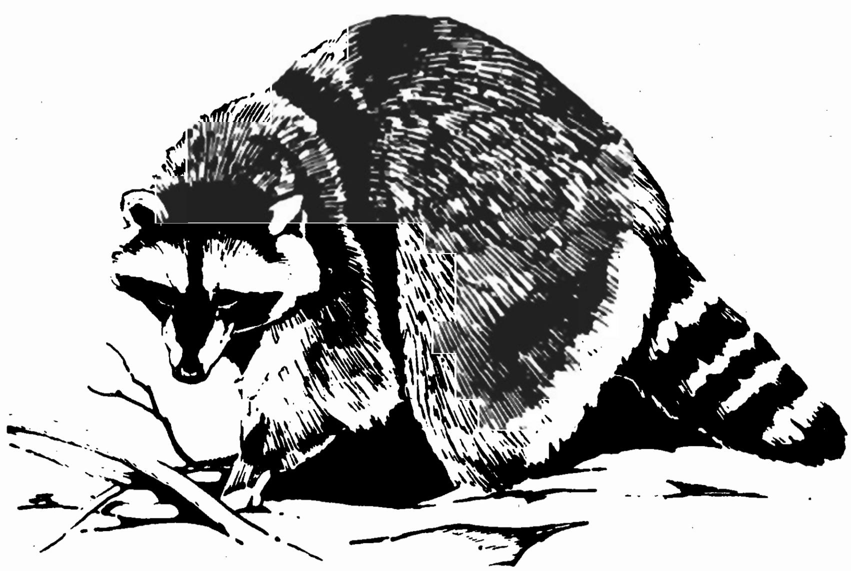
Improving Animal Welfare in U.S. Trapping Programs:

Process Recommendations and Summaries of Existing Data



International Association of Fish and Wildlife Agencies (IAFWA)

Improving Animal Welfare in U.S. Trapping Programs: Process Recommendations and Summaries of Existing Data

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Contents

Executive Summary

Over the past 18 months, the IAFWA Fur Resources Technical Subcommittee and trapping work group participants from USDA/APHIS Animal Damage Control, U.S. Fish and Wildlife Service, and the National Trappers Association have been working to:

1) develop and compile existing data on trap research and testing;

2) identify priority species and trapping systems for additional work;

3) recommend common and consistent protocols for use by agencies or researchers conducting trap testing so that usefulness and comparability of results are maximized;

4) identify appropriate processes and procedures that could be developed to allow state wildlife agencies to systematically and objectively improve trapping within their jurisdictions, including the development of regionally based Best Management Practices (BMPs) for trapping; and

5) identify public information and education needs to improve the understanding and acceptance of trapping programs.

This report summarizes the results of the "first steps" of efforts of the Subcommittee and the working group to identify, compile, and synthesize data and to conceptualize and design processes for improving trapping and the welfare of trapped animals in the U.S.

Next steps in this process will require the commitment of agencies and organizations at the state, regional, and national levels to aggressively move forward in the development of data and guidelines that can be applied to the improvement of trapping programs and that can be incorporated into programs of public and trapper education.

Acknowledgments

The work group wishes to thank the U.S. Fish and Wildlife Service Office of Federal Aid for financial support. We also want to thank our respective state wildlife agencies, the U.S. Department of Agriculture APHIS/ADC program, and the National Trappers Association for supporting the involvement of the group members in developing the information in this report. We would also like to express our appreciation to Ken Gruver, USDA/APHIS/ADC, Fort Collins who helped to compile information on trap testing for some of the species.

V. Summary of Existing Data on Trap Performance and Use

The work group reviewed existing literature on trap performance and use and summarized available information. A review of all of the trap literature by species is included in Appendix A. No data was found for trapping bassarisk or for swift and kit foxes. This section summarizes the general findings by species for the information contained in Appendix A. It will be used by the work group in the future to 1) determine whether information is adequate to proceed with BMP development without additional testing; and 2) determine the best performing traps for each species or species group.

A species by species summary of trap testing literature follows:

Arctic Fox. Two studies conducted in Canada have focused on Sauvageau 2001-8 (a killing trap) and the standard No. 1½ Victor coil spring foothold trap. Compound testing demonstrated that the Sauvageau trap quickly killed 9 of 9 foxes. Most foxes captured in the 1½ coil spring trap had only minor injuries when traps were checked daily. (Appendix A).

Badger. Limited research in the western United States indicates #1½ coil spring traps with unpadded, laminated, or padded jaws can be used to capture badgers with only minor injuries. Also, 78% of 45 badgers captured for telemetry research in Illinois using #3 Victor Soft Catch™ traps had no visible injuries. (Appendix A).

Beaver. Research in Canada, performed under controlled conditions, has shown that beaver can be killed in ≤6 minutes on land using standard Conibear 330 and modified (jaws bent inward) Conibear 280 and 330 traps. When captured underwater in locking snares or in drowning sets using #3 and #4 Victor foothold traps, beaver die in 5 to 10 minutes due to CO_2 narcosis or asphyxiation. Five beaver trapped underwater in modified Conibear 330 traps were killed in ≤9 minutes 15 seconds. Lab tests on anesthetized animals have determined the minimum energy forces required to cause death when delivered via a blow to the head, neck, thorax, abdomen, or chest. (Appendix A).

Bobcat. Research in the western United States and Michigan has shown that the No. 3 Victor Soft Catch is effective in capturing bobcats with minimal injuries compared to unpadded traps. Replacement of stock 1.75 springs on Soft Catch traps with No. 3 springs and modification of pans, linkage, and jaws reduced injury scores and improved trapping success. (Appendix A).

Coyote. More trap research has been conducted on coyotes than any other furbearer species. This research has focused primarily on comparing the rate and injuries associated with different trap types. Additionally, there has been work to evaluate pan tension systems, trap jaw modifications, swiveling systems, chain length, shock springs, and jaw closure speed. (Appendix A).

Much of the field testing was done in the western United States and Canada, with only a few studies in the East. Many of the trap studies compared the performance of the No. 3 Victor Soft Catch to other types of unpadded traps.

The most significant conclusion from these studies is that coyotes captured in padded traps have fewer and less severe injuries than those captured in unpadded traps. Reduction in injury is exemplified by fewer broken bones, cut tendons and ligaments, and periosteal abrasions. Recent research suggests that capture rates for padded traps are similar to those for unpadded models. Several types of pan tension devices have been evaluated on a variety of coyote traps and all have been effective in reducing nontarget captures. A summary of the major research findings on injury and capture rates for seven types of traps tested by USDA's National Wildlife Research Center is shown in Table 1:

Table 1. Summary of trap testing results for coyotes for seven traps tested by the USDA National Wildlife Research Center.

