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Welfare Performance of Three Foothold Traps for Capturing North American River Otters *Lontra canadensis* --Manuscript Draft--

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Welfare Performance of Three Foothold Traps for Capturing North American River Otters *Lontra canadensis*

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Abstract

Foothold traps are effective tools for the live capture and restraint of wildlife for management and research and were used extensively during successful river otter *Lontra canadensis* restoration programs throughout North America. A variety of methods and models of foothold traps were used during restoration programs, but comprehensive efforts to describe and quantify injuries associated with river otter captures have been limited. We evaluated injuries of river otters caught in three commercially available models of foot hold traps including the number 11 double long spring with standard jaws, the number 11 double long spring with double jaws, and the number 2 coil-spring trap. Based on examinations of 70 captured river otters, 78% of the total injuries detected were classified as “mild” ($n = 174$ injuries) and 17% were classified as “moderate” ($n = 37$ injuries). Less than 3% of the injuries observed were classified as “moderately severe” or “severe”. We focused only on the animal welfare performance of traps; the three trap types we tested met the animal welfare criteria required for inclusion in the Best Management Practices for trapping river otter. The criteria based on International Standards Organization guidelines used in this assessment of trap performance provides a scientific basis for future evaluations of river otter welfare when foothold traps are used for restoration, research, and population management.

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findings and conclusions in this article are those of the author(s) and do not necessarily represent the views of the U.S. Fish and Wildlife Service.

Introduction

Foothold traps are effective tools for the live capture and restraint of wildlife for management and research programs worldwide (Shemnitz et. al. 2009; White et. al 2015). During the past 50 years, 23 state wildlife management agencies implemented river otter *Lontra canadensis* reintroduction efforts (Raesly 2001; Erb et. al. 2018; Roberts et. al. 2020). A variety of methods and models of foothold traps and several designs of cage type traps were used during these successful restoration programs but comprehensive efforts to describe and quantify injuries associated with river otter captures have been limited (Serfass et. al. 1996; Blundell et. al. 1999; Belfore 2008; Rutter et. al. 2020).

Research addressing the efficiency and animal welfare performance of foothold trap designs commonly used to capture and restrain wildlife intensified throughout North America during the 1990's, due largely to multinational interests to improve animal welfare performance. These interests resulted in a non-binding agreement between the European Community and the United States of America on humane trapping standards (Agreed Minute; European Commission 1998) and development of Best Management Practices (BMPs) for trapping in the United States (White et. al. 2021). The BMPs program is a field-based trap-testing program coordinated by the Association of Fish and Wildlife Agencies and cooperating state wildlife agencies. Extensive testing of foothold traps in this program has resulted in trapping BMPs for 23 species of furbearers. As part of the broader effort to develop trapping BMPs for river otters, we evaluated animal welfare performance of three foothold trap types by quantifying the types, frequencies, and relative severities of injuries sustained, and then compared capture-related injuries to other published reports.

Study Sites

River otters were trapped in the Southeastern United States (Arkansas, North Carolina, South Carolina, and Tennessee) and Missouri, where river otter populations were known to be abundant and where we were able to find experienced and skilled trappers to capture them. This allowed for trapping to occur in diverse conditions (e.g., weather, soil conditions, habitats) and in areas with varying abiotic and biotic conditions that may affect trap performance. River otters were trapped in riparian corridors, swamps, marshes, reservoirs, and artificial impoundments that were flooded for wintering waterfowl. Climate in the Southeastern United States is predominated by mild temperatures with fully humid, hot summers (Chen and Chen 2013). Major land-use and

land-cover types include deciduous forest (23.0%), evergreen forest (13.8%), pasture-hay (12.7%), and woody wetlands (11.2%; Homer et al. 2015). Missouri has a humid continental type of climate (Köppen climate classification Dfa) in its northern portion and humid subtropical (Köppen climate classification Cfa) type of climate in its southern part. Summers are hot and long, while winters are cold and snowy. The annual rainfall in Missouri ranges from an average 40" (1016mm) in the north to 45" (1143mm) in the south. Snowfall is moderate to heavy, with an average of fifteen snowy days in the year that gathers 15" (381mm) to 20" (508mm) of snowfall. Missouri receives ample sunshine of at least 2500 to 2800 hours annually across the state. The average relative humidity lies between 65% and 70% and is at the highest during spring and summer (Yu Media Group 2021). Relative to land use and coverage, Missouri consists of farmland (63%; the majority of which is cropland and pastureland), forested land (31.9%; USDA 2017), and various types of wetlands including swamps, shrub swamps, forested wetlands, marshes, wet meadows, fens and seeps, pond and lake borders and stream banks which make up about 1.4% of the state's surface area (Missouri Department of Natural Resources Water Resources Center 2021).

