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The use of scent glands to improve the efficiency of mink (*Mustela vison*) captures in the Outer Hebrides

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Abstract Introduced invasive American mink are currently posing a threat to endangered bird species on the Western Isles, an archipelago off the west coast of Scotland. As part of a 5-year eradication campaign established in 2001, we conducted a small-scale experiment in 2002 and 2003 on six offshore islands, ranging from 9 to 31 ha. Over 810 trap-nights, 82 live traps were alternately baited with mink scent gland extracts or with traditional fish baits. Baiting traps with scent gland extracts was significantly more effective than baiting with fish. In 2003 a large-scale field trial was carried out over a 900 km^2 section of the Western Isles, using either commercially made scent gland lure or fish to bait complete trap-lines of 20–35 traps. Trapping with 2154 live traps over 22 525 trap-nights confirmed the results of the small-scale experiment, and also showed that the scent lure was equally attractive to both male and female mink. The technique is recommended as a means of improving the efficiency of individual traps to catch mink. The implications for large-scale invasive mustelid eradication programmes are discussed.

Keywords invasive species; Western Isles; trapping; eradication; scent lures; mink; *Mustela vison*

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INTRODUCTION

The American mink (*Mustela vison*) is a highly successful invasive species, now established over much of Europe and South America (Dunstone 1993). Mink escaping from two fur farms set up in the 1950s colonised the Western Isles, Scotland, in the 1960s (Cuthbert 1973). Since then, mink have spread steadily southwards, and have now reached the southern tip of the island chain (195 km long). The Western Isles support internationally important populations of several species of ground-nesting birds and salmonid fish, and the human economies of many areas rely on fishing, shooting and wildlife tourism for income. Mink threaten both the ecological (Clode & MacDonald 2002) and economic values of the islands.

The Hebridean Mink Project (HMP) is a large-scale project set up in November 2001, funded by the European Union (EU) Life Programme and a consortium of local government and non-government organisations, to eradicate mink from a discrete 900 km^2 area of the archipelago (Fig. 1) (Moore et al. 2003). Live-capture wire cage traps are laid out over large areas along watercourses and coastlines, approximately 200–400 m apart, baited and checked daily. As this is a labour intensive process, we are always looking for ways of improving the efficiency of each trap-night.

Many carnivores communicate intra-specifically via deposits of scent strategically placed within their home ranges (MacDonald 1980; Kruuk 1992; Feldman 1994; Hutchings & White 2000; Briscoe et al. 2002). These deposits allow animals to orientate themselves and learn about the presence of, and even the breeding status of, other individuals in the area (Feldman 1994; Hutchings et al. 2001). In territorial species the marks also serve to warn other individuals of the presence of territory holders, thus minimising the risk of unintended physical conflict (Gorman 1980; Gosling 1982). The scent marks themselves range from normal faeces and urine to highly developed excretory products, and they often communicate very detailed information about

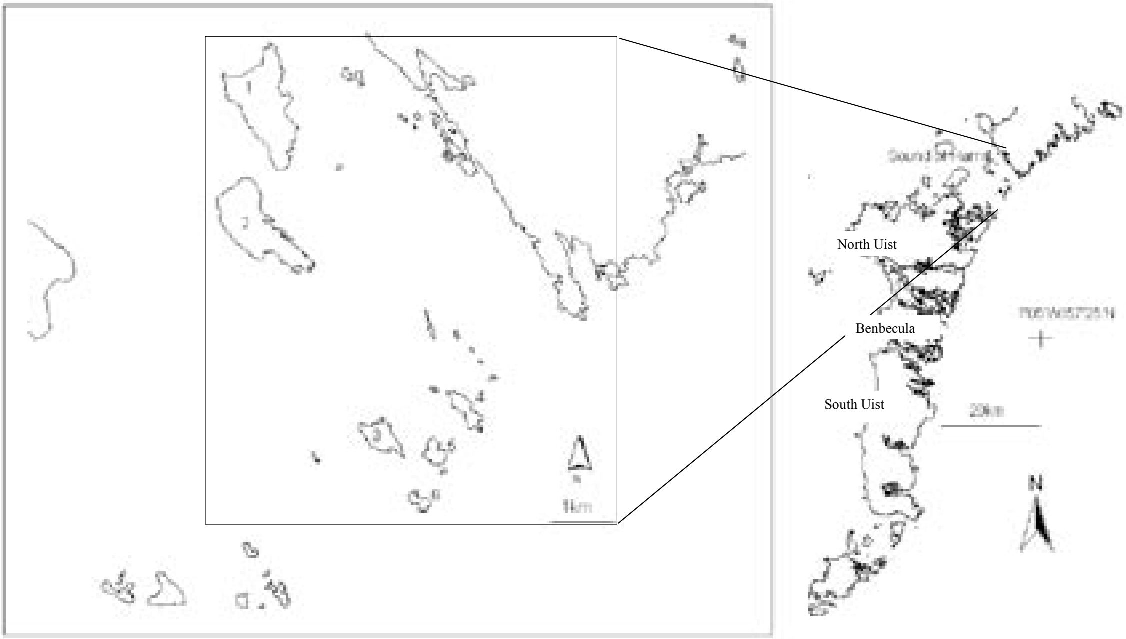

Fig. 1 Location of the experimental islands (1–6) used for the small-scale field trial, and the area from which the dataset for the large-scale field trial was gathered (North Uist, Benbecula and South Uist).

individuals (MacDonald 1980; Feldman 1994). This, in turn, influences behaviour, usually in the form of frequent revisiting of old scent marking sites and intense investigation of new ones. Many of these behaviour patterns are well illustrated by the mustelids, including *M. vison* (Kruuk 1992).