Trap Type	Test States	N[1]	Median Injury Score[2]	Capture Rate[3]
Sterling MJ600	CA,TX,ID	68	80.0	94
No. 3 Northwoods	CA,TX,ID	59	80.0	95
Victor 3NM	TX	33	60.0	95
Heimbrock Special	CA, TX	30	80.0	94
Standard No. 3 Soft Catch	CA,OR,NV,MT, WY,OK,NM,TX	53	15.0	95
Modified No, 3 Soft Catch	CA	60	15.0	97
No. 3½ EZ Grip	CA,TX,CO	65	10.0	88

[1] N = sample size for calculating injury score using ISO (International Organization for Standardization) Trauma Scale.
[2] Median score for trap related injuries, based on standardized point scale for injuries.
[3] Capture rate = percent of animals captured of potential captures (target animals captured plus identifiable escapes).

Fisher. Various killing traps have been evaluated for capturing fisher in Canada. Compound testing has shown that the Bionic trap cocked to 8 notches consistently kills fisher in <1 minute. The mechanical characteristics of modified (stronger springs) Conibear 220 and Sauvageau 2001-8 traps exceed the kill threshold established for fisher, but the standard Conibear 220 and AFK Kania traps do not. Double strikes (head/neck and thorax) with a modified Conibear 220 trap equipped with 280 springs killed 5 of 6 fishers (avg. time to unconsciousness = 51 ± 13 sec.). Cage traps were used to capture 35-95% of the fishers trapped annually in Massachusetts from 1980-1988. (Appendix A).

Gray Fox. Limited research has been done in the eastern United States comparing the standard No. 1½ Victor coil-spring with the No. 1½ Soft Catch. Results of these studies indicate no difference in capture efficiency between trap type and reduced injuries for foxes captured in padded traps. (Appendix A).

Gray Wolf. Wolf traps have been evaluated in Alaska, Minnesota, and Wisconsin. Custom-made No. 14 Newhouse long spring traps with offset, toothed jaws were effective and caused the least injuries compared to other trap types. Suggested methods for reducing injury included shortened chains, center-mounting of the chain, and the use of tranquilizer tabs. (Appendix A).

Lynx. Footsnares, foothold traps, and kill traps have been evaluated for capturing lynx in Canada. Compound testing has shown that the modified 330 Conibear can consistently kill lynx in ≤3 minutes. Modified Fremont footsnares caused less injury when compared to Soft Catch traps. (Appendix A).

Marten. Several studies have been conducted in Canada to evaluate the performance of killing traps for capturing marten. Compound testing has shown that the standard Conibear 110 and 120 traps fail to consistently kill marten in <5 minutes. In comparison, 13 of 14 marten caught in the C120 Magnum trap equipped with a pitchfork trigger had an average time to unconsciousness of ≤68 sec. Field tests indicated the C120 Magnum placed in elevated box sets was as efficient as foothold traps for harvesting marten. In Ontario, wire box traps and the Conibear 120 had similar selectivity, but box traps were less efficient. The most efficient and selective set for marten utilized a killing trap placed in a "Trapper's Box" on a horizontal pole. (Appendix A).

Mink. Research in Canada performed under controlled conditions has shown that mink can be killed in ≤3 minutes on land using the C120 Magnum trap with a pan trigger, the Bionic trap with a 6 cm bait cone, or the C180 trap with a pan trigger. However, terrestrial sets employing the standard Conibear 110 and 120 fail to consistently kill mink in <5 minutes. Lab tests on anesthetized animals have determined the minimum energy forces required to cause death when delivered via a blow to the head, neck, thorax, and abdomen. When captured in drowning sets using foothold traps, mink die in <4 minutes, but most wet drown. During field tests in British Columbia and Newfoundland, the C120 Magnum with a pan trigger was as efficient for capturing mink as the Conibear 120 and standard foothold traps. (Appendix A).

Muskrat. Muskrat traps have been evaluated in Louisiana, New Jersey, and Canada. Lab tests on anesthetized animals have determined the minimum energy forces required to cause death when delivered via a blow to the head, neck, thorax, and abdomen. Death occurs in ≤4 minutes if Conibear 110 traps are used underwater, but standard Conibear 110 and 120 traps fail to consistently kill muskrats in <5 minutes when used on land. Muskrats caught in modified (18 kg springs) Conibear 110 traps on land died in ≤3 minutes 20 seconds. Controlled experiments have shown muskrats taken in drowning sets using #1½ long spring traps die in ≤5 minutes 15 seconds, and about half have no injuries. A New Jersey field study determined the Victor #1 VG Stoploss with padded jaws caused significantly less damage to limbs of trapped muskrats compared to the unpadded #1 VG Stoploss; both traps captured and held muskrats equally well in drowning sets. Other studies have found that Conibear traps are usually more efficient and selective for harvesting muskrats than standard footholds. (Appendix A).

Nutria. Field tests have been conducted in Louisiana and Great Britain to evaluate the efficiency of nutria traps. In the marshes of Louisiana, the #1½ and #2 Victor long spring traps proved to be more efficient for capturing nutria than the Conibear 220. Also, 69-91% of the animals caught in foothold traps were alive at the time of trap check and could be released. In Great Britain, large cage traps set on rafts caught significantly more nutria and about half the number of non-target animals compared with those set on land. (Appendix A).

Opossum. Restraining traps for the opossum have been evaluated on a limited basis in the eastern United States, Washington, and Alabama. Research indicates: 1) no difference in efficiency between the #1½ Victor coil spring and the #1½ Victor Soft Catch, 2) significantly lower injury scores for opossums captured in padded foothold traps compared with unpadded models, and 3) offset jaws can reduce the frequency of bone fractures compared with non-offset versions. Several types of pan tension devices have been evaluated on a variety of coyote traps and all have been effective in reducing accidental opossum captures. Killing traps (e.g. Conibear 120 and 220) appear to be more efficient for capturing opossums when placed in boxes on the ground rather than above ground level. (Appendix A).

Raccoon. Killing and restraining traps for raccoons have been extensively researched in the United States and Canada. Controlled lab tests have been conducted on anesthetized animals to determine the minimum energy forces a killing trap must deliver to cause death via a blow to the head, neck, and chest. Also, limited data about the effects of clamping force have been obtained. (Appendix A).

