A1a.7 Bats

A1a.7.1 UK distribution, abundance and broad migratory movement

There are seventeen species of bat recorded living in Britain and Ireland. The great majority of these species do not undertake large-scale migrations and so do not spend significant time over the sea. The exception to this is Nathusius' pipistrelle (*Pipistrellus nathusii*), which is known to undertake long-distance migrations, including sea crossings. *P. nathusii* has a widespread distribution from western Europe to western Asia; it migrates seasonally from breeding strongholds in eastern Europe to overwintering areas with milder climates in western Europe. This species is rare in the UK, and has long been considered under-reported, but records have increased in recent years alongside targeted survey efforts. In Britain and Ireland, it is considered both a winter migrant and a resident breeding species (Russ *et al*. 2001).

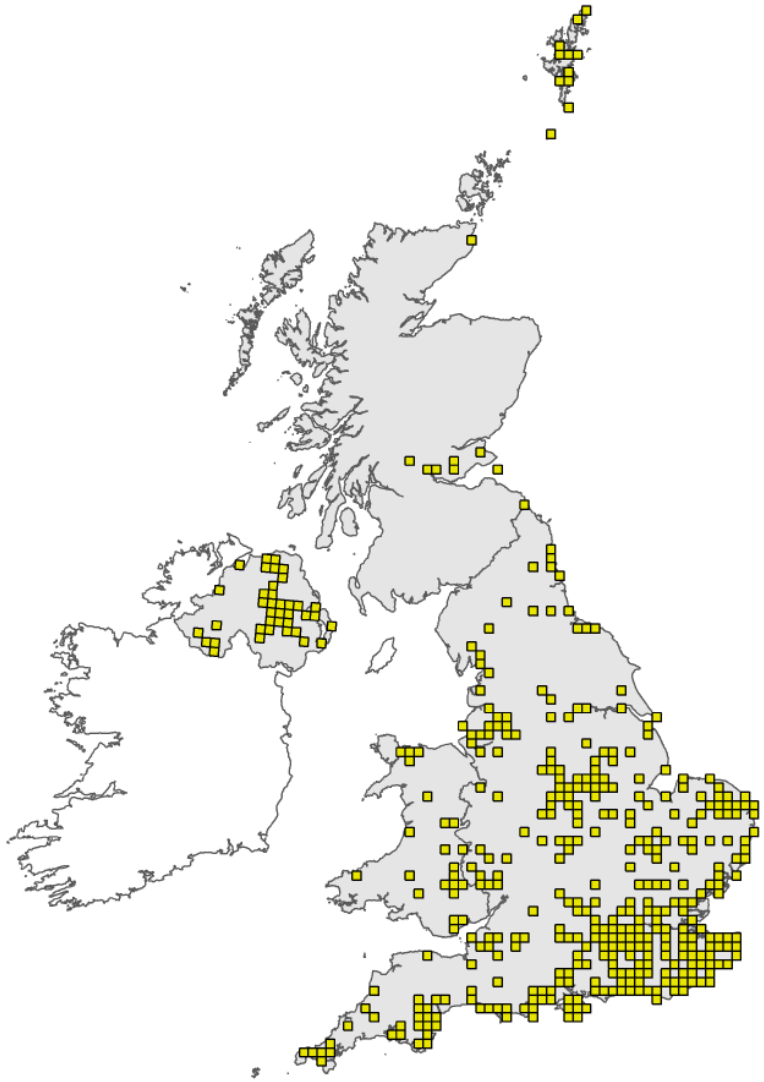
The systematic Nathusius' pipistrelle survey (2009-2014) verified species presence at 84 of the 261 sites surveyed, with possible presence at a further 94 sites. Through the National Nathusius' Pipistrelle Project (NNPP)[1], launched in 2014 to determine the status and migratory origins of the species in Great Britain, extensive trapping surveys across over one hundred sites have resulted in ~600 captures of *P. nathusii* (as of 2018). Records are widely distributed throughout much of Great Britain and Ireland; the distribution of UK records from approximately the last ten years are illustrated in Figures A1a.7.1 and A1a.7.2. Population estimation is hampered by a lack of information, with a population of at least several hundred estimated to occur in Great Britain (Mathews *et al*. 2018). Numbers peak during autumn and again in spring, coinciding with its migration to and from continental Europe (Russ *et al.* 2001, Hutterer *et al.* 2005).

