APPENDIX E – MONITORING TECHNIQUES

REMOTE DIGITAL STILL OR VIDEO CAMERAS

Digital still cameras or video cameras equipped with infrared sensors record images of wildlife entering, within, or exiting crossing structures. These "passive-type" sensors detect moving warm objects and can be set to only detect species larger than a predefined threshold size. Such cameras can be deployed outside of culverts attached to trees or posts as shown in Figure 75 or attached directly to culvert walls. Newer generation cameras are weatherproof, can be operated in all seasons, and can record an almost limitless number of images. Video versions provide information on crossing behavior (e.g., degree of animal willingness to cross, speed of crossing), and some still models can also be set to capture multiple photos in a rapid burst, providing some information on crossing behavior.

Figure 75. Photo. Remote digital infrared-operated camera (Credit: Tony Clevenger/WTI).

Benefits

Unambiguous species identification; low labor cost; can be deployed during all seasons and in locations with running water; some (limited in North America) potential for differentiating individuals; permanent record; photos valuable for outreach to public.

Constraints

Low ability to detect all sizes of species—most effective for medium to large species; risk of theft; high initial cost.

Estimated Cost

High initial cost (but lower labor cost during surveys) of $550-$800 per camera (including protective, theft-resistant box and data cards).

Applications

Assess use/effectiveness of wildlife crossing structures (existing and proposed)

- Assess rate of wildlife at grade highway crossings (cameras deployed randomly)
- Assess rate of wildlife, at grade, highway crossings (cameras deployed at targeted locations)
- Monitor wildlife use of locations throughout and adjacent to the project area (cameras deployed at scent stations)
- Evaluate effectiveness of jump-outs (cameras deployed on top of jump-outs).

REMOTE DIGITAL STILL OR VIDEO CAMERAS DEPLOYED SPECIFICALLY FOR EVALUATING AT GRADE, WILDLIFE HIGHWAY CROSSINGS

Remote cameras can also be deployed along roadsides with "active-type" sensors composed of "break the beam" components. When an animal approaching the side of the highway breaks the beam between two sensors, a photo is taken or a video camera is turned on. Sensors can be separated by up to 100 ft, can be combined to monitor longer stretches, and can be set-up to fire multiple still cameras.

Benefits

Unambiguous species identification; low labor cost; permanent record; photos/video valuable for outreach to public.

Constraints

High level of complexity with setup and untested for this purpose; likely difficulty in discerning species at greater distances from camera location; low ability to detect all sizes of species—most effective for larger species; only detects crossing attempts, not successful crossings; risk of theft; high initial cost.

Estimated Cost

High initial cost (but lower labor cost during surveys) of $1000-$2000 per 200 ft stretch of road (including protective, theft-resistant box and data cards).

Applications

- Assess rate of at grade, wildlife highway crossings (cameras deployed randomly)
- Assess rate of at grade, wildlife highway crossings (cameras deployed at targeted locations).

TRACK BEDS

Track beds are constructed from a mixture of sand and silt deposited in a linear bed (typically about 2 yards in width) across culvert entrances or within the culvert itself as Figure 76 shows. Such beds are raked smooth and are generally checked every three to four days for tracks that indicate animal crossings: species, direction of travel, number of individuals, etc.

Figure 76. Photo. Raking of track bed in culvert Banff National Park, Alberta (Credit: Tony Clevenger/WTI).

Benefits

Detect wide-variety of animal sizes (but generally coyote-size and larger); can provide back-up in case remote camera malfunctions or is stolen; relatively low up-front cost; Generally not

affected by weather events that may obliterate tracks if structure is covered (e.g., underpass or culvert).

Constraints

Unable to deploy at locations with running water unless natural banks or engineered pathways are constructed in structures; occasionally problems with species identification; trampling of tracks (i.e., many overlapping tracks) can make interpretation difficult if not checked regularly; difficult to confirm that an individual animal passed completely through the structure or simply crossed the bed and returned.

Estimated Cost

Low cost (field vehicle and labor cost during surveys for personnel to check track pads regularly); personnel costs: $1300 for one month of monitoring @ 10 days of work per month @ $130/day [$16/hr]; low equipment costs: rake, personal data assistant (PDA), digital camera, tape measure, field guide to animal tracks.

