From the Field: A comparison of survey techniques for swift fox pups


Key words automated video, den probe, night vision, survey techniques, swift fox, visual counts, Vulpes velox

Swift foxes (Vulpes velox) are one of the smallest and most den-dependent and nocturnal canids in North America (Egoscue 1979, Tannerfeldt et al. 2003). Though research concerning swift fox fecundity has been conducted, it is a difficult and arduous task because pups do not emerge from natal dens until they are weaned at 5–7 weeks of age (Egoscue 1979). Previous techniques for determining fecundity of swift foxes have included excavating the den and counting pre-emergent pups (Cutter 1958, Kilgore 1969) and visual counts of post-emergent pups (Covell 1992, Olson and Lindzey 2002, Schauster et al. 2002, Harrison 2003, Sovada et al. 2003).

Visual counts are the most commonly reported technique for counting post-emergent swift fox pups (Covell 1992, Olson and Lindzey 2002, Schauster et al. 2002, Harrison 2003, Sovada et al. 2003). In this technique ≥1 concealed observers with binoculars or spotting scopes watch a female’s den from a distance (usually >40 m) in the evening and morning hours during early summer, in an attempt to count the number of pups. Visual counts also have been effectively used with similar species such as the kit fox (Vulpes macrotis; Cypher et al. 2000, Koopman et al. 2000) and arctic fox (V. lagopus; Strand et al. 2000).

Prior research concerning determination of pre-emergent pups has been highly invasive, as dens were excavated or disturbed via observer presence. As more advanced technology becomes available to researchers, less insidious means of obtaining data can be implemented. Recently, video probe systems have been used to document various cavity-nesting and burrowing animals such as red-cockaded woodpeckers (Picoides borealis; Richardson et al. 1999) and western burrowing owls (Athene cunicularia burtiga; Gervais et al. 2000). Night-vision devices have been used to enumerate migrating owls (Tyto alba, Aegolius acadicus, Asio otus, Asio flammeus, and Otus asio; Russell et al. 1991) and to observe the emergence of big brown bats (Eptesicus fuscus) from maternal colonies (Kirkwood and Cartwright 1993). Automated videography has been used to observe nests and index population abundance (York 1991, Kristan et al. 1996, Booms and Fuller 2003). Yet, none of this technology has been evaluated for use in swift fox research.

Measuring fecundity is an essential component in examining demographics of any wildlife species. Information on litter sizes is necessary to understand the dynamics of swift fox populations. Yet, no pups were observed from preliminary efforts at visual counts of swift fox pups during our study. Thus, the objective of this study was to compare visual counts, night vision, a den-probe system, and an automated video monitoring system for counting swift fox pups.
Techniques

We conducted research on 2 study sites in northwestern Texas: the Rita Blanca National Grassland (NG) and a private ranch (PR) (Kamler et al. 2002). We captured and radiocollared 89 swift foxes in 2,451 trap-nights for both study sites combined according to procedures outlined by Kamler et al. (2002). We tracked swift foxes to their diurnal dens using a hand-held antenna once a week from January 2002–July 2004. We monitored dens \((n = 18)\) of radiocollared females for pups from late May–June (weaning) of each year.

Visual counts

We made visual counts 30 minutes–1 hour before sunset (until dark) in an attempt to enumerate pups as they emerged from dens. Initially, we observed dens from approximately 100 m within a truck with a spotting scope and binoculars. After 5 failed attempts from the vehicle, we moved into a more concealed position about 40–50 m from den sites and again used a spotting scope \((20-60 \times 63)\) and binoculars \((10 \times 50)\).

We conducted visual counts during June. We spent 18 days obtaining visual observations at natal dens. We observed no juvenile or adult swift foxes from vehicles or concealed locations during visual count trials.

Human-induced mortalities were a threat to our study animals. Using our automated video systems (see below), we recorded someone shooting at a swift fox pup at the NG study site. On the PR study site, a prairie-dog \((Cynomys ludovicianus)\) hunter returned a radiocollar from an adult male swift fox he had shot.

Night vision

Night-vision technology has been used to enumerate or observe wildlife (Black and Collopy 1982, McCracken and Gustin 1991, Russell et al. 1991, McMahon and Evans 1992, King and King 1994). We tested observer ability to enumerate swift fox pups with a night-vision device (NVD). Observations were made for 1 hour after complete darkness. We used a Generation-III NVD (United States Night Vision® Goggle PVS-7B Ultra with an attachable 3x lens; Night Vision Corporation, Huntington Beach, Calif.) because they have fewer perceivable image distortions and provide better low-light performance than previous generations, allowing use in rural, dark areas (Biss and Gourley 2001). The NVD cost approximately $3,500 (U.S.). We tested the NVD on 4 occasions at 4 separate dens in May and June 2004 but observed no swift foxes.