Research on various killing traps conducted in enclosures indicates raccoons can not be consistently killed in <5 minutes using standard Conibear 220, 280 (with pan trigger), and 330 traps. However, about 60% of the animals captured in the 220 and 280 die in <4 minutes. Investigations on immobilized raccoons have shown that the Sauvageau 2001-8 and a modified (extra clamping bar) Conibear 280 have the potential to consistently render animals irreversibly unconscious in ≤4 minutes, but not in ≤3 minutes. In a separate lab study the average time to unconsciousness for 4 of 5 immobilized raccoons caught in the BMI™ 160 (a rotating-jaw trap similar to Conibear) was 172 ± 16 seconds; the remaining animal was euthanized after 5 minutes. The raccoon capture efficiency of the Conibear 220 may be comparable to or better than some restraining traps under certain environmental conditions, but in other instances it may not.

Results from 1 enclosure and 13 field studies of restraining traps for raccoons are available. This research has focused on comparing the capture rate and injuries associated with different trap types. The majority of the field testing was done in the eastern United States with only a few studies in the west and Canada.

Injury data from these investigations are difficult to compare because scoring systems have varied and several studies report only on injuries to the trapped limb. A significant conclusion has been that most of the serious injuries observed are due to self-mutilation. Results are somewhat mixed, but the available information indicates padded traps fail to preclude this behavior in raccoons and thus do not significantly reduce injury scores compared with unpadded traps. Padded traps also appear to be less efficient for capturing raccoons than unpadded versions. However, #1 size jaw traps (both padded and unpadded) do reduce the frequency of self-mutilation and are as efficient as comparable #1½ size models. Foot snares have been used to trap raccoons with some reduction in injuries, but their efficiency is significantly lower than standard foothold traps.

The only restraining trap tested to date that significantly reduces the frequency of self-mutilation and the severity of injuries to trapped raccoons compared with padded and unpadded jaw traps is the EGG™. The mean total injury score (based on a modified Olsen scale) assigned to raccoons caught in the EGG in an Illinois field study was 68 compared with 116 for those trapped with the #1 coil spring. The EGG has a raccoon capture efficiency which exceeds that of the unpadded #1 coil spring and at least equals that of box traps.

River Otter. Various restraining traps for the live-capture of otters have been evaluated in Newfoundland, Idaho, Minnesota, Louisiana, and the eastern United States. Capture success with Hancock traps has varied depending on the season and setting techniques. In Newfoundland, Bailey traps proved ineffective. A recent study compared unpadded Victor #11 double long spring and modified (heavier spring added) Victor #1½ Soft Catch traps for catching otters for relocation. Fewer severe injuries were noted in animals captured with the Soft Catch trap, but there was no difference in frequency or severity of dental injuries between trap types. No published research on killing traps for river otter is available. (Appendix A).

Red Fox. Numerous studies have been conducted in the United States, Canada, Sweden, and Australia to evaluate the performance of leghold traps and snares for capturing red fox under a variety of environmental conditions.

The No. 1½ Victor coil spring is the most common trap used to capture foxes in North America. Several studies have compared the performance of this trap to the No. 1½ Soft Catch. In general, the padded No. 1½ Soft Catch has proved to be as effective as its unpadded counterparts. Also, padded traps cause fewer and less serious injuries. Foot snares have proved to be effective devices for capturing foxes in the powder snow conditions of northern Sweden. Plastic footsnares were also effective in reducing trap-relate injuries. Limited testing of power snares indicates that foxes can be rendered unconscious within six minutes. (Appendix A).

Striped Skunk. Three studies (2 in the United States and 1 in Canada) indicate leg injuries to striped skunks captured in standard and padded foothold traps are extensive due to a high frequency of self-mutilation. A field study in Ontario revealed skunks can be captured with few injuries using the Novak foot snare, but this trap has a low capture rate and an unacceptable level of efficiency. Several types of pan tension devices have been evaluated on a variety of coyote traps and all have been effective in reducing accidental skunk captures. (Appendix A).

Weasel. Research data on traps commonly used for harvesting weasels in North America are not available. One killing trap (the Fenn) has been used successfully to capture weasels in New Zealand. (Appendix A).

Wolverine. Only one study is published on a technique for capturing wolverines. This study evaluated the log traps which captured 12 Idaho wolverines with no reported injuries. (Appendix A).

VI. Priority species and trapping systems for research and testing

The trap testing needs for twenty-three species of furbearers were prioritized and assessed, considering criteria for the species such as: 1) the type and proportion of trapping systems predominantly used; 2) the total harvest in this country; 3) the importance to trappers; 4) the amount and type of economic damage caused; 5) the urgency and opportunity for additional work from the biologists' perspective; and 6) and the availability and quality of data from past trap research programs.

First, a systematic approach to ranking furbearer species' priority for trap research was used that incorporated some of the variables suggested by Todd (1987), as further developed by the FRTS (Table 2.). This process required the relative ranking and scoring of these criteria using available data and professional judgements. These sources of data included the trap use and ownership study from 1992, the fur harvest summaries compiled annually by the FRTS, data collected by the FRTS regarding furbearer nuisance and damage problems, and the assessment of existing data on trap performance.

These species were then placed in one of three priority categories: high, medium, and low, based on their relative rankings and the need to accomplish critical research in the next three to five years (Table 3.).

The relative sense of urgency or opportunity to accomplish this research was based on several considerations, such as whether or not the species was listed on the EU fur regulation, the amount of environmental damage at risk if the species is not controlled in the future, and whether the trapping systems currently used are particularly troublesome due to unique habitat conditions, or where it appears that a superior trap is now widely available. For example, the relative ranking for pine marten was relatively low based on scores alone, but because a widely available killing trap appears to be at least as efficient and likely more humane, the committee felt that immediate testing was necessary prior to making the recommendation in a BMP. Species that received high marks for urgency or opportunity include raccoon, nutria, gray fox, beaver, mink, wolf, pine marten, swift fox, and fisher. Also, the committee gave additional weight to species that had very little existing data on trap performance. For this reason, nutria, opossum, muskrat, striped skunk, gray fox, mink, fisher, bassarisk, wolverine, and weasel were given extra consideration.

This prioritized list of trap research needs for the United States along with existing information on performance of traps will be used to identify gaps in trapping data for the various regions and for specific traps, especially new technology.

Table 2. Priority rankings based only on composite species scores (CSS) using a variation of the method developed by Todd (1987). CSS scores were calculated from data on type of traps most commonly used (system), total harvest, trapper preference (presumed to be based on a combination of pelt value, abundance, ease of capture), and amount of damage to property and the need for damage control.

