

## First record of greater white-toothed shrew *Crocidura russula* in Ireland

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### ABSTRACT

**1.** Skeletal remains of greater white-toothed shrew *Crocidura russula* were recovered from barn owl *Tyto alba* and kestrel *Falco tinnunculus* pellets collected at 15 locations in Counties Tipperary and Limerick in Ireland in September 2007 and March 2008. Seven greater white-toothed shrews were trapped at four locations in Tipperary in March 2008. This is the first Irish record of *C. russula* and compelling evidence that the species is established in Ireland.  
**2.** The absence of *C. russula* from earlier surveys of owl pellets and small mammals in Ireland suggests a recent introduction by uncertain means, possibly since 2001. It seems likely that *C. russula* will expand its range in Ireland. Its impact on the ecology of habitats in which it is found is uncertain but may be considerable.

*Keywords:* barn owl, biogeography, introduced species, invasive species, mammal, *Tyto alba*

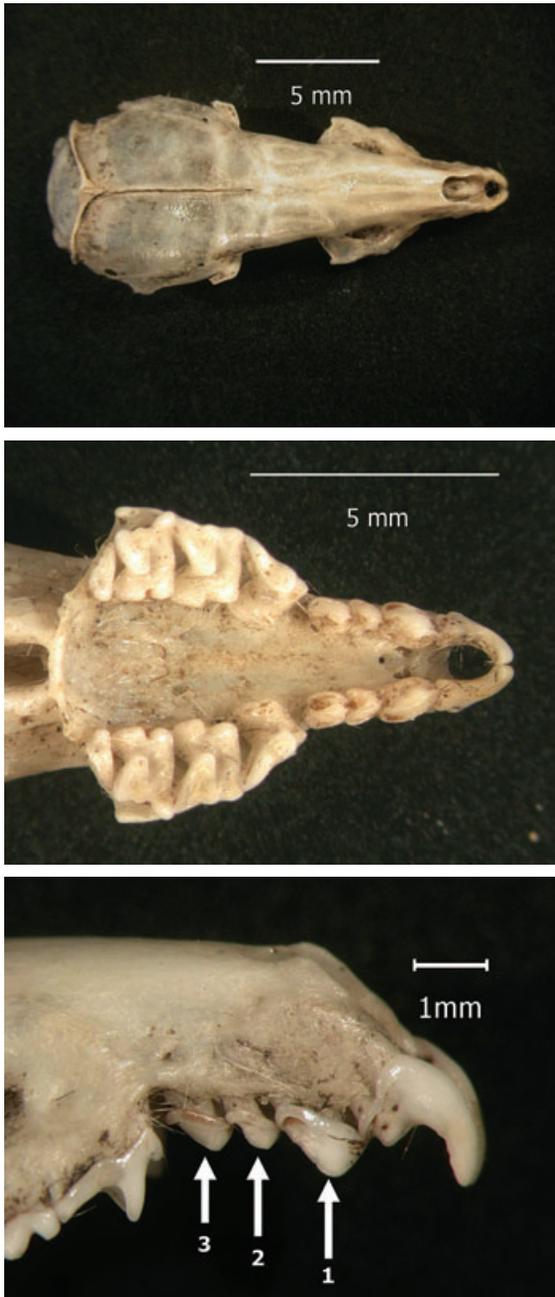
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The known range of the greater white-toothed shrew *Crocidura russula* extends from the northern fringe of Africa through Iberia, France and parts of Germany to the Benelux countries (Mitchell-Jones *et al.*, 1999). It occurs on Sardinia and Ibiza (Mitchell-Jones *et al.*, 1999; Sommer *et al.*, 2005) and on many Atlantic offshore islands, including Gran Canaria (Nogales *et al.*, 2006) and Guernsey, Alderney and Herm in the Channel Islands (Harris & Yalden, 2008). Its presence on several of these Atlantic islands is most likely the result of accidental introduction by people (Nogales *et al.*, 2006; Harris & Yalden, 2008). Fossil material attributed to *Crocidura* spp. is unknown from Ireland and, before now, it had not been recorded in recent times.

A total of 53 shrew skulls were discovered in 10 pellets collected from an active barn owl *Tyto alba* roost in County Tipperary, Ireland. The pellets were collected on 30 September 2007 as part of a study of barn owl ecology in Ireland and were analysed on 4 March 2008. Other species found in the pellets included six wood mice *Apodemus sylvaticus*, six bank voles *Myodes glareolus* and a further two mouse skulls that could not be identified to species.

