Aquatic Mammals 2017, *43*(1), 26-32, DOI 10.1578/AM.43.1.2017.26

Short Note

Killer Whale (*Orcinus orca*) Occurrence in the Moray Firth, Northeast Scotland: Incidental Sightings, Behavioural Observations, and Photo-Identification

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The killer whale (*Orcinus orca*, Linnaeus 1758) is a cosmopolitan species found in all the world's major oceans and seas (Forney & Wade, 2007). In the northern North Sea, the species is regularly seen feeding upon mackerel and herring around trawlers (Couperus, 1994; Luque et al., 2006), predating upon seals around the Northern Isles (Fisher et al., 1999; Bolt et al., 2009), and hunting herring around Iceland (Simon et al., 2007); and mark-recapture studies have revealed individual movements between northern Scotland and Iceland respectively linking these communities (Foote et al., 2010). Whilst killer whales occur throughout Scottish waters (Evans et al., 2003; Reid et al., 2003), sightings reports are typically clustered in the extreme northeast, between the Caithness mainland and the Northern Isles, or along the opposing west coast, in the Minches and Sea of Hebrides (Evans, 1988; Evans et al., 2003, 2011; Bolt et al., 2009; Beck et al., 2014). Animals also intermittently frequent the southern Moray Firth and Aberdeenshire coastlines (Evans et al., 2003; Robinson et al., 2007; Bolt et al., 2009), occasionally moving further south to Fife and the Firth of Forth beyond (Evans, 1988; Bolt et al., 2009; Weir, 2011); however, no detailed information on the occurrence of the species or their behaviour in these waters has been published to date. In the present note, killer whale sightings collated from public shore watches and boat-based encounters in the Moray Firth (MF) between 2001 and 2015 are presented to better define the presence, seasonal occurrence, and activities of the animals utilising this northeast coastal location.

Data were gathered from several sources in this investigation. Firstly, sightings were extracted from the Cetacean Research & Rescue Unit's (CRRU) database of over 1,900 cetacean encounters, documented from dedicated boat surveys in the outer southern MF region carried out between May and October 2001 to 2015 inclusive (e.g., Robinson et al., 2009, 2010). Secondly, incidental reports were added from the CRRU's public sightings scheme, which included records from local observers, tour operators, fishermen, the coastguard, and trained volunteers in the region. Thirdly, sightings were provided by the Sea Watch Foundation (SWF), particularly from Regional Coordinators from the northern and southern Moray Firth coastlines, obtained from systematic shore watches, charter vessels, ferry platforms of opportunity, and local boat operators and fishermen. In addition to the date, time, and geographical position for each sightings record, information on the number of animals, their behaviour (e.g., travelling, hunting, etc., where and when recorded), plus any supporting images for photo-identification were also assembled. The data were then scrutinised to ensure the removal of any duplicate or ambiguous records from the multiple data providers/sources incorporated.

Between 2001 and 2015, 143 sightings were confirmed from within or immediately adjacent to the outer MF boundary (from Duncansby Head to Fraserburgh) (Figure 1). The majority of sightings (~95%) were reported from the outer MF coastline (only nine records were confirmed within the inner firth Special Area of Conservation), with approximately 75% clustered along the northern coastline between Helmsdale and Duncansby Head (Figure 1). Whilst killer whales were recorded year-round in the firth, the highest number of sightings were made between May and July from both northern and southern coastlines alike (Figure 2A). Sightings were highly variable both within and between years (Figure 2B),

