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INJURIES AND BEHAVIOR OF RACCOONS (*PROCYON LOTOR*) CAPTURED IN THE SOFT CATCH® AND THE EGG® TRAPS IN SIMULATED NATURAL ENVIRONMENTS

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ABSTRACT: The behavior and injuries of raccoons held for 12 and 24 hr in the Soft Catch® and the EGG® traps were studied in simulated natural environments. Nine raccoons held for 12 hr in the Soft Catch® received minor injuries. However, one of nine raccoons held for 24 hr in this trap mutilated itself. The EGG® trap caused only minor injuries to nine raccoons held for 12 hr, and nine others held for 24 hr. Thus the EGG® trap can be expected, at a 95% level of confidence, to hold ≥70% of the raccoons on traplines for 24 hr without serious injury. Raccoons captured in the Soft Catch® fought their surroundings more than the trap. Those captured in the EGG® trap fought the trap more than their surroundings. During the 24-hr capture study, escape behavior was more intense during the first 12 hr of capture, during both day and night.

Key words: Experimental study, raccoon, *Procyon lotor*, Soft Catch® foothold trap, EGG® trap, humane trapping.

INTRODUCTION

Rubber-padded foothold traps generally are less injurious than conventional steel-jawed footholds (Proulx and Barrett, 1991). However, in the case of raccoon (*Procyon lotor*), the findings have been equivocal. On the basis of Tullar's (1984) data, Olsen et al. (1988) concluded that the Victor® No. 1½ (Woodstream Corporation, Lititz, Pennsylvania, USA) foothold trap, when equipped with rubber pads and lighter-than-standard springs, caused less damage to raccoons than the steel-jawed foothold trap. Saunders et al. (1988) also suggested that padded foothold traps were less injurious to raccoons than the standard traps. Olsen et al. (1988) found no difference in the amount of damage noted in raccoons captured in the northeastern states in the Soft Catch® (trade name of the padded No. 1½ foothold trap marketed by Woodstream Corporation) versus its steel-jawed counterpart. However, they found that raccoons captured in the southeastern states had significantly less damage with the padded trap than with the standard trap. Olsen et al. (1988) indicated that these injuries were still serious and more work was needed to further improve padded traps for raccoons.

Berchielli and Tullar (1980) and Tullar (1984) pointed out that, independent of the type of foothold trap used, raccoons had a tendency to chew the captured toes or foot. Therefore, there was a need to identify and test new foothold devices.

Our objectives were to assess and compare the behavior and the type and magnitude of limb injuries of raccoons held in the Soft Catch® and the EGG® (EGG Trap Co., Ackley, Iowa, USA) traps for 12 and 24 hr.

MATERIALS AND METHODS

The study was conducted in fall 1989, in 12.2 × 5.2 × 4.4-m test enclosures landscaped with natural vegetation and kept under surveillance with remote control video cameras. Raccoons captured in box traps in southern Alberta (49°25′N, 112°00′W) were individually introduced in the enclosures and were allowed a minimum of 3 days to acclimate to simulated natural conditions before any tests were conducted. They were fed 250 g of dog chow daily. The research facilities, equipment, and husbandry procedures were detailed by Proulx et al. (1989).

The Soft Catch® is a No. 1½ foothold device with two coil springs, a pan trigger, and jaws

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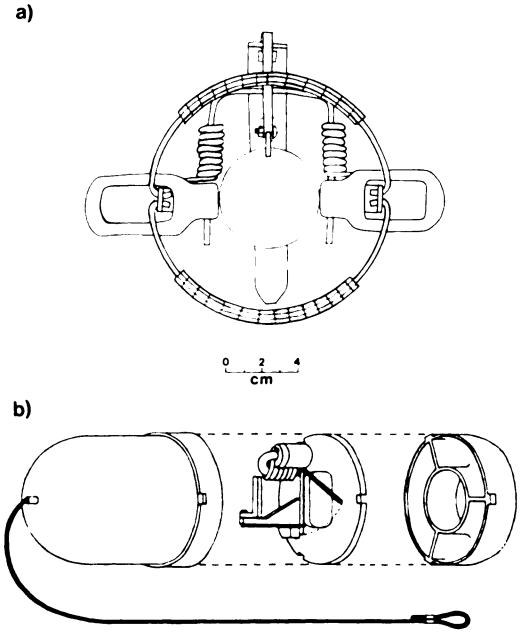


FIGURE 1. Diagram of the Soft Catch® (a) and the EGG® (b) traps.

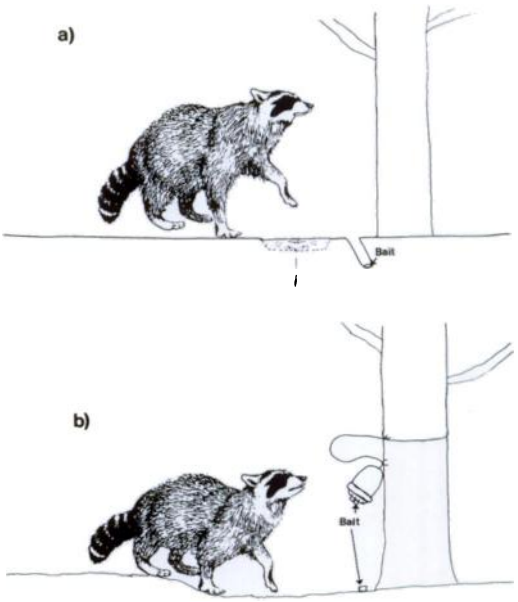


FIGURE 2. Sets used to capture raccoons in the Soft Catch® (a) and the EGG® (b) traps.

covered with rubber pads (Fig. 1a). The EGG® trap consists of a plastic housing and a pull trigger mechanism which releases a 5.7-cm-long striking bar (diameter: 0.38 cm), moving laterally across the opening to block the animal's paw (Fig. 1b). A mechanical evaluation (based on three traps fired ten times; Cook and Proulx, 1989) indicated that the mean (± SE) momentum of the EGG® trap's striking bar ($\bar{x}$: 0.309 ± 0.020 kg m/sec) was significantly lower than that of the Soft Catch® ($\bar{x}$ = 0.679 ± 0.150 kg m/sec) (R. Drescher, unpubl.). At openings of 5 and 10 mm (which correspond to the distance between the trap jaws of the Soft Catch®, and between the striking bar and the trap frame of the EGG® trap, when a raccoon is captured by the paw) the clamping forces of the EGG® trap (15.76 Newtons [N] and 28.54 N, respectively) were lower than those of the Soft Catch® (37.78 N and 34.22 N, respectively) (R. Drescher, unpubl.). The Soft Catch® was set on the animal's trail or in front of a hole baited with meat (Alberta Vocational Centre, 1987) (Fig. 2). The EGG® trap was set on a tree and baited with marshmallow at its opening and on the trigger (Fig. 2b).

The Fur Institute of Canada (1989) recommends that all live-holding devices set on land be checked at least daily. In this study, the tests were first carried out for 12 hr after capture. The behavior of captured raccoons was videotaped and closely monitored. Four types of behavioral activities were recorded: fighting the surroundings was defined as the animals digging out the grounds and chewing on logs and surrounding vegetation; fighting the trap was defined as the animals pulling, kicking, biting or licking the trapping device; calm was defined as the animals sleeping, looking around from a sitting or resting position, or grooming themselves; and other included such activities as animals eating bait leftovers or activities which could not be identified on videotapes.

At the end of the 12-hr period, the animals were anesthetized with an intramuscular injection of ketamine hydrochloride (10 to 20 mg/kg; Austin Laboratories, Joliette, Quebec, Canada), killed by an intracardiac injection of 540 mg/ml sodium pentobarbitol (Euthanyl forte; M.T.C. Pharmaceuticals, Cambridge, Ontario, Canada), and necropsied. Onderka et al.'s (1990) cumulative scoring system was used to assign points to limb injuries. A trapping device was judged humane if it held nine of nine raccoons without serious injury (i.e., <50 points in the scoring system). On the basis of a one-tailed binomial test (Zar, 1984), a trap with this score could be expected, at a 95% level of confidence, to hold ≥70% of raccoons captured on traplines for 12 hr without serious injury (Proulx et al., 1993). If a trap was found humane after a 12-hr capture period, it was further tested in a 24-hr capture period. The research protocol and the humaneness criteria were identical to those used during the 12-hr capture period.

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TABLE 1. Injuries and cumulative scores of raccoons held in the Soft Catch™ and the EGG™ traps for 12 hr and 24 hr.

Trap	Capture period	Number of raccoons	Frequency of capture[a]				Frequency of notable injuries[b]					Cumulative score		
			LF	RF	LH	RH	I	II	III	IV	V	$\bar{x}$	SE	Range
Soft Catch	12 hr	9	1	4	4	0	2	5	0	2	0	10.1	4.8	0–40
EGG	12 hr	9	6[c]	4[c]	0	0	1	5	3	0	0	7.6	2.5	0–20
Soft Catch	24 hr	9	2	5	2	0	1	7	0	0	1	17.2	12.7	0–120
EGG	24 hr	9	4	5	0	0	1	4	4	0	0	5.8	1.9	0–15

[a] LF: left front; RF: right front; LH: left hind; RH: right hind leg.

[b] I: no visible lesion; II: congestion, edema, or dermal desiccation; III: skin puncture; focal maceration of soft tissue sometimes involving the tendon; IV: subluxation of metacarpal joint or phalangeal luxation; V: self-mutilation; severance of tendon and exposure of bones.

[c] One raccoon was captured by both front legs.

The total number of min/behavioral activity was recorded for each animal. A t-test was used to compare the activities of both groups (Soft Catch™ vs. EGG™) of raccoons (Dixon and Massey, 1969). In the analysis of the data for the 24-hr period, the activities of the raccoons for the first 12 hr were compared with those for the second 12 hr with the Wilcoxon matched-pairs signed-ranks test (Siegel, 1956).

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

All nine raccoons captured in the Soft Catch™ (five by a front paw and four by a back paw) received injuries rating <50 points over the 12-hr capture period (Table 1). Most injuries consisted of minor soft tissue maceration and subcutaneous congestion and edema. Metacarpal subluxations in one raccoon, and the luxation of a phalangeal joint in another animal, were rated as minor injuries (30 to 40 points). No self-mutilation occurred. The Soft Catch™ was considered to be humane during the 12-hr capture period.

The raccoons captured in the EGG™ trap (8 by one paw and 1 by two paws) also received only minor injuries consisting of small skin wounds (due to the tip of the striking bar), maceration of soft tissues, and edema over the 12-hr capture period (Table 1). No self-mutilation occurred. The EGG™ trap was considered to be humane during the 12-hr capture period.

Raccoons captured in Soft Catch™ spent, on average, more (t = 3.197, $P < 0.05$) time during the 12-hr capture period fighting their surroundings than those captured in the EGG™ trap (Table 2). Raccoons captured in the EGG™ trap fought the trapping device more (t = 5.32, $P < 0.05$) than those captured in the Soft Catch™. Overall, raccoons captured in the Soft Catch™ spent as much time ($\bar{x}$ = 431 min, SE = 57) fighting as those of the EGG™ trap ($\bar{x}$ = 412 min, SE = 49) (t = 0.256, $P > 0.05$). There was no significant difference ($P > 0.05$) between the two groups of raccoons in the average amount of time allocated to "calm" and "other" behavioral activities (Table 2).

Eight of nine raccoons captured in the Soft Catch™ (seven by a front paw and two by a back paw) sustained minor in-

TABLE 2. Importance (number of minutes) of behavioral activities of raccoons held in the Soft Catch™ and the EGG™ traps for 12 hr.

Behavioral activity	Soft Catch™ (n = 9 raccoons)		EGG™ (n = 9 raccoons)	
	$\bar{x}$	SE	$\bar{x}$	SE
Fighting surroundings	375.0	66.6	137.8	32.7
Fighting trap	56.3	15.5	274.2	37.9
Calm	275.7	54.8	291.9	48.8
Other	13.0	6.9	16.1	11.7

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TABLE 3. Importance (number of minutes) of behavioral activities of raccoons held in the Soft Catch® and the EGG® traps for 24 hr.

Behavioral activity	Soft Catch® (n = 9 raccoons)						EGG® (n = 9 raccoons)					
	First 12 hr		Second 12 hr		All 24 hr		First 12 hr		Second 12 hr		All 24 hr	
	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE
Fighting surroundings	335.4	50.2	102.7	24.6	438.1	72.7	241.2	66.2	62.3	26.8	303.5	85.3
Fighting trap	90.8	25.5	40.4	22.7	131.2	38.7	192.8	46.8	42.1	18.4	234.9	59.4
Calm	280.3	44.4	565.9	29.6	846.2	61.7	262.1	42.0	611.1	28.5	873.2	60.2
Other	13.4	6.5	11.0	4.5	24.4	6.2	23.9	8.6	4.5	3.4	28.4	10.6

juries (≤5 points) over the 24-hr capture period; these consisted of bruising, congestion, and edema (Table 1). One raccoon chewed on its paws. This resulted in severe injuries (120 points) consisting of dislocation of a digit, severance of a tendon, and the exposure of digit bones (Table 1). The Soft Catch® was not recognized as a humane trap during the 24-hr capture period.