Priority	Species	Trapping System [1]	Total Harvest [2]	Trapper Preference [3]	Damage [4]	Composite Species Score (CSS) [5]
1	Raccoon	4	5	5	5	19
2	Coyote	5	4	4	5	18
3	Fox, Red	5	4	5	3	17
4	Nutria	5	5	2	4	16
5	Opossum	4	5	3	3	15
6	Muskrat	1	5	5	4	15
7	Beaver	1	4	4	5	14
8	Bobcat	5	3	4	2	14
9	Fox, Gray	5	4	4	1	14
10	Skunk	5	3	2	4	14
11	Mink	3	4	5	1	13
12	Badger	5	3	2	2	12
13	Marten	3	3	3	1	10
14	Bassarisk	5	3	1	1	10
15	Wolf	5	1	2	2	10
16	Otter	3	2	3	2	10
17	Lynx	5	2	2	1	10
18	Fox, Swift/Kit	5	2	1	1	9
19	Fisher	3	2	3	1	9
20	Fox, Arctic	5	1	1	1	8
21	Wolverine	3	1	2	1	7
22	Weasel	1	2	1	1	5

[1] "Trapping System" ratings (on a 5-point scale) were from: 1 = primarily captured in killing or submersion sets, up to: 5 = primarily captured in standard leghold traps on land, based on the judgement of the IAFWA Fur Resources Technical Subcommittee

[2] "Harvest" = ranking of total U.S. harvest for 1976-77, 1981-82, 1986-87, and 1991-92, where 1 = lowest harvest and 5 = highest harvest

[3] "Trapper Preference" = % of trappers listing species as one of four most important (1 = 0%; 2 = >0<5%; 3 = >5<20%; 4 = >20<30%; 5 = > 30%)

[4] "Damage" = ranking of relative damage to property as judged by IAFWA Fur Resources Technical Subcommittee on a 5-point scale, with 1 = lowest damage and 5 = greatest damage

[5] "Composite Species Score" (CSS) based on a method described by Todd (1987). In this exercise, all criteria were given equal weight in calculating the composite score.

Table 3. Recommended trap testing priorities from the trapping work group based on the CSS scores summarized in Table 1, and on a more subjective analysis by the work group of the amount and quality of existing data and the urgency or opportunity for additional work.

Recommended Trap Testing Priorities, by Species		
High Priority	**Medium Priority**	**Low Priority**
Raccoon	Beaver	Canada Lynx
Coyote	Bobcat	Bassarisk (Ring-tailed Cat)
Red Fox	Opossum	Arctic Fox
Nutria	Striped Skunk	Wolverine
Muskrat	Gray Wolf	Weasels
Gray Fox	Badger	
Mink	River Otter	
Pine Marten	Swift/Kit Fox	
	Fisher	

VII. Recommended trap testing protocols

The work group recognized the need to recommend appropriate and consistent trap testing protocols so that results of trap testing would be scientifically and statistically valid, as well as directly comparable from study to study.

After reviewing trap testing protocols proposed by the International Organization for Standardization (ISO), the Canadian General Standards Board (CGSB), and the EU/Canada/Russia/United States quadrilateral process, the work group recommends that the ISO approach (which is the basis for the other efforts) be followed by those testing traps in the U.S.

The ISO standards for trap testing are currently Draft International Standards in the form of approved Committee Drafts (CDs). ISO/CD 10990-5, entitled *Animal (Mammal) Traps - Part 5. Methods for Testing Restraining Traps*, is a standard to provide test methods for performance evaluation of restraining traps in the areas of animal welfare, capture efficiency, selectivity, and user safety. ISO/CD 10990-4, entitled *Animal (Mammal) Traps - Part 4. Methods for Testing Killing Traps*, is a similar document relating to killing traps.

Both documents have been approved by consensus by the 15 Participating countries involved in this standard, including the U.S., and will be circulated for review and approval by all member countries of ISO later this year.

These documents set forth appropriate trap testing protocols to ensure uniformity throughout the world in how animal trap performance is tested for capture efficiency, selectivity, user safety, and animal welfare. The testing protocols include standard definitions, sampling and replication guidelines, laboratory and field testing procedures, pathological examination procedures, selectivity testing, capture efficiency testing, user safety evaluation, and standardized reporting formats.

Threshold values are not identified in an ISO Testing Methodology Standard. However, informative scales related to physical trauma are included in these Committee Drafts as examples of scientifically measurable criteria that might be useful to those involved with trap testing.

These ISO CDs have considerable support from the nations involved in this work. It is expected that these CDs will be approved by ISO in 1997.

VIII. Public education needs and strategies: Summary

The trapping work group discussed public knowledge and understanding of trapping programs and how problems of the public's lack of knowledge, misconceptions, and misinformation could be addressed. The discussion was facilitated by Brian Hay of Paragon Corporation, a Reputation Management Consultant based in Toronto, Ontario, who has had considerable experience with this issue. Following is a brief summary of that discussion:

Demographic population changes within the United States since the Second World War, including increasing urbanization, have resulted in less direct personal contact and experience with the land for an increasing majority of American residents. This has translated into a lack of understanding and appreciation of natural habitats and of rural lifestyles, including trapping, hunting, and fishing.

Lack of public awareness, appreciation, or understanding of natural habitats and wildlife populations, and of the encroachment of humanity on wild areas and encounters with resurging populations of many wild animal species, have contributed to public misunderstanding of trapping as a management tool. Increased distancing of human populations from a direct and visible reliance on "the land" have also reduced public understanding of trapping as a lifestyle choice or an economic contribution to many rural families or those who retain close ties to the land.

In addition, there has been a dramatic change in the role of government agencies regarding the decisions made about the use of natural resources. No longer are agencies able to use scientific/practical experience alone to justify decisions, especially those that increase public access to and use of wildlife populations. In the public arena, input from the public has become nearly as important in the decision-making process on some issues as professional expertise. In some states with initiative petition processes, the authority of wildlife agencies has been completely usurped at the ballot box, completely by-passing the traditional role of government agencies.

Given the importance of trapping to management programs and to individuals, it is appropriate and necessary to increase the level of public understanding of wildlife populations and habitats, wildlife interactions with human populations, outdoor lifestyles, and the role and utilization of hunting and trapping therein. The work group will work with other committees of the IAFWA, as well as other agencies and organizations with an interest in wildlife management, to achieve this goal.

A program of information and education must be developed to reach key audiences within the general population. There is no integrated plan by government agencies to provide timely, useful, accurate public information and education on fur resource or wildlife management and use issues. Opinions and knowledge of key publics must be assessed on a regular basis to monitor changes and measure effectiveness of programs and messages. Key audiences must be identified, and their interests, positions and concerns defined, addressed, and monitored. Key themes and messages need to be developed for each audience group.

Selected agency and organization personnel should be provided with effective media and public communications training. Results of research and BMP development efforts should be included as available in communications materials. The program should use synergy with other related programs to multiply benefits and increase effectiveness while reducing costs.