These scent-mediated social behaviours may have applications in pest control and wildlife management. Generations of fur trappers and many wildlife managers use or have experimented with scent glands in order to facilitate the capture of their target species (Howard et al. 2002), although experiments with some mustelids have shown mixed results (Clapperton et al. 1994; Spurr et al. 2004). The technique has also been used to attract animals to marking posts as a means of monitoring carnivore populations (Roughton & Sweeny 1982).

This paper describes a two-stage study aiming to investigate whether scent gland lures could be more effective in improving the efficiency of trapping efforts than conventional fish bait alone. The trials were part of a larger eradication campaign being carried out by the Hebridean Mink Project (HMP) (Moore et al. 2003). First, we conducted a small-scale experimental trial on six small offshore islands in 2002–03, followed in 2003 by a large-scale comparison between commercially available scent gland lure and fish bait.

METHODS

General methods

Wire cage traps (Bethel Rhodes and Sons, Keighley, Yorks) were set 200–250 m apart and checked daily. Scent lures were made from cigarette filters soaked in sub-caudal scent gland extracts, removed from male mink culled as part of the HMP. Captured mink were humanely dispatched with a 0.22 air pistol and removed.

All trapping was carried out as part of the larger eradication campaign of the HMP, and therefore still had to be effective as a trapping operation. Hence, no unbaited control traps were set in either the large-scale or small-scale trials.

Observations made during the wider HMP trapping operations showed that fish baits were rarely touched or eaten by captured mink, so they did not seem to need access to food prior to humane dispatch.

Therefore, in the two trials reported here the traps baited with scent gland extracts did not also contain fish, in order to avoid confounding effects of multiple bait treatments.

Small-scale field trial

In August 2002 traps we chose four small islands in the Sound of Harris (Fig. 1), ranging from 9 to 31 ha (Table 1) and set a total of 28 traps on them (between 5 and 9 on each island). All traps were placed 20–40 m from the high tide mark, alternately baited with either fish or male scent lures, and operated for 4 nights simultaneously. In April 2003 the experiment was repeated on two larger islands in the Sound of Harris. One (160 ha) had 26 traps, and the other (188 ha) had 28 traps. On all six islands, traps were placed in a ring around the coast.

In 2003, on the two larger islands, scent glands from both males and females were used to check whether there were any differences in the attractiveness of the scent baits associated with gender. We could not do the same on the smaller islands in 2002 as there were insufficient numbers of traps to allow the required four-fold sequence of baiting with male scent followed by fish, and then female scent followed by fish). Traps were again operated for 4 nights.

The data were analysed using Generalised Estimating Equation (GEE) (Fahrmeir & Tutz 1996) using Genstat (Payne et al. 2002). Radio-telemetry studies of mink on the Western Isles has shown that the average daily movements of mink in HMP were 230 m, ranging from 0.03 km to 0.81 km/day. High density populations, such as those on offshore islets, moved far less than other coastal or inland populations (Helyar 2006); 85% of all mink were caught on the first night's trapping. Therefore, we used a model assuming that each trap was a sampling unit, and each trap-night it was open was treated as an independent subsample. In the analysis the treatment of either scent gland extract or fish bait was applied as the fixed effects term. The model was then run using a binomial distribution and a logit link function. There were no sprung but empty traps during this section of the study, so we did not need to use corrected values of trapping effort.

Large-scale field trial

Over a 900 km^2 section of the eradication area trapped by the HMP, entire trap-lines of 20–35 traps were baited, either with fish or with scent gland lure. The bait type for each line was determined opportunistically, but bait types were then kept constant throughout each trapping period of 5–10 nights per trap-line. The results were analysed to assess the effects on mink captures of baiting with fish or with a commercial scent gland lure (mink scent gland, made by Kishel Scents and Lures, Saxonburg, USA). Once trapped, trap-lines were shut down and not operated again for a minimum of 4 months, so any traces of previous fish or scent gland treatments were negligible when they were operated again. Where trap-lines were operated for more than a week continuously, baits were replaced weekly, before deterioration.

