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ASSESSMENT OF THE KANIA® TRAP TO HUMANELY KILL RED SQUIRRELS (*TAMIASCIURUS HUDSONICUS*) IN ENCLOSURES

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ABSTRACT: The Kania® trap equipped with side wings and baited with a pine cone quickly killed nine of nine red squirrels (*Tamiasciurus hudsonicus*) in enclosures. Mean times to loss of consciousness and heartbeat were estimated at ≤65 sec and ≤91 sec, respectively, after firing the trap. Thus the Kania® can be expected to render ≥70% of captured red squirrels irreversibly unconscious in ≤3 min ($P < 0.05$).

Key words: Experimental study, humane trapping, Kania® quick-kill trap, mousetrap, red squirrel, *Tamiasciurus hudsonicus*.

INTRODUCTION

In most years, more red squirrels (*Tamiasciurus hudsonicus*) are harvested in Canada than any other furbearer except the muskrat (*Ondatra zibethicus*) and the beaver (*Castor canadensis*) (Obbard et al., 1987). Snares on a pole set usually are recommended for the harvest of this furbearer (Alberta Vocational Centre, 1987; Baker and Dwyer, 1987). However, members of the Federal Provincial Committee for Humane Trapping (1981) found that snared red squirrels did not lose consciousness within 3 min and concluded that snares were not a suitable means of trapping this species humanely.

Members of the Federal Provincial Committee for Humane Trapping (1981) suggested that traps with a momentum of 0.2 kg m/sec and a clamping force of 30 Newtons (N) may humanely kill red squirrels struck in the head and neck region. The C120 Magnum trap, with an average momentum of 1.1 kg m/sec and clamping forces exceeding 325 N (Proulx et al., 1989a) has the capability to humanely kill red squirrels (Barrett et al., 1989). However, red squirrel trappers usually set hundreds of snares and the C120 Magnum, because it is more expensive than copper wire, is not considered a reasonable alternative to their actual trapping device.

R. Drescher (pers. comm.) found that the Kania® trap (E. Kania, Winlaw, British Columbia, Canada) generated an average momentum of 1.1 kg m/sec and clamping forces greater than 17 N. Although the Kania® had clamping forces inferior to the recommended ones, its high momentum warranted testing with animals.

The objectives of this study were to determine the ability of the Kania® trap to consistently strike red squirrels in the head and neck region and to render the animals irreversibly unconscious in ≤3 min.

MATERIAL AND METHODS

The study was conducted from the end of September to the beginning of December, 1990 in two 3.8-×-4.5-×-2.3-m test enclosures with running poles. The research facilities included a remote control video system described by Proulx et al. (1989b).

The Kania® trap is a narrow mousetrap with a 14-cm-long (diameter: 0.63 cm) striking bar powered by a coil spring (Fig. 1). The trap is set perpendicular to a running pole and when an animal steps on the trigger that lays over the pole, it is struck by a bar closing 180° on the trap frame (Fig. 1). The sensitivity of the trigger varies, firing under weights ranging from 10 to 55 g.

The Kania® trap was evaluated in a test sequence described by Proulx et al. (1989a, b) which consisted of approach tests, preselection tests, kill tests, and performance confirmation tests. In order to qualify for each new category

of testing, traps had to pass the previous category.

In approach tests, squirrels were allowed to approach Kania® traps wired in the set position so that the trap could be triggered, but would not close completely and injure the animals. The strike locations were determined on video monitors by projecting the arc movement of the striking bar on the animal at firing time. These tests were used to develop a trigger system and a set that would ensure that squirrels would be consistently struck in vital regions: the head, neck or thorax regions (Abdinoor et al., 1977). A trigger system was judged acceptable if animals were properly positioned in at least five of a maximum of six approaches. The trap was first set according to the inventor's recommendation. A wire loop was placed in front of the trap to force the squirrels to break their stride and step on the trigger. When the trap failed to properly strike an animal during a first kill test, a new series of approach tests was conducted with a modified trap set. The wire loop was removed. So as to not attract carnivores or scavengers, the trap was baited with a pine cone to stop the animal. To stretch the animal's body and position the head and neck region in line with the striking bar, wings made from wire were added to the sides of the trap (Fig. 1).

The killing potential of the Kania trap was first assessed in preselection tests with red squirrels immobilized with 10 to 20 mg/kg of ketamine hydrochloride (Austin Laboratories, Joliette, Quebec, Canada) and situated in traps in a position that duplicated their placement in the approach tests. This preliminary assessment allowed the researchers to determine if the Kania® trap had the potential to quickly kill red squirrels without causing suffering (Proulx et al., 1989b). Traps passed the preselection tests if they rendered at least five of a maximum of six animals unconscious in ≤3 min (Proulx et al., 1989b); this was a control level without implied statistical significance to justify subsequent kill tests with unanesthetized animals. Unconsciousness was determined by loss of corneal and palpebral reflexes (Walker, 1979; Horton, 1980; Rowsell et al., 1981). Tests were successful only if squirrels did not regain consciousness after the 3-min period and subsequently died, as determined by loss of cardiac activity using a stethoscope.