IX. Next steps

Trapping programs continue to be essential wildlife management tools in most countries of the world. This includes the U. S., but also includes Europe where much of the opposition to trapping is strongest, yet where considerable trapping is done to control damage to agriculture, and to dikes, dams and water control structures

Management agencies and trappers must be responsible about addressing legitimate issues involving the welfare of captured animals wherever possible, and must be willing to develop and adopt scientifically proven improvements in trapping devices and methods. Unless management agencies quickly take the initiative to advance the understanding and application of improvements in trapping, national and world opinion will result in actions that take away the opportunity and the option to use these important tools in management programs.

Specific recommendations from the work group include:

1) **Aggressively pursue the highest priority trap testing**, by species, to scientifically establish what methods and devices will and will not be effective, efficient, safe, and selective while improving the welfare of trapped animals;

2) **Begin immediately to use the best available information and the results of testing to develop a set of trapping Best Management Practices (BMPs)** that can be regionally adapted to the diversity of species, climate, and terrain present in this country;

3) **Facilitate the understanding and adoption of BMPs by members of the public who use traps** so that the welfare of animals captured in trapping programs is improved while human safety, trapping efficiency, and selectivity are also maintainde; and

4) **Effectively involve, communicate with, and educate the public** so that information and cultural gaps are identified and a more thorough understanding and acceptance of trapping is developed.

Effective accomplishment of these recommendations will require a significant commitment of financial and human resources; they cannot be accomplished by any individual state or federal agency alone. The Technical Subcommittee and Trapping Work Group intend to pursue options to form partnerships and to develop financial support for pursuing these recommendations.

Literature Cited (see Appendix for trap testing literature cited)

Todd, A.W. 1987. A method of prioritizing furbearer species for research and development in humane capture methods as applied in Canada. Wildl. Soc. Bull. 15:372-380

Appendix A

Summary of Trap Research and

Testing Data, by Species

TRAP RESEARCH AND PERFORMANCE DATA SUMMARY

ARCTIC FOX *(Alopex lagopus)* *December 2, 1996*

Reference	Trap	Results
Proulx et al. (1993)	Sauvageau 2001-8	Compound testing at Vegreville testing facility. The Sauvageau 2001-8 rotating jaw trap set in a portable 3-sided wire mesh cubby quickly killed 9 of 9 arctic foxes. Average times to loss of consciousness and heartbeat were estimated at <73.4 and 213.6 seconds, respectively. These averages did not differ ($P>0.05$) from those of the preselection tests.
Proulx et al. (1994)	1½ Victor Sauvageau 2001-8	Field test on 2 traplines in Northwest Territories. Sixty-two arctic foxes were captured and killed in the Sauvageau 2001-8 using a baited trigger; all animals received head/neck strikes; trap judged to be humane. One hundred fifty-five foxes were captured on traplines using the 1½ Victor foothold trap. On traplines visited an average of 1.4 days, most foxes were held with only minor injuries. On traplines visited at an average interval of 8 days, 21 of 53 animals had injury scores >50. On daily check the No. 1½ was found to be humane and more successful than the Sauvageau trap.

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IAFWA - FRTS
TRAP RESEARCH AND PERFORMANCE DATA SUMMARY

BADGER *(Taxidea taxus)* *February 14, 1997*

Reference	Trap	Results
Kern et al. (1994)	Victor #1½ Coil Spring (CS); plus 3 prototypes: Victor #1½ with laminated jaws Butera #1½ with offset jaws Victor #1½ with padded jaws	Field study in Wyoming. The median Olsen injury scale scores for the offset jaw trap (5.0, n=6), laminated jaw trap (5.0, n=6), padded jaw trap (5.0, n=4), and standard trap (7.5, n=8) were not significantly different (P=0.40).
Warner, R. (Univ. of Illinois, Urbana, unpubl. data)	Victor #3 Soft Catch	Field study in Illinois. No injuries observed for 78% of badgers (n=45)captured for radio-telemetry study. Injuries recorded in other 22% were minor (claw loss, edema, small lacerations, etc.).

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Prepared by: George Hubert, Jr., Illinois DNR

BEAVER *(Castor canadensis)* *February 14, 1997*

Reference	Trap	Results
Novak (1975)	Carbon monoxide (CO)	Lab test. CO not effective; adverse reactions.
Gilbert (1976)	Simulated "Killing"	Lab tests on anesthetized beavers (n=6) to determine the minimum energy forces necessary to cause immediate death when delivered to the neck. Threshold value = 805 cm kg for a neck blow. The threshold value for a chest strike was 780 cm kg(n=10). No clamping force applied.
Gilbert (1981)	#3 Victor Double Long Spring #4 Victor Double Long Spring	Lab test. Evidence suggested death due to CO_2 narcosis (n=25). Isoelectric EEG at 9 min. 30 sec.
Novak (1981)	1/16" locking snare w/ 10"dia. loop Mohawk (large) Conibear 220, 280, 330 #4 Victor Double Long Spring	Controlled field test in Ontario. Beaver (n=8) died in 5.5 to 10.5 minutes when caught in underwater locking snares. Death occurred in 7.5 to 9.0 minutes in drowning sets using #4 Victor DLS (n=5). Five beaver captured in modified Conibear 330 were killed in 7.0 to 9.25 minutes in underwater sets. All 4 beaver trapped with large Mohawk escaped from trap. When used in land sets, Conibear 330 killed beaver in 2.5 to 5.5 minutes (n=6), but only 3/5 beavers caught in Conibear 220 died in 3.0 to 5.3 minutes (2/5 were released). Beaver (n=6) caught in modified (jaws bent inward) Conibear 330 traps on land were killed in 1.0 to 5.5 minutes. Three beaver caught in land sets with modified Conibear 280 traps that had pan triggers were killed in 2.0 to 6.1 minutes. Recommended all Conibear traps should have jaws bent inward and be supplied with safety releases.

Gilbert and Gofton (1982)	#3 Victor Double Long Spring #4 Victor Double Long Spring	Controlled lab tests in aquatic tank using a drowning set. The average time to cessation of struggling was 8 min. 11 sec. (n=20); EEG loss occurred in an average of 9 min. 11 sec. (n=16). EKG loss took place after an average of 16 min. 27 sec. (n=14). Death occurred due to anoxia (asphyxiation).
Zelin et al. (1983)	Simulated "Killing"	Controlled lab tests on anesthetized animals; determined mean kill thresholds using 335-g striking bar; 10-minute time to death test period employed. With no holding force, the thresholds for head (n=8), neck (n=6), and thorax (n=8) hits of beavers were 3.7, 3.0, and 5.9 kg.m/sec, respectively. For abdominal hits of beaver, the impact momentum required to kill the animals (n=3) was beyond the capability of the test equipment (>13.9 kg.m/sec).