Methods

We evaluated three commercially available models of foothold traps, specifically the number 11 double long spring with standard jaws (11S), the number 11 double long spring with double jaws (11DJ), and the number 2 coil-spring trap (2C). Both models of number 11 double long spring traps were manufactured by Sleepy Creek Manufacturing (Berkeley Springs, WV, 25411 USA) whereas the number 2 coil-spring trap was manufactured by Oneida-Victor Inc. (Cleveland, OH, 44101 USA). Chaining systems used to anchor traps included four swivels and a shock spring and were consistent across the three trap types tested. The chain construction included one swivel at the anchor point followed by two links of size 2/0 chain, one swivel attached to each end of a shock-spring (PIT #17; 14.5 kg [35 lb.] pull) followed by three links of size 2/0 chain, and one swivel followed by one link of size 2/0 chain attached to the center of the trap base-plate (Figure 1).

River Otter Captures

We used two person teams that consisted of one experienced private trapper responsible for deploying traps and one field technician responsible for local project management and data collection. We selected trappers in areas with relatively abundant populations of river otters and

from different geographic locations within a state or region to encompass a broad range of trapping conditions. Trappers followed manufacturer's instructions for restraining traps and used their own knowledge and experience to capture river otters on their established traplines. Trappers conducted capture activities during regulated trapping seasons and adhered to all state trapping regulations. We instructed trappers to set two traps of the same design at each site, which we refer to as a trap station. To avoid bias, each trapper selected a location for a trap station and then the technician randomly assigned a specific model of restraining trap to be tested at the station. Traps were set within each trap station from three to 10 m apart at the discretion of the trapper. Trap stations were a minimum distance of 100 m apart to increase spatial independence. Technicians recorded set-related data as well as daily trap check information. Traps were deployed for up to 21 days or until a combined total of at least 20 river otters were captured in each trap type.

Our objective was to quantify injuries associated with the use of foothold traps for live restraint of river otters. Hence, trappers did not deploy traps in sets that would potentially result in drowning or mortality due to other factors. Notwithstanding that restriction, trappers deployed traps using their preferred set locations or methods (e.g., on land or near the water's edge). We required trappers to check each trap daily and remove captured animals before 1200 hr. At each trap station, technicians recorded the species responsible, if possible, for activity at the set including captured and restrained, temporarily captured but not restrained upon inspection, traps activated with no evidence of a capture, and trap sites disturbed but the trap not activated. For each captured river otter, technicians recorded which foot was secured in the trap, the capture position of that foot (e.g., toe, metatarsal or metacarpal pad, wrist, or proximal to wrist), and the physical condition (i.e., alive, dead, unconscious) when the trap was checked. Trappers used a .22 caliber rimfire firearm to dispatch captured river otters. Consistent with the American Veterinary Medical Association guidance for euthanizing captured animals, trappers placed shots to the head to ensure rapid and humane death and avoid damage to teeth, legs, or other body parts that could influence post-mortem examination results (American Veterinary Medical Association 2020, Sikes et al. 2011). Technicians marked each dispatched river otter with a unique identification number, secured the river otter in a sealed plastic bag, and then froze each specimen following completion of daily trap checks. Trappers released any non-furbearing species (domestic or wild) and any furbearers with closed seasons or that were otherwise not

legal to trap in the state where testing occurred.

Injury Assessments

Wildlife veterinary pathologists experienced with evaluating trap-related injuries used established procedures to conduct comprehensive whole-body post-mortem examinations. To avoid bias, pathologists did not have knowledge of the trap model or any capture related information, including the foot that each river otter was held by, prior to examination. In cases where physical injuries were difficult to detect by visual observation, pathologists used radiograph examinations of river otter limbs to verify trap-related trauma. Pathologists reported results using the International Organization for Standardization (ISO) methods for scoring specific injuries from restraining traps (ISO 1999). Pathologists determined the sex and age of each river otter; age was determined based on body weights, condition and wear on the teeth, size of the penis and testicles for males, and evidence of pregnancy or placental scars for females.

