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## Croft management and economics: impacts on bumblebee conservation

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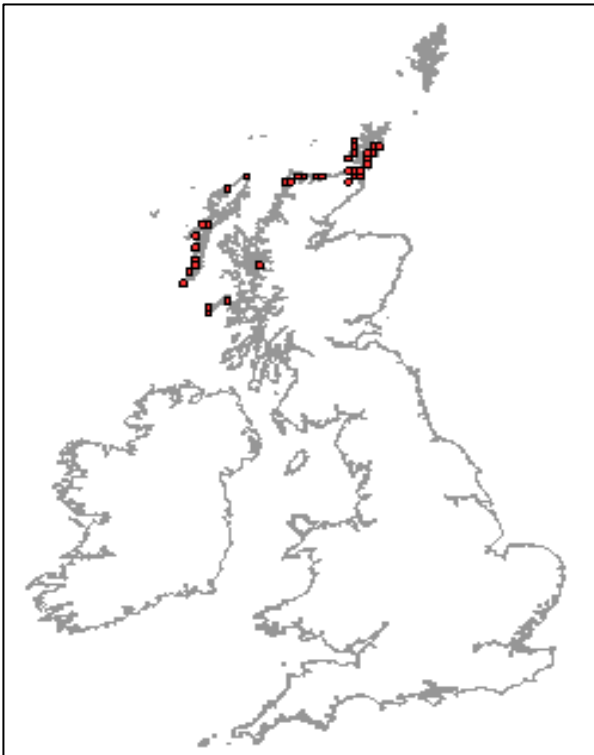
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The crofting agricultural system is unique to the Scottish Highlands and Islands. The low intensity of traditional crofting practices results in a farming system that is sympathetic to the landscape and enables a diverse array of organisms to survive alongside it (Love, 2003). Crofting on the machair habitats of the Western Isles is particularly valuable to biodiversity, with several rare and endangered species persisting in these habitats. Winter cattle grazing and cultivation of the machair plain is a prime example of how crofting practices benefit wildlife: the combination of grazing and occasional cultivation promotes the growth of a wide variety of wildflowers throughout the summer months that are an important foraging resource for invertebrate fauna (Love, 2003), particularly for the island's bumblebee species (MacDonald, 2003). Butterflies and moths also benefit from the abundance and variety of wildflowers (Love, 2003), whilst other organisms such as the corn bunting (*Emberiza calandra*) historically found suitable habitat within traditionally cultivated areas (Wilson *et al.*, 2007).

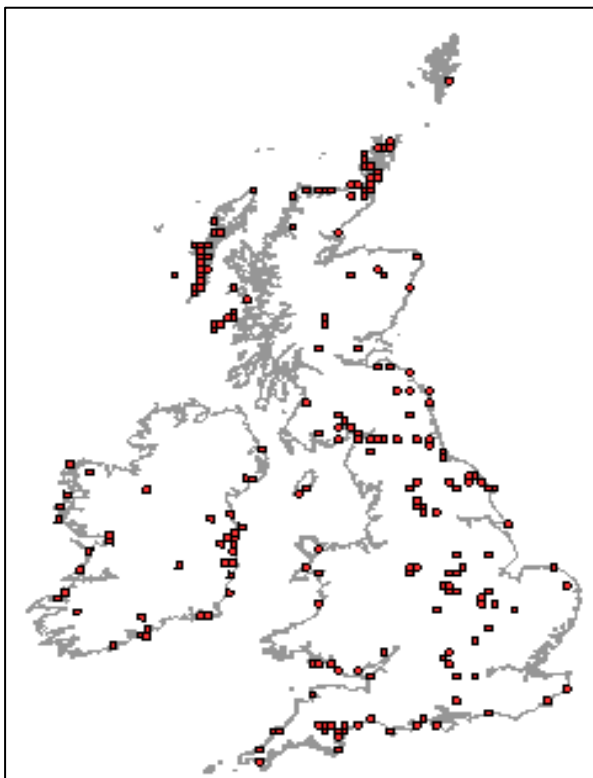
Britain is home to approximately 10% of the world's bumblebee fauna. However, of the 25 native British species three are extinct, a further six are rare or endangered and are UK Biodiversity Action Plan (BAP) species. Only six species remain common and ubiquitous throughout Britain (Goulson, 2003). The primary driver of this decline has been attributed to post war agricultural intensification and the subsequent loss of suitable foraging habitats (Benton, 2006; Goulson, 2003; Goulson, Lye and Darvill, 2008). Flower rich habitats such as permanent unimproved pasture are important foraging resources for bumblebees (Carvell *et al.*, 2006). However, the development of rapid growing varieties of grass (Goulson, Lye and Darvill, 2008) combined with the decreased cost of nitrogenous fertilisers (Strijker, 2005) has substantially increased agricultural productivity leading to a significant reduction in these habitats (Goulson, 2003). As a result of this and other intensification measures the UK lost over 90% of its lowland unimproved grassland between 1932 and 1984 (Fuller, 1987).