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Prepared by: George Hubert, Jr., Illinois DNR

BOBCAT *(Felis rufus)* *December 2, 1996* *Page 1 of 2*

Reference	Trap	Results
Linscombe and Wright (1988)	No. 1½ Victor padded No. 1½ standard coil spring	This was part of a 9-state study to compare the capture efficiency of padded jaw foothold traps with standard steel jaw traps. Thirty-nine bobcats were captured during this study. The No. 1½ Victor "fox" trap caught fewer bobcats ($P<0.01$) than the standard unpadded model.
Olsen et al. (1988)	No. 1½ Victor padded No. 1½ standard coil spring No. 3 Victor Soft Catch No. 3 Victor coil spring	Necropsies were performed on 59 bobcats as part of the 9-state trap study. Seven bobcats were caught in the "fox" padded trap and 14 in standard traps. There was no difference in the level of injury between trap types. Bobcats captured with the No. 3 Victor Soft Catch in the western United States had less leg damage than those captured in unpadded traps; only 13% had injuries that scored $\geq$ 50 points. Twenty-four percent captured in the No. 3 standard trap (No. 3 coil spring) had $\geq$ 50 points damage.
Earle et al. (1996)	No. 3 Victor Soft Catch (standard & modified)	One hundred twenty-six bobcat (*Felis rufus*) were live-trapped in Roscommon County, Michigan, during the period 1991-95 using standard and modified No. 3 Victor Soft Catch traps. Injuries were described in detail when each bobcat was handled and an injury score was assigned based on the most severe injury. Bobcats caught in double coil spring traps were injured more frequently and severely than those held in standard Soft Catch traps ($P<0.05$). Replacement of stock 1.75 springs on Soft Catch traps with No. 3 springs and modification of the pans, linkage, and jaws reduced injury scores and improved trapping success.

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Reference	Trap	Results
Linhart et al (1981)	No. 3 Victor NM	Two hundred sixty-seven coyotes were captured in Texas, New Mexico, and Nevada using Victor 3NM traps affixed with tranquilizer tabs containing propiopromazine HCl, or a mixture of propiopromazine HCl and chlordiazepoxide HCl. Foot injuries were reduced up to 90% when compared to 41 control coyotes captured in the same trap type in which no tranquilizer tabs were used. Sixty-two coyotes captured in traps with shortened chains or chains with coil springs did not reduce foot injury when compared to 21 coyotes captured in unmodified traps. While the pan tension testing was incomplete at the time of this writing, nearly 90% of the gray fox, swift fox, striped skunks, opossums, and jackrabbits were excluded as compared with an average of 24% exclusion rate for standard traps.
Novak (1981)	Novak leg snare No. 4 Victor long spring No. 2 Victor coil spring	The Novak footsnare was compared with 2 types of leghold traps under field conditions in southern Ontario. No differences were found between the 2 traps in frequency in which animals discharged traps, capture rate, and escape rate. Eight coyotes were captured in the footsnare and 1 in a leghold trap. Two percent of all animals captured in the legsnare sustained injuries, compared to 52% of all animals captured in leghold traps.
Saunders and Rowsell (1984)	No. 1 coil spring padded No. 1 coil spring unpadded No. 3 coil spring padded No. 3 coil spring unpadded	Padded and unpadded traps were tested on 25 coyotes captured in British Columbia during autumn and winter. X-ray analysis and post mortem examination of trapped limbs were conducted and foot damage was assessed and compared to other studies. Results indicate padded traps reduce physical injury by 80-85% compared to unpadded traps used during Canadian trapping conditions.

Turkowski et al (1984)	No. 3Victor NM	Data was collected on the numbers of coyotes and nontarget animals that stepped on standard traps and traps equipped with shear-pin, curved leaf spring, or steel tape tension devices and were captured or excluded. Exclusion rates for designated nontarget animals were 92, 100, 95, and 6% for shear-pin, leaf spring, steel tape, and standard traps, respectively. Coyote capture rates were 87, 92, 84, and 98% for shear-pin, leaf spring, steel tape, and standard traps respectively. The pan tension devices functioned adequately for use in coyote trapping activities.
Linhart et al (1986)	No. 3 Victor NM No. 3 Victor NR No. 3 Victor OS coil spring No. 3 Victor NR padded jaw	Six trappers caught 111 coyotes from Colorado, Idaho, Nebraska, Nevada ,New Mexico, and Oklahoma during this study. The catch rate for unpadded traps was higher than for either the padded No.3 Victor NR or the Soft Catch. Unpadded traps sprung more frequently than padded traps when coyotes stepped on trap pans. More coyotes pulled out of padded 3NR traps (12.3%) and Soft Catch traps (15.7%) than unpadded traps (12.3%), and the number of toe-caught coyotes was higher for the padded 3 NR (18.2%) than for the Soft Catch (5.9%) or unpadded traps (4.5%). While the padded-jaw traps were somewhat less efficient, they were able to capture and hold coyotes under moderate trapping conditions.
Olsen et al (1986)	No. 3 Victor NR No. 3 Victor NR padded-91 cm chain No. 3 Victor NR padded-15 cm chain No. 3 Victor Soft Catch	Twenty coyotes were captured in each type of device in eastern Colorado and south Texas during this study. Traps were checked every 24 hours, but coyotes were left in traps until the following day to simulate a maximum time period under a 48-hour trap law. Coyotes caught in unpadded traps had more injuries than legs from coyotes taken in 3 types of padded-jaw traps. Tendon or ligament damage occurred in 95% of legs from unpadded traps. Coyotes caught in the unpadded Victor 3NR had a 91% fracture rate. Tendon and ligament damage occurred in only 5 (30%) and fractures in only 15 (25%) of the legs from padded-jaw traps. No statistical differences in extent of leg injury were found among the 3 types of padded foothold traps, but injuries were reduced by 71% with the padded traps compared to the unpadded traps.

Linhart et al (1988)	No. 3 Victor Soft Catch No. 1.75 Victor Soft Catch No. 3 Victor NR padded No. 3 Victor NM	Eighty coyotes were captured in California, Colorado, Nevada, New Mexico, Oklahoma and Texas during this study. Coyotes taken in padded traps, sustained less injury than those taken in unpadded traps. The Soft Catch trap with the stronger size No. 3 springs had a significantly lower injury score than the same trap with smaller 1.75 springs. Both Soft Catch traps caused less injury than padded long-spring traps. The 3NM trap with unpadded malleable jaws caused less injury than the unpadded 3NR having stamped jaws. Data showed that the use of padded traps resulted in lower capture efficacy, but significantly reduced injury to captured animals.
Linscombe and Wright (1988)	No. 3 Victor coil spring No. 3 Victor Soft Catch No. 1 ½ Victor coil spring No. 1 ½ Victor Soft Catch	Fifty-one trappers from Georgia, Louisiana, Minnesota, Mississippi, New York, and Texas participated in this study. Fifty-three coyotes were captured in the No. 3 Soft Catch and 100 were captured in the No. 3 coil spring. This study found that padded traps might be expected to catch about 66% of the coyotes that could be captured with standard traps.
Olsen et al (1988)	No. 3 Victor Soft Catch No. 3 Victor standard coil spring	Sixty-seven coyotes were caught in Arizona, Georgia, Idaho, Kansas, Louisiana, and Texas. The difference in injuries associated with trap types was striking for coyotes; 53% had >50 point damage with the standard trap, while only 16% had this much damage with the padded trap. Results indicated that padded jaw traps can substantially reduce limb injuries to coyotes when compared to injuries from standard foothold traps.