Nine of nine raccoons captured in the EGG® (all by one front paw) trap sustained minor injuries (≤20 points) over the 24-hr capture period; these consisted mostly of skin puncture, soft tissue maceration, and edema (Table 1). The EGG® was considered to be humane during the 24-hr capture period. Based on these findings, the trap can be expected, at a 95% level of confidence, to hold ≥70% of raccoons on traplines for 24 hr without serious injury.

No significant difference ($P > 0.05$) was found between the behavioral activities of raccoons held for 24 hr in the Soft Catch® and the EGG® traps (Table 3). Raccoons captured in the Soft Catch® fought their surroundings more (Wilcoxon T: 0, $P < 0.05$) and were less calm (T: 1, $P < 0.05$) during the first 12 hr than during the second 12 hr (Table 3). They spent as much time (T: 8, $P > 0.05$) fighting the trap during the first and the second 12-hr periods. However, this activity was not frequent and represented 13 and 6% of each time period, respectively (Table 3). Raccoons fought the trap (T: 0, $P < 0.05$) and their surroundings (T: 1, $P < 0.05$) more and were less calm (T: 0, $P < 0.05$) during the first 12 hr of capture in the EGG® trap than during the second 12 hr (Table 3).

We compared responses of the animals over the 12-hr and 24-hr capture periods. With the exception of the self-mutilation recorded during the 24-hr capture period, all the raccoons captured in the Soft Catch® sustained minor injuries that were not life-threatening (Table 1). Most raccoons were captured in the morning during the 12-hr capture period (seven of nine raccoons) and the 24-hr capture period (eight of nine raccoons). There was no significant difference ($P > 0.05$) between the behavior of raccoons recorded during the first 12 hr of the 24-hr capture period and that of raccoons of the 12-hr capture period (Tables 2, 3).

The raccoons captured in the EGG® trap sustained similar minor injuries during the 12-hr and the 24-hr capture periods (Table 1). Eight of nine of the raccoons of the 12-hr capture period were live-trapped in the morning. Therefore, most of their activities occurred during daylight. In contrast, most of the raccoons of the 24-hr capture period were live-trapped in the evening. Therefore, the first 12 hr of capture occurred mostly during the night time. Nevertheless, there was no significant ($P > 0.05$) difference between the behavior of raccoons recorded during the first 12-hr of the 24-hr capture period and that of raccoons of the 12-hr capture period (Tables 2, 3).

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DISCUSSION

While no humane standards have been established for live-holding devices (Proulx and Barrett, 1991), an acceptable live-trap should be one that holds an animal with minimal trauma. We found that the EGG℠ trap could hold raccoons for 24 hr without serious injuries. The striking bar held a raccoon's paw without breaking bones or severing tendons. Its plastic housing completely covered the paw and the wrist, and protected the captured limb from torsion injuries, which could occur when an animal tries to escape. Furthermore, an animal had no access to its paw and could not mutilate itself.

The Soft Catch℠ did not break any bones or sever tendons. However, during the 24-hr capture period, one animal chewed on its paw. Self-mutilations are frequent in raccoons captured in padded and unpadded foothold traps (Atkeson, 1956; Berchielli and Tullar, 1980). If the Soft Catch℠ was modified to protect the captured limb from being mutilated, the trap could be found humane. However, because foothold traps are known to cause fractures and other serious injuries (Berchielli and Tullar, 1980; Olsen et al., 1988), it would be necessary to repeat the experiments in enclosures to ascertain the humaneness of such a modified trap.

We showed that the behavior of captured raccoons varied greatly from one animal to another. However, the raccoons captured in the Soft Catch℠ usually kept their captured limb on the ground and would lean on it while digging the ground with the other front limb. In contrast, the EGG℠-trapped raccoons could not use their captured limb for support. In comparison to the EGG℠-trapped raccoons, the Soft Catch℠ raccoons markedly disturbed the capture sites. Still, the animals captured in both trap models fought for similar periods of time. When the whole 24-hr capture period was considered, it was evident that such fighting occurred mostly during the first 12 hr, during day as well as night.

The EGG℠ trap was easily set; it was safe to use and it appeared durable. Although it was found humane in natural simulated environments, its humaneness should be verified in field studies. Raccoons live-captured on traplines may be approached by other animals. Their behavior in the wild may differ from the behavior in enclosures and may result in serious injuries to the captured limb. Field studies also are necessary to compare the capture-efficiency of the EGG℠ trap to that of other trapping devices commonly used by trappers.

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