–1323.
- BAAGØE, H. J. 2007. Flagermus, Chiroptera. Pp. 40–99, in *Danske pattedyr atlas*. [Atlas of Danish bats.] (H. J. BAAGØE and T. S. JENSEN, eds.). Gyldendalske Boghandel, Nordisk Forlag A/S, København, 392 pp. [In Danish].
- BAAGØE, H., and D. BLOCH. 1994. Bats (Chiroptera) in the Faroe Islands. *Fróðskaparrit*, 41 (1993): 83–88.
- BALDURSDÓTTIR, L. H. 1960. Leðurblakan. [The bat.] *Blik*, 21: 86–87. [In Icelandic].
- BARLOW, K. E., and G. JONES. 1999. Roosts, echolocation calls and wing morphology of two phonic types of *Pipistrellus pipistrellus*. *Zeitschrift für Säugetierkunde*, 64: 257–268.
- BARRETT-HAMILTON, G. E. H. 1910–11. A history of British mammals. 1 Gurney and Jackson, London, xvi + 263 pp.
- BOOTH, C. J. 1979. Assisted passage? Some unusual visitors to Orkney. *Orkney Field Club Bulletin*, (1): 6.
- BOOTH, C. J. 1980. Pipistrelle bat. *Orkney Field Club Bulletin*, (1): 8.
- BOOTH, C. J. 1986. Bats in Orkney. *Orkney Field Club Bulletin*, (1): 7–9.
- BOOTH, C. J. 1989. Bats in Orkney 1987 and 1988. *Orkney Field Club Bulletin*, (1): 20.
- BOOTH, C. J. 1992. Bats. *Orkney Field Club Bulletin. Biological Records Supplement*: 34.
- BOOTH, C. J. 1993. Bats. *Orkney Field Club Bulletin and Biological Records Supplement*: 21.
- BOOTH, C. J. 1994. Bats 1993. *The Orkney Naturalist Bulletin*: 38.
- BOOTH, C. J. 1995. Bats 1994. *Orkney Field Club Bulletin*: 54.
- BOOTH, C. J. 1996. Bats 1995. *Orkney Field Club Bulletin*: 43.
- BOOTH, C. J. 1997. Bats 1996. *Orkney Field Club Bulletin*: 25.
- BOOTH, C. J. 1998. Bats records 1997. *Orkney Field Club Bulletin*: 31.
- BOOTH, C. J. 1999. Bats records 1998. *Orkney Field Club Bulletin*: 40.
- BOOTH, C. J. 2000. Bats 1999. *Orkney Field Club Bulletin*: 54.
- BOOTH, C. J. 2001. Bats in 2000. *Orkney Field Club Bulletin*: 41.
- BOOTH, C. J. 2002. Bats 2001 records. *Orkney Field Club Bulletin*: 29–30.
- BOOTH, C. J. 2003. Bats 2002. *The Orkney Naturalist*: 22.
- BOOTH, C. J. 2005. Bats 2004. *The Orkney Naturalist*: 47.
- BOOTH, C. J. 2006. Bats 2005. *The Orkney Naturalist*: 48–49.
- BOOTH, C. J. 2007. Bat report 2006. *The Orkney Naturalist*: 47–48.
- BOOTH, C. J. 2008. Bat report 2007. *The Orkney Naturalist*: 43.
- BOOTH, C. J. 2009. Bat report 2008. *The Orkney Naturalist*: 46.
- BOOTH, C. J. 2010. Bat report 2009. *The Orkney Naturalist*: 57.
- BOOTH, C. J. 2011. Bat report 2010. *The Orkney Naturalist*: 57–58.
- BOOTH, C. J. 2012. Bat report 2011. *The Orkney Naturalist*: 66.
- CACERES, M. C., and R. M. R. BARCLAY. 2000. *Myotis septentrionalis*. *Mammalian Species*, 634: 1–4.
- CAPPELEN, J. 2011. Teknisk rapport 11–01. Danmarks klima 2010 med Tórshavn, Færøerne og Nuuk, Grønland. [Technical Report 11–01. Denmark's climate 2010 in Torshavn, Faroe Islands and Nuuk, Greenland.] *Danmarks Meteorologiske Institut, København*. Available at [www.dmi.dk/dmi/tr11-01](http://www.dmi.dk/dmi/tr11-01). [In Danish, with English summary].
- CORBET, G. B. 1970. Vagrant bats in Shetland and the North Sea. *Journal of Zoology (London)*, 161: 281–282.
- CRYAN, P. M. 2003. Seasonal distribution of migratory tree bats

- (*Lasiurus* and *Lasionycteris*) in North America. *Journal of Mammalogy*, 84: 579–593.
- DEGERBØL, M. 1940. Mammalia. Pp. 1–132, in *The zoology of the Faroes*. Part 55 (A. S. JENSEN, W. LUNDBECK, T. MORTENSEN and R. SPÁRCK, eds.). A. F. Høst og Søn, Copenhagen.
- DIETZ, C., O. VON HELVERSEN and D. NILL. 2009. Bats of Britain, Europe and northwest Africa. A&C Black Publishers Ltd., London, 400 pp.
- ENTWISTLE, A. C., and S. M. SWIFT. 2008. Genus *Plecotus*. Pp. 364–370, in *Mammals of the British Isles: handbook*, 4th edition (S. HARRIS and D. W. YALDEN, eds.). The Mammal Society, Southampton, xiv + 799 pp.
- ENTWISTLE, A. C., S. HARRIS, A. M. HUTSON, P. A. RACEY, A. WALSH, S. D. GIBSON, I. HEPBURN, and J. JOHNSTON. 2001. Habitat management for bats. A guide for land managers, land owners and their advisors. Joint Nature Conservation Committee, Peterborough, 47 pp.
- FRAFJORD, K. 2013. Influence of night length on home range size in the northern bat *Eptesicus nilssonii*. *Mammalian Biology*, 78: 205–211.
- GUÐMUNDSSON, F. 1943. Leðurblökuheimsóknin. [The bat visit.] *Náttúrufræðingurinn*, 13: 153–154. [In Icelandic].
- GUÐMUNDSSON, F. 1944. Ný leðurblökuheimsókn. [Another bat encounter in Iceland.] *Náttúrufræðingurinn*, 14: 143. [In Icelandic].
- GUÐMUNDSSON, F. 1957. Leðurblaka handsömuð í Selvogi. [A bat captured in Selvogur, SW-Iceland.] *Náttúrufræðingurinn*, 27: 143–144. [In Icelandic].
- HADDOW, J. F., and J. S. HERMAN. 1995. Recorded distribution of bats in Scotland. *Scottish Bats*, 3: 32–37.
- HADDOW J. F., and J. S. HERMAN. 1997. New record of *Nathusius' pipistrelle* from Scotland. *Scottish Bats*, 4: 6–7.
- HADDOW J. F., and J. S. HERMAN. 2000. Recorded distribution of bats in Scotland. *Scottish Bats*, 5: 35–47.
- HAYMAN, R. W. 1959. American bats reported in Iceland. *Journal of Mammalogy*, 40: 245–246.
- HERMAN, J. S. 1992. The earliest record of *Nathusius' pipistrelle* from the British Isles. *Scottish Bats*, 1: 48.
- HILL, J. E., and J. D. SMITH. 1984. Bats. A natural history. British Museum Natural History, Dorchester, 243 pp.
- HILL, J. E., and D. W. YALDEN. 1990. The status of the hoary bat, *Lasiurus cinereus*, as a British species. *Journal of Zoology* (London), 222: 694–697.
- HITCHCOCK, H. B. 1943. Hoary bat, *Lasiurus cinereus*, at Southampton Island, N.W.T. *Canadian Field Naturalist*, 57: 86.
- HOLMES, M. 1994. The most northerly bat colony in the British Isles. *Bat News*, 34 (July): 6–7.
- HOLMES, M., P. A. RACEY, and J. RYDELL. 1995. Do pipistrelles use night roosts. *Scottish Bats*, 3: 19.
- HUTSON, A. M. 1993. Action plan for the conservation of bats in the United Kingdom. The Bat Conservation Trust, London, 49 pp.
- HUTSON, A. M. 1997. Two species of bat new to the UK. *Bat News*, 47 (July): 2.
- HUTSON, A. M. 2008a. Accidental imports from America. Pp. 374–375, in *Mammals of the British Isles: handbook*, 4th edition (S. HARRIS and D. W. YALDEN, eds.). The Mammal Society, Southampton, xiv + 799 pp.
- HUTSON, A. M. 2008b. Genus *Eptesicus*. Pp. 357–361, in *Mammals of the British Isles: handbook*, 4th edition (S. HARRIS and D. W. YALDEN, eds.). The Mammal Society, Southampton, xiv + 799 pp.
- HUTTERER, R., T. IVANOVA, C. MEYER-CORDS, and L. RODRIGUES. 2005. Bat migrations in Europe. A review of banding data and literature. *Naturschutz und Biologische Vielfalt*, 28: 1–162.
- JAKOBSSON, J. 1967. Leðurblökur á Íslandi. [Bats found in Iceland.] *Veðrið*, 12(2): 39–45. [In Icelandic].
- JENSEN, J-K. 2001. An invasion of migrating insects (Syrphidae and Lepidoptera) on the Faroe Islands in September 2000. *Norwegian Journal of Entomology*, 48: 263–267.
- JENSEN, J-K., and H. E. SIVERTSEN, 2010. Firvaldar 155 ymiskir firvaldar í Føroyum. [Butterflies. 155 different butterflies in Faroe Islands.] *Føroyar Skúlabókagrunnur*, Tórshavn, 208 pp. [Faroese].
- JONES, G., and P. A. RACEY. 2008. Genus *Pipistrellus*. Pp. 343–351, in *Mammals of the British Isles: handbook*, 4th edition (S. HARRIS and D. W. YALDEN, eds.). The Mammal Society, Southampton, xiv + 799 pp.
- KAABER, S., P. GJELSTRUP, D. BLOCH, and J-K. JENSEN. 1994. Invasion af Admiralen (*Vanessa atalanta* L.) og andre sommerfugle på Færøerne i 1992. [Invasion of red admiral (*Vanessa atalanta* L.) and other butterflies in the Faroe Islands in 1992.] *Fróðskaparrit*, 41 (1993): 125–149. [In Danish].
- KEYSERLING, A. G. v., and I. H. BLASIUS. 1839. Übersicht der Gattungs und Archcharaktere. *Archiv für Naturgeschichte*, 5, 1: 293–331.
- KOOPMAN, K. F., and F. GUÐMUNDSSON. 1966. Bats in Iceland. *American Museum Novitates*, 2262: 1–6.
- KRZANOWSKI, A. 1977. Contribution to the history of bats on Iceland. *Acta Theriologica*, 22: 272–273.
- KUHL, H. 1817. Die deutschen Fledermäuse. Privately published, Hanau, 67 pp.
- LAING, J. 1815. A voyage to Spitzbergen: containing a full description of that country, of the zoology of the North, and of the Shetland Isles, with an account of the Whale Fishery. J. Mawman, London and David Brown, Edinburgh, 173 pp.
- LEACH, 1825. Description of the *Vespertilio pygmaeus*, a new species, recently discovered in Devonshire. *Zoological Journal*, 1(4): 559–561.
- LECONTE, J. E. 1831. In H. MCMURTRIE. The animal kingdom arranged in conformity with its organization by the Baron Cuvier (translated from French with notes and additions by H. McMurtrie). H. Carvill, New York, 1: 1–448. [Not seen].
- LINNAEUS, C. 1758. *Systema naturae*, 10th edition. Holmiae, 823 pp.
- LOW, G. 1879. A tour through the islands of Orkney and Schetland containing hints relative to their ancient modern and natural history collected in 1774; and with an introduction by Joseph Anderson. William Peace and Son, Kirkwall, xi + 223 pp.
- LUNDY, M., I. MONTGOMERY, and J. RUSS. 2010. Climate-change linked range expansion of *Nathusius' pipistrelle* bat, *Pipistrellus nathusii* (Keyserling & Blasius, 1839). *Journal of Biogeography*, 37: 2232–2242.
- MACKIE, I. J., and P. A. RACEY. 2008. Noctule *Nyctalus noctula*. Pp. 338–342, in *Mammals of the British Isles: handbook*, 4th edition (S. HARRIS and D. W. YALDEN, eds.). The Mammal Society, Southampton, xiv + 799 pp.
- MARWICK, J. G. 1931. Long-eared bat in Orkney. *Scottish Naturalist*: 88.
- MØBJERG, T., and J. ROSING. 2001. Folkekunst i Grønland gennem 1000 år. [Folk art in Greenland through 1000 years.] Borgens Forlag, København, 261 pp. [In Danish].
- ORDNANCE SURVEY. 1999. *Gazetteer of Great Britain*, 4th