Skinner and Todd (1990)	No. 3 Victor standard coil spring No. 3 Victor Soft Catch Novak footsnare Fremont footsnare	Ninety coyotes were captured during a 2 year study in the agricultural lands of Alberta. The proportion of sets approached by coyotes differed among the devices. The number of coyotes approaching sets was highest for padded traps (53% of 314), intermediate for unpadded traps (45% of 358), and lowest for the 2 footsnares (40% of 257 and 42% of 294 for the Novak and Fremont, respectively). Capture efficiency of foothold traps was 3 times ($P<0.001$) that of the footsnares (4.3 vs.1.5 / 1000 TN)($P>0.30$ in all cases) . Capture rates were higher ($P<0.001$) for foothold traps than footsnares, however, capture rates were similar between types of foothold traps and types of foot snares (9-11 / 1000 TN). In this study, the foothold trap was found to be superior to footsnares in terms of performance.
Onderka et al (1990)	No. 3 Victor standard coil spring No. 3 Victor Soft Catch Novak footsnare Fremont footsnare	Eighty-two coyotes were captured during winter conditions in Alberta, Canada. Maceration of soft tissue occurred far less frequently in coyotes taken in Fremont snares (25%) and padded traps (21%), than unpadded traps (60%) and Novak snares (80%). Limbs of coyotes captured in the Fremont snare or padded trap were never fractured, but fractures commonly occurred in the Novak snare (50%) and unpadded trap (48%). This study showed that padded foothold traps reduce limb injuries. Fremont snares caused minimal injuries, but injuries produced by the Novak snare were similar to those of the unpadded foothold trap.
Phillips et al (1990)	Hopkins S hook Pederson fastener pin Lucero hand crimped Gregerson leg snare Gregerson neck snare McKinney notched lock	Seven types of breakaway snares were evaluated for breaking strength and variability using a universal testing machine. Maximum tension before breakage for individual snares ranged from 142 to 486 pounds. Sheet metal lock which ripped out, and S-hooks which straightened, provided the least variable results. Coyotes, mule deer, domestic calves and lambs were tested to determine the tension loads they applied to snares.

Goodrich (1991)	No. 3 Victor Soft Catch	Five coyotes were captured and then recaptured 6 more times and all trap related injuries were noted. All injuries to coyotes were considered minor.
Linhart and Dasch (1992)	No. 3 Victor NM No. 3 Victor coil spring No. 3 Victor Soft Catch	Sixty-three coyotes were captured during this study in south Texas. Capture rates did not differ among long-spring, coil-spring and Soft Catch traps. Capture rate for the 3NM was 83% while the Soft Catch trap was 79%. Results indicated that the fourth generation Soft Catch trap was improved from previous studies.
Phillips et al (1992)	No. 3 Victor Soft Catch No. 3 Victor NM No. 4 Newhouse	Sixty-one coyotes were captured in south Texas during this study. Little difference was noted in the capture rates among the 3 trap types. In 52 of 60 instances, trap jaws were positioned above the foot pads. Soft Catch traps caused the least visible injury. The 3NM caused the most evident foot injury with 80% of the animals having moderate to severe injuries. The Newhouse was intermediate with 55% of the animals having slight or no visible injury and 45% having moderate to severe injury. Pan tension devices on all traps were successful in excluding most of the small nontarget species.
Houben et al (1993)	No. 3 Victor Soft Catch No. 3 Northwoods coil spring	Legs from 20 coyotes captured in Mississippi were examined and there was no significant difference in mean scores between limbs of coyotes held in modified Soft Catch and laminated Northwoods traps. Results indicate that laminated Northwoods traps substantially reduce limb injury to coyotes (n=10) compared to other types of unpadded traps. Data also suggest that increasing the spring tension in the Victor padded coil spring trap can be done without increasing the injury rate.
Kern et al (1994)	No. 1 ½ Victor coil spring No. 1 ½ Victor laminated No. 1 ½ Butera offset No. 1 ½ Victor Soft Catch	Twenty-five coyotes were caught in northeastern Wyoming and southwestern Montana. Traps were evaluated for the potential of passing the draft ISO trap standards. All traps had similar efficiency and catch rate, except for Soft Catch traps on one trapline where more precipitation and heavier soil types were present.

Hubert et al (1996)	No. 3 Bridger standard coil spring No. 3 Bridger modified coil spring	Forty-eight coyotes were captured in Illinois using standard No. 3 Bridger coil-spring traps and the same trap modified with laminated jaws. The standard No. 3 Bridger trap was modified with offset, laminated jaws, 2 additional coil springs, and center-mount chain. Whole bodied necropsies were performed on captured coyotes. The mean total (whole body) injury score for the standard trap was 97 (n=19) compared with 80 for the modified trap (n=29). The total (whole body), trapped limb only, and oral injury scores assigned to coyotes captured in the standard trap failed to differ from those trapped in the modified traps. Minor injuries totaling <50 points were observed in approximately one-half of the animals examined. Most coyotes (85%) showed no oral injuries. The frequency of oral injuries and the proportion of coyotes with serious and severe injuries also failed to differ between trap types.
Phillips (1996)	DWRC neck snare Gregerson neck snare Kelley neck snare	Three hundred seventy-four coyotes, 91 deer, and 6 domestic cows were captured in 3 types of snares in Montana, North Dakota, and South Dakota. Capture rates were 87% for the Gregerson, 89% for the DWRC and 97% for the Kelley snare. The Kelley, DWRC, and Gregerson snares released 67, 48, and 30% of the captured deer. All domestic cows were captured in the DWRC snares and successfully escaped. This study suggests that snare locks can be developed to hold all coyotes and release nearly all livestock.
Gruver et al (1996)	No. 3 Victor Soft Catch No. 3 Victor modified Soft Catch	Leg injuries of coyotes captured in standard No. 3 Soft Catch traps were compared with those captured in the same trap type modified with 2 additional coil springs. One hundred-thirteen coyotes were trapped in southern California, 53 in standard traps and 60 in modified traps. Observed injuries were similar in both trap types. Most frequent injuries were edematous hemorrhages and small cutaneous lacerations. Injuries, such as joint luxation and bone fractures, were noted more frequently for coyotes trapped in standard Soft Catch traps.