Applications

- Assess use/effectiveness of wildlife crossing structures (existing and proposed)
- Monitor wildlife use of locations throughout and adjacent to the project area (beds deployed as round "plots" and used in conjunction with a bait or scent lure
- Evaluate effectiveness of jump-outs (beds deployed on top and around the base of jump-outs).

TRACK BEDS DEPLOYED SPECIFICALLY FOR EVALUATING AT GRADE, WILDLIFE HIGHWAY CROSSINGS

Track beds can also be deployed along highway shoulders or in medians, providing a means to detect animals approaching the side of the highway or in the median.

Benefits

Detect wide variety of large mammals; can provide back-up in case remote camera malfunctions or is stolen;

Constraints

Unable to deploy at locations with little or no shoulder, where shoulder is steep or inundated with water, where shoulder is mostly vegetation, or in locations where monitoring and maintenance would be a safety risk to personnel; ambiguous species identification common; tracks cannot easily be collected and reviewed later; over-tracking (i.e., many overlapping tracks) can make interpretation difficult; difficult to confirm that animals leaving tracks actually attempted to cross highway or had simply crossed the bed and returned; only detects crossing

attempts, not successful crossings; installation requires heavy machinery and coordination with Department of Transportation; high labor cost (must be maintained frequently).

Estimated Cost

High initial cost: $350–$400 for materials and installation of one 100 ft bed (depends largely on access to sand and machinery); low operational cost: labor cost to conduct surveys=$1300 for one month of monitoring @ 10 days of work per month @ $130/day [$16/hr]; low equipment costs: rake, PDA, digital camera, tape measure, field guide to animal tracks (same as "track bed" monitoring above).

Applications

- Assess rate of at grade, highway wildife crossings (cameras deployed randomly)
- Assess rate of at grade, highway wildlife crossings (cameras deployed at targeted locations).

UNENCLOSED TRACK PLATES

A metal plate covered partially with a thin layer of soot and then a section of light-colored contact paper with the sticky side up. Animals crossing the plate first walk over soot and then track the soot on the contact paper, leaving a print as captured in Figure 77. Plates are checked for prints every five to seven days and soot/paper is replaced. Contact paper with prints is removed and stored in plastic page protector.

Figure 77. Photo. Sooted track plate with tracks of small and medium-sized mammals (Credit: Robert Long/WTI).

Benefits

Detect wide-variety of animal sizes; provides a high-resolution print that makes identification of species likely; print can be collected, reviewed later, and stored indefinitely; low initial cost.

Constraints

Unable to deploy at locations with running water; difficult to deploy effectively in wide structures (>6 ft); must be deployed under cover or in very dry climate conditions.

Estimated Cost

Low up-front cost (but labor cost during surveys); $200 for materials; $800 for one month of monitoring (6 days of work per month @ $16/hr).

Applications

- Assess use/effectiveness of smaller wildlife crossing structures (existing and proposed)
- Monitor wildlife use of locations throughout and adjacent to the project area (used in conjunction with a bait or scent lure).

ENCLOSED TRACK PLATES

Similar to an unenclosed track plate (Figure E-3) but where the metal plate is typically smaller and inserted (with soot and contact paper) into a rectangular or triangular enclosure. Enclosed plates permit deployment in light rain or snow and can also be fitted with hair collection devices.

Benefits

Readily used by many smaller species (e.g., fisher, marten, raccoon, and smaller); provides a high-resolution print that makes identification of species likely; print can be collected, reviewed later, and stored indefinitely; ability to incorporate hair collection devices; protected from some weather; low up-front cost.

Constraints

Unable to deploy at locations with running water; limited to small species; can only be deployed in very small structures unless used with bait or scent lures.

Estimated Cost

Low up-front cost (but labor cost during surveys); $200 for materials; $800 for one month of monitoring (6 days of work per month @ $16/hr).

Applications

- Assess use/effectiveness of smaller wildlife crossing structures (existing and proposed)
- Monitor wildlife use of locations throughout and adjacent to the project area (used in conjunction with a bait or scent lure).

HAIR COLLECTION DEVICES WITH DNA METHODS

Various hair collection devices are available and selection typically depends on species of interest and specific objectives. Most hair collection at crossing structures is conducted via two barbed-wire strands stretched across the mouth of the structure at heights appropriate for the target species of interest as sketched in Figure 78.