- edition. Ordnance Survey, Southampton and Macmillan Reference Ltd., London, xvii + 791 pp.
- PALISOT DE BEAUVOIS, A. M. F. J. 1796. Catalogue raisonné du muséum de Mr. C. W. Peale, Philadelphia. Parent, Philadelphia, 42 pp.
- PARMESAN, C., N. RYRHOLM, C. STEFANESCU, J. K. HILL, C. D. THOMAS, H. DESCIMON, B. HUNTLEY, L. KAILA, J. KULLBERG, T. TAMMARU, *et al.* 1999. Poleward shifts in geographical ranges of butterfly species associated with regional warming. *Nature*, 399: 579–583.
- PARMESAN, C., and G. YOHE. 2003. A globally coherent fingerprint of climate change impacts across natural systems. *Nature*, 421: 37–42.
- PENNANT, T. 1784. Arctic zoology. Volume 1. Introduction. Class 1. Quadrupeds. Robert Faulder, London, 185 pp.
- PETERSEN, A. 1993. Leðurblökukomur til Íslands. [Arrival of bats in Iceland.] Pp. 347–351, in *Villt íslensk spendýr* (P. HERSTEINSSON and G. SIGBJARNARSON, eds.). Hið íslenska náttúrufræðifélag and Landvernd, Reykjavík, 351 pp. [In Icelandic].
- PETERSEN, A. 1994. Leðurblökur á Íslandi. [The occurrence of bats (order Chiroptera) in Iceland.] *Náttúrufræðingurinn*, 64 (1): 3–12. [Icelandic, with English summary].
- PETERSONS, G. 2004. Seasonal migrations of north-eastern populations of Nathusius' bat *Pipistrellus nathusii* (Chiroptera). *Myotis*, 41–42: 29–56.
- PÉTURSSON, G., and K. H. SKARPHÉDINSSON. 1978. Flækingsfuglar á SV-landi haustíð 1977. [Vagrant birds in SW-Iceland, autumn 1977.] *Náttúruverkur*, 5: 10–31. [In Icelandic, with English summary].
- PIERSON, E. D. 1998. Tall trees, deep holes, and scarred landscapes. Conservation biology of North American bats. Pp. 309–325, in *Bat biology and conservation* (T. H. KUNZ and P. A. RACEY, eds.). Smithsonian Institution Press, Washington D.C., xiv + 365.
- PREYER, W. 1862. Systematische Uebersicht der Rückgrathiere Islands. Pp. 375–434, in *Reise nach Island im Sommer 1860. (Mit wissenschaftlichen Anhängen)*. (W. PREYER and F. ZIRKEL). F. A. Brockhaus, Leipzig, 499 pp.
- PRYDATKO, V., V. MAKARENKO, and G. KOLOMYTSEV. 2011. Lesser Noctule (*Nyctalus leisleri*) habitats change modelling in EEBO Region in scope of the IMAGE climate change data: GLM-scenario by 2050. *Biomodel. Vefsíða*. <http://bio.model.info/species/lesser-noctule-nyctalus-leisleri/>.
- RACEY, P. A. 1977. A vagrant noctule in Orkney. *Journal of Zoology* (London), 183: 555–556.
- RACEY, P. A., E. M. BARRATT, T. M. BURLAND, R. DEAVILLE, D. GOTELLI, G. JONES, and S. B. PIERTNEY. 2007. Microsatellite DNA polymorphism confirms reproductive isolation and reveals differences in population genetic structure of cryptic pipistrelle bat species. *Biological Journal of the Linnean Society*, 90: 539–550.
- RACEY, P. A., I. J. MACKIE, and A. M. HUTSON. 2008. Genus *Vespertilio*. Pp. 361–362, in *Mammals of the British Isles: handbook*, 4th edition (S. HARRIS and D. W. YALDEN, eds.). The Mammal Society, Southampton, xiv + 799 pp.
- REBELO, H., P. TARROSO, and G. JONES. 2010. Predicted impact of climate change on European bats in relation to their biogeographic patterns. *Global Change Biology*, 16: 561–576.
- RITCHIE, J. 1927. A long flight — the particoloured bat (*Vespertilio murinus*) in Scotland. *Scottish Naturalist*: 101–103.
- ROLLAND, J., F. L. CONDAMINE, F. JIGUET, and H. MORLON. 2014. Faster speciation and reduced extinction in the tropics contribute to the mammalian latitudinal diversity gradient. *PLoS Biology*, 12: e1001775.
- RUSS, J. M. 2008. Species profile: Nathusius' pipistrelle. *Bat News*, 34 (Summer): 6–7.
- RUSS, J. M., J. K. O'NEILL, and W. I. MONTGOMERY. 1998. Nathusius' pipistrelle *Pipistrellus nathusii* (Keyserling & Blasius, 1839) breeding in Ireland. *Journal of Zoology* (London), 245: 345–349.
- RUSS, J. M., A. M. HUTSON, W. I. MONTGOMERY, P. A. RACEY, and J. R. SPEAKMAN. 2001. The status of Nathusius' pipistrelle (*Pipistrellus nathusii* Keyserling & Blasius, 1839) in the British Isles. *Journal of Zoology* (London), 254: 91–100.
- RYBERG, O. 1947. Studies on bats and bat parasites. *Svensk Natur*, Stockholm, 330 pp.
- RYDELL, J., K.-B. STRANN, and J. R. SPEAKMAN. 1994. First record of breeding bats above the Arctic Circle: northern bats at 68–70°N in Norway. *Journal of Zoology* (London), 233: 335–339.
- SCHREBER, J. C. D., VON. 1774 *Die Säugethiere in Abbildungen nach der Natur mit Beschreibungen*. 1(1). Leipzig, 188 pp.
- SHEIL, C. B., G. JONES, and D. WATERS. 2008. Genus *Nyctalus*. Pp. 334–338, in *Mammals of the British Isles: handbook*, 4th edition (S. HARRIS and D. W. YALDEN, eds.). The Mammal Society, Southampton, xiv + 799 pp.
- SHERWIN, H. A., W. I. MONTGOMERY, and M. G. LUNDY. 2013. The impact and implications of climate change for bats. *Mammal Review*, 43: 171–182.
- SIVONEN, Y., and T. WERMUNDSEN. 2008. Distribution and foraging habitats of bats in northern Finland: *Myotis daubentonii* occurs north of the Arctic Circle. *Vespertilio*, 12: 41–48.
- SIMMONS, N. B. 2005. Order Chiroptera. Pp. 312–529, in *Mammal species of the World: a taxonomic and geographic reference*, 3rd edition (D. E. WILSON and D. M. REEDER eds.). Johns Hopkins University Press, Baltimore, Volume 1: xxxv + 743 pp.
- SPEAKMAN, J. R., P. A. RACEY, A. M. HUTSON, P. I. WEBB, and A. M. BURNETT. 1991. Status of Nathusius' pipistrelle (*Pipistrellus nathusii*) in Britain. *Journal of Zoology* (London), 225: 685–690.
- SPEAKMAN, J. R., P. A. RACEY, J. MCLEAN, and A. C. ENTWISTLE. 1993. Six new records of Nathusius' pipistrelle *Pipistrellus nathusii* for Scotland. *Scottish Bats*, 2: 14–16.
- SPEAKMAN, J. R., P. A. RACEY, and J. RYDELL. 1995. Second British record for the Northern Bat *Eptesicus nilssonii*: from a North Sea oil platform. *Scottish Bats*, 3: 9.
- SPENCE, M. 1909. Pipistrelle bat in Orkney. *Annals of Scottish Natural History*: 47.
- STANSFIELD, G. 1966. Parti-coloured bat *Vespertilio murinus* L. from a North Sea drilling rig. *Journal of Zoology* (London), 150: 491–492.
- STEBBINGS, R. E. 1970. A bat new to Britain, *Pipistrellus nathusii*, with notes on its identification and distribution in Europe. *Journal of Zoology* (London), 161: 282–286.
- STEBBINGS, R. E. 1986. Which bat is it? A guide to bat identification in Great Britain and Ireland. The Mammal Society and The Vincent Wildlife Trust, London, 49 pp.
- STEBBINGS, R. E., D. W. YALDEN, and J. S. HERMAN. 2007. Which bat is it? A guide to bat identification in Great Britain and Ireland, 3rd edition. The Mammal Society, London, 48 pp.
- STRELKOV, P. 1969. Migratory and stationary bats (Chiroptera) of the European part of the Soviet Union. *Acta Zoologica Cracoviensia*, 14: 393–440.