The NNPP has also identified the long-distance movement of individual bats (through ringing) between the south of England and mainland Europe (Figure A1a.7.4), including the coast of the Netherlands, Latvia and Lithuania (Bat Conservation Trust 2019). While the exact migratory routes across Europe are currently not known (Mathews *et al*. 2018), evidence suggests a broad path along the Baltic coast (e.g. Rydell *et al*. 2014) which then approximately follows the southern North Sea coast of mainland Europe (Figure A1a.7.3). The extent of movement between Great Britain and Ireland is currently unknown.

Maternity colonies have now been discovered in Kent and Northumberland, in addition to those few previously reported in Northern Ireland and eastern England, further reinforcing the theory that the UK and Ireland may represent a transitional area where resident bats mix with those migrating (to overwinter) from continental Europe (Russ *et al.* 2001). There is evidence that maternity sites in Britain and Ireland are under-reported (Mathews *et al*. 2018). Stable isotope analysis of fur samples of *P. nathusii* caught in the UK provides further evidence that a large proportion of these bats have a migratory origin further northeast than the UK, while some appear to be resident in the UK (BSG Ecology 2014a).

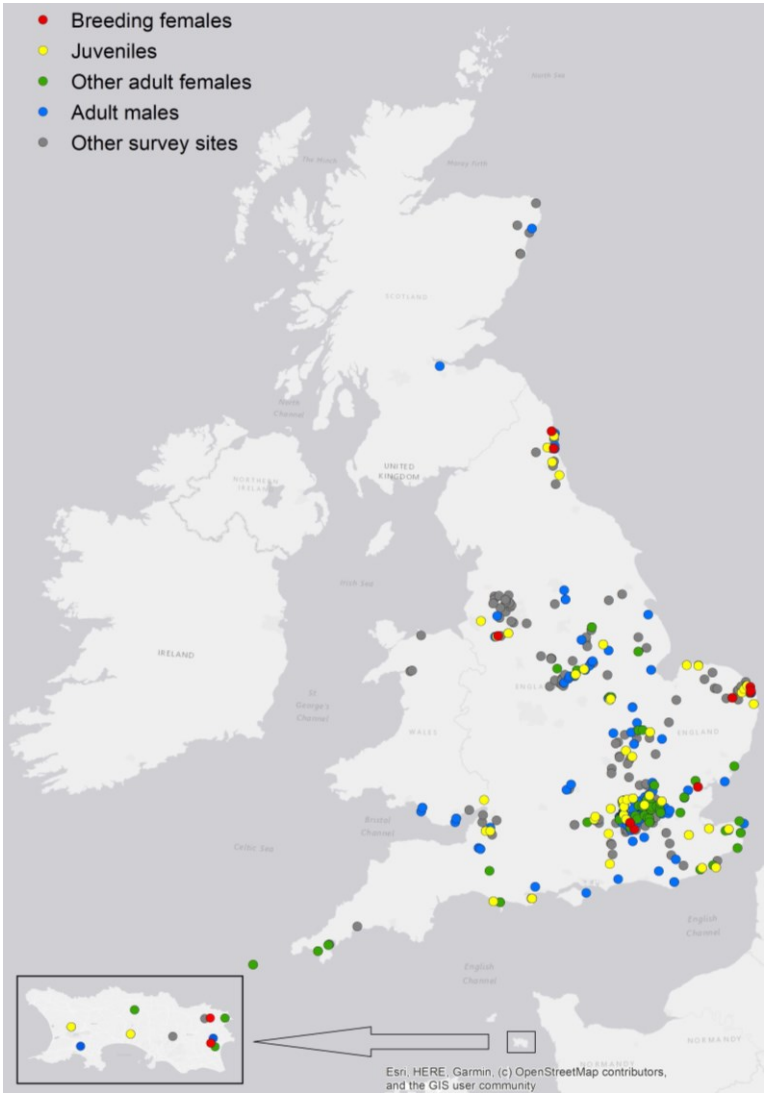
[1] http://www.bats.org.uk/pages/national_nathusius_pipistrelle_project.html

Figure A1a.7.1: UK distribution map for *P. nathusii*



Notes: Coloured cells represent 10km grid squares with positive species records (including from bat detectors) available for the reporting period 2013-2019. Source: JNCC (2019).