The dataset included 2154 traps and 22 525 trap-nights (18 996 with fish and 3529 with scent gland lure). Trap sites were constant throughout the trial. The proportion of mink caught with each bait type was compared with the number of trap-nights offering each bait type, using a X^2 test. Sprung traps, and any traps that were moved during the trial period, were omitted from the analysis. Data from the May to July denning period were excluded from the analyses, as traditional line trapping is ineffective during this period. Instead, dogs are used to locate mink at den-sites, where they are then caught using high intensity trapping (Moore et al. 2003). Data from the rest of the year (Dunstone 1993), were pooled for the analysis, as they were not independent from each other.

Table 1 Number of traps baited with scent gland lure or with fish on each of the islands in the small-scale field trial, and the numbers of mink caught in each.

Island	Area (ha)	Lure traps	Lure captures	Fish traps	Fish captures
Ensay	180.85	16	1	12	0
Killigray	160.31	15	5	11	2
Groay	31.31	4	2	4	0
Gilsay	22.10	4	4	5	1
Lingay	16.17	3	2	3	0
Scaravay	9.20	3	2	2	1

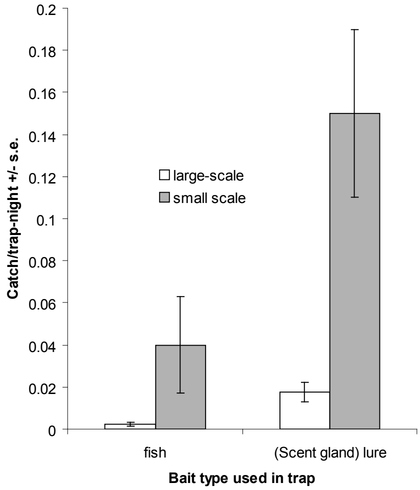

Fig. 2 The average catch per trap-night with standard errors for the two different bait types in the small-scale and large-scale trials.

RESULTS

Small-scale field trial

Altogether, 20 mink were caught during this experiment over 810 trap-nights from 2002 and 2003; 16 with lure and 4 with fish. Seventeen of these animals were caught within the first 3 nights of trapping. Over the 4-day trapping period, traps baited with scent gland extracts (genders pooled) were consistently more effective (average 0.14 mink/trap-night) than traps baited with fish (0.03 mink/trap-night) (Fig. 2).

This difference between baits was highly significant ($X^2_1 = 6.63$, $P = 0.01$), but the difference between individual islands was not ($X^2_5 = 5.15$, $P > 0.05$). When traps were baited with male and female scent glands (64 and 60 trap-nights, respectively) or fish (88 trap-nights), insufficient numbers of animals were caught on the two larger islands (2 male and 3 female) to analyse gender based differences separately. These results were therefore pooled.

Large-scale field trial

A total of 55 animals (22 males and 33 females) was caught during the large-scale field trial, all within 3 nights of setting the trap, regardless of how long the trap-line was operated. This difference in sex ratio may reflect the changing sex ratio of the population as their numbers were depleted following several years of trapping (Roy et al. unpubl. data) since factors such as trap spacing remained unchanged during the project. There was no significant difference in the observed number of captures of either sex in traps with scent glands (5 males to 10 females) compared with their expected values based on the overall sex ratio of captures during the trial (6 males to 9 females) ($X^2 = 0.382$, d.f. = 1, $P = 0.537$).

Even though the number of trap-nights offering scent gland lure was far lower than the number offering fish bait, the observed values (15 captures on scent gland lure:40 captures fish) were significantly different from their expected values (8.63 scent gland lure:46.37 fish) ($X^2 = 5.585$, d.f. = 1, $P < 0.05$). Use of scent gland lures therefore seems to be more effective than fish bait (Fig. 2).

DISCUSSION

The results of both the small-scale experiment and the large-scale field trial support the hypothesis that trapping with scent gland extract is more effective than trapping with fish bait. The catch per trap-night of mink of both sexes was significantly higher in traps baited with scent lure than with fish, consistent with the results studies of other mustelids (Clapperton et al. 1994; Spurr et al. 2004). We could not test the difference between male and female scent lures, but one study on ferrets found that female scent gland lure was more effective than male scent gland lure (Spurr et al. 2004).

There is very little information on potential changes in carnivore behaviour with reduced density. It is possible that, as mink populations decline and become fragmented through an eradication programme, the reduced competition for resources could cause a breakdown in territorial behaviour. This effect is seen in many small mammals (Gray & Hurst 1998; Luna & Baird 2004) and has also been recorded in feral ferrets (*Mustela furo*) (Norbury et al. 1998). If this were the case here, scent gland lure could become more effective as the eradication campaign progresses, since mink may become disproportionately more inquisitive about the scent or presence of other mink when intra-specific encounters through the year are few (Hutchings & White 2000). Thus, baiting traps with scent gland extracts as populations are culled may well counteract the lowered capture rates and possible reductions in trappability typical of low-density, transient populations (Baker et al. 2001). The results of this work show that baiting traps with scent gland lures can be used to improve the efficiency of large-scale trapping programmes for mink, and in the long-term may reduce the time and labour costs associated with such programmes.

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