- SWENSON, J. E., A. BJØRGE, K. KOVACS, P. O. SYVERTSEN, Ø. WIIG, and A. ZEDROSSER. 2010. Pattedyr Mammalia. Pp. 431–455, in Norsk Rødliste for arter 2010. The 2010 Norwegian Red List for Species (J. A. KALÁS, Å. VIKEN, S. HENRIKSEN, and S. SKJELSETH, eds.). Artsdatabanken, Trondheim, 480 pp.
- SWIFT, S. M. 2004. Bat species in Scotland. Pp. 1–39, in A review of European Bat Lyssavirus (EBLV) and the status of bats in Scotland (P. A. RACEY, R. RAYNOR and S. PRITCHARD, eds.). Scottish Natural Heritage Commissioned Report, No. 063, 121 pp.
- SYVERTSEN, P. O., T. A. STORMARK, M. NORDSETH, and T. STARHOLM. 1995. A tentative assessment of bat diversity and distribution in Norway. *Myotis*, 32–33: 183–191.
- SZTENCCEL-JABLONKA, A., and W. BOGDANOWICZ. 2012. Population genetics study of common (*Pipistrellus pipistrellus*) and soprano (*Pipistrellus pygmaeus*) pipistrelle bats from central Europe suggests interspecific hybridization. *Canadian Journal of Zoology*, 90: 1251–1260.
- THOMAS, C. D., and J. J. LENNON. 1999. Birds extend their ranges northwards. *Nature*, 399: 213.
- THORNE, R. H. F. 1983. Shetland animal studies. Education Committee, Shetland Islands Council, Shetland, 128 pp. [Not seen].
- TROUESSART, E.-L. 1897. *Catalogus mammalium tam viventium quam fossilium*. 1. R. Friedländer & Sohn, Berolini, 664 pp.
- TULLOCH, J. S. 1904. Bat in Shetland. *Annals of Scottish Natural History*: 125.
- VENABLES, L. S. V., and U. M. VENABLES. 1955. *Birds and Mammals of Shetland*. Oliver and Boyd, Edinburgh, xii + 391 pp.
- VISSER, M. E., and L. J. M. HOLLEMAN. 2001. Warmer springs disrupt the synchrony of oak and winter moth phenology. *Proceedings of the Royal Society of London*, 268B: 289–294.
- WALTHER, G.-R., E. POST, P. CONVEY, A. MENZEL, C. PARMESAN, T. J. C. BEEBEE, J.-M. FROMENTIN, O. HOEGH-GULDBERG, and F. BAIRLEIN. 2002. Ecological responses to recent climate change. *Nature*, 416: 389–395.
- WOLLEY, J. 1849. Occurrence of a foreign bat in Orkney. *Zoologist*, 7: 2343.
- WOLLEY, J. 1850. Occurrence of a foreign bat in Orkney. *Zoologist*, 8: 2813.
- YALDEN, D. W. 2008. Genus *Lasiurus*. Pp. 334, *Mammals of the British Isles: handbook*, 4th edition (S. HARRIS and D. W. YALDEN, eds.). The Mammal Society, Southampton, xiv + 799 pp.
- YALDEN, D. W., and P. A. MORRIS. 1975. *The lives of bats*. David and Charles, Newton Abbot, 247 pp.

*Received 14 January 2014, accepted 30 June 2014*



## APPENDIX I

## Details of the bats recorded from Iceland

Date	Locality	Coordinates	Species	Record	Institute	References
18th century	Iceland		xxxx	Si		Pennant (1784); Preyer (1862); Krzanowski (1977)
c 1817	Dýrafjörður, V-Ísf.	65.8756°N 23.4891°W	xxxx	Fd		Petersen (1994)
c 1936	Álfarhöll, A-Landeyjar, Rang.	63.6011°N 20.1394°W	xxxx	Fad		Petersen (1994)
9Oct.1943	Gerðisgarður, Hvoli, Mýrdalur, V-Skaft.	63.4325°N 19.2289°W	<i>Lasius cinereus</i>	Fad	NÍ	Guðmundsson (1943); Hayman (1959); Petersen (1994)
23Aug.1944	Skúlagata: Hús Fiskifélags, Reykjavík	64.1491°N 21.9309°W	<i>Myotis lucifugus</i>	Fad	NÍ	Guðmundsson (1944); Ryberg (1947); Hayman (1959); Petersen (1994)
1955to1960	Svelgsá, Helgafellssveit, Snæf.	64.9949°N 22.6698°W	xxxx	Si		
8Oct.1957	Bjarnastaðir, Selvogur, Arn.	63.8280°N 21.6707°W	<i>Lasius cinereus</i>	Fad	NÍ	Guðmundsson (1957); Hayman (1959); Petersen (1994)
9Dec.1957	Heimaey, Vestmannaeyjar	63.4376°N 20.2726°W	<i>L. cinereus</i>	Fad	NÍ	Baldursdóttir (1960); Koopman and Guðmundsson (1966); Petersen (1994)
15Nov.1958	Fíjótur, Meðalland, V-Skaft.	63.6187°N 17.9992°W	xxxx	Si		Petersen (1994)
1Oct.1964	Ragnheiðarstaðir, Flói, Arn	63.7982°N 20.8272°W	<i>Lasius cinereus</i>	Sh	NÍ	Jakobsson (1967); Koopman and Guðmundsson (1966); Petersen (1994)
autumn1967	At sea, Eldeyjarbanki	63.7000°N 24.2500°W	xxxx	Si		Petersen (1994)
8Aug.1970	Pálsbær, Surtsey, Vestmannaeyjar	63.3066°N 20.6034°W	xxxx	Si		Petersen (1994)
21Oct.1971	Skólabraut 11, Seltjarnarnes	64.1516°N 21.9916°W	<i>Pipistrellus nathusii</i>	Fd	NÍ	Petersen (1994)
24Aug.1981	Sundahöfn harbour, Reykjavík	64.1507°N 21.8610°W	<i>Myotis lucifugus</i>	Fd	NÍ	Petersen (1994)
24Aug.1981	Sundahöfn harbour, Reykjavík	64.1507°N 21.8610°W	<i>Myotis septentrionalis</i>	Fd	NÍ	Petersen (1994)
24Aug.1981	Sundahöfn harbour, Reykjavík	64.1507°N 21.8610°W	xxxx	Fdd		Petersen (1994)
22Nov.1985	Varrir, Garður, Miðnes, Gull.	64.0682°N 22.6403°W	<i>Pipistrellus nathusii</i>	Fd	NÍ	Petersen (1994)
15Aug.1993	Hvassaberg 12, Hafnarfjarðarbær	64.0708°N 21.9358°W	<i>Myotis septentrionalis</i>	Fad	NÍ	
6Sep.1999	Björk, Hvolsvöllur, Rang.	63.7498°N 20.2335°W	xxxx	Si		
2Mar.2000	Súðarvogur 2f, Reykjavík	64.1288°N 21.8471°W	<i>Eptesicus fuscus</i>	Fad	NÍ	
7Mar.2000	Efmissalan, Smiðjuvegur 9, Kópavogur	64.1119°N 21.8505°W	<i>Pipistrellus nathusii</i>	Fad	NÍ	
6May.2000	Reykjavík domestic airport	64.1312°N 21.9448°W	<i>Nyctalus leisleri</i>	Fae	NÍ	
4Aug.2000	Eskifjarðarbær	65.0758°N 14.0240°W	xxxx	Fd		
30Sep.2001	Dalatangi, S-Múl.	65.2691°N 13.5766°W	xxxx	Si		
11May.2003	Strandvegur, Heimaey, Vestmannaeyjar	63.4423°N 20.2719°W	<i>Pipistrellus nathusii</i>	Fad	NÍ	
11May.2003	Strandvegur, Heimaey, Vestmannaeyjar	63.4423°N 20.2719°W	xxxx	Si		
26Mar.2004	Rúmftalagerinn, Skeifan 13, Reykjavík	64.1308°N 21.8686°W	<i>Pipistrellus</i>	Fd	NK	
24Oct.2004	Ytra-Áland, Þistilfjörður, N-Þing.	66.2106°N 15.5495°W	<i>Vesperugo murinus</i>	Fae	NÍ	
7Mar.2006	Melabraut 20, Hafnarfjarðarbær	64.0583°N 21.9731°W	<i>Pipistrellus nathusii</i>	Fae	NÍ	
16Nov.2006	Fríholt 2, Garður, Miðnes, Gull.	64.0678°N 22.6526°W	xxxx	Si		
22Apr.2008	Digranes Church, Kópavogur	64.1078°N 21.8862°W	xxxx	Si		
14Nov.2008	Álfanes swimming centre	64.1044°N 22.0187°W	xxxx	Fad		
16Jun.2010	Reykjavík harbour	64.1492°N 21.8588°W	<i>Nyctalus noctula</i>	Fae	NÍ	
8Oct.2010	Faxabraut 30, Reykjanesbær	63.9967°N 22.5583°W	xxxx	Si		
12Oct.2010	Svöluhöfði 9, Mosfellsbær	64.1710°N 21.7216°W	xxxx	Si		
25Aug.2011	Grundartangi harbour, Hvalfjörður, Borg.	64.3567°N 21.7766°W	<i>Vesperugo murinus</i>	Fad	NÍ	
24Jan.2012	Efmissalan, Smiðjuvegur 9, Kópavogur	64.1119°N 21.8505°W	<i>Pipistrellus nathusii</i>	Fae	NÍ	

Key to abbreviations. Record codes: Cr — caught and released; F — found; Fa — found alive; died; Fad — found alive, euthanased; Fd — found dead; Fdd — found dead, discarded; Ph — photograph; Sh — shot; Si — sight record. Institutions: NÍ — Náttúrufræðistofnun Íslands (Icelandic Institute of Natural History); NK — Náttúrufræðistofa Kópavogs (Natural History Museum of Kópavogur, Iceland). Unidentified bats — xxxx