The Western Isles have not escaped the impacts of agricultural change. Owing to the increasing average age of active crofters, increasing input prices and declining sheep prices, traditional crofting methods that have maintained important machair habitats are now becoming economically unviable. The expense of contracting labourers to carry out croft operations in a traditional manner often outweighs the financial benefits received by crofters and exacerbates the problem. As a result there is increasing reliance on more efficient and intensive agricultural methods, such as the replacement of seaweed with nitrogenous fertilisers to improve fertility. The complete abandonment of croft land is also an issue and both intensification and land abandonment have serious implications for bumblebees in the Western Isles that depend on low intensity crofting operations to persist.

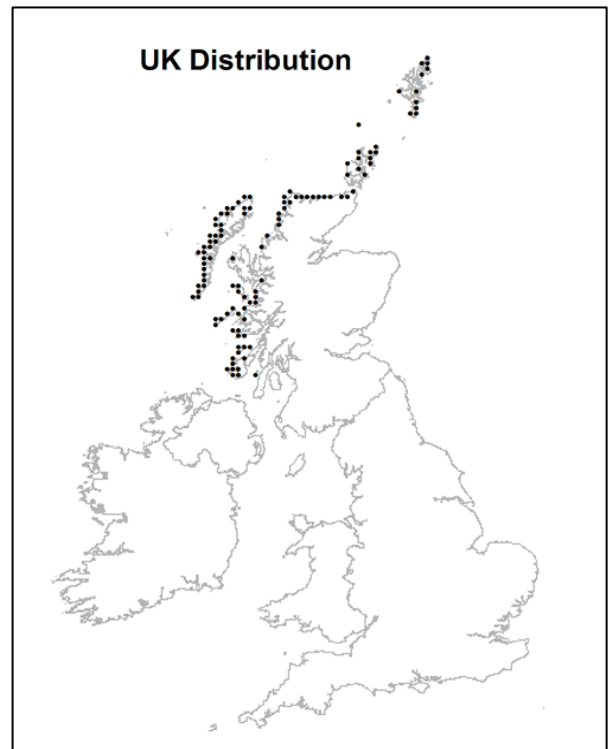
Of the five bumblebee species found on the Western Isles the great yellow bumblebee (*Bombus distinguendus*) is the species most frequently associated with crofting and machair. It is currently only found in the Outer Hebrides, Coll and Tiree, in pockets along the north coast of the Scottish mainland and in Orkney (Fig. 1a). The present distribution closely reflects the distribution of machair in the UK (Fig. 2) and has resulted in the great yellow bumblebee becoming synonymous with this habitat. However, this species was previously widespread throughout Britain (Fig. 1b) until experiencing a decline in its range and distribution of over 95% in the past 60 years (Fig. 1b). This has led to it becoming the UK's rarest bumblebee (Benton, 2006) and its listing as 'nationally scarce' on the UK Biodiversity Action Plan (BAP) (Benton, 2006; UK BAP). In line with the decline of other bumblebee species, agricultural intensification and subsequent habitat loss have driven the decline of the great yellow bumblebee (Benton, 2006). The great yellow bumblebee is classified as a long tongued bumblebee and specialises in collecting pollen from flowers with deep corollas belonging to the Fabaceae family (Goulson *et al.*, 2005). The loss of Fabaceae rich grasslands from farming systems throughout Britain is thought to have made an important contribution to the decline of the great yellow bumblebee. Red clover (*Trifolium pratense*) belongs to the Fabaceae and has been identified as an important species for long tongued bumblebees (Goulson and Darvill, 2004), and it remains abundant on the machair of the Western Isles.



**Fig.1a.** Current distribution of the great yellow bumblebee in the UK (2000-2008). Map from NBN Gateway.



**Fig.1b.** Historical distribution of the great yellow bumblebee in the UK between 1900-1999. Map from NBN Gateway.



**Fig 2.** Current UK distribution of machair habitats. Map from JNCC.

The intrinsic benefits of crofting to the great yellow bumblebee and other biodiversity are of great interest to conservationists. A three year study to investigate the interaction between croft management, economics and great yellow bumblebee conservation is currently underway at Stirling University. Through this work the relationship between bumblebee abundance and current croft management practices are being investigated, alongside an analysis of the current economics of the crofting system. The development of farm production models which combine ecological and economic data collected in summer 2008 will allow the potential impacts of different croft management decisions on rare bumblebee populations to be investigated. From the outputs of the models we hope to be able to promote croft management practices that are both economically viable for crofters to undertake and that are beneficial to bumblebees in the Western Isles.

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