Figure A1a.7.2: *P. nathusii* captures April 2011 to October 2019



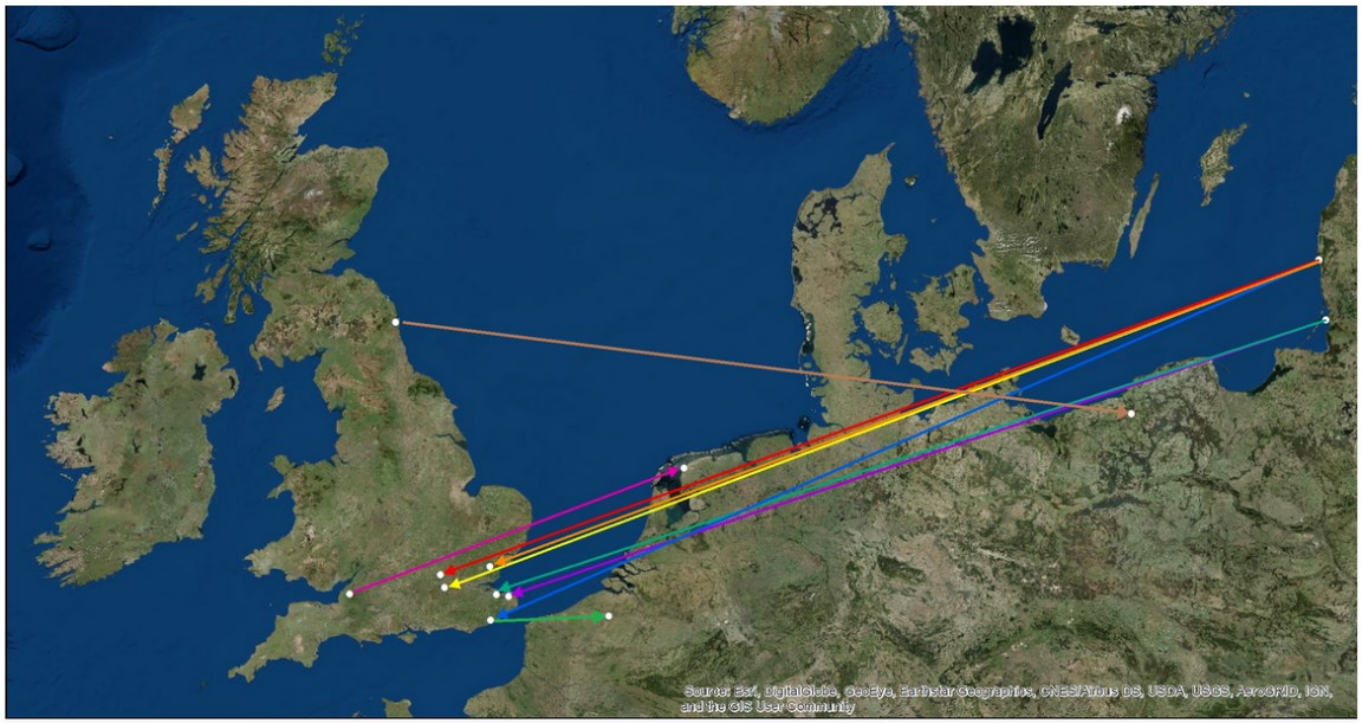
Note: At each site there may be records falling into more than one category but the symbol indicates the level to which breeding or potential breeding has been identified: breeding females > juveniles (potentially born locally, though may have come from elsewhere) > other adult females > males. Source: Bat Conservation Trust website[2]

Figure A1a.7.3: *P. nathusii* distribution and migration

Source: Riccardo Pravettoni, UNEP/GRID-Arendal (https://www.grida.no/resources/7643)

[2] https://www.bats.org.uk/our-work/national-bat-monitoring-programme/surveys/national-nathusius-pipistrelle-survey

Figure A1a.7.4: Records of Nathusius' pipistrelle migrations between the UK and continental Europe



Note: Ring recoveries linked with a straight line; the actual migratory route taken is unknown. Arrows indicate direction of movement. Source: Bat Conservation Trust website[3]

A1a.7.1.1 Occurrence of *P. nathusii* at the coast and offshore

Efforts to understand the migratory movements of *P. nathusii*, including their occurrence in coastal and offshore habitats, have been increasing in recent years on the southern North Sea coast of continental Europe. Studies include monitoring of bats from platforms in the German (Hüppop & Hill 2016), Dutch (Lagerveld *et al*. 2014, 2017) and Belgian (Brabant *et al*. 2020) sectors of the North Sea. Offshore records of bats in the southern North Sea are dominated by *P. nathusii*. Other species which have been recorded in small numbers offshore include: common pipistrelle (*Pipistrellus pipistrellus*), common noctule (*Nyctalus noctula*), Leisler's bats (*Nyctalus leisleri*), northern bat (*Eptesicus nilssonii*), serotine bat (*Eptesicus serotinus*) and parti-coloured bat (*Vespertilio murinus*) (Boshamer & Bekker 2008; Poerink *et al*. 2013; Hüppop & Hill 2016; Lagerveld *et al*. 2017).