## APPENDIX II

Details of the bats recorded from the Faroe Islands

Date	Locality	Coordinates	Species	Record	Institute	References
c1964	Í Trøðum, Sandoy	61.8374°N 6.8095°W	xxxx	Si		Baagøe & Bloch (1994)
c1970	Hvalba, Suðuroy	61.5979°N 6.9578°W	xxxx	Si		Baagøe & Bloch (1994)
c1980	Sandavágur, Vágoy	62.0502°N 7.1679°W	xxxx	Si		Baagøe & Bloch (1994)
21Jul.1984	Mykines bygd, Mykines	62.1026°N 7.6509°W	<i>Myctalus leisteri</i>	Fad	FN	Baagøe & Bloch (1994)
1986	Vestmanna, Stremoy	62.1602°N 7.1542°W	xxxx	Si		Baagøe & Bloch (1994)
17Feb.1987	Miðvágur, Vágoy	62.0483°N 7.2036°W	<i>Pipistrellus nathusii</i>	Fad	FN	Baagøe & Bloch (1994)
27Dec.1987	Nólsoy bygd, Nólsoy	62.0096°N 6.6739°W	<i>P. nathusii</i>	Fad	FN	Baagøe & Bloch (1994)
27Jun.1988	Sandavágur, Vágoy	62.0502°N 7.1679°W	<i>Vespertilio murinus</i>	Fad	FN	Baagøe & Bloch (1994)
1Nov.1989	At sea, Munkagrundin, S of Suðuroy.	61.0500°N 6.3500°W	xxxx	Si		Baagøe & Bloch (1994)
8Jan.1992	Sumba, Suðuroy	61.4043°N 6.7147°W	<i>Pipistrellus nathusii</i>	Fad	FN	Baagøe & Bloch (1994)
1Oct.1992	Lopra, Suðuroy	61.4427°N 6.7758°W	<i>P. nathusii</i>	Fad	FN	Baagøe & Bloch (1994)
2Nov.1993	Skopun, Sandoy	61.9035°N 6.8786°W	xxxx	Cr		
3Nov.1993	Tórshavn, Stremoy	62.0197°N 6.7837°W	xxxx	Si		
3Nov.1993	Hvalba, Suðuroy	61.5979°N 6.9578°W	xxxx	Si		
25Nov.1993	Skopun, Sandoy	61.9035°N 6.8786°W	<i>Pipistrellus nathusii</i>	Si	FN	
25May1994	Hvalba, Suðuroy	61.5979°N 6.9578°W	<i>Eptesicus nilssonii</i>	Fad	FN	
3Nov.1994	Lervík, Eysturoy	62.2116°N 6.7133°W	xxxx	Si		
13Mar.1995	Nólsoy bygd, Nólsoy	62.0096°N 6.6739°W	xxxx	Si		
6Oct.1999	Skúvoy bygd, Skúvoy	61.7769°N 6.8076°W	xxxx	Si		
25Sep.2000	Nólsoy bygd, Nólsoy	62.0096°N 6.6739°W	xxxx	Si		
24Oct.2000	Nólsoy bygd, Nólsoy	62.0096°N 6.6739°W	xxxx	Si		
31Oct.2000	Hvalba, Suðuroy	61.5979°N 6.9578°W	<i>Pipistrellus nathusii</i>	Fad	FN	
2000	Klaksvík, Borðoy	62.2310°N 6.5856°W	<i>P. nathusii</i>	Fd	FN	
11Dec.2000	Klaksvík, Borðoy	62.2310°N 6.5856°W	xxxx	Si		
16Jun.2001	Tórshavn, Stremoy	62.0121°N 6.7774°W	xxxx	Si		
2Jun.2002	Velbastad, Stremoy	61.9835°N 6.8544°W	<i>Pipistrellus nathusii</i>	Fad	FN	
27Jul.2004	Nólsoy bygd, Nólsoy	62.0096°N 6.6739°W	xxxx	Si		
17Oct.2005	Nes, Hvalba, Suðuroy	61.5932°N 6.9252°W	<i>Pipistrellus nathusii</i>	Fad		
27Apr.2007	Hógvík, Stremoy	62.0345°N 6.7815°W	<i>Eptesicus serotinus</i>	Fd		
9Aug.2007	Tórshavn, Stremoy	62.0048°N 6.7722°W	xxxx	Si		
15Sep.2008	Nólsoy bygd, Nólsoy	62.0096°N 6.6739°W	<i>Pipistrellus nathusii</i>	Fad		
15Sep.2008	Nólsoy bygd, Nólsoy	62.0096°N 6.6739°W	xxxx	Si		
23Sep.2008	Tórshavn, Stremoy	62.0065°N 6.7841°W	xxxx	Si		
23Sep.2008	Hvannasund, Viðoy	62.2957°N 6.5183°W	xxxx	Ph		
25Sep.2008	Nólsoy bygd, Nólsoy	62.0096°N 6.6739°W	<i>Pipistrellus nathusii</i>	Fad		

## APPENDIX II

Continued

Date	Locality	Coordinates	Species	Record	Institute	References
25Sep.2008	Nólsoy bygd, Nólsoy	62.0096°N 6.6739°W	xxxx	Si		
19Oct.2008	Vági, Suðuroy	61.4732°N 6.8242°W	xxxx	Si		
7Nov.2008	Fróðba, Suðuroy	61.5466°N 6.7710°W	xxxx	Si		
30Jun.2009	Mykines bygd, Mykines	62.1026°N 7.6509°W	xxxx	Si		
22Aug.2009	Nólsoy bygd, Nólsoy	62.0096°N 6.6739°W	xxxx	Si		
15Sep.2009	Nólsoy bygd, Nólsoy	62.0096°N 6.6739°W	<i>Pipistrellus nathusii</i>	Cr		
15Sep.2009	Nólsoy bygd, Nólsoy	62.0096°N 6.6739°W	xxxx	Si		
25Oct.2009	Hógvík, Stremoy	62.0325°N 6.7799°W	xxxx	Si		
1Dec.2009	Hvalba, Suðuroy	61.5979°N 6.9578°W	<i>Pipistrellus</i>	Fd		
16Jan.2010	Nólsoy bygd, Nólsoy	62.0096°N 6.6739°W	<i>Pipistrellus nathusii</i>	Fad	FN	
1May.2010	Klaksvík, Borðoy	62.2280°N 6.5937°W	xxxx	Ph		
12Sep.2010	Hvalba, Suðuroy	61.5979°N 6.9578°W	<i>Vespertilio murinus</i>	Fad		
12Sep.2010	Víkarbyrgi, Suðuroy	61.4417°N 6.7278°W	<i>Pipistrellus nathusii</i>	Fad		
14Sep.2010	Nólsoy bygd, Nólsoy	62.0096°N 6.6739°W	xxxx	Si		
14Sep.2010	Norðagøta, Eysturoy	62.1966°N 6.7360°W	xxxx	Si		
14Sep.2010	Norðoyri, Borðoy	62.2015°N 6.5321°W	xxxx	Si		
15Sep.2010	Skopun, Sandoy	61.9035°N 6.8786°W	xxxx	Si		
18Sep.2010	Tórshavn, Stremoy	62.0104°N 6.7604°W	xxxx	Si		
20Sep.2010	Nólsoy bygd, Nólsoy	62.0096°N 6.6739°W	xxxx	Sr		
20Sep.2010	Svínoy bygd, Svínoy	62.2825°N 6.3388°W	xxxx	Si		
26Sep.2010	Tórshavn, Stremoy	62.0062°N 6.7927°W	xxxx	Sr; Ph		
26Sep.2010	Hvalba, Suðuroy	61.5979°N 6.9578°W	xxxx	Si		
27Sep.2010	Tórshavn, Stremoy	62.0012°N 6.7822°W	xxxx	Ph		
27Sep.2010	Nólsoy bygd, Nólsoy	62.0096°N 6.6739°W	xxxx	Sr		
28Sep.2010	Norðoyri, Borðoy	62.2015°N 6.5321°W	xxxx	Si		
29Sep.2010	Fuglaifjørður, Eysturoy	62.2430°N 6.8170°W	xxxx	Si		
29Sep.2010	Rituvík, Eysturoy	62.1048°N 6.6790°W	xxxx	Ph		
3Oct. 2010	Tórshavn, Stremoy	62.0069°N 6.7847°W	xxxx	Sr		
3Oct. 2010	Tórshavn, Stremoy	62.0201°N 6.7659°W	xxxx	Si		
3Oct.2010	Tvøroyri, Suðuroy	61.5575°N 6.8146°W	xxxx	Si		
4Oct.2010	Tvøroyri, Suðuroy	61.5575°N 6.8146°W	xxxx	Ph		
4Oct.2010	Skála, Eysturoy	62.1118°N 6.7581°W	xxxx	Si		
6Oct. 2010	Tórshavn, Stremoy	62.0121°N 6.7795°W	xxxx	Sr		
8Oct.2010	Tinganes, Tórshavn, Stremoy	62.0087°N 6.7705°W	xxxx	Si		
8Oct.2010	Hattarvík, Fugloy	62.3300°N 6.2770°W	xxxx	Si		

## APPENDIX II

Continued

Date	Locality	Coordinates	Species	Record	Institute	References
8Oct.2010	Hattarvík, Fugloy	62.3300°N 6.2770°W	xxxx	Ph		
9Oct.2010	Nólsoy bygd, Nólsoy	62.0096°N 6.6739°W	xxxx	Sr		
9Oct.2010	Klaksvík, Borðoy	62.2273°N 6.5818°W	xxxx	Cr; Ph		
10Oct.2010	Mykines bygd, Mykines	62.1026°N 7.6509°W	xxxx	Si		
10Oct.2010	Sandvík, Suðuroy	61.6297°N 6.9348°W	xxxx	Si		
10Oct.2010	Hvannasund, Viðoy	62.2957°N 6.5183°W	xxxx	Si		
11Oct.2010	Klaksvík, Borðoy	62.2310°N 6.5856°W	xxxx	Si		
12Oct.2010	Norðagøta, Eysturoy	62.2004°N 6.7441°W	xxxx	Si		
13Oct.2010	Nólsoy bygd, Nólsoy	62.0096°N 6.6739°W	xxxx	Sr		
13Oct.2010	Kirkja, Fugloy	62.3247°N 6.3302°W	xxxx	Si		
15Oct.2010	Tjørnuvík, Stremoy	62.2892°N 7.1521°W	xxxx	Si		
15Oct.2010	Hvalba, Suðuroy	61.5979°N 6.9578°W	xxxx	Si		
15Oct.2010	Viðareiði, Viðoy	62.3598°N 6.5317°W	xxxx	Si		
26Oct.2010	Nólsoy bygd, Nólsoy	62.0096°N 6.6739°W	xxxx	Sr		
26Oct.2010	Tinganes, Tórshavn, Stremoy	62.0087°N 6.7705°W	xxxx	Si		
26Oct.2010	Tórshavn, Stremoy	62.0155°N 6.7829°W	xxxx	Si		
2Nov. 2010	Marknargarjilvegir, Tórshavn, Stremoy	62.0084°N 6.8021°W	xxxx	Si		
24Feb.2011	Mykines bygd, Mykines	62.1026°N 7.6509°W	<i>Pipistrellus nathusii</i>	Fad		
8Apr.2011	Tórshavn, Stremoy	62.0390°N 6.8001°W	<i>P. nathusii</i>	Fad	FN	
16Apr.2011	Nólsoy bygd, Nólsoy	62.0096°N 6.6739°W	xxxx	Si		
17Apr.2011	Tórshavn, Stremoy	62.0177°N 6.7784°W	xxxx	Si		
1Jun.2011	Hvalba, Suðuroy	61.5979°N 6.9578°W	<i>Pipistrellus nathusii</i>	Fad	FN	
18Jun.2011	Tórshavn, Stremoy	62.0008°N 6.7797°W	xxxx	Sr		
19Jun.2011	Tórshavn, Stremoy	62.0008°N 6.7797°W	xxxx	Si		
12Aug.2012	Nólsoy bygd, Nólsoy	62.0096°N 6.6739°W	xxxx	Si		
23Oct.2012	Kvivík, Stremoy	62.1162°N 7.0429°W	xxxx	Si		