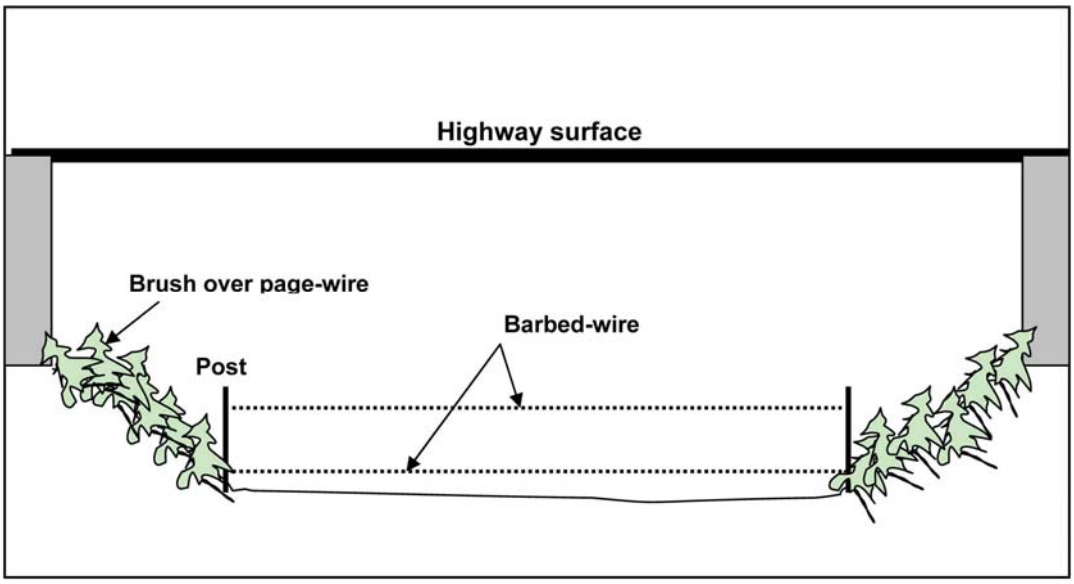

Figure 78. Schematic. Diagram of hair-snagging system at a wildlife underpass used in DNA-based research of population-level benefits of crossing structures (Source: Tony Clevenger/WTI).

Animals using the crossing structure are forced to slide under or between the wires, or step over the top wire, and in the process leave tufts of snagged hair on one or more barbs as Figure 79 shows. If enclosed track plates are used for small and medium mammals, hair snagging devices can be installed that will collect hair in addition to prints. Other options for locating hair snares within or adjacent to crossing structures are available, but most would require a scent lure to entice animals to either rub or interact with a device.

Figure 79. Photo. Grizzly bear passing through hair-snagging device at wildlife overpass in Banff National Park, Alberta (Credit: Tony Clevenger/WTI).

Benefits

Provide both confirmation of animal presence and DNA sample for further analyses; low up-front cost and fairly low labor cost to maintain.

Constraints

Fairly species-specific; some DNA analyses can be relatively expensive; should be used in conjunction with track bed/plate or remote camera.

Estimated Cost

Depends on objectives—identifying a hair sample to species can cost from $15–25, whereas more detailed DNA analyses (e.g., microsatellite analysis to identify individuals) can cost from $50–$120 per sample. In all cases, per-sample costs are highly dependent on the sample quality and specific lab.

Applications

- Assess use/effectiveness of wildlife crossing structures (existing and proposed)
- Monitor wildlife use of locations throughout and adjacent to the project area (used in conjunction with a bait or scent lure)

- Determine relatedness of individuals using crossing structures
- Determine whether numerous crossings are by the same individual or by many individuals.
- Collection of DNA samples for Tier 2 objectives.

TRAP, TAG, AND RECAPTURE/RESIGHT

Animals such as amphibians/reptiles and small mammals that are relatively easy to capture can be trapped or hand-captured and tagged as shown in Figure 80, on both sides of the highway. Subsequent capture efforts can permit the estimation of highway crossing rates.

Figure 80. Photo. Digital barcode tag for frogs (Source: Steve Wagner/CWU).

Benefits

Only effective method for monitoring some species (e.g., amphibians, reptiles, small mammals); direct confirmation that animals have successfully crossed highway; relatively low cost for some species.

Constraints

Difficult to confirm whether individuals are crossing at grade or through crossing structures; labor intensive; potential negative effects on captured/tagged individuals; typically results in few recaptures unless number of tagged individuals is very large.