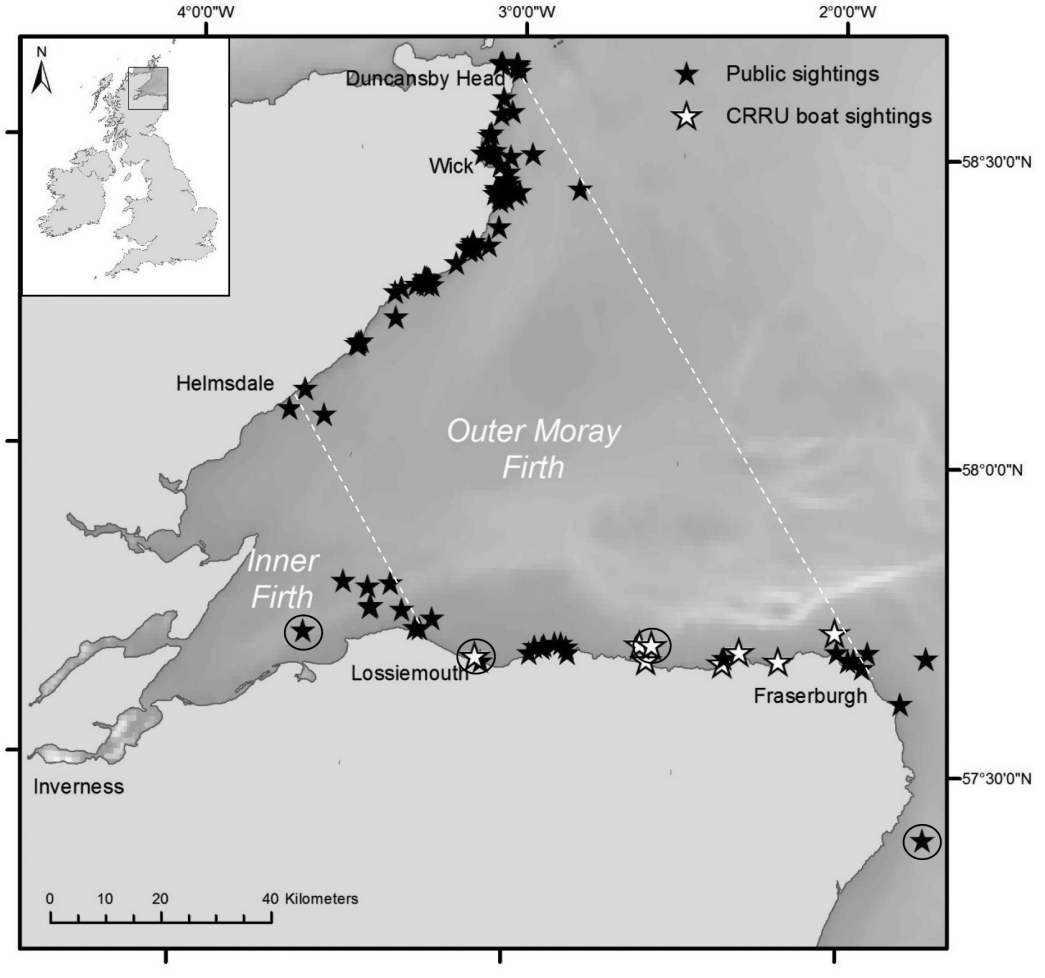

Figure 1. Map of the Moray Firth in northeast Scotland showing the distribution of incidental public and boat-based sightings of *Orcinus orca* from 2001 to 2015 inclusive ($n = 143$). The four circled points along the southern coastline highlight the four confirmed sightings of a known west coast adult male (ID#W001).

although this may have been biased due to the variability in intra- and interannual observer effort, as significantly higher effort was inevitably recorded during the warmer spring and summer months and also during more recent years due to increased social media networks and information sharing.

Documented group sizes of killer whales in the MF ranged from 1 to 17 with a mean of 4.6 ± 3.3 and a mode of 5. Where behavioural data were reported ($n = 112$), the majority of groups (~78%) were characterised as travelling or socialising animals. Feeding/suspected feeding was described in 19% of the reports. The targeted prey in most of these events remained unconfirmed, however at least five accounts of active hunting/predation upon seals were recorded—all notably during May and June—plus an additional observation involving an attack upon white-beaked dolphins (*Lagenorhynchus albirostris*). Analyses of photographs taken during CRRU boat surveys and available images from 16 public sightings resulted in the photo-identification of 18 individual whales, of which 13 were positively matched (Table 1) from the *North Atlantic Killer Whale Catalogue* (A. D. Foote, pers. comm., October 2015). This included the recapture of several distinctive bulls (Figure 3), one of which (ID#W001) (Figure 3B), sighted on four separate occasions in the southern MF on 5 July 2001, 3 July 2002, and 20 and 29 August 2013, respectively (Figure 1), was a well-known member of the west coast killer whale community (Evans et al., 1993; Beck et al., 2014). Twelve whales were recaptured on at least two or more occasions (Table 1), with 11 being recaptured in two or more separate years, indicating a

high degree of site fidelity by these individuals for these northeast waters.

To date, dedicated mark-recapture studies by Foote et al. (2010) have noted at least 50 identifiable whales utilising the Northern Isles (Shetland and Orkney) and northeast Scottish coastline each year, with individuals being linked through association patterns to a larger number of animals (*ca.* 200) from the east coast of Iceland (Foote et al., 2010; Beck et al., 2012). The presence of the species in northeast Scotland is thought to be related to the availability of phocid prey (e.g., Bolt et al., 2009), and the heightened number of sightings in the MF in June certainly corresponds with the annual pupping season of the common seal (*Phoca vitulina*) in this location (Thompson et al.,

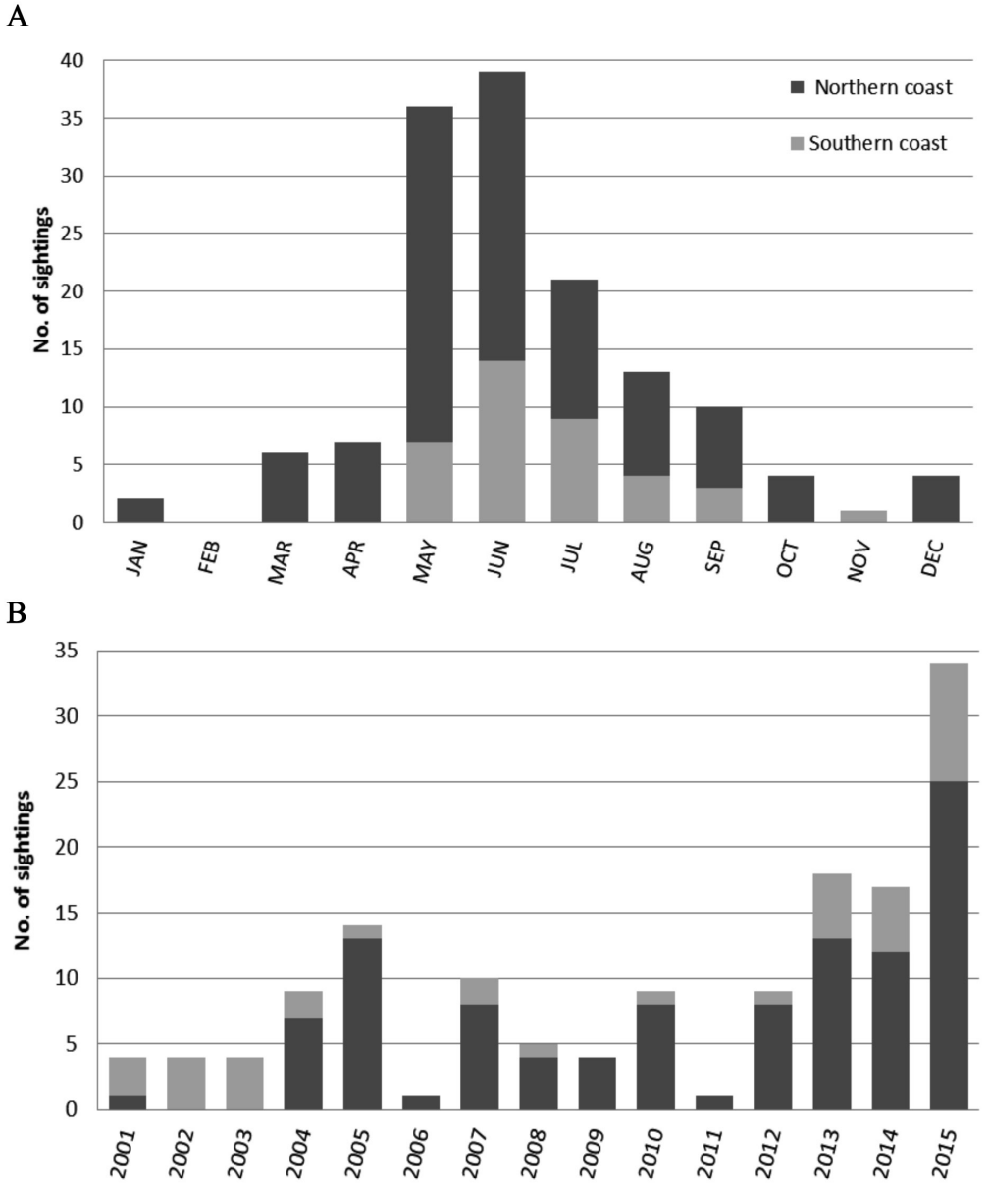

Figure 2. Histograms of killer whale sightings in the Moray Firth from 2001 to 2015 showing (A) the pooled monthly and (B) the interannual sightings records, respectively

Figure 3. Photographs of killer whales from the Moray Firth showing (A) a mixed-sex group, including a known male (ID#032), positioned second from the top (as identified from the *North Atlantic Killer Whale Catalogue*); (B) John Coe (ID#W001), a distinctive adult bull and established member of the supposedly site-faithful west coast community (e.g., Beck et al., 2014); and (C) a female (ID#012), far right, recaptured from both northern and southern MF locations alike during the study period.