Key to abbreviations. Record codes: Cr — caught and released; Fa — found alive; Fad — found alive, died; Fd — found dead; Ph — photograph; Si — sight record; Sr — sonar recording / bat detector. Institutions: FN — Føroya Náttúrugripasavn (Faroese Museum of Natural History, Tórshavn, Faroe Islands). Unidentified bats — xxxx

## APPENDIX III

## Details of the bats recorded from the Shetland Islands

Date	Locality	Coordinates	Species	Record	Institute	References
1774	Unst	60.7633°N 0.8717°W	xxxx			Low, 1879; Tulloch, 1904; Venables and Venables, 1955
1815	Shetland		xxxx			Laing, 1815; Venables and Venables, 1955
1904	North Roe, Mainland	60.5700°N 1.3717°W	<i>Pipistrellus</i>			Tulloch, 1904; Venables and Venables, 1955; SBRC
31Mar.1927	Whalsay	60.3517°N 0.9767°W	<i>Iespertilio murinus</i>			Ritchie, 1927; Venables and Venables, 1955; Corbet, 1970
2Nov.1940	Isbister, Whalsay	60.3517°N 0.9583°W	<i>Pipistrellus nathusii</i>		NMS	Herman, 1992; Haddow and Herman, 1997; SBRC
Dec.1947	Lerwick, Mainland	60.1550°N 1.1450°W	<i>Plecotus auritus</i>	Fa		Venables and Venables, 1955; SBRC
24Jul.1968	Nissetter, Ollaberry, Mainland	60.5067°N 1.3367°W	<i>Nyctalus leisleri</i>			Corbet, 1970
25Jul.1977	Burraoe, Yell	60.5867°N 1.3167°W	<i>Nyctalus noctula</i>			Thorne, 1983; SBRC
24Aug.1978	Ollaberry, Mainland	60.5066°N 1.3367°W	<i>Nyctalus leisleri</i>			SBRC
19Nov.1981	Anderson High School, Lerwick, Mainland	60.1550°N 1.1450°W	<i>Iespertilio murinus</i>			SBRC
3Oct.1982	Sumburgh, Mainland	59.8683°N 1.2783°W	<i>Pipistrellus</i>			SBRC
1983	Reafirth, Yell	60.6033°N 1.0600°W	<i>Plecotus auritus</i>			Thorne, 1983; SBRC
26Oct.1984	Unst	60.7633°N 0.8717°W	<i>Pipistrellus</i>			SBRC
16Nov.1984	Mid Yell	60.5950°N 1.0600°W	<i>Iespertilio murinus</i>			SBRC
20Aug.1986	Asta, Mainland	60.1567°N 1.2533°W	<i>Nyctalus noctula</i>	Fa		SBRC
12Mar.1987	Sumburgh Airport, Mainland	59.8783°N 1.2950°W	<i>Plecotus auritus</i>			SBRC
9Oct.1987	Lerwick, Mainland	60.1550°N 1.1450°W	<i>Pipistrellus</i>			SBRC
23Nov.1987	Voe, Mainland	60.3502°N 1.2675°W	<i>Nyctalus noctula</i>			SBRC
15Dec.1987	Tingwall, Mainland	60.1917°N 1.2350°W	<i>Pipistrellus nathusii</i>			Russ <i>et al.</i> , 2001; SBRC
3May.1989	Fair Isle	59.5283°N 1.6033°W	<i>P. nathusii</i>			Russ <i>et al.</i> , 2001; SBRC
7Sep.1989	Mainland		<i>P. nathusii</i>		NMS	Haddow and Herman, 1997; Russ <i>et al.</i> , 2001
13Sep.1989	Levenwick, Mainland	59.9767°N 1.2750°W	<i>P. nathusii</i>			Speakman <i>et al.</i> , 1991; Russ <i>et al.</i> , 2001; SBRC
7Feb.1990	Shetland		<i>P. nathusii</i>			Russ <i>et al.</i> , 2001
6Mar.1991	Whalsay	60.3517°N 0.9767°W	<i>Pipistrellus</i>			SBRC
Jun.1991	Burraoe, Yell	60.5867°N 1.3167°W	<i>Pipistrellus</i>			SBRC
18Oct.1991	Whalsay	60.3517°N 0.9767°W	<i>Eptesicus serotinus</i>			SBRC; Swift, 2004
24Jan.1992	Garderhouse, Sand, Mainland	60.2200°N 1.3967°W	<i>Pipistrellus nathusii</i>			Speakman <i>et al.</i> , 1993; Russ <i>et al.</i> , 2001; SBRC
4Feb.1992	Baltersound, Unst	60.7633°N 0.8717°W	<i>P. nathusii</i>			Speakman <i>et al.</i> , 1993; Russ <i>et al.</i> , 2001; SBRC
16May.1992	Whalsay	60.3517°N 0.9767°W	<i>Pipistrellus</i>			SBRC
28Oct.1993	Burraoe, Yell	60.5867°N 1.3167°W	<i>Pipistrellus nathusii</i>			Russ <i>et al.</i> , 2001; SBRC
3Oct.1994	Sandwick, Mainland	59.9967°N 1.2237°W	<i>P. nathusii</i>			Russ <i>et al.</i> , 2001; SBRC
16Oct.1996	Norwick, Unst	60.8083°N 0.7967°W	<i>P. nathusii</i>			Russ <i>et al.</i> , 2001; SBRC
16Oct.1996	East Burrafirth, Mainland	60.3000°N 1.3400°W	<i>Nyctalus leisleri</i>	Fa		SBRC
13Nov.1998	Whalsay	60.3517°N 0.9767°W	<i>Pipistrellus nathusii</i>			Russ <i>et al.</i> , 2001; SBRC

## APPENDIX III

Continued

Date	Locality	Coordinates	Species	Record	Institute	References
Nov.2001	Mid Yell	60.5950°N 1.0600°W	<i>Vesperugo murinus</i>			Racey <i>et al.</i> , 2008
24Mar.2003	Haroldswick, Unst	60.7900°N 0.8350°W	<i>Pipistrellus</i>	Ph		SBRC
24Aug.2003	RAF Camp, Haroldswick, Unst	60.7900°N 0.8350°W	<i>Vesperugo murinus</i>	Cr; Ph		SBRC
2Sep.2005	Veensgarth	60.1833°N 1.2350°W	xxxx	Si		SBRC
16Sep.2006	Bakland, Lerwick	60.1550°N 1.1450°W	xxxx	Si		SBRC
11Oct.2006	Sumburgh	59.8683°N 1.2783°W	<i>Pipistrellus</i>	Ph		SBRC
25Oct.2006	Swinister, Sandwick	60.0033°N 1.2567°W	<i>Pipistrellus</i>	Si		SBRC
10Dec.2008	Haroldswick	60.7900°N 0.8350°W	<i>Pipistrellus</i>	Cr; Ph		SBRC
9Jan.2009	South Trondra	60.1200°N 1.2900°W	<i>Pipistrellus</i>	Fd		SBRC
23Feb.2009	Pullar's Loch, Ness of Sound, Lerwick	60.1283°N 1.1633°W	xxxx	Si; Ph		SBRC
23Jun.2009	Bell's Brae school, Lerwick	60.1550°N 1.1450°W	<i>Vesperugo murinus</i>	Fa; Ph		SBRC
30Jun.2010	Westerloch Brae, Lerwick	60.1550°N 1.1450°W	xxxx	Si		SBRC
14Sep.2010	Ordale, Baltasound	60.7450°N 1.8367°W	xxxx	Si		SBRC
3Oct.2010	Lerwick	60.1550°N 1.1450°W	<i>Pipistrellus</i>	Ph		SBRC
16Nov.2010	Baliasta, Unst	60.7633°N 0.8900°W	xxxx	Si		SBRC
26Feb.2011	Skaw, Unst	60.8250°N 0.7783°W	xxxx	Si		SBRC
28?Feb.2011	Norwick	60.8083°N 0.7967°W	xxxx	Si; Ph		SBRC
10Jun.2011	Whalsay	60.3517°N 0.9767°W	<i>Myotis leisleri</i> ?	Fa; Ph		SBRC
15Jun.2011	Noss, Spiggie	59.9317°N 1.3650°W	<i>Vesperugo murinus</i>	Fd; Ph		SBRC
29Aug.2011	Baliasta, Unst	60.7633°N 0.8900°W	<i>Pipistrellus</i>	F		SBRC
30Oct.2011	Burrafirth	60.8000°N 0.8700°W	xxxx	Si		SBRC
16Dec.2012	Shore Station, Burrafirth, Unst	60.8000°N 0.8700°W	<i>Myotis leisleri</i> ?	Fa; Ph		SBRC

Key to abbreviations. Record codes: Cr — caught and released; F — found; Fa — found alive; Fd — found alive, died; Fd — found dead; Ph — photograph; Si — sight record. Institutions: NMS — National Museums of Scotland; SBRC — Shetland Biological Records Centre. Unidentified bats — xxxx

