The Development of A Swift Fox *Vulpes velox* Hair Trap

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Abstract
A hair trap for swift fox *Vulpes velox* was developed and tested on a captive colony of the species in Alberta, Canada. The hair trap consisted of a closed design and bait was used to encourage the swift fox to enter. Field trials of the hair trap were conducted in areas where swift fox had been previously reintroduced in both Canada and the United States. The hair trap successfully attracted foxes to them and hair samples were collected for DNA analysis. Laboratory analysis of the hair follicles suggested that contamination of samples was minimal. Thus the hair trap is an effective and non-invasive method of population monitoring for a cryptic species such as the swift fox.

Introduction

Hair samples are routinely collected and the DNA within the follicles analysed to monitor mammal populations such as those of brown bears in both Europe (Taberlet *et al*., 1997) and in North America (Woods *et al*., 1999). Hair traps for bears consist of a strand of barbed wire strung in a line between tree trunks. Barbed wire is important to snag the hair, as hair follicles are where the majority of DNA is found (Woods *et al*., 1999, Mowat & Strobeck 2000).

Swift fox have been the focus of reintroduction programmes in Canada (Smeeton & Weagle, 2000) and, more recently, in Montana, USA (Smeeton, 1999; Waters *et al*., in press). Monitoring is essential for both populations to ensure that there are enough individuals surviving and breeding to enable the population to be self-sustaining. Hair-traps have great potential as an inexpensive, non-invasive method of determining the presence of a cryptic species such as the swift fox and can also identify individuals. This paper describes the development of a method of taking hair samples from swift fox so that the technique can be used to monitor population expansion and population trends. These are key objectives of the National Recovery Plan for the Swift Fox (Brechtel *et al*., 1996). Recent research on rock hyrax *Procavia capensis* has shown that hair follicles can also be used to monitor stress levels over a long-term period using hormones isolated from the follicles (Koren *et al*., 2002). This could be another potential use for the samples collected.

Methods of surveying small canids such as the swift and kit fox include spotlighting; scent stations and mark recapture involving live trapping. In a study to evaluate the effectiveness of spotlighting and scent stations Warrick &Harris (2001) found that these methods were only able to detect long-term changes in population size. Live trapping has negative implications for animal welfare and if carried out at the optimal

time of year i.e. January/February, severe weather conditions can impede or prevent trapping (Moehlenschrager & Moehlenschrager 2002). With these factors in mind, a DNA based inventory of the population appeared to be the method of choice for monitoring swift fox populations. It was preferable to obtain tissue samples non-invasively and so hair follicles were selected as the method of collecting them. Thus a reliable method of collecting hair follicles such as a hair trap needed to be developed.

The simple strand of wire method used by bear researchers is inappropriate for swift fox as they could avoid a barbed wire strand by jumping over it. A more complicated method of hair trapping and a closed design was necessary for the foxes to come into contact with the barbed wire.

The Cochrane Ecological Institute is home to the only swift fox breeding colony in the world. The offspring from the adults in the colony formed the majority of the swift fox released in Canada during a reintroduction project which took place between 1972 and 1997 (See Smeeton & Weagle 2000). These individuals were released along with translocated Swift Fox from Wyoming. Since 1998, captive bred foxes from the colony have been released on Blackfeet Tribal Lands in Montana in the first reintroduction of swift fox in the United States (Smeeton, 1999; Waters et al. unpublished data). These animals, as far as we are aware, have not been supplemented with foxes from outside the colony and so their genetic origin along with that of the captive colony is well documented.

Live trapping was the method of choice for the population surveys undertaken to monitor the Canadian population of swift fox and the last one was carried out in 2001 (Moehlenschrager & Moehlenschrager 2002). However this method has several drawbacks not least being the welfare concerns regarding small canids exposed in a trap for even short periods of time in winter when weather conditions could be severe. In 2000, the Canadian Swift fox Recovery Team asked the CEI to develop a hair-trapping device for use in the field to monitor swift fox populations.

The captive individuals housed at CEI consisted of 14 pairs of swift fox, most of which were housed in single pair enclosures with additional animals in a 9 ha enclosure. These individuals were used to test prototypes of the hair-trapping device.

Development of the Hair Trap

Several hair trap designs were experimented with over a period of approximately three months. The trap design that had a consistent success rate was a half tunnel of sheet metal open at each end. Barbed wire was then securely attached to the inside edge of each tunnel opening. The approximate dimensions are: 90 cm long by 20 cm high by 17.8 cm at the widest point of the tunnel opening. (Plate 1).