The skulls were identified by this team as those of *C. russula* and our identification was confirmed by two independent experts (J. S. Fairley and D. W. Yalden, personal communi-

cations). Identification was made on the diagnostic features of greater white-toothed shrew, including three unicuspid teeth on the maxilla, contrasting with five unicuspid teeth in *Sorex* spp., including *S. minutus* which is the only shrew previously recorded in Ireland. Teeth of *Sorex* spp. are also pigmented while those of white-toothed shrews are not. The height of the third unicuspid relative to the second unicuspid and PM<sup>4</sup>, and the length of the overall tooththrow distinguish *C. russula* from the two other *Crocidura* species known from continental Europe (Fig. 1, Table 1). *C. suaveolens* is appreciably smaller, and both it and *C. leucodon*



**Fig. 1.** Top: dorsal view of greater white-toothed shrew skull recovered from a barn owl pellet in Ireland. Middle: view of upper teeth and palate. Bottom: lateral view of unicuspid teeth on upper jaw with numbers indicating first, second and third unicuspid teeth.

**Table 1.** Means and ranges of *Crocidura* spp. from continental Europe (Saint-Girons, 1973) and recent Irish material

	Condylobasal length	Width of rostrum	Upper I1-M3	Lower I1-M3	<i>n</i>
<i>C. russula</i> (Ireland)	*19.1 (18.6–19.5)	6.3 (6.0–6.6)	8.4 (7.8–8.9)	5.8 (5.0–6.9)	40
<i>C. russula</i> (Europe)	19.2 (18.2–22.0)	6.3 (5.4–7.3)	8.0 (6.9–9.3)	5.8 (5.0–6.9)	177
<i>C. leucodon</i>	19.6 (18.9–21.0)	6.8 (6.5–7.0)	8.1 (7.5–9.0)	6.1 (5.6–6.5)	15
<i>C. suaveolens</i>	16.6 (15.7–17.8)	5.4 (5.0–5.7)	6.8 (6.0–7.8)	4.9 (4.3–5.4)	14
<i>Sorex minutus</i> (Ireland)	*15.7 (15.5–15.9)	4.0 (3.5–4.3)	5.9 (5.0–6.6)	4.2 (3.8–4.8)	13

\*Sample sizes for condylobasal length measurements of Irish material, *C. russula* *n* = 4 and *S. minutus* *n* = 3.

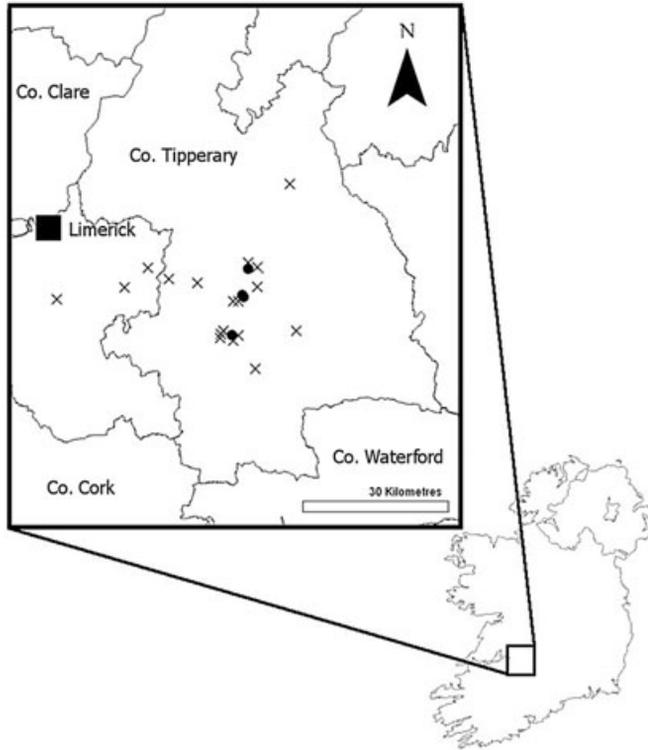
differ in the relative sizes of unicuspid and PM<sup>4</sup> (Miller, 1912; Harris & Yalden, 2008). While it is unlikely that the Irish material is anything other than *C. russula*, the identity and possible source population of the Irish material will require confirmation using molecular genetic methods.