## APPENDIX IV

## Details of the bats recorded from the Orkney Islands

Date	Locality	Coordinates	Species	Record	Institute	References
c.Sep.1847	South Ronaldsay	58.7900°N 2.9617°W	<i>Lasturus cinereus</i>	Fad		Wolley, 1849; Barrett-Hamilton, 1910–11; Corbet, 1970; Stebbings, 1986; Hill and Yalden, 1990
Sep.1908	Deerness, Mainland	58.9433°N 2.7217°W	<i>Pipistrellus pipistrellus</i>	Fad		Spence, 1909; Barrett-Hamilton, 1910–11
18Feb.1931	Start Point, Sanday	59.2767°N 2.3783°W	<i>/pygmaeus</i>	Fa		Marwick, 1931; Booth, 1986
11Oct.1948	Roseness, Holm	58.8717°N 2.8250°W	<i>Plecotus auritus</i>	Fa		Booth, 1986
14Jun.1976	Close to lighthouse, North Ronaldsay	59.3833°N 2.3833°W	<i>P. auritus</i>	Fa		Racey, 1977
29Sep.1978	Backaskail, Sanday	59.2400°N 2.6233°W	<i>Nyctalus noctula</i>	Fad		Booth, 1979
26Dec.1979	Near Pumping Station, Wideford Reservoir, Mainland	58.9600°N 2.9300°W	<i>N. noctula</i>	F		Booth, 1980
18-25Aug.1987	Banks Farm, Sandwick, Mainland	59.0567°N 3.3000°W	<i>Pipistrellus</i>	Si		Booth, 1989
25Oct.1988	Claybraes, South Ronaldsay	58.7900°N 2.9617°W	<i>Plecotus auritus</i>	Cr		Booth, 1989
1991	Stromness, Mainland	58.9667°N 3.2967°W	<i>Nyctalus noctula</i>	Si		Booth, 1992
13Apr.1991	North Ronaldsay	59.3667°N 2.4317°W	<i>Pipistrellus?</i>	Si		Booth, 1992
Jun.1991	Melsetter, Hoy	58.7867°N 3.2717°W	xxxx	Si		Booth, 1992
Jul.1991	Melsetter, Hoy	58.7867°N 3.2717°W	xxxx	Si		Booth, 1992
1Jul.1991	Ley House, Hoy	58.9117°N 3.3467°W	xxxx	Si		Booth, 1992
18Aug.1991	St Peter's Church, Skaill, Deerness, Mainland	58.9433°N 2.7217°W	xxxx	Si		Booth, 1992
Aug.1991	Melsetter, Hoy	58.7867°N 3.2717°W	xxxx	Si		Booth, 1992
1991	Franklin Road and Back Road area, Stromness, Mainland	58.9667°N 3.2967°W	xxxx	Si		Booth, 1992
12Sep.1991	Hillside Road, Stromness, Mainland	58.9667°N 3.2967°W	xxxx	Si		Booth, 1992
Jun.1992	Melsetter, Hoy	58.7867°N 3.2717°W	xxxx	Si		Booth, 1993
19-21Aug.1992	Balfour Castle, Shapinsay	59.0317°N 2.9150°W	xxxx	Si		Booth, 1993
25Sep.1992	Holland House, North Ronaldsay	59.3667°N 2.4317°W	<i>Nyctalus</i>	Si		Booth, 1993
2Sep.1992	Holland House, North Ronaldsay	59.3667°N 2.4317°W	<i>Nyctalus</i>	Si		Booth, 1993
10Sep.1992	North Ronaldsay	59.3667°N 2.4317°W	xxxx	Si		Booth, 1993
23-24Sep.1992	Elsness, Sanday	59.2317°N 2.5700°W	xxxx	Si		Booth, 1993
6Nov.1992	Jewson's woodyard, Kirkwall, Mainland	58.9783°N 2.9483°W	<i>Pipistrellus pipistrellus</i>	Fd		Booth, 1993
Jun.1993	Melsetter, Hoy	58.7867°N 3.2717°W	<i>/pygmaeus</i>	Si		Booth, 1994
Jul.1993	Melsetter, Hoy	58.7867°N 3.2717°W	xxxx	Si		Booth, 1994
Aug.1993	Melsetter, Hoy	58.7867°N 3.2717°W	xxxx	Si		Booth, 1994
Sep.1993	Melsetter, Hoy	58.7867°N 3.2717°W	xxxx	Si		Booth, 1994
Oct.1993	Melsetter, Hoy	58.7867°N 3.2717°W	xxxx	Si		Booth, 1994
5-9Oct.1993	Frustigarth, Shapinsay	59.0500°N 2.8283°W	xxxx	Si		Booth, 1994
7-8Oct.1993	Roe Farm, Sanday	59.2500°N 2.5883°W	xxxx	Si		Booth, 1994
15Oct.1993	Bu, Hoy	58.9200°N 3.3300°W	xxxx	Si		Booth, 1994

## APPENDIX IV

Continued

Date	Locality	Coordinates	Species	Record	Institute	References
19Oct.1993	North Ronaldsay Bird Observatory	59.3567°N 2.4417°W	xxxx	Si		Booth, 1994
11May.1994	Beafield, Sanday	59.2500°N 2.5533°W	<i>Pipistrellus</i>	Cr		Booth, 1995
24May.1994	Melsetter, Hoy	58.7867°N 3.2717°W	<i>Pipistrellus pipistrellus</i>	Si; Sr		Holmes, 1994; Holmes <i>et al.</i> , 1995; Booth, 1995
25May.1994	Melsetter, Hoy	58.7867°N 3.2717°W	<i>P. pipistrellus</i>	Si; Sr		Holmes, 1994; Holmes <i>et al.</i> , 1995; Booth, 1995
26May.1994	Melsetter, Hoy	58.7867°N 3.2717°W	<i>P. pipistrellus</i>	Si; Sr		Holmes, 1994; Holmes <i>et al.</i> , 1995; Booth, 1995
2May.1995	Melsetter, Hoy	58.7867°N 3.2717°W	<i>P. pipistrellus?</i>	Si		Booth, 1996
12Jun.1995	Lythes, South Ronaldsay	58.7900°N 2.9433°W	<i>Pipistrellus nathusii</i>	Fad	NSM	Booth, 1996; Haddow and Herman, 1997; Russ <i>et al.</i> , 2001
29Jun.1995	Melsetter, Hoy	58.7867°N 3.2717°W	<i>Pipistrellus pipistrellus?</i>	Si		Booth, 1996
29Jun.1995	Willowburn Road, Kirkwall, Mainland	58.9783°N 2.9483°W	<i>P. pipistrellus?</i>	Fad		Booth, 1996
17Sep.1995	North Manse and lighthouse, North Ronaldsay	59.3667°N 2.4317°W	xxxx	Si		Booth, 1996
20Oct.1995	Honeysgoe, South Ronaldsay	58.8250°N 2.8933°W	xxxx	Si		Booth, 1996
Oct.1995	Roeberry, South Ronaldsay	58.8250°N 2.9967°W	xxxx	Si		Booth, 1996
9Nov.1995	North Ronaldsay Bird Observatory	59.3567°N 2.4417°W	xxxx	Si		Booth, 1996
20May.1996	Melsetter, Hoy	58.7867°N 3.2717°W	<i>Pipistrellus pipistrellus?</i>	Si		Booth, 1997
11Aug.1996	Bewan Croft, North Ronaldsay	59.3667°N 2.4317°W	xxxx	Si		Booth, 1997
13Aug.1996	Lighthouse, North Ronaldsay	59.3667°N 2.4317°W	xxxx	Si		Booth, 1997
14-15Aug.1996	Finstown, Mainland	59.0033°N 3.1233°W	xxxx	Si		Booth, 1997
25Sep.1996	Honeysgoe, South Ronaldsay	58.8250°N 2.8933°W	xxxx	Si		Booth, 1997
25Sep.1996	Holland, North Ronaldsay	59.3667°N 2.4317°W	xxxx	Si		Booth, 1997
18Mar.1997	Scapa Distillery, Hoy	58.9517°N 2.9833°W	<i>Pipistrellus</i>	Fad		Booth, 1998
29May.1997	Melsetter, Hoy	58.7867°N 3.2717°W	<i>Pipistrellus pipistrellus?</i>	Si		Booth, 1998
Jun.1997	Burra House and Orgil Farm, Hoy	58.9117°N 3.3467°W	xxxx			Booth, 1998
Apr.1998	Melsetter, Hoy	58.7867°N 3.2717°W	<i>Pipistrellus pipistrellus</i>	Si; Sr		Booth, 1999
May.1998	Melsetter, Hoy	58.7867°N 3.2717°W	<i>P. pipistrellus</i>	Si; Sr		Booth, 1999
Jun.1998	Melsetter, Hoy	58.7867°N 3.2717°W	<i>P. pipistrellus</i>	Si; Sr		Booth, 1999
2Jun.1998	Bu Farm, Hoy	58.9200°N 3.3300°W	xxxx	Si		Booth, 1999
11Jul.1998	Bu, Hoy	58.9200°N 3.3300°W	xxxx	Si		Booth, 1999
Jul.1998	Melsetter, Hoy	58.7867°N 3.2717°W	<i>Pipistrellus pipistrellus</i>	Si; Sr		Booth, 1999
Aug.1998	Melsetter, Hoy	58.7867°N 3.2717°W	<i>P. pipistrellus</i>	Si; Sr		Booth, 1999
Sep.1998	Melsetter, Hoy	58.7867°N 3.2717°W	<i>P. pipistrellus</i>	Si; Sr		Booth, 1999
1998	Quoyloo, Sandwick, Mainland	59.0650°N 3.3167°W	xxxx	Fd		Booth, 1999
12Jul.1999	Blackhamar, Rousay	59.1650°N 3.0767°W	xxxx	Si		Booth, 2000
15-16Jul.1999	Scar, Sanday	59.2950°N 2.5717°W	xxxx	Si		Booth, 2000
22Jul.1999	Rousay	59.1567°N 3.0417°W	xxxx	Si		Booth, 2000
24Sep.1999	Berstone Loan, St Ola, Mainland	58.9683°N 2.9650°W	xxxx	Si		Booth, 2000
19Jun.2000	Bu, Hoy	58.9200°N 3.3300°W	xxxx	Si		Booth, 2001
2-3Jul.2000	Hedde Road, Finstown, Mainland	59.0033°N 3.1233°W	<i>Pipistrellus pipistrellus</i>	Sr		Booth, 2001
9Jul.2000	Nisthouse, Harray, Mainland	59.0567°N 3.1950°W	xxxx	Si		Booth, 2001