Phillips et al (1996)	Sterling MJ600 No. 3 Northwoods laminated No. 3 ½ E Z Grip padded	One hundred ninety-two coyotes were captured by 9 experienced trappers in California, Colorado, Idaho and Texas. Some level of edematous swelling was noted on nearly all the legs (95%) with no apparent difference among trap types. Lacerations were observed in 87% of the legs from unpadded traps while only 31% of the coyotes captured in the E Z Grip received cuts. A higher frequency of more serious injuries were noted in the 2 unpadded traps. Even though the E Z Grip padded trap was much larger and stronger than the No. 3 Victor Soft Catch , injury patterns observed appeared to be similar for the 2 traps.
Phillips and Gruver (1996)	No. 3 Victor Soft Catch No. 3 Victor NM No. 4 Newhouse	Three types of traps were equipped with Paws-I-Trip (PIT) pan tension devices and tested in California, Idaho, Montana, Nevada, North Dakota, Oklahoma, Oregon, and Texas. Eight hundred twenty-six nontarget animals and 902 coyotes visited the PIT-equipped traps resulting in the capture of 22 nontargets. The PIT pan tension device used on 3 types of coyote traps effectively reduced nontarget captures without adversely affecting performance of the traps for capturing coyotes. Because of a high rate of exclusion of nontargets, more traps were functional for coyotes and the trapline efficiency increased.
Phillips and Mullis (1996)	No. 3 Victor Soft Catch No. 4 Newhouse No. 3 Victor NM Sterling MJ600	Four hundred-twelve coyotes were caught in California, Montana, Nevada, New Mexico, Oklahoma, Oregon, and Wyoming. Capture rates ranged from 83% in the Newhouse to 100% in the Sterling MJ600. This study found that the No. 3 Victor Soft Catch trap was as effective as other unpadded traps used for capturing coyotes under a variety of field conditions.

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TRAP RESEARCH AND PERFORMANCE DATA SUMMARY

FISHER *(Martes pennanti)* *February 18, 1997*

Reference	Trap	Results
Gilbert (1981)	Conibear 220 Gabry Bionic	Compound test in Ontario. Approach tests showed fisher could be effectively trapped with Conibear 220 in baited cubby sets when bait was tied to pronged trigger. Fisher also well-positioned by Gabry, but strike would be on forepart of skull.
Proulx (1990)	Conibear 220 Sauvageau 2001-8 Modified Conibear 220 AFK Kania	Lab test in Alberta. Mechanical characteristics of Sauvageau 2001-8 and Conibear 220 with 330 springs exceeded kill threshold for fisher. AFK Kania and Conibear 220 did not.
Mahaney et al. (1991)	Cage	Field data from Massachusetts. Cage traps used to harvest ca. 35-95% of the fishers trapped annually from 1980-1988.
Proulx and Barrett (1993a)	Modified Conibear 220	Compound test in Alberta using Conibear 220 with 330 springs. When equipped with a pan trigger, this trap killed 4 of 6 fisher (avg. time to unconsciousness [ATTU] = 107 sec $\pm$ 12 sec) via a double strike. Single strikes from the same trap killed 5 of 5 fisher (ATTU = 11 $\pm$ 4 sec). Also, 5 of 6 fisher killed by double strike (head/neck and thorax) with Conibear 220 with 280 springs (ATTU = 51 $\pm$ 13 sec).
Proulx and Barrett (1993b)	Bionic	Compound test in Alberta using Bionic trap with 10 cm bait cone. Trap killed 9 of 9 fisher when cocked to 8 notches (avg. time to unconsciousness [ATTU] = $\leq$ 55 sec). When cocked to 7 notches and set on a tree, 5 of 6 fisher killed (ATTU = $\leq$ 65 sec).

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Prepared by: George Hubert, Jr., Illinois DNR

GRAY FOX *(Urocyon cinereoarenteus)* *December 2, 1996*

Reference	Trap	Results
Berchielli and Tullar (1980)	No. 1½ Victor double coil Ezyonem leg snare	Field study conducted in New York state to compare efficiency of No. 1½ coil spring trap with the Ezyonem leg snare. Thirteen gray foxes were captured in the 1½ coil spring versus 1 in the leg snare. There was no significant difference between the 2 devices in the incidence of trap related injuries. However, the leg snare was significantly less effective in capturing foxes than the leg-gripping trap.
Tullar (1984)	No. 1½ Victor soft catch No. 1½ Victor standard coil spring	Field study conducted in New York state comparing efficiency and leg injuries of padded and unpadded No. 1½ coil spring traps. Seventeen foxes were captured (species were not separated). Padded traps caused less damage to trapped feet and were not significantly different in terms of capture efficiency.
Linscombe and Wright (1988)	No. 1½ Victor soft catch No. 1½ Victor standard coil spring	This was part of a 9-state field study to compare the capture efficiency of padded jaw foothold traps with standard steel jaw traps. One hundred eight gray fox were captured. No difference was found between the numbers of foxes caught in different trap types ($P>0.70$).
Olsen et al. (1988)	No. 1½ Victor soft catch No. 1½ Victor standard coil spring	Necropsies were performed on 65 gray foxes taken during 9-state study. Thirty-three percent of the gray foxes caught in padded traps had $\geq$ 50 points damage, while 61% of those caught in standard traps had this much or more damage.

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Reference	Trap	Results
Van Ballenberghe (1984)	No. 3 Newhouse long spring No. 4 Newhouse long spring No. 14 Newhouse (with teeth and offset jaws) Aldrich foot snare	Comparisons of injuries in wolves caught by trapping and helicopter darting in Alaska and Minnesota were made. Wolves were trapped with foothold traps (No. 3 or 4 double longspring, No. 14 double longspring with teeth and offset jaws), foot snares, and leg snares: injuries were rated from minor (class I) to severe (class IV). No distinction between foothold trap types was made in the injury data due to small sample sizes. Class III and IV injuries occurred in 41% of 109 foothold trap captures; severe injuries were seen in 11% of all captures. Tooth, lip, and gum injuries occurred in 46% of the wolves caught in foothold traps. No class III or IV injuries or oral damage resulted from foot snares (n=14). Small sample sizes precluded a comparison of injuries caused by snares and foothold traps. Suggested methods of reducing damage include shortened chains, center-mounting of the chain, and the use of drug trap tabs.
Kuehn et al. (1986)	No. 4 Newhouse (smooth jaws) No. 4 Newhouse (smooth jaws, offