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ASSESSMENT OF ROTATING-JAW TRAPS TO HUMANELY KILL RACCOONS (*PROCYON LOTOR*)

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ABSTRACT: Rotating-jaw traps (Conibear 280™ and Sauvageau 2001-8™, and mechanically improved models) failed to render irreversibly unconscious in ≤3 min raccoons (*Procyon lotor*) immobilized with ketamine hydrochloride and struck in the head-neck region. It is unlikely that these traps, and the less powerful Conibear 220™, have the potential to humanely kill raccoons.

Key words: Conibear 280™ trap, experimental study, humane trapping, *Procyon lotor*, raccoon, Sauvageau 2001-8™ trap.

INTRODUCTION

Thousands of raccoons (*Procyon lotor*) are trapped every year for their fur, or because they damage private property in agricultural and urban areas (Kaufmann, 1982). Krause (1989) recommended the use of leghold traps to capture this species. However, raccoons have a tendency to chew the captured foot (Berchielli and Tullar, 1980; Tullar, 1984) and many jurisdictions have banned legholds in land sets for capturing most furbearers (Barrett et al., 1988). The Conibear 280™ (Woodstream Corporation, Lititz, Pennsylvania, USA) is recommended as a quick-killing trap for raccoons (Association Provinciale des Trappeurs Indépendants, 1988; Currie and Robertson, 1992). However, the Federal Provincial Committee for Humane Trapping's (1981) findings implied that this trap was not powerful enough to produce a humane kill. The Alberta Vocational Centre (1985) recommended the Conibear 280™ (Woodstream Corporation, Lititz, Pennsylvania, USA), and Currie and Robertson (1992) suggested the Sauvageau 2001-8™ (Les Pièges du Québec Enr., St-Hyacinthe, Quebec, Canada), to humanely kill raccoons. However, the killing ability of these traps was never assessed. Our objective was to assess the potential of rotating-jaw traps (Conibear 280™ and Sauvageau 2001-8™, and mechanically improved models) to render raccoons irreversibly unconscious in ≤3 min.

MATERIALS AND METHODS

This study was conducted from June 1986 to December 1991 at the field station of the Alberta Research Council in Vegreville, Alberta, Canada. Six rotating-jaw traps were tested: Conibear 280™ (Woodstream Company, Lititz, Pennsylvania, USA), Conibear 280™ with clamping bars, Sauvageau 2001-8™ (Les Pièges du Québec Enr., St-Hyacinthe, Quebec, Canada), Sauvageau 2001-8™ with Conibear 330™ (Woodstream Company) springs, Sauvageau 2001-8™ with short Conibear 330™ springs, and Sauvageau 2001-8™ with short Conibear 330™ springs and small eyes (Fig. 1). Using mechanical evaluation based on three traps fired ten times (Cook and Proulx, 1989), we determined the mean momentum and range of clamping forces for trap jaw openings of 15 to 40 mm for each trap; these trap openings corresponded to the distance between the trap jaws when raccoons are struck in the head-neck region. Mean momentums ranged from 2.026 to 2.390 kg m/sec and clamping forces, from 0 to 585 Newtons (Table 1).

The killing ability of traps was evaluated in preselection tests described by Proulx et al. (1989a). Traps were waxed and a new trap was used for each preselection test. Raccoons immobilized with ketamine hydrochloride (10 to 20 mg/kg; Austin Laboratories, Joliette, Quebec) were placed into traps in a dorso-ventral position that ensured a head-neck strike. The presence of their eye reflexes was confirmed before firing the trap. A test was judged successful if the trap rendered the animal unconscious in ≤3 min and resulted in death of the animal (loss of cardiac activity determined with stethoscope) (Proulx and Barrett, 1988). Unconsciousness was determined by loss of corneal and palpebral reflexes (Walker, 1979; Horton, 1980; Rowsell et al., 1981). If the raccoons were still conscious after 3 min, they were left in the trap

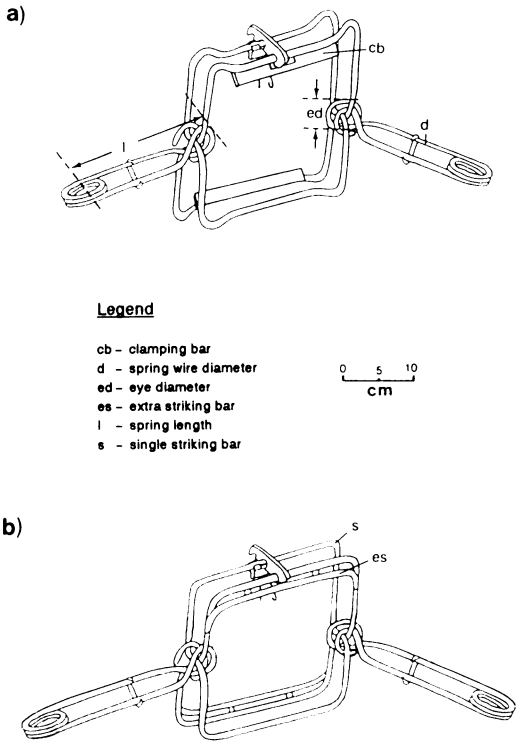

FIGURE 1. Diagrams of a) the Conibear 280™ with clamping bars, and b) the Sauvageau 2001-8™.

for an additional 2 min at which time they were euthanized by an intracardiac injection of 540 mg/ml sodium pentobarbital (Euthanyl forte; M.T.C. Pharmaceuticals, Cambridge, Ontario, Canada).

In order for a trap model to pass the preselection tests and become eligible for kill tests with unanesthetized animals (Proulx et al., 1989a), no more than one failure was allowed. A t-test was used to compare the mean times for loss of consciousness and heartbeat of different trap models (Dixon and Massey, 1969).

Animals were necropsied by pathologists from the Alberta Environmental Centre (Vegreville, Alberta, Canada) and Alberta Agriculture (Edmonton, Alberta, Canada). All animal husbandry and research procedures were approved by the institutional Animal Care Committee and carried out in accordance with the guidelines of the Canadian Council on Animal Care (1984).

RESULTS

Preselection tests with the Conibear 280™ trap rendered three of six raccoons struck in the neck region irreversibly unconscious in ≤3 min. Mean (±SE) times to loss of consciousness and loss of heartbeat were 156 (±5) sec and 486 (±77) sec, respectively. Two raccoons lost consciousness 194 and 195 sec after being struck. Another was euthanized after 5 min. In all cases, no major trauma was recorded (Table 2). The trap failed the preselection tests.

In preselection tests with the modified Conibear 280™ traps, only one clamping bar came in contact with the animal and, depending on how the trap was set, it struck raccoons from either the top or the bottom. However, in all cases, the modified Conibear 280™ failed the preselection tests. The mean (±SE) times to loss of consciousness and loss of heartbeat in six preselection tests with the clamping bar on the bottom striking jaw were 232 (±8) sec and 496 (±14) sec, respectively. With the clamping bar striking from above, these values were 224 (±14) sec and 443 (±24) sec, respectively. There was no significant difference between these mean times to loss of consciousness ($t = 0.439$, $P > 0.05$) and heartbeat ($t = 1.885$, $P > 0.05$). In two raccoons killed in the Conibear 280™ with a clamping bar on the top, the spinal process of a cervical vertebra was broken. In all other raccoons, trauma was minor (Table 2).

The Sauvageau 2001-8™ rendered one raccoon struck in the neck unconscious in 58 sec. However, two other animals were euthanized. In all cases, trauma was minor (Table 2). When equipped with standard or shortened Conibear C330™ springs, the trap failed to render unconscious in ≤3 min raccoons struck on the head (Table 2). The nuchal crest of one of these animals was fractured but the parietal bones were intact. All others received minor injuries (Table 2).

The Sauvageau 2001-8™ with short springs and small eyes quickly rendered unconscious ($\bar{x}$ ± SE: 140 ± 26 sec) three raccoons struck on the head. The mean (±SE) time to loss of heartbeat was 516 (±70) sec. Serious trauma was recorded in only one animal (Table 2). Two raccoons struck in the neck were euthanized; no

TABLE 1. Spring dimensions (mm), mean ($\bar{x}$) momentums (kg-m/sec) and standard errors (SE), and ranges of clamping forces (Newtons) for 15 to 40 mm trap jaw openings of the Conibear 280® and the Sauvageau 2001-8® traps, and mechanically improved models.

Trap type	Springs			Momentum		Range of clamping forces
	Length	Wire diameter	Eye diameter	$\bar{x}$	SE	
Conibear 280®	190	7.0	38	2.026	0.02	0–364
Conibear 280® with clamping bars	190	7.0	38	2.303	0.04	128–489
Sauvageau 2001-8®	216	7.2	35	2.097	0.02	446–585
Sauvageau 2001-8® with Conibear 330® springs	229	7.9	46	2.023	0.06	429–566
Sauvageau 2001-8® with short Conibear 330® springs	178	7.9	46	2.390	0.04	73–512
Sauvageau 2001-8® with short Conibear 330® springs and small eyes	178	7.9	33	2.320	0.02	466–527

major trauma was recorded (Table 2). This trap model also failed the preselection tests.