## APPENDIX IV

Continued

Date	Locality	Coordinates	Species	Record	Institute	References
21Sep.2000	Upper Comquoy, Holm, Mainland	58.9150°N 2.8783°W	<i>Pipistrellus pipistrellus</i>	Cr, Sr		Booth, 2001
2000	Papdale Wood, Kirkwall, Mainland	58.9783°N 2.9483°W	xxxx	Si		Booth, 2001
30Sep.2000	The Don, Outertown, Stromness, Mainland	58.9750°N 3.3317°W	xxxx	Si		Booth, 2001
12Oct.2000	Flotta Community Centre, Flotta	58.8333°N 3.1183°W	xxxx	Si		Booth, 2001
21Oct.2000	North Ronaldsay	59.3667°N 2.4317°W	xxxx	Si		Booth, 2001
Apr.2001	Melsetter, Hoy	58.7867°N 3.2717°W	<i>Pipistrellus pipistrellus</i>	Si; Sr		Booth, 2002
Jun.2001	Newlot, Shapinsay	59.0233°N 2.8283°W	xxxx	Si		Booth, 2002
26Aug.2001	Southbank, Stronsay	59.1150°N 2.6033°W	<i>Pipistrellus ?</i>	Cr		Booth, 2002
Sep.2001	Melsetter, Hoy	58.7867°N 3.2717°W	<i>Pipistrellus pipistrellus</i>	Si; Sr		Booth, 2002
29Sep.2001	Braefoot, Shapinsay	59.0417°N 2.8467°W	<i>Pipistrellus</i>	Fad		Booth, 2002
2001	Berstane House, Mainland	58.9783°N 2.9317°W	xxxx	Fd		Booth, 2002
4-7May.2002	Sangar, North Ronaldsay	59.2567°N 2.8683°W	xxxx	Si		Booth, 2003
4-7May.2002	Auncum loch, North Ronaldsay	59.3767°N 2.4150°W	xxxx	Si		Booth, 2003
9May.2002	Finstown, Mainland	59.0033°N 3.1233°W	xxxx	Si		Booth, 2003
7Jun.2002	Old Kirk, North Ronaldsay	59.3667°N 2.4317°W	<i>Pipistrellus nathusii</i>	Fd	NSM	Booth, 2003
20Jun.2002	North Ronaldsay	59.3667°N 2.4317°W	xxxx	Si		Booth, 2003
26Jul.2002	Melsetter, Hoy	58.7867°N 3.2717°W	<i>Pipistrellus pipistrellus?</i>	Si		Booth, 2003
5-6Aug.2002	Finstown, Mainland	59.0033°N 3.1233°W	xxxx	Si		Booth, 2003
3Nov.2002	South Ronaldsay	58.7900°N 2.9617°W	xxxx	Si		Booth, 2003
5Nov.2002	Smithy Cottage, Holm, Mainland	58.9150°N 2.8783°W	xxxx	Si		Booth, 2003
11Nov.2002	West Heath, Holm, Mainland	58.9150°N 2.8783°W	xxxx	Si		Booth, 2003
29Nov.2002	Upper Linnay, North Ronaldsay	59.3767°N 2.4317°W	xxxx	Si		Booth, 2003
Jul.2004	Finstown area, Mainland	59.0033°N 3.1233°W	<i>Pipistrellus pipistrellus</i>	Si; Sr		Booth, 2005
Aug.2004	Finstown area, Mainland	59.0033°N 3.1233°W	<i>P. pipistrellus</i>	Si; Sr		Booth, 2005
30Oct.2004	Howan, Sandwick, Mainland	59.0750°N 3.2483°W	<i>P. pipistrellus</i>	Fd		Booth, 2005
Apr.2005	Finstown area, Mainland	59.0033°N 3.1233°W	<i>P. pipistrellus?</i>	Si		Booth, 2006
May.2005	Finstown area, Mainland	59.0033°N 3.1233°W	<i>Ps. pipistrellus?</i>	Si		Booth, 2006
Jun.2005	Finstown area, Mainland	59.0033°N 3.1233°W	<i>P. pipistrellus?</i>	Si		Booth, 2006
Jun.2005	Bu, Hoy	58.9200°N 3.3300°W	xxxx			Booth, 2006
Jul.2005	Finstown area, Mainland	59.0033°N 3.1233°W	<i>Pipistrellus pipistrellus</i>	Si; Sr		Booth, 2006
Aug.2005	Finstown area, Mainland	59.0033°N 3.1233°W	<i>P. pipistrellus?</i>	Si		Booth, 2006
17Aug.2005	Bu, Hoy	58.9200°N 3.3300°W	xxxx	Si		Booth, 2006
20Aug.2005	High Street, Kirkwall, Mainland	58.9783°N 2.9483°W	<i>Pipistrellus pipistrellus</i>	Si; Sr		Booth, 2006
25Sep.2005	High Street, Kirkwall, Mainland	58.9783°N 2.9483°W	<i>P. pipistrellus</i>	Si; Sr		Booth, 2006
Sep.2005	Finstown area, Mainland	59.0033°N 3.1233°W	<i>P. pipistrellus?</i>	Si		Booth, 2006
5Sep.2005	West End, Burray	58.8517°N 2.9633°W	xxxx	Si		Booth, 2006
11Oct.2005	Twiness, North Ronaldsay	59.2567°N 2.8867°W	<i>Pipistrellus</i>	Si		Booth, 2006
20Oct.2005	North Ronaldsay	59.3667°N 2.4317°W	xxxx	Si		Booth, 2006

## APPENDIX IV

Continued

Date	Locality	Coordinates	Species	Record	Institute	References
5May.2006	Finstown area, Mainland	59.0033°N 3.1233°W	<i>Pipistrellus pipistrellus</i>	Si; Sr		Booth, 2007
18Jun.2006	Finstown area, Mainland	59.0033°N 3.1233°W	<i>P. pipistrellus</i>	Si; Sr		Booth, 2007
26Jun.2006	Finstown area, Mainland	59.0033°N 3.1233°W	<i>P. pipistrellus</i>	Si; Sr		Booth, 2007
26Sep.2006	Northfield, Burray	58.8700°N 2.8933°W	<i>Pipistrellus nathusii</i>	Fd	NSM	Booth, 2007
26Sep.2006	Twingness, North Ronaldsay	59.3667°N 2.4317°W	<i>Plecotus auritus</i>	Si; Sr		Booth, 2007
Jun.2007	Finstown area, Mainland	59.0033°N 3.1233°W	<i>Pipistrellus pipistrellus</i>	Si; Sr		Booth, 2008
Jun.2007	Finstown area, Mainland	59.0033°N 3.1233°W	<i>P. pipistrellus</i>	Si; Sr		Booth, 2008
Jun.2007	Binscarth Wood, Mainland	59.0117°N 3.1417°W	<i>P. pipistrellus</i>	Si; Sr		Booth, 2008
Jul.2007	Binscarth Wood, Mainland	59.0117°N 3.1417°W	<i>P. pipistrellus</i>	Si; Sr		Booth, 2008
Aug.2007	Finstown area, Mainland	59.0033°N 3.1233°W	<i>P. pipistrellus</i>	Si; Sr		Booth, 2008
Aug.2007	Binscarth Wood, Mainland	59.0117°N 3.1417°W	<i>P. pipistrellus</i>	Si; Sr		Booth, 2008
Sep.2007	Finstown area, Mainland	59.0033°N 3.1233°W	<i>P. pipistrellus</i>	Si; Sr		Booth, 2008
Sep.2007	Binscarth Wood, Mainland	59.0117°N 3.1417°W	<i>P. pipistrellus</i>	Si; Sr		Booth, 2008
10May.2008	Wasdale Firth, Mainland	59.0117°N 3.1417°W	<i>P. pipistrellus</i>	Si; Sr		Booth, 2009
21May.2008	Bu, Hoy	58.9200°N 3.3300°W	xxxx	Si		Booth, 2009
23May.2008	Binscarth Wood, Mainland	59.0117°N 3.1417°W	<i>Pipistrellus pipistrellus</i>	Si; Sr		Booth, 2009
24May.2008	Binscarth Wood, Mainland	59.0117°N 3.1417°W	<i>P. pipistrellus</i>	Si; Sr		Booth, 2009
25May.2008	Binscarth Wood, Mainland	59.0117°N 3.1417°W	<i>P. pipistrellus</i>	Si; Sr		Booth, 2009
26May.2008	Binscarth Wood, Mainland	59.0117°N 3.1417°W	<i>P. pipistrellus</i>	Si; Sr		Booth, 2009
11Sep.2008	Widewall, South Ronaldsay	58.8067°N 2.9783°W	xxxx	Si		Booth, 2009
14Oct.2008	North Ronaldsay	59.3667°N 2.4317°W	xxxx	Si		Booth, 2009
May.2009	Finstown area, Mainland	59.0033°N 3.1233°W	<i>Pipistrellus pipistrellus?</i>	Si		Booth, 2010
Jun.2009	Finstown area, Mainland	59.0033°N 3.1233°W	<i>P. pipistrellus?</i>	Si		Booth, 2010
24Jul.2009	High Street, Kirkwall, Mainland	58.9783°N 2.9483°W	xxxx	Si		Booth, 2010
26Jul.2009	High Street, Kirkwall, Mainland	58.9783°N 2.9483°W	xxxx	Si		Booth, 2010
Aug.2009	Finstown area, Mainland	59.0033°N 3.1233°W	<i>Pipistrellus pipistrellus?</i>	Si		Booth, 2010
3-8Aug.2009	Cairnston Road, Stromness, Mainland	58.9567°N 3.2783°W	xxxx	Si		Booth, 2010
10Aug.2009	Melsetter, Hoy	58.7867°N 3.2717°W	<i>Pipistrellus</i>	Si; Sr		Booth, 2010
18Nov.2009	Millhouse, Twatt, Mainland	59.1017°N 3.2667°W	xxxx	Fd		Booth, 2010
10A.pr.2010	Wasbister, Rousay	59.1750°N 3.0583°W	xxxx	Si		Booth, 2011
Jun.2010	Hoy - various sites	58.9117°N 3.3467°W	<i>Pipistrellus pipistrellus</i>	Si; Sr		Booth, 2011
Jun.2010	Evie, Mainland	59.1117°N 3.1267°W	<i>P. pipistrellus</i>	Si; Sr		Booth, 2011
Jun.2010	Finstown area, Mainland	59.0033°N 3.1233°W	<i>P. pipistrellus</i>	Si; Sr		Booth, 2011
Jun.2010	Bu, Hoy	58.9200°N 3.3300°W	xxxx	Si		Booth, 2011
Jul.2010	Hoy - various sites	58.9117°N 3.3467°W	<i>Pipistrellus pipistrellus</i>	Si; Sr		Booth, 2011
Jul.2010	Evie, Mainland	59.1117°N 3.1267°W	<i>P. pipistrellus</i>	Si; Sr		Booth, 2011
Jul.2010	Finstown area, Mainland	59.0033°N 3.1233°W	<i>P. pipistrellus</i>	Si; Sr		Booth, 2011
Aug.2010	Hoy - various sites	58.9117°N 3.3467°W	<i>P. pipistrellus</i>	Si; Sr		Booth, 2011
Aug.2010	Evie, Mainland	59.1117°N 3.1267°W	<i>P. pipistrellus</i>	Si; Sr		Booth, 2011