Upon success at the preselection-test level, the killing ability of the Kania® trap was assessed in two series of kill tests. The first series involved the original trap and set. The second series was conducted with a modified trap and set. Traps passed the kill tests if they rendered at least five of a maximum of six (control level without implied statistical significance to justify additional

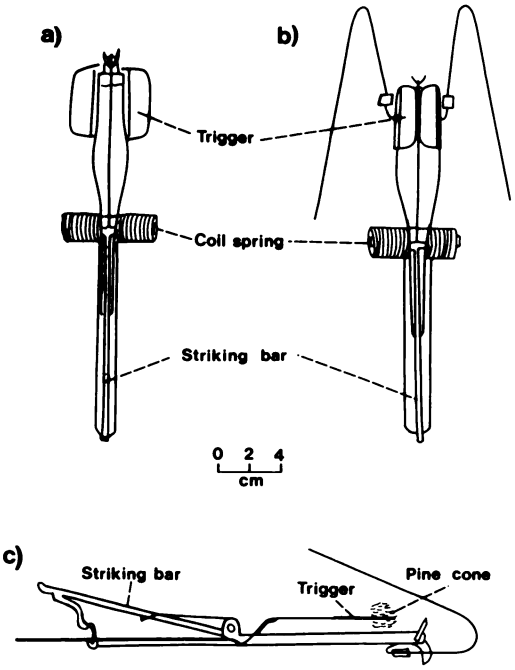

FIGURE 1. The Kania® trap for red squirrel: original (a) and modified (b and c) designs.

kill tests) animals irreversibly unconscious in ≤3 min.

Upon success at the kill-test level, the Kania® trap was evaluated in additional kill tests, termed performance confirmation tests (Proulx et al., 1989a, 1990). The Kania® was considered humane if, during the kill and performance confirmation tests, it rendered nine of nine squirrels irreversibly unconscious in ≤3 min (Proulx et al., 1989a, 1990). On the basis of a one-tailed binomial test (Zar, 1984), the Bionic® trap would be expected, at a 95% level of confidence, to humanely kill ≥70% of all red squirrels captured on traplines (Proulx et al., 1993).

According to members of the Federal Provincial Committee for Humane Trapping (1981), the presence of researchers testing for the corneal reflex may be a cause of shock and rapid death in snared red squirrels. In this study, in the kill and performance confirmation tests, we waited until the animals had ceased struggling before approaching them. Only one squirrel was improperly struck and did not lose consciousness in ≤3 min. At the end of the 3-min period, it was immobilized with ketamine hydrochloride and euthanized by an intracardiac injection of 540 mg/ml sodium pentobarbital (Euthanyl forte: M.T.C. Pharmaceuticals, Cambridge, Ontario, Canada). Animals were necropsied by a veterinary pathologist from Alberta Agriculture (Edmonton, Alberta, Canada). All animal hus-

TABLE 1. Location of strikes, time intervals between trap firing and irreversible loss of corneal/palpebral reflexes and heartbeat, and major trauma of red squirrels in preselection tests with the Kania® trap.

Red squirrel number	Sex[a]	Location of strike	Time of loss after firing: Corneal/palpebral reflexes (sec)	Time of loss after firing: Heartbeat (sec)	Trauma
725	M	Behind the eyes	25	45	Maceration of parietal bones; maceration of the brain and hemorrhage extending along the neck.
731	F	Across the eyes	5	27	Total maceration of the occipitalis and the cerebellum; obliteration of the cerebral column and cord; considerable hemorrhage over the scapula and the dorsal thorax between the shoulder blades.
721	M	Across the ears	4	38	Fracture of skull and maceration of brain.
717	M	Back of skull	25	61	Total severance of the spinal column and spinal cord at the level of the first cervical vertebra, with much hemorrhage and soft tissue maceration in that area.
704	M	Behind the ears	—[b]	64	Maceration and fragmentation of frontal bones; fracture of right parietal bone and maceration of underlying anterior cerebrum; considerable hemorrhage over the dorsal skull.

[a] M, male, F, female.
[b] Temporary failure of the audio-video system.

bandry and research procedures were approved by an Animal Care Committee and carried out in accordance with the guidelines of the Canadian Council on Animal Care (1984).

RESULTS

Five approaches involving the original trap and set suggested that the animals would have been struck on the head. In preselection tests, mean (±SE) times of loss of consciousness and heartbeat were 15 (±6) sec and 47 (±7) sec, respectively (Table 1). Maceration of the skull and the brain, or damage to the spinal column and cord, were apparent in all cases (Table 1). The trap successfully passed (five of five) the preselection tests.

Only one kill test was conducted with the original Kania® trap. The animal was struck on the lower thorax but did not lose consciousness in ≤3 min. No trauma was recorded. When the videotape was paused at firing time and the striking bar was projected on the animal (as was done during the approach tests), the strike location was estimated to be on the neck. Therefore, strike locations projected during the approach tests with the original trap and set were possibly incorrect because of the rapid movements of the squirrels at firing time. Because of this finding, the series of kill tests with the original trap and set was immediately stopped.