DISCUSSION

Although the Conibear 220® (Proulx, 1990) often is recommended to quickly kill raccoons (Association Provinciale des Trappeurs Indépendants, 1988; Currie and Robertson, 1992), it is unlikely that it can humanely kill this furbearer consistently. All the traps used in this study were much more powerful than the Conibear 220® and yet, they did not consistently render raccoons irreversibly unconscious in ≤3 min. In order to accept these traps at the preselection-test level, it would be necessary to increase the minimum time to loss of consciousness to 4 min. However, these traps were tested on immobilized raccoons. The muscles of these animals were more relaxed than those of unanesthetized ones and offered less resistance to the strik-

TABLE 2. Strike locations, ranges of times to loss of consciousness, and trauma of raccoons killed in preselection tests with rotating-jaw traps.

Test series	Number of tests	Strike locations		Loss of consciousness ≤3 min		Loss of consciousness >3 min		Trauma[a]					
		Head	Neck	Number of raccoons	Range of times (sec)	Number of raccoons	Range of times (sec)	I	II	III	IV	V	VI
Conibear 280	6	0	6	3	148–165	3	194–300[b]	4	1	1	–	–	
Conibear 280A[c]	6	0	6	0	–	6	210–264	1	3	2	–	–	–
Conibear 280B[d]	6	0	6	0	–	6	182–270	2	1	1	2	–	–
Sauvageau 2001-8	3	1	2	1	58	2	300[b]	3	–	–	–	–	–
Sauvageau 2001-8A[e]	2	2	0	0	–	2	244–300[b]	2	–	–	–	–	–
Sauvageau 2001-8B[f]	2	2	0	0	–	2	260–300[b]	1	–	–	–	1	–
Sauvageau 2001-8C[g]	5	3	2	3	89–173	2	300[b]	4	–	–	–	–	1

[a] I, No visible lesions, emphysema, edema; II, Muscular hemorrhage at strike location; III, Broken tracheal ring; IV, Fracture of cervical vertebra; V, Fracture of skull; VI, Fracture of skull and brain maceration.
[b] The animal was euthanized at 300 sec.
[c] With clamping bar on the bottom striking jaw.
[d] With clamping bar on the top striking jaw.
[e] With Conibear 330 springs.
[f] With short Conibear 330 springs.
[g] With short Conibear 330 springs and small eyes.

ing bars. Therefore, traps that do not quickly render immobilized animals unconscious probably will not humanely kill unanesthetized animals that are fighting the trap (Proulx et al., 1989a).

In the past, the addition of clamping bars and larger springs resulted in humane killing traps (Proulx et al., 1989b). With raccoons, however, it apparently is difficult to produce sufficient trauma to result in a quick loss of consciousness. Further work with rotating-jaw traps would require that the momentum and the clamping forces of these traps be enhanced. Proulx and Barrett (1993a) also found that mechanically improved Conibear 220® traps could not humanely kill fishers (*Martes pennanti*), a species similar in size to raccoon. In order to humanely kill fishers, they used the Bionic® (W. Gabry, Vavenby, British Columbia, Canada) trap cocked at eight notches (Proulx and Barrett, 1993b). At that setting, the trap's momentum was four times greater than that of the Conibear 220® trap. We speculate that the same impact energy would be required to kill raccoons. However, because of design limitations, it is unlikely that rotating-jaw traps could be developed to such a powerful level.

The Conibear 280® and the Sauvageau 2001-8® traps, and their mechanically improved models, failed to meet the humaneness requirements of our trap research program. We believe that these traps, and the weaker Conibear 220®, are unsuitable for the humane trapping of raccoons. With the recent developments in the field of humane trapping (Proulx and Barrett, 1991), we recommend that these rotating-jaw traps be banned for the capture of raccoons. While more research may be carried out on other killing devices such as mousetraps (Proulx and Barrett, 1993b) and planar traps (Proulx, 1990), we recommend the use of live-holding devices for the capture of raccoons. For example, the EGG® (EGG Trap Co., Wagner, South Dakota, USA) trap, a device less expensive than the Conibear®-type traps, can be efficiently used (Proulx et al., 1993a) to selectively live-capture raccoons (Proulx, 1991), without serious injury (Proulx et al., 1993b).

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