The deployment of bat detectors on the east and south coasts of England, including sites in Dorset, Kent and East Yorkshire, have provided information about the seasonal activity of bats at the coast and whether there are pulses of activity indicative of migratory movements (BSG Ecology 2013a,b,c). Monitoring from April to October in 2012 and 2013 on the Kent coast revealed peaks in passes of *P. nathusii* in autumn (September and October, n=112; 0.34 bat passes per hour) and also in spring (May, n=43, 0.26 bat passes per hour). The diurnal timing of detections was indicative of migratory movements from adjacent mainland Europe, and the majority occurred in wind speeds of < 15kph (< 4.2m/s) of a westerly or southerly direction (BSG Ecology 2013b). Low levels of activity were recorded throughout July and August at some sites. Monitoring along the coast of continental Europe also shows peaks in activity of *P.*

[3] https://www.bats.org.uk/our-work/national-bat-monitoring-programme/surveys/national-nathusius-pipistrelle-survey

nathusii corresponding with autumn and spring migrations, but also a regular presence throughout the summer (Lagerveld *et al*. 2017).

Offshore observations from oil/gas platforms and boats are uncommon, but widely distributed in the western North Sea from east of Shetland to the eastern English Channel (Russ *et al*. 2001); the seasonal pattern of records is consistent with the species' seasonal migration. Records from two ferries transiting the southern North Sea (Hull to Belgium and Felixstowe to the Netherlands) equipped with bat detectors recorded *P. nathusii* in May, September and October; with at-sea detections made up to 106km offshore (BSG Ecology 2014b).

Hüppop & Hill (2016) present data on bat echolocation calls at the FINO 1 platform, located 57km off the German mainland coast in the south-eastern North Sea. The vast majority of data, which spanned over 10 years, was for *P. nathusii*, which was exclusively recorded during spring and autumn migration periods. The authors conclude that the migrating bats were attracted by the brightly lit platform and/or sought refuge there, with most detections coinciding with dense cover of clouds, fog/low stratus and/or rain.

Lagerveld *et al*. (2017) reported on monitoring from 2015-2016 at offshore platforms and met masts (n=12) and coastal (n=5) locations in the Dutch North Sea. Offshore locations were between 22 and 69km from the coast. At coastal locations, *P. nathusii* was common during both spring and autumn migration, but also regularly detected throughout the summer. It was the most frequently recorded species at offshore locations, albeit much less frequently recorded than at the coast. Higher detections at the coast may reflect a higher proportion of bats migrating over the coast than at sea, but are also likely higher due to funnelling, whereas migration over sea likely follows a broad front in the absence of guiding landscape features. Offshore, it was recorded from late August until late October (and one observation in November), and, to a lesser extent, from early April until the end of June. There were no offshore detections from July to mid-August.

At the monitoring locations closer to shore, bat activity peaked 3-5 hours after darkness, whereas at the more offshore locations bat activity started closer to dusk and slowly levelled off during the course of the night (Lagerveld *et al*. 2017). This latter observation confirms that bats had spent the day offshore, in the vicinity of the monitoring location. Modelling showed wind speed to be the most important predictor of *P. nathusii* occurrence at the coast and offshore, with peaks at low to moderate wind speeds; detections at wind speeds over 8m/s were scarce. High temperature and wind directions between northeast and southeast were also linked to increased bat activity.

Brabant *et al*. (2020) present the results of monitoring from bat detectors placed on the nacelle (93m, n = 4) and transition piece (16m, n = 7) of turbines in an offshore wind farm in the Belgian North Sea (C-Power) approximately 27km from the coast. All detections were of *P. nathiusii,* although the configuration was such that *N. noctula* and *V. murinus* would not be detected. Bats were recorded on 20 different nights throughout the study period from late August to late November; activity peaked in the latter half of September (63% of all calls recorded) and was considerably less in October and November. The vast majority of detections were recorded between two hours after sunset and throughout the night. A few detections close to, and even after, sunrise, suggest some individuals may continue their migration in daylight or seek roosting opportunities offshore, as supported by observations of roosting bats on turbine structures. The average number of detections at transition piece height was approximately nine times greater than that at nacelle height. While most longer recordings were categorised as transiting behaviour, approximately a quarter of longer recordings included search calls (possibly indicating simultaneous transit and looking for prey), with a lesser number described as intensive exploratory behaviour and/or feeding buzzes. The