Further field surveys to locate barn owl and kestrel *Falco tinnunculus* roosts were conducted in Counties Clare, Cork, Limerick and Tipperary between 5 and 8 March 2008. From a total of 91 sites visited, barn owl pellets were collected at 20 locations and kestrel pellets collected at a further 24 locations. Initial analysis revealed the presence of greater white-toothed shrew remains in pellets from 14 locations in Counties Tipperary and Limerick (Fig. 2).

Trapping using Longworth traps on five nights from 14 to 26 March 2008 resulted in the capture of seven greater white-toothed shrews (five females, two males) at four locations in County Tipperary (Fig. 3). Voucher specimens collected from these sites have been deposited with the National Museum of Ireland – Natural History, Dublin (NMINH. 2008.22.1–2) and the National Museums of Scotland (NMS.Z. 2008.022.001–002). These initial investigations suggest a range within Limerick and Tipperary in excess of 30 km by 60 km (Fig. 2).

It seems implausible that this mass of material recovered from barn owl and kestrel pellets originated outside Ireland given the limited foraging range of these species (Village, 1990; Cayford, 1992; Taylor, 1994; Bond *et al.*, 2005) and the location of these records in west central Ireland. The frequency and extent of these records also contrast markedly with previous isolated reports of non-native mammals in Ireland, including mole *Talpa europaea* remains in a single pellet from an owl that was thought to have flown from Scotland (Adams, 1905) and a single instance of field vole *Microtus agrestis* remains in a cave in Ireland, again associated with owl movements (Savage, 1966). It is also highly unlikely that there has been a long-term presence of the greater white-toothed shrew in Ireland without it being recorded either as fossil material or as a recent member of the Irish mammal fauna. Previous extensive analyses found no evidence of white-toothed shrews in barn owl and raptor pellets in Ireland (Fairley & Clark, 1972; Fairley, 1973, 1984; Clark, 1974; Smal, 1987; Fairley & Smal, 1989; Cooke *et al.*, 1996; Foley *et al.*, 2006; O'Connell *et al.*, 2006). More recent surveys from 1997 to 2001 of the bank vole, another introduction to Ireland (Claassens & O'Gorman, 1965) also failed to record the presence of the greater white-toothed shrew, despite good coverage of Tipperary and Limerick (Meehan, 2005).

We propose that the records presented here are evidence of at least one recent introduction event, probably accidental, from continental Europe to Ireland, and that this has resulted in a rapid increase in numbers over a short period. Given the absence of greater white-toothed shrew in Meehan's survey, completed in 2001, the time since introduction may be less than 7 years. The combination of a long breeding season, multiple litters of up to 11 young per



**Fig. 2.** Map of Ireland indicating locations where remains of greater white-toothed shrew were discovered in kestrel and barn owl pellets (x) and where live shrews were trapped (●).



**Fig. 3.** Adult greater white-toothed shrew caught in County Tipperary, Ireland, 16 March 2008.

year, early maturation, communal nesting and use of buildings and habitats close to people (Harris & Yalden, 2008), may facilitate range expansion in greater white-toothed shrews following an introduction.

The frequency of occurrence of shrew remains in bird of prey pellets suggests that there is potential for the greater white-toothed shrew to become a major prey item of avian predators in parts of Ireland. In Ireland, where there is an impoverished small mammal fauna compared with Great Britain, the introduction of this species may prove beneficial for predators such as the barn owl, especially when the barn owl is regarded as under threat in this part of its range (Lynas *et al.*, 2007). Studies in Europe have shown the greater white-toothed shrew to be an important part of barn owl diet (Taylor, 1994; Sommer *et al.*, 2005) and in time this may prove to be the case in Ireland.

Although potentially positive in this respect, the introduction of the greater white-toothed shrew to Ireland may also prove to have negative implications as it is a potential invasive species and a possible threat to the island's ecology (Nogales *et al.*, 2006). Research has demonstrated that the greater white-toothed shrew has the potential to displace other shrew species (Vogel *et al.*, 2002). Therefore, like other recently introduced mammal species in Ireland (grey squirrel *Sciurus carolinensis*, mink *Mustela vison*, brown hare *Lepus europaeus* and bank vole), the presence of this species raises issues of mechanisms and prevention (Stokes *et al.*, 2006) and management and control (Courchamp *et al.*, 2003). Further research on the origin, means of introduction, and potential impact of the greater white-toothed shrew on native biological communities in Ireland is in progress.

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