Initial testing of the tunnel hair trap was conducted on the single pair pens and the 9 ha enclosure using anchovy paste as an attractant. The traps were left in the enclosures for 24 hours and then checked for hair. Hair was successfully captured from 13 of the 14 single pair pens but no hair was collected from the 9 ha enclosure. The successful traps collected from one to seven samples per trap.

The next phase of testing evaluated the effectiveness by using day old chicks secured to the ground in the centre of the trap. Six traps were left in the 9 ha enclosure for a

period of 24 hours and then checked. All chicks were still in the traps and no hair was collected. However, footprints left in the snow around the traps showed that foxes had visited the sites. Three traps were then modified to reduce the size of entrance points so that the foxes would have more contact with the barbed wire if they chose to stretch into the trap to investigate it. Twenty-four hours later the six traps were checked. The three original traps still had no hair samples but two out of three modified traps had collected hair. The conclusion was that the device would successfully collect hairs provided that the foxes put their heads in the trap to investigate or remove the bait. Butcher scraps mixed with bacon were used as an attractant in these tests as this was easier to obtain in the field than day old chicks. However, in the field, a single, small serving of bacon was used to discourage multiple entries to the trap and reduce the risk of contaminated samples. To enable the bait to be fixed to the middle of the trap and to make the traps sturdier to transport in the field the sheet metal tunnel was affixed to a wooden base that had two holes drilled into it for fixing bait with string. The next phase in the development of the hair trap was to test its performance in the field. The sites in Saskatchewan were chosen because a Swift Fox Survey Team were working in those areas thus aiding the logistics of the trial. This team were undertaking the 2000/2001 population survey using live trapping techniques (Moehlenschrager & Moehlenschrager 2002). The sites in Montana were near the release site and the presence of foxes was known in some but not all of the areas chosen.
In order to assess the success of the hair trap the following needed to be determined:

1) The frequency that wild foxes would take the bait and leave hair samples with follicles;
2) Whether other wildlife interfered significantly with the traps;
3) The frequency of multiple entries by different foxes (reporting on this objective could only be done once DNA analysis was complete. This was a separate project);
4) The logistical costs (i.e. the number of traps that can be deployed and monitored in a day) of this technique for use in future census planning;

Field Testing

Two areas in Saskatchewan were selected for field-testing the hair traps. Swift Fox presence in the Saskatchewan sites was determined by live trapping, scent posting and spotlighting during the 2000-2001 census and the probability that swift foxes would encounter the hair-trapping device was high. Unfortunately a planned calibration of the hair trap results against the live trapping results was not possible because data from the live trap study was unavailable. Twenty-five (25) hair traps were deployed in each area. Two trap lines were set up in Area 1, 18 traps in the first line and seven in the second and were monitored from 14-16th February, 2001. Three trap lines were set up in Area 2, six in the first, seven in the second and 12 in the third and were monitored from 15-17th February, 2001. See Fig. 1.

In Montana two trials took place one between the 3-6th of March, 2001 and the second in 3-5th June, 2001. In March two trap lines were set up, one line of 17 traps in Area 1 and the other line of eight traps in Area 2. In June two trap lines were again set in Areas 1 (12 traps) and Area 2 (8 traps). See Fig. 1.

Traps were deployed at 1 km intervals in the Saskatchewan trial and at 0.5 km intervals in the Montana trial. All traps were baited with bacon and set along roads and fence lines as this is where foxes commonly travelled. UTM locations were noted using a handheld GPS. All traps were secured to the ground with long nails to prevent them being moved or lost due to inclement weather conditions or by livestock in Montana. The traps were checked every day for three days in the Grasslands trial but were not checked for 48 hours during the Montana trials when they were checked and removed. All hair and scat samples from each trap site were collected. All hair captured on one barb was counted as one sample. Each hair sample was collected individually using haemostats. The sample was then put in a coin envelope. All hair samples from one trap site were then kept together in a Ziploc bag. Each barb that had successfully captured hair was sterilized with a cigarette lighter after the sample had been collected. This technique is used to prevent future contamination. All samples were clearly labelled with the trap number and the date. All samples were frozen each night on return to the field base; this was to preserve them until DNA analysis took place.

Where possible notes were made on any tracks in or around the traps and the species identified. Ambient weather conditions were also recorded (temperature, wind strength, snow conditions).