authors note that the distances from shore of the turbines far exceed the known foraging distance of *P. nathusii* from the coast, such that any feeding activity recorded was likely opportunistic and not associated with an extended foraging flight. From these same data, Brabant *et al*. (2019) show that 66, 72 and 87% of detections were when wind speed was ≤ 3, 4 and 5m/s, respectively. Most detections were also made during easterly and southeasterly winds, and to a lesser extent southerly winds. There was also a clear peak in detections when wind originated from the east and southeast, which also corresponded to periods of the lowest wind speed.

A1a.7.1.2 Ecological importance

All UK resident bat species feed exclusively on insects. *P. nathusii* mainly feed on flying aquatic insects of small-medium size, primarily Chironomidae (non-biting midges). They feed over lakes, rivers and a variety of adjacent riparian habitats, including broadleaf and mixed woodland, parkland, and occasionally farmland (Russ 2008).

A1a.7.1.3 Regional importance

Due to the limited available information on bats in the UK marine environment, a Regional Sea-specific breakdown in occurrence is not provided. For example, the specific migratory routes and stepping stones used from the continental Europe to Britain and from Britain to Ireland are not known (Rodrigues *et al.* 2014). However, given the distribution of records in the UK and their occurrence along the coast of continental Europe, Regional Seas 2 (southern North Sea) and 3 (English Channel) and perhaps to a lesser extent, Regional Sea 1 (central and northern North Sea), are expected to experience the majority of migratory movement. Any movement between Great Britain and Ireland would also result in bats crossing Regional Sea 6.

A1a.7.2 Evolution of the baseline

Records of *P. nathusii* from acoustic detectors have increased rapidly over the past decade, while records of grounded bats have also increased. While this is partly owing to increased effort and improved identification, the scale of the change suggests a genuine increase in the number of *P. nathusii* in Great Britain can be reasonably inferred (Mathews *et al*. 2018). Nonetheless, the current trend in both population size and range is assessed as ‘unknown’, while the habitat is assessed as ‘stable’ (Mathews *et al*. 2018).

Mathews *et al*. (2018) list climate change as a driver of increased occurrence, through alteration of migration routes and summering/wintering grounds. This is supported by the modelling of habitat and climatic associations of *P. nathusii* by Lundy *et al*. (2010), showing an expansion of suitable habitat in the UK since the 1940s, and a potential two-fold increase by 2050, driven largely by a projected increase in minimum temperature. It has also been noted that the time span between first and last observations of bats in summer habitats has extended by four weeks since the 1980s (Hargreaves *et al*. 2015).

A1a.7.3 Environmental issues

While not considered major threats, *P. nathusii* is affected by issues relevant to other migratory bat species, including habitat fragmentation on migration routes and disturbance to and loss of roost sites (buildings, mature trees with cavities) (Paunovic & Juste 2016). Additionally, water quality changes which may affect food supply, as can unusually hot summer/autumns and a related decrease in insect prey abundance at traditional migration sites (Hargreaves *et al*. 2015).

A1a.7.3.1 Collision

Bat mortality has been reported around terrestrial wind turbines worldwide (e.g. Barclay *et al.* 2007, Arnett *et al.* 2008), with mortality most commonly associated with species migrating long distances (Kunz *et al.* 2007). Due to their excellent ability to detect moving objects through echolocation, their relatively high mortality at wind farms is surprising, and possible reasons for this have been the topic of much debate (Kunz *et al.* 2007, Baerwald *et al.* 2008). While direct collisions do occur, evidence has suggested barotrauma resulting from exposure to pressure differences in the vicinity of turbine blades to be a significant cause of death (Baerwald *et al.* 2008). Information on interactions between bats and offshore wind turbines is almost completely lacking. Ahlén *et al.* (2007) monitored bat behaviour around offshore wind farms in the Baltic and Kattegat; bats were observed foraging in close proximity to the turbines, feeding on accumulations of flying insects. However, no mention is made of observed collisions between bats and turbines.