1996). The observed increase in *O. orca* sightings in the MF from 2001 to 2015 also coincides with the exaggerated decline in *P. vitulina* populations in Shetland and Orkney during this period (e.g., Lonergan et al., 2007), as whales are perhaps compelled to move further south in search of this pinniped quarry. That said, in the present study, just a handful of whale sightings were reported from the inner MF where the most notable common seal haul-out sites are found (e.g., Butler et al., 2008). Whilst common seals are clearly predated by whales in this region (as confirmed from several events reported in this study), other species such as grey seals (*Halichoerus grypus*), seabirds, and even small cetaceans (e.g., Weir, 2002; Smith, 2006; this study) are also evidently targeted here—these whales acting, quite atypically, as generalist feeders upon fish stocks, marine mammals, and seabirds alike. This is certainly an interesting finding, although our present understanding of the dietary dynamics of *O. orca*, and indeed the response of individuals to available prey, remains rudimentary at this time (Samarra & Foote, 2015). Ultimately, a better understanding of the ecological changes affecting the distribution of targeted fish stocks in the northeast Atlantic Ocean (e.g., Similä et al., 1996; Nøttestad et al., 2014) may help to predict future responses by the whales frequenting these waters in the years to come.

In addition to understanding the impact of these top predators upon local resources and ecosystems, a knowledge of their movements and distribution is also important for effective management (Samarra & Foote, 2015). For example, previous studies from the west of Scotland, Ireland, and Wales have identified a small unit of just nine or so killer whales that are thought to be confined year-round to this area, showing no associations or connectivity with the catalogued individuals from the Northern Isles and northeast Scotland (Foote et al., 2010; Beck et al., 2014). In the present study, however, at least one identifiable bull from this west

Table 1. Photo-identified killer whales individually matched from the North Atlantic Killer Whale Catalogue during opportunistic sightings in the Moray Firth from 2001 to 2015 inclusive; S = Southern firth and N = Northern firth for locations of sightings, respectively.

ID#	2001	2002	2005	2009	2011	2012	2013	2014	2015
W001	S	S	--	--	--	--	S	--	--
12	S	--	--	--	--	N	--	--	N
16	--	--	S	--	--	--	--	--	--
32	S	--	--	--	--	N	--	--	N
19	--	--	S	--	N	--	N/S	N	--
14/13*	S	S	--	--	--	--	--	--	--
21	--	S	S	--	--	--	N/S	N	--
62	S	S	--	--	--	N	--	--	S
122	--	--	--	N	--	--	--	--	--
65	S	S	--	--	--	N	--	--	--
34	--	--	--	--	--	--	--	S	--
73	--	--	--	--	--	--	--	S	S
108	--	--	--	--	--	--	--	S	--

* This is the actual ID# for this animal as identified from the *North Atlantic Killer Whale Catalogue* as opposed to an uncertain identification

coast community was recaptured on four separate occasions from the MF and Aberdeenshire coast (Figure 1)—on its own in July 2001 and 2002, and among a pod of three and five animals respectively, in two sightings from August 2013. Unfortunately, identification of the companion whales seen in 2013 was not possible. Even so, this series of recaptures across multiple years infers that the west coast community is not as discrete as previously purported, thus extending our present knowledge of the potential movements of these animals in inshore Scottish waters at this time.

Movements of individual killer whales between Iceland and Scotland (Samarra & Foote, 2015) suggest seasonal, rather than permanent, passages by individuals, with animals travelling to Scotland in the late spring and summer. In the present study, the highest number of sightings was equally observed in May and August, but, conversely, animals were notably recorded year-round in the MF, suggesting some diversity in seasonal passages by individuals between these locations. Indeed, those known animals migrating between Iceland and Scotland represent just 2% of the total individuals presently identified in Iceland and only 10% of those identified from northeast Scotland (Foote et al., 2010; Samarra & Foote, 2015). Thus, investigating the seasonal movements of a larger number of whales identified from ongoing focal studies will be key to evaluating the extent of this diversity and the effects of subsequent consumption rates upon local prey resources.

Acknowledgments

The CRRU would like to thank the many support staff and volunteers who participated in boat survey work and the numerous members of the public for submission of sightings records. Boat survey work by the CRRU was carried out under licence from Scottish Natural Heritage with the support of the Earthwatch Institute, Care for the Wild International, and, more recently, the Born Free Foundation. SWF additionally thanks its many observers from the Moray Firth and northern Scotland regions, particularly Paul Castle, Howard Loates, Donald Mitchell, Karen Munro, Dave and Ivor Thomas, and North Coast Marine Adventures.

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