Estimated Cost

Low to moderate, depending on species.

Applications

- Assess use/effectiveness of wildlife crossing structures (existing and proposed)
- Assess rate of at grade, wildlife highway crossings (in locations without crossing structures)
- Monitor wildlife use of locations throughout and adjacent to the project area

SNOW TRACK TRANSECTS

Snow tracking can be used to detect species that are active during winter. Snow tracking can be conducted while driving the road, traveling off-road parallel to and at close distances (e.g., within 150 ft) from the roadside, or on secondary roads or off-road transects away from the road.

Benefits

Fairly high effectiveness for detecting some species; easily tailored for use in many locations; low cost.

Constraints

Limited to locations with consistent snowfall; short time window to conduct surveys after each snowfall; difficult to schedule surveys; can be labor-intensive to collect substantial amounts of data during relatively few snowfalls (i.e., many personnel may be required to cover multiple transects within a short timeframe); difficult to confirm species unless track and snow conditions are ideal; tracks cannot easily be collected and reviewed later; traffic safety concerns when conducting road surveys;

Estimated Cost

Low to moderate; limited to cost of labor, one-time purchase of skis/snowshoes, and winter safety and avalanche training.

Applications

- Assess use/effectiveness of wildlife crossing structures (existing and proposed)
- Assess rate of at grade, wildlife highway crossings
- Monitor wildlife use of locations throughout and adjacent to the project area (used in conjunction with a bait or scent lure)

SCAT DETECTION DOGS WITH DNA METHODS

Professionally trained dogs can now be used to effectively and efficiently locate scats from target species. A single dog, working with a handler and an "orienteer," as Figure 81 shows, typically searches a predefined transect or grid. Located scats are collected for DNA analysis.

Figure 81. Photo. Scat-detection dog working to locate scat (Credit: Robert Long/WTI).

Benefits

High degree of effectiveness and cost efficiency (i.e., cost per detection); does not require site preparation before survey; can be easily tailored to specific locations and can quickly adapt to changes in protocol; can be used in most conditions and on most types of topography; provides scat sample for multiple analyses (e.g., species and individual identification, diet, hormone analysis).

Constraints

High initial cost; substantial logistical issues; each dog limited to detecting a fairly discrete number of target species; in most cases requires DNA confirmation, or at least some DNA testing.

Estimated Cost

High up-front cost for training and dog leasing; actual cost depends largely on whether dogs are leased or purchased and whether handlers are hired professionals or are existing personnel that can be trained.

Applications

- Monitor wildlife use of locations throughout and adjacent to the project area
- Collection of DNA samples for Tier 2 objectives.

GPS COLLARING

Some species can be captured and fitted with collars containing a GPS tracking device. Very high-resolution data on movements are recorded and either remotely downloaded by researchers or, more often, downloaded after the collar has either been shed or recovered on recapture.

Benefits

Very high resolution data allows assessment of fine-scale movement and reaction to crossing structures; ability to collect additional data such as mortality and behavioral data; ability to collect information on genetics and demographic parameters of population if sample sizes are large.

Constraints

High initial cost and capture of animals is very labor intensive; substantial logistical issues; generally results in small sample sizes which may not be representative of populations; potential negative effects on captured/tagged individuals.

Estimated Cost

High initial cost for purchase of GPS collars and animal capture; actual cost depends on how long the collars stay on the animal; occasional malfunction of GPS transmitting and receiving system.

Applications

- Assess use/effectiveness of wildlife crossing structures (existing and proposed)
- Assess rate of at grade, wildlife highway crossings
- Monitor wildlife use of locations throughout and adjacent to the project area
- Evaluate effectiveness of wildlife fencing.

DOT MAINTENANCE CREW REPORTING

Data on road-killed wildlife are currently collected during regular work conducted by DOT highway crews. After highway construction is completed, maintenance crews would also be asked to collect data on fence condition and to report wildlife intrusions on the highway right-of-way. Data recording is facilitated by a Roadkill Observation Collection System (ROCS)—a combined PDA–GPS device shown in Figure 82. Regular contacts by monitoring personnel with road crews to emphasize the importance of collecting data will be important to ensure consistent survey effort.