Results

Saskatchewan: Over the three day collection period a total of 17 hair samples were collected from Area 1. No samples were collected from Area 2. During the trial, swift fox presence was noted on only one occasion in Area 2. This was believed to be due to severe weather conditions. During the first two nights there were snowstorms accompanied by strong winds in Area 2. This led to most of the traps being completely covered by snow. There was little evidence of movement from any animal species during this time

A total of 17 trap visits were made to these 10 traps in Area 1. Repeat visits were made on five occasions. The traps had been approached by swift fox but not entered 6 times and were entered 11 times. Figure 1 summarizes the data for trap entry, the number of hair samples collected and the total number of traps set.

The data from the live trapping survey in the same areas show that there were a total of four swift fox trapped in Area 1 and 14 trapped in Area 2. Comparisons with the hair trap for the latter area cannot be made because of the blizzard conditions encountered during the hair trap testing in Area 2.

Montana (March): Four hair samples were collected from three traps from Area 1 Eleven hair samples were collected from three traps set in Area 2. No hair samples were collected from Area 3. Temperatures during this field trial were very mild for early March and averaged about 55f during the day.

Although there was some tracks indicating that a coyote had approached a trap – there was no interference with that particular trap. However, some interference was noted on one trap from which two samples were taken. Interference in the former case may have been the result of exploratory behaviour by domestic dogs living nearby and did not damage the trap.

Montana (June) The wind was very strong on both days of the trial and only three samples were collected although bait was taken in five cases.

Hair traps also successfully collected hair when set up outside swift fox natal dens in Montana during the spring and summer of 2002. Abdomen fluff which breeding females pluck from their abdomens before giving birth, was also collected from around the holes of natal dens sites during June 2002 in an attempt to discover if DNA could be isolated from the samples.

It was found that under field conditions each trap took between five and ten minutes to set up. This included attaching bait. The time could be significantly reduced if the traps were baited beforehand. Driving time must be added. This can vary depending on the terrain, distances involved and weather conditions. Checking each trap took approximately ten minutes if a hair sample was present and substantially less if no sample was present.

Discussion

One of the major concerns before the field trials took place was that coyotes might destroy the traps such that hair could not be captured from foxes visiting the site. However, during the trial, it was found that coyotes did not approach the devices.

A minor problem encountered was the slight loosening of the barbed wire hoops during transit. With an increased diameter the chances of hair being snagged from the visiting fox is decreased. In order to maintain the correct hoop size the tunnel design was modified slightly for the swift fox hair-trap field trial in Montana. Any further modification would have to be made from a material that would withstand burning because of the sterilization process, which must take place to prevent past samples contaminating future samples.

The main problem that was encountered in the Grasslands trial was the severe winter weather conditions. Heavy snowstorms caused the traps to be completely covered and filled with snow. Foxes did not attempt to dig through the snow to reach the bait. When conditions were extreme few animal tracks were seen so the traps were not encountered. In such conditions live trapping cannot take place (Cotteril, 1997). When it was snowing but temperatures were low, swift fox were active and hair was collected. The hair traps therefore have the advantage over live traps in that live trapping is not carried out at temperatures below –20C. Hair traps can be left out in winter weather, as there is no risk to the fox. Hair does not have to be collected during severe conditions and it is merely a case of resetting the trap the next day.

The weather in Montana during early March was much milder and the foxes had begun to disperse due to the imminent onset of the breeding season so were traveling outside their normal winter range. Hair samples were successfully collected in March but a possible factor for the lack of success in Area 2 during the time the traps were out in early June could have been due to the very strong wind blowing hair samples out of the barbs as bait was taken in five different traps but only two traps contained hair samples.

The field-testing of the swift fox hair traps in Saskatchewan and Montana met the objectives of the study. The testing showed that there was limited interference with the traps by other species although DNA analysis has shown that skunks may enter the traps (Cullingham *et al.*, unpublished data?). However, skunks are also a problem during live trapping. The subject of multiple entries to a trap by the same individual Swift Fox will be addressed on completion of the DNA analysis of the samples but preliminary analysis has shown that there is little contamination of samples. The abdomen fluff collected from natal den sites also yielded DNA that could be successfully analysed. (Cullingham *et al*., unpub. Data?).

The hair traps are cheap and simple to construct and can be easily set up and checked in the field. This means that significant numbers could be set and checked in a day. The hair traps can also be left out in severe weather conditions as they do not represent any danger to wildlife and successfully collect hair follicles from swift fox.

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