P. nathusii are considered to be at high risk of collisions from wind farms due to their occurrence in open habitats and migratory behaviour, and the species has been reported among the most commonly observed fatalities under turbines at onshore wind farms in mainland Europe (Rodrigues *et al*. 2015). The results of monitoring at offshore platforms and recent ringing provide further evidence of the use of the southern North Sea as a migration pathway for *P. nathusii*, with consequent potential for interactions with offshore wind farms and other illuminated surface structures. While observations on land and at sea suggest the majority of migrating bats fly at altitudes below the rotor swept zone (e.g. Ahlén *et al.* 2009, Troxell *et al*. 2019, Brabant *et al*. 2020), they are also reported at higher altitudes; information on their flight heights offshore, along with the conditions which may influence these flight heights, is limited (Brabant *et al*. 2020).

In the Dutch North Sea, based on bat monitoring data collected offshore from 2012-2014, a precautionary mitigation measure was applied to the Borssele offshore wind farm to reduce the likelihood of collisions between migrating *P. nathusii* and turbines. The measure imposed a turbine cut-in wind speed of 5m/s (the usual is 3.5 to 4m/s) over the period 15 August until 01 October. Subsequent modelling has recommended refining the measure to a cut-in wind speed of 5.5 to 6.0m/s during an easterly wind, an unaltered cut-in during low temperatures and westerly winds, and a shift in the temporal application of these measures to 25 August to 10 October (Boonman 2018). It is claimed that, relative to the existing mitigation measure, this refined approach will reduce loss in energy production and reduce the risk of bat collision mortality. There has been some experimentation using deterrents at onshore wind farms in the USA (e.g. Weaver *et al.* 2020), but more research is needed to understand the potential for these to reduce mortality, and to understand the wider implications of their use.

A1a.7.4 Conservation frameworks

A wide range of international treaties and conventions, European directives and national legislation apply to the protection and conservation of marine species and habitats in the UK as outlined in Appendix 1j and Appendix 2. Many of these are directly relevant to the protection of marine mammals, otters and bats.

A1a.7.4.1 International

Internationally, *P. nathusii* is listed as ‘least concern’ on the IUCN’s Red List of Threatened Species (Paunovic & Juste 2016).

All species of bats are listed on Annex IV (Animal and Plant Species of Community Interest in Need of Strict Protection) of the EU Habitats Directive[4]. Under Annex IV, the keeping, sale or exchange of such species is banned as well as deliberate capture, killing or disturbance[5]. *P. nathusii* is also listed on Annex II; while a network of SACs exist throughout continental Europe, there are no SACs in Britain or Ireland with this species as a qualifying feature.

The latest Article 17 UK status report (JNCC 2019) assesses *P. nathusii* as exhibiting a short-term trend of increasing (favourable) reference range, unknown population size and trend, and unknown habitat occupation, quality or trend. Overall, conservation status was assessed as unknown.

All European bats are listed under Appendix II of the Convention on the Conservation of Migratory Species (CMS, The Bonn Convention), to which the UK is a signatory state. Additionally, an agreement on the Conservation of Bats in Europe (EUROBATS) under the auspices of the Bonn Convention is in force.

In the UK, all species of bats are protected under Schedule 5 of the *Wildlife and Countryside Act 1981*[5] (WCA 1981) and the *Wildlife (Northern Ireland) Order 1985*. Under WCA 1981, it is an offence (subject to exceptions) to intentionally kill, injure, or take, possess, or trade in any wild animal listed under Schedule 5, and prohibits interference with places used for shelter or protection, or intentionally disturbing animals occupying such places.

UK Biodiversity Action Plan (UK BAP) was first published in response to the Convention on Biological Diversity (Rio de Janeiro, 1992); it included a number of specific plans for listed priority species and habitats including several bats. After devolution, each country developed strategies for biodiversity and the environment while maintaining a shared vision; these are ongoing. Following the publication of the CBD's Strategic Plan for Biodiversity 2011-2010 and its 20 'Aichi Biodiversity Targets', the UK BAP has been succeeded by the UK Post-2010 Biodiversity Framework published in 2012 and supported by an Implementation Plan published in 2013 (see JNCC website for further details http://jncc.defra.gov.uk/page-5155).

[4] *Council Directive 92/43/EEC on the conservation of natural habitats of wild flora and fauna*

[5] The definition of disturbance in Scotland is slightly different from elsewhere in the UK. To help avoid or minimise the risk by activities in the marine environment to kill, injure or disturb European Protected Species, guidance has been prepared by JNCC, Natural England and Countryside Council for Wales (2010), relevant to for the marine area in England and Wales and the UK offshore marine area and by Marine Scotland (2014) for Scottish inshore waters.

[5] The Wildlife and Countryside Act (as amended) implements the Convention on the Conservation of European Wildlife and Natural Habitats (the Bern Convention) which entered into force in 1982.

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