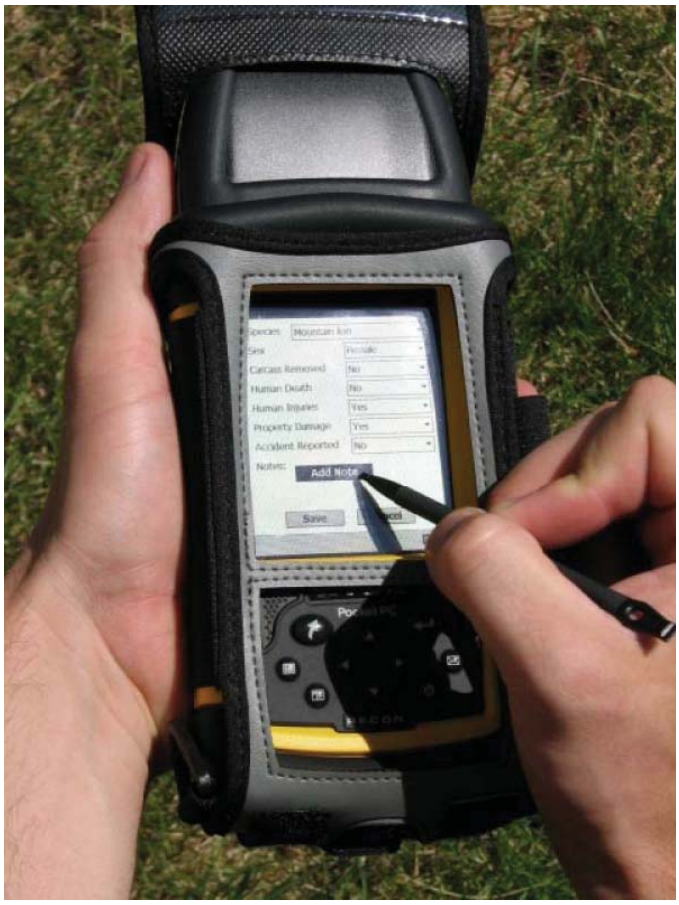

Figure 82. Photo. Roadkill Observation Collection System (ROCS) (Credit: WTI).

Benefits

Can be tailored to include any species that can be recognized as either live or road-killed wildlife; DOT Maintenance crews are regularly traveling the highway and may receive direct reports of wildlife–vehicle collisions or carcasses.

Constraints

Method requires both spatially and temporally consistent survey effort by crews for data collected to be valid and useful for analyses.

Estimated Cost
Low - consisting of training DOT Maintenance crews to operate ROCS units and routine refresher training and meeting with crews to encourage regular use of ROCS units.

Applications

- Assess wildlife–vehicle collision rate
- Evaluate effectiveness of wildlife fencing

STATE PATROL REPORTING

Currently, in many states and provinces information on wildlife–vehicle collisions resulting in vehicle damage (>$1000) is collected by State patrols and may also be requested from other agencies that collect such data.

Benefits

Effort is consistent and will likely remain so into the future; cost is relatively minimal; species monitored are limited; can be cross-referenced with DOT maintenance crew reports and monitoring personnel.

Constraints

Mortality data are limited to collisions with > $1000 in property damage (generally Elk and Deer).

Estimated Cost

Negligible.

Applications

- Assess wildlife–vehicle collision rate
- Evaluate effectiveness of wildlife fencing

MONITORING PERSONNEL ROAD-KILL AND FENCE INTEGRITY SURVEYS

Monitoring personnel can collect information on wildlife–vehicle collisions during systematic drives through the project area (e.g., every 1-7 days). Fencing can be visually examined during regular course of work and field-examined twice per year by DOT maintenance crews and/or monitoring personnel.

Benefits

Provides spatially and temporally consistent effort that can be closely controlled; all species coyote-size and larger can be monitored.

Constraints

Relatively high rate of survey (e.g., daily or minimally twice per week) may be required to locate carcasses, especially of small animals; does not detect instances when animals are injured and die undetected at a later time, or where carcasses leave the roadway and are not seen; single drive through may provide little chance of detecting carcasses; limited number and distribution of safe-

stopping locations may make carcass identification impossible; slow required driving speeds often unsafe.

Estimated Cost

Low during seasons when other survey work is being conducted; moderate at other times.

Applications

- Assess wildlife–vehicle collision rate
- Evaluate effectiveness of wildlife fencing