We used two methods described by ISO (1999; much of which was also described in the Agreed Minute [European Commission 1998]) to evaluate welfare of animals captured in restraining traps (White et al. 2021). The ISO protocols did not include thresholds for acceptable levels of physical trauma, but rather established standardized and comprehensive approaches to evaluate physical trauma using post-mortem examination of injuries. The first method assigned points to each specific injury, which ranged from 0 points (no injury) to 100 points for more severe types of injuries (e.g., severance of major tendon, trap-related mortality). The sum of all injuries sustained by a single river otter constituted the cumulative injury score. The second system assigned each observed injury to pre-determined ISO trauma categories, specifically “mild”, “moderate”, “moderate-severe”, or “severe”. We quantified the animal welfare performance of each trap using two metrics: mean cumulative injury score, and the percentage of individuals in the sample exhibiting either no injuries or injuries categorized only as mild or moderate. This two-pronged approach was intended to account for animal welfare concerns associated with multiple lesser injuries as well as single greater injuries. We use Chi-Square tests to compare age and sex ratios of captured river otters across trap types and Analysis of Variance to compare cumulative injury scores associated with the three trap types.

Results

A total of 70 river otters were captured during 1999 ($n = 2$), 2004 ($n = 4$), 2005 ($n = 4$), 2006 ($n = 42$), and 2007 ($n = 18$) in Arkansas ($n = 16$), Missouri ($n = 26$), North Carolina ($n = 23$), and South Carolina ($n = 5$; Table 1). Trappers restrained 22 river otters in the 11DJ trap, 21 in the 11S trap, and 27 in the 2C trap. Eighty percent of river otters were captured by a front foot; the proportion of front foot to hind foot captures was similar across all trap types ($X^2 = 1.193$, 2df, $P=0.551$). Thirty eight percent of the river otters trapped were females; the sex ratio of captured river otters was similar across all trap types ($X^2 = 2.97$, 2df, $P = 0.227$). Eighty-nine percent of the river otters captured were adults; the age ratio of captured river otters was similar across all trap types ($X^2 = 0.184$, 2df, $P = 0.912$; Table 1). Mean body weights were 7.0 kg ($SD = 1.3$ kg) for adult females, 5.2 kg ($SD = 1.3$ kg) for yearling females, 8.8 kg ($SD = 1.7$ kg) for adult males, and 5.4 kg ($SD = 0.5$ kg) for yearling males.

All river otters were alive and active prior to dispatch by trappers. One river otter captured in a 11S trap had no injuries based on post-mortem examinations. Radiograph examinations were conducted to further investigate potential injuries on two river otters. The mean number of unique injury types observed per individual river otter was three and ranged from zero to six (Table 2).

Oedematous swelling or hemorrhage was the most common injury and was observed on 67 of the 70 (96%) river otters examined (Table 2). Other common injuries, all classified as “mild”, included minor subcutaneous soft-tissue maceration or erosion ($n = 43$; 61%), minor cutaneous lacerations ($n = 35$; 49%), and minor periosteal abrasions ($n = 22$; 31%). Joint luxation at or below the carpus or tarsus was the most common (26-33% of animals observed) “moderate” injury observed on river otters captured with 11S and 11DJ traps; this injury was uncommon ($n = 1$; 4%) with the 2C trap (Table 2). Conversely, dental injuries were the most common ($n = 5$; 19%) “moderate” injury in the 2C trap but were rare (0-5%) in both models of number 11 traps.

Mean cumulative injury scores were 39.4 for the 11DJ, 48.3 for the 11S, and 45.3 for the 2C trap (Table 3). Mean cumulative injury scores were similar across trap types ($F = 0.37$, 2df, $P = 0.694$). There was no difference in mean cumulative injury scores between sexes ($t = 1.42$, $P = 0.162$) or age-classes ($t = -0.37$, $P = 0.721$) of the river otters we examined. Heavier river otters generally exhibited lower cumulative injury scores, but the correlation was not strong ($r = -0.207$, $P = 0.085$).