## APPENDIX IV

Continued

Date	Locality	Coordinates	Species	Record	Institute	References
Aug.2010	Finstown area, Mainland	59.0033°N 3.1233°W	<i>Pipistrellus pipistrellus</i>	Si; Sr	Booth, 2011	
Sep.2010	Hoy - various sites	58.9117°N 3.3467°W	<i>P. pipistrellus</i>	Si; Sr	Booth, 2011	
Sep.2010	Evie, Mainland	59.1117°N 3.1267°W	<i>P. pipistrellus</i>	Si; Sr	Booth, 2011	
Sep.2010	Finstown area, Mainland	59.0033°N 3.1233°W	<i>P. pipistrellus</i>	Si; Sr	Booth, 2011	
21Sep.2010	Lady Village, Sanday	59.2500°N 2.5883°W	<i>Pipistrellus nathusii</i>	Fd	NSM	
25Sep.2010	Woodwick, Evie, Mainland	59.0933°N 3.0733°W	<i>P. nathusii</i>	Si; Sr	Booth, 2011	
26Sep.2010	Sunnybank, Deerness, Mainland	58.9433°N 2.7567°W	xxxx	Si	Booth, 2011	
20Oct.2010	Honeysgoe, South Ronaldsay	58.8250°N 2.8933°W	xxxx	Si	Booth, 2011	
120Oct.2010	Kirkwall marina, Mainland	58.9783°N 2.9483°W	xxxx	Si	Booth, 2011	
130Oct.2010	Holland House, North Ronaldsay	59.3667°N 2.4317°W	xxxx	Cr	Booth, 2011	
13-May-11	Moan, Graensay	58.9300°N 3.2950°W	xxxx	Si	Booth, 2012	
17May.2011	Twingness, North Ronaldsay	59.3667°N 2.4317°W	<i>Pipistrellus?</i>	Si	Booth, 2012	
18May.2011	Twingness, North Ronaldsay	59.3667°N 2.4317°W	<i>Pipistrellus?</i>	Si	Booth, 2012	
20May.2011	Twingness, North Ronaldsay	59.3667°N 2.4317°W	<i>Pipistrellus?</i>	Si	Booth, 2012	
25May.2011	Graemeshall, Holm, Mainland	58.8983°N 2.8950°W	<i>Pipistrellus</i>	Si; Sr	Booth, 2012	
28May.2011	Lyde Road, Firth, Mainland	59.0133°N 3.1233°W	xxxx	Si	Booth, 2012	
1Jul.2011	Burra House, Hoy	58.9200°N 3.3300°W	<i>Pipistrellus</i>	Si; Sr	Booth, 2012	
2Jul.2011	Melsetter, Hoy	58.7867°N 3.2717°W	<i>Pipistrellus</i>	Si; Sr	Booth, 2012	
29Jul.2011	Hedde Road, Finstown, Mainland	59.0033°N 3.1233°W	<i>Pipistrellus</i>	Si; Sr	Booth, 2012	
14Oct.2011	Binscarth Wood, Finstown, Mainland	59.0117°N 3.1417°W	<i>Pipistrellus</i>	Si; Sr	Booth, 2012	
30Oct.2011	Durkadale Road, c. 200 m from Evie / Douby junction, Mainland c.	59.1117°N c. 3.1267°W	<i>Pipistrellus?</i>	Si	Booth, 2012	
2011	Evie, Mainland	59.1117°N 3.1267°W	<i>Pipistrellus pipistrellus</i>	Si; Sr	Booth, 2012	
2011	Binscarth Wood, Finstown, Mainland	59.0117°N 3.1417°W	<i>P. pipistrellus</i>	Si; Sr	Booth, 2012	
2011	Hedde Road, Finstown, Mainland	59.0033°N 3.1233°W	<i>P. pipistrellus</i>	Si; Sr	Booth, 2012	
2011	Papdale Wood, Kirkwall, Mainland	58.9783°N 2.9483°W	<i>P. pipistrellus</i>	Si; Sr	Booth, 2012	
2011	Bu, Hoy	58.9200°N 3.3300°W	<i>Pipistrellus</i>	Si; Sr	Booth, 2012	
2011	Longhope, Hoy	58.7994°N 3.2077°W	<i>Pipistrellus</i>	Si; Sr	Booth, 2012	
2011	Woodwick House, Evie, Mainland	59.1033°N 3.0567°W	<i>Pipistrellus</i>	Si; Sr	Booth, 2012	
2011	Finstown area including Redland Farm, Mainland	59.0033°N 3.1233°W	<i>Pipistrellus</i>	Si; Sr	Booth, 2012	

Key to abbreviations. Record codes: Cr — caught and released; F — found; Fa — found alive; Fad — found alive, died; Fd — found dead; Ph — photograph; Si — sight record; Sr — sonar recording / bat detector. Institutions: NMS — National Museums of Scotland. Unidentified bats — xxxx

## APPENDIX V

Details of the bats recorded from North Sea installations and vessels

Date	Locality	Coordinates	Species	Record	References
13Jun.1965	"Mr Cap" oil rig, 274 km E of Berwick, 306 km from coast of Denmark	54.8667°N 2.3833°E	<i>Vespertilio murinus</i>		Stansfield, 1966; Corbet, 1970
1980	Fulmar Alpha oil platform, 312 km E of Dundee	56.4833°N 2.1333°E	<i>Nyctalus noctula</i>		Haddow and Herman, 1995, 2000; Swift, 2004
1988	Fulmar Alpha oil platform, 312 km E of Dundee	56.4833°N 2.1333°E	<i>N. noctula</i>		Haddow and Herman, 1995, 2000; Swift, 2004
5May.1988	North Sea		<i>Pipistrellus nathusii</i>		Speakman <i>et al.</i> , 1991; Russ <i>et al.</i> , 2001
10May.1988	North Sea		<i>P. nathusii</i>		Speakman <i>et al.</i> , 1991; Russ <i>et al.</i> , 2001
30May.1989	North Sea		<i>P. nathusii</i>		Speakman <i>et al.</i> , 1991; Russ <i>et al.</i> , 2001
23Sep.1989	North Sea		<i>P. nathusii</i>		Speakman <i>et al.</i> , 1991; Russ <i>et al.</i> , 2001
4Oct.1991	Oil platform "Esmond", Off Redcar	54.5833°N 1.4000°E	<i>P. nathusii</i>		Russ <i>et al.</i> , 2001
Jul.1992	Forties Charlie oil rig, 190 km ENE of Fraserburgh	57.7000°N 1.0000°E	<i>Vespertilio murinus</i>		Racey <i>et al.</i> , 2008
13Sep.1992	North Allwyn Field, off coast of Shetland	60.7500°N 1.7000°E	<i>Pipistrellus nathusii</i>		Speakman <i>et al.</i> , 1993; Russ <i>et al.</i> , 2001
19Sep.1992	Santa Fe 135 rig, Nelson Field	57.6667°N 1.1667°E	<i>P. nathusii</i>		Speakman <i>et al.</i> , 1993; Russ <i>et al.</i> , 2001
25Sep.1992	Hutton TLP Conoco rig, 150 km NE of Shetland	61.0000°N 1.2000°E	<i>P. nathusii</i>	Fa	Speakman <i>et al.</i> , 1993; Russ <i>et al.</i> , 2001
7Oct.1992	Amerada Hess 001 rig, Rob Roy Field, 150 km NE of Peterhead	58.1667°N 0.6000°E	<i>P. nathusii</i>		Speakman <i>et al.</i> , 1993; Russ <i>et al.</i> , 2001
Aug.1993	Dundee Explorer oil platform		<i>Eptesicus nilssonii</i>		Speakman <i>et al.</i> , 1995
22Sep.1993	Bruce installation, 161 km off Shetland	59.7500°N 1.5000°E	<i>Pipistrellus nathusii</i>		Russ <i>et al.</i> , 2001
17Sep.1995	North Sea		<i>P. nathusii</i>		Russ <i>et al.</i> , 2001
17Sep.1995	North Sea		<i>P. nathusii</i>		Russ <i>et al.</i> , 2001
17Sep.1995	North Sea		<i>P. nathusii</i>		Russ <i>et al.</i> , 2001
18Oct.1995	209 km off Aberdeen	c.57°N 0°E	<i>P. nathusii</i>	Fd	Russ <i>et al.</i> , 2001
28Nov.1995	North Sea		<i>P. nathusii</i>		Russ <i>et al.</i> , 2001
3Jul.1997	Viking B platform, 138 km off the Lincolnshire coast	53.4167°N 2.3000°E	<i>P. nathusii</i>		Russ <i>et al.</i> , 2001
7Sep.1998	Texasco's Captain Wpp platform, 97 km N of Peterhead	58.2500°N 1.6000°W	<i>P. nathusii</i>		Russ <i>et al.</i> , 2001
1Jun.1999	BP Forties Echo platform, 200 km NE of Aberdeen	57.6667°N 0.8000°E	<i>P. nathusii</i>		Russ <i>et al.</i> , 2001
2001	North Sea		<i>P. nathusii</i>		Swift, 2004
2001	North Sea		<i>P. nathusii</i>		Swift, 2004
Nov.2001	256 km E of Newcastle	c.55°N 2°E	<i>Vespertilio murinus</i>		Racey <i>et al.</i> , 2008
Dec.2001	128 km E of Aberdeen	c.57°N 0°E	<i>V. murinus</i>		Racey <i>et al.</i> , 2008
2002	North Sea		<i>Nyctalus leisleri</i>		Swift, 2004
Jan.2002	Ocean Nomad oil rig		<i>Vespertilio murinus</i>		Racey <i>et al.</i> , 2008
Nov.2004	64 km NE of Fraserburgh	c.57°N 1°W	<i>V. murinus</i>		Racey <i>et al.</i> , 2008

Key to abbreviations. Record codes: Fa — found alive; Fd — found dead