Den-probe system

We used a den-probe system at den entrances diurnally. The system consisted of a FIELDCAM MDP (Monitor Driver Power Supply), Burrow Probe 3 closed-circuit video camera, and 20 m of waterproof cable (Fuhman Diversified, Inc., Seabrook, Tex.). The FIELDCAM MDP system was an integrated waterproof-cased monitor, remote camera control, and rechargeable battery system for various FIELDCAM remote video cameras. Case size was 33 \(\times\) 25 \(\times\) 15 cm, and system weight was 5.9 kg. The Burrow Probe 3 came with a wide-angle fixed-iris lens and infrared ring-light that was enclosed in a hard-coated anodized aluminum housing 3.5 cm in diameter and 3.25 cm long. The camera lens was protected with a scratch- and impact-resistant optically flat sapphire lens cover. Camera weight was <0.15 kg. The Burrow Probe 3 mounted on the end of a 20-m semi-flexible power-video cable and was designed to be pushed down into the burrow. According to the manufacturer, the flexibility of the probe allowed it to be directed over moderately sized objects and down divergent tunnels so that the burrow may be thoroughly explored. Total cost of the system was approximately $12,000 (U.S.).

In June 2002 we inserted the den probe in 16 entrances at natal dens occupied by 4 different female foxes and observed pups, but counts were incomplete. The maximum depth to which we could insert the probe was 1.33±0.36 m. We were able to see swift fox pups at 5 separate entrances at 2 dens. On 4 occasions a single pup would approach the camera, then turn around and run away. On one occasion we saw 2 swift fox pups at the same time. Due to the low number of adult female foxes on study sites during that time and ineffectiveness of the probe to count pups in dens, we did not examine more dens.

The den probe may have yielded limited results because swift fox dens were too complex. Excavations conducted by Cutter (1958) and Kilgore (1969) revealed that swift fox dens have many branches, tunnels, and entrances. We were able to briefly observe but not able to enumerate pups. This system may be useful in verifying and documenting the presence–absence of swift fox pups within a den, but the benefits need to be
weighed against the high cost of the equipment. As den-probe equipment becomes more cost-effective and continues to evolve, especially to allow for more maneuverability within complex burrows, we expected further advances in knowledge of swift fox den ecology. By having the camera mounted to a miniature, remote-controlled vehicle, it may be possible to penetrate further into complex den configurations.

Automated video monitoring system

We designed an automated video monitoring system that cost approximately $1,600 (U.S.) per unit. The automated video monitoring system was a hybridization of the designs of King et al. (2001), Kristan et al. (1996), and Lewis et al. (2004). The major components included a Sony® CVX-V18NS 18x Zoom Color Nightshot Video Camera (Sony Corporation, Tokyo, Japan), a First Alert® FTR-960R Time-Lapse VCR (JJ Communications, Inc., Englewood, N.J.), and a Vector® 350-Watt 12-Volt DC to 110-Volt AC Power Inverter (Vector Manufacturing, Ltd., Fort Lauderdale, Flor.). We used one 12-volt, 125-amp-hour, deep-cycle marine battery to power the system.

We placed the power supply components and VCR in a weatherproofed cargo box (Figure 1a) and placed the video camera in a weatherproofed metal camera housing (Figure 1b). To maintain weatherproofing, we enclosed the primary video cable, which connected the video camera and video camera control unit, in nonmetallic flexible conduit, connected to the cargo box and the camera housing (Figure 2). The camera housing was mounted to a wood stand. We used a Sony® GV-D800 Video Walkman™ (Sony Corporation, Tokyo, Japan; an additional cost of approximately $800 U.S.) to view the video-feed in the field and aim the camera.

We used 3 identical video monitoring systems to observe swift foxes at dens. We set up the automated video monitoring systems 40–70 m from...
dens of radiocollared adult females. We used the zoom feature to fit the area within 10 m of the den entrances within the frame. We programmed the VCRs to record approximately 1 hour before and after sunrise and sunset. We recorded the video on standard Sony® vertical helical scan (VHS) videotape (Sony Corporation, Tokyo, Japan) at 60 frames/second. Thus, approximately 8 hours of video could be recorded on 1 VHS videotape.

We placed video monitoring systems over dens of 7 adult females in May and June 2004. We were able to see swift foxes on each occasion. We observed 21 individual pups and 9 adults. We initially observed all pups during the first evening of monitoring.

We observed no pups at dens of 2 females over 2 consecutive days of initial monitoring. We captured 1 of the females within a week following video monitoring, and a visual inspection of her teats revealed that she had not been suckled. Two weeks following initial setup, we placed a video monitoring system at the den of the other female for 2 more consecutive days. Again, we observed the female without pups. In mid-July, we captured the female during a 40-trap-nights effort. Her teats showed no sign of suckling. Also, we captured no pups within her range. Thus, we assumed that both females had no pups at the time of video monitoring.

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