Based on examinations of 69 river otters exhibiting injuries, 174 (78%) of the total injuries detected were classified as “mild” and 37 (17%) were classified as “moderate”. Eleven (< 3%) of the observed injuries were classified as “moderately severe” or “severe” (Table 2). “Mild” injuries were the most frequently observed classification for all three trap types evaluated (Table 3). “Moderate” injuries were observed on 6 (27%) of river otters captured in the 11DJ traps, 10 (48%) of river otters captured in the 11S traps, and 14 (52%) of river otters captured in 2C traps. Twenty (91%) of the river otters captured in the 11DJ traps exhibited only “mild” or “moderate” injuries. Seventeen (81%) of the river otters captured in 11S traps exhibited either no injuries or only “mild” or “moderate” injuries. Twenty-two (82%) river otters captured in the 2C traps exhibited only “mild” or “moderate” injuries (Table 4).

Discussion

For traps to meet BMP animal welfare criteria for a given species, the mean cumulative injury score must be ≤ 55 points, and $\geq 70\%$ of individuals in the sample must have either no injuries or injuries categorized only as mild or moderate. The three trap types we tested for river otters met these animal welfare criteria. The ISO criteria used in this assessment of trap performance provides a scientific basis for future evaluations of river otter welfare when foothold traps are used for research or population management (ISO 1999).

A variety of approaches have been used previously to assess the welfare performance of traps used to capture river otters and, less frequently, to comprehensively identify and quantify all injuries sustained by captured river otters. Belfiore (2008) evaluated five models of foothold traps, including the 11S trap evaluated in our study, to capture river otters in California and developed an injury rating scaled from “class I”, for relatively minor injuries, to “class IV”, for severe injuries. Although specific injuries were not described by trap type, 79% of the river otters captured exhibited “class I” injuries. Fernandez-Moran et al. (2002) used a similar injury scoring system to quantify injuries sustained by Eurasian otters *Lutra lutra* captured in 1.5 Soft Catch[®] traps (Woodstream Corp. Lititz, PA, 17543 USA) and reported that 79% of the 43 Eurasian otters captured exhibited “class I” injuries. Many of the injuries described as “class I” (e.g., minor swelling, claw loss, and small abrasions) during these investigations were consistent with the “mild” injury category in our evaluations (Table 2). Similar to these studies, 78% percent of the injuries we detected using three trap types were classified as “mild”, suggesting that researchers can expect similar frequencies of “mild” injuries when using traps of similar size

and design. Blundell et al. (1999) used the ISO scoring system to compare injuries associated with river otter captures in 11S and Hancock cage traps (Hancock Trap Co, Custer, SD; Olsen et al. 1986). They reported that cumulative injury scores for 30 river otters captured in 11S traps ranged from zero to 100, with a median score of five. Median cumulative injury scores for river otters captured in 11DJ and 11S during our study were 28.5 and 45 respectively. The lower cumulative injury scores reported by Blundell et al. (1999) may be attributed to their ability to check traps several times each day and their use of trap transmitters to detect and quickly respond to river otter captures.

Dental injuries are classified as “moderate” based on ISO scoring and are of particular concern as they could affect an individual’s ability to capture and consume prey (Van Valkenberg 1988). Dental injuries associated with river otters captured in Hancock cage traps have been substantial (e.g., >45% of river otters captured in Alaska) and dental injuries are permanent whereas foothold trap related injuries usually heal with no apparent debilitation (Blundell et al. 1999; Shirley et al. 1983). Rutter et al. (2020) documented a 25% tooth fracture rate for river otters captured in Comstock Custom Cage traps (Comstock Custom Cage LLC, Gansevoort, NY) in southern Illinois. Tooth damage has been a major consideration in river otter trap selection for research and restoration and foothold traps have been recommended over cage-type traps (Blundell et al. 1999; Shirley et al. 1983). We observed no dental injuries from river otters captured in 11DJ traps; one (5%) river otter captured in 11S traps had a dental injury which was consistent with Blundell et al. (1999) who found that 6% of the 30 river otters captured in 11S traps had injured teeth. Dental injuries were more common (n = 5; 19%) in the larger 2C traps that we tested; Fernandez-Moran et al. (2002) indicated that 19% of the Eurasian otters captured in 1.5 Soft Catch™ traps exhibited oral cavity or dental injuries. Serfass et al. (1996) reported that 42% of the 38 river otters captured in 1.5 Soft Catch™ traps, equipped with rubber padded jaws, for reintroduction in Pennsylvania exhibited canine injuries and 26% exhibited injuries to incisors. Of the 17 river otters captured in 11S double long spring traps for reintroductions in Pennsylvania, 11 (65%) exhibited canine injuries and four (24%) exhibited incisor injuries. Serfass et al. (1996) used a chaining system which ranged from 0.5 to 1.5 m in length and was anchored to steel plates. Other studies have recommended shorter chaining systems and have suggested that longer chaining systems may result in higher injury rates (Belfiore 2008; Blundell et al. 1999).