During a second series of approach tests, the trap and its set were modified to bring the animals to a full stop at firing time. The trap, baited with a pine cone and equipped with side wings, properly positioned six of six squirrels for a head strike. Because the original Kania® trap rendered immobilized squirrels struck on the head irreversibly unconscious in ≤3 min, the preselection tests were not repeated here.

All kill and performance confirmation tests with the modified Kania® trap were successful (Table 2). In three kill tests, the trap failed to hold animals struck on the head; the animals fell to the ground. However, in all kill and performance confirmation tests, animals were unconscious

TABLE 2. Location of strikes, trigger sensitivity, time intervals between trap firing and irreversible loss of corneal/palpebral reflexes and heartbeat, and major trauma of red squirrels in kill and performance confirmation tests with the modified Kania® trap.

Red squirrel number	Sex[a]	Trigger sensitivity (g)	Location of strike	Time of loss after firing: Corneal/palpebral reflexes (sec)	Time of loss after firing: Heartbeat (sec)	Trauma
715	F	15	Top of skull	57[b]	105	Total maceration of the parietal, temporal and occipital bones, and the brain; incomplete severance of the ventral neck muscles and considerable hemorrhage into the lateral neck muscles.
713	M	25	Neck	<94[b]	<120[c]	Very congested lungs with much stable froth throughout the bronchial tree, no bruises.
735	M	20	Behind the head	<59[b]	80	Severance of spinal column at the first cervical vertebra and partial maceration of spinal cord; fracture of the left ramus of the mandible; bruising of the shoulder.
707	M	55	Upper thorax	<117[b]	<135[c]	Nasal hemorrhage; no other lesions.
703[d]	F	30	Top of skull	<63[b]	<63[c]	Fracture of right parietal and temporal bones, and the zygomatic arc; hemorrhage into the brain.
730	M	15	Behind the ears	50[b]	101	Fracture of ramus of the mandible and the bulla; fracture of the suture line of the right frontal bone.
702	F	10	Across the left eye and the top of the skull	<46[b]	79	Oblique fracture from the left anterior to the right posterior skull involving the parietal, zygomatic, temporal bones on the left side, and parietal and occipital bones on the right side; the brain underlying the fracture line was deeply macerated; much bruising in the muscle extending back over the shoulder.
710[d]	M	25	Top of skull	<46[b]	<65[c]	Fracture of the frontal and left parietal bones, and left zygomatic arc; much hemorrhage over the dorsal skull and maceration of the underlying anterior cerebrum.
718[d]	M	20	Top of skull	<55[b]	<69[c]	Fracture of the parietal bones and the occipitalis with fragmentation; much hemorrhage in the area, and maceration of the posterior cerebrum and the cerebellum.

[a] M, male; F, female.
[b] Unconscious upon arrival of observer.
[c] No heartbeat when first assessed.
[d] The animal fell from the trap.

upon arrival of the researchers. In five of nine cases, heartbeat had been lost before researchers assessed it (Table 2). Mean times to loss of consciousness and heartbeat were ≤65 sec and ≤91 sec, respectively. Most squirrels sustained multiple skull fractures and damage to the central nervous system (Table 2).

From these results, the Kania® trap can be expected to render ≥70% of captured red squirrels irreversibly unconscious in ≤3 min ($P < 0.05$).

DISCUSSION

The Kania® trap, although more expensive than the manual snare, may be a valuable trapping device for red squirrel trappers. Because of its size and simple design,

it could be manufactured at a lower cost than the C120 Magnum.

While the trap is light and easily set on a running pole, particular attention must be paid to the bait and the trigger. The pine cone must be small and placed between the tips of the trigger prongs in order to force the animals to keep their head low and away from the coil spring. This allows for more powerful strikes on the animals' head. In order to consistently strike the squirrels on the head, neck or upper thorax, the trigger must be properly sensitized. When it is calibrated to fire at a 10-g weight, a trap may fire before most of the squirrel's head is in line with the striking jaw. At a 50-g weight, the animal depresses the trigger with the weight of its upper body; if the animal is in motion at firing time, it may get struck on its lower body. When the trap is calibrated to fire at weights ranging from 15 to 30 g, it can consistently strike an animal on the top of or just behind the skull.

The Kania® trap kills red squirrels quickly without damaging their pelt. However, the trap does not always hold its capture. In three tests involving deadly head strikes, the squirrels fell on the ground, as a result of the animals being thrown away by the side strike. This means that a trapper should carefully inspect the surrounding of the trap set when no animal is found in a fired trap. Of course, the fallen furbearer may be removed by a scavenger or covered by a snowfall.

The Kania® trap is powerful enough to kill a red squirrel but is unlikely to injure larger furbearers such as marten (*Martes americana*). When set under conifer branches, it is unlikely that it would attract and capture birds (Currie and Robertson, 1992). The potential of the Kania® trap to humanely kill red squirrels warrants capture efficiency tests on traplines.

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