We acknowledge that the issue of animal welfare is complex and involves not only physical injury, but other considerations as well (e.g., pain, distress). However, we selected injury as the primary criterion to evaluate animal welfare based on the recommendations of ISO. Other potential methods or components of welfare could include criteria related to behavior, physiology (stress), immunology, and molecular biology, but the ISO process concluded that there was insufficient knowledge or technology to incorporate those potential metrics (International Organization for Standardization 1999). Likewise, we remain unaware of any cumulative metric that addresses these considerations, can be reliably measured in typical field situations, is science-based, and has a broadly accepted threshold for acceptance. For these reasons, we focused on quantifying injury levels across trap models using standardized ISO scoring protocols, with a goal of improving animal welfare when live-trapping river otters.

Although the development of the ISO testing standards resulted in internationally agreed-upon trap testing and injury measurement protocols, it did not provide an international agreement that included acceptable injury thresholds. Criteria and thresholds developed for BMPs were based on the level of injury that was deemed unlikely to directly or indirectly (i.e., through behavioral changes) have a meaningful effect on subsequent survival or reproduction for >70% of the animals. Because ISO injury assessments required whole body necropsies, it was not possible to relate observed injury scores with subsequent release, monitoring, behavior, or survival of captured river otters. Instead, BMP threshold development relied on expert opinion from individuals who had been involved in the ISO process, along with that from other experienced biologists and wildlife veterinary pathologists in the U.S.

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Table 1. Numbers of river otters *Lontra canadensis* captured in three foothold trap types: number 11 double long-spring traps with double jaws (11DJ), number 11 double long-spring traps with standard jaws (11S), and number 2 coil-spring traps (2C), by jurisdiction, sex, and age, during the development of Best Management Practices for trapping river otters 1999-2007.

State	Sex	Age	Trap Type		
			11DJ (n=22)	11S (n=21)	2C (n=27)
Arkansas	Female	Adult	1	1	6
		Yearling	0	0	0
	Male	Adult	1	7	0
		Yearling	0	0	0
Missouri	Female	Adult	2	4	2
		Yearling	1	1	1
	Male	Adult	6	5	2
		Yearling	1	1	0
North Carolina	Female	Adult	1	0	3
		Yearling	1	0	0
	Male	Adult	8	2	7
		Yearling	0	0	1
South Carolina	Female	Adult	0	0	1
		Yearling	0	0	0
	Male	Adult	0	0	3
		Yearling	0	0	1
States Pooled	Female	Adult	4	5	12
		Yearling	2	1	1
	Male	Adult	15	14	12
		Yearling	1	1	2

Table 2. Organization for Standardization (ISO) Injury type, class, score, and distribution for all injuries sustained by 70 river otters *Lontra canadensis* captured in three foothold trap types: number 11 double long-spring trap with double jaws (11DJ), number 11 double long-spring trap with standard jaws (11S), and number 2 coil-spring trap (2C) tested in live-restraining sets in Arkansas, Missouri, North Carolina, and South Carolina during 1999 to 2007.

Injury Category	ISO Code	Trauma type	Trauma score	Trap Types					
				11DJ (N=22)		11S (N=21)		2C (N=27)	
				n	%	n	%	n	%
None	0	No trauma	0	0	0	1	5	0	0
Mild	1	Claw loss	2	1	4	2	10	4	15
Mild	2	Oedematous swelling or hemorrhage	5	22	100	19	90	26	96
Mild	3	Minor cutaneous laceration	5	11	48	10	48	14	52
Mild	4	Minor subcutaneous soft-tissue maceration or erosion (contusion)	10	15	68	17	81	11	41
Mild	5	Major cutaneous laceration, except on foot pads or tongue	10	0	0	0	0	0	0
Mild	6	Minor periosteal abrasion	10	8	35	7	33	7	26
Moderate	7	Severance of minor tendon or ligament (each occurrence)	25	0	0	2	10	3	11
Moderate	8	Amputation of one digit	25	0	0	0	0	3	11
Moderate	9	Permanent tooth fracture exposing pulp cavity	30	0	0	1	5	5	19
Moderate	10	Major subcutaneous soft-tissue maceration or erosion	30	2	9	0	0	2	7
Moderate	11	Major laceration on foot pads or tongue	30	0	0	0	0	2	7
Moderate	12	Severe joint hemorrhage	30	0	0	0	0	0	0
Moderate	13	Joint luxation at or below carpus or tarsus	30	6	26	7	33	1	4
Moderate	14	Major periosteal abrasion	30	1	4	0	0	1	4
Moderate	15	Simple rib fracture	30	0	0	0	0	0	0
Moderate	16	Eye lacerations	30	0	0	0	0	0	0
Moderate	17	Minor skeletal muscle degeneration	30	0	0	1	5	0	0
Mod-Severe	18	Simple fracture at or below carpus or tarsus	50	0	0	1	5	1	4
Mod-Severe	19	Compression fracture	50	0	0	0	0	0	0
Mod-Severe	20	Comminuted rib fracture	50	0	0	0	0	0	0
Mod-Severe	21	Amputation of two digits	50	0	0	0	0	1	4
Mod-Severe	22	Major skeletal muscle degeneration	55	0	0	0	0	0	0
Mod-Severe	23	Limb ischemia	55	0	0	1	5	1	4
Severe	24	Amputation of ≥ 3 digits	100	0	0	1	5	1	4
Severe	25	Any fracture or joint luxation on limb above carpus or tarsus	100	2	9	0	0	0	0
Severe	26	Any amputation above digits	100	0	0	0	0	0	0
Severe	27	Spinal cord injury	100	0	0	0	0	0	0
Severe	28	Severe internal organ damage (internal bleeding)	100	0	0	1	5	0	0
Severe	29	Compound or comminuted fracture at/below carpus or tarsus	100	0	0	0	0	1	4
Severe	30	Severance of major tendon or ligament	100	0	0	0	0	0	0
Severe	31	Compound rib fractures	100	0	0	0	0	0	0
Severe	32	Ocular injury resulting in blindness of an eye	100	0	0	0	0	0	0
Severe	33	Myocardial degeneration	100	0	0	0	0	0	0
Severe	34	Mortality	100	0	0	0	0	0	0

Table 3. Cumulative Injury score statistics based on evaluations of 70 river otters *Lontra canadensis* captured in Arkansas, Missouri, North Carolina, and South Carolina during 1999 to 2007 in three trap types: number 11 double long-spring traps with double jaws (11DJ), number 11 double long-spring traps with standard jaws (11S), and number 2 coils-spring traps (2C).

Trap Type	N	Mean	SE	95% CI	Median	Range
11DJ	22	39.4	6.2	25.3 - 54.0	28.5	10 - 105
11S	21	48.3	9.2	33.3 - 63.3	45.0	0 - 155
2C	27	45.3	6.2	32.1 - 58.6	40.0	5 - 135

Table 4. Distribution of Organization for Standardization (ISO) injury-class data from 70 river otters *Lontra canadensis* captured in three foothold trap models: number 11 double long-spring traps with double jaws (11DJ), number 11 double long-spring traps with standard jaws (11S), and number 2 coils-spring traps (2C) tested in live-restraining sets in Arkansas, Missouri, North Carolina, and South Carolina during 1999 to 2007.

ISO Injury Categories	Trap Types		
	11DJ (<i>n</i> = 22)	11S (<i>n</i> = 21)	2C (<i>n</i> =27)
No injuries (ISO 0)	0	1	0
Mild injuries (ISO 1-6)	22	20	27
Moderate injuries (ISO 7-17)	6	10	14
Moderately severe injuries (ISO 18-23)	0	2	3
Severe injuries (ISO 24-34)	2	2	2

Figure 1. Three models of foothold traps: number 11 double long-spring trap with double jaws (bottom), number 11 double long-spring trap with standard jaws (center), and number 2 coil-spring trap (top) used to capture 70 river otters *Lontra canadensis* to assess trap related injuries in Arkansas, Missouri, North Carolina, and South Carolina during 1999 to 2007. Chaining systems were consistent among trap types. All three trap types met animal welfare criteria established within the Best Management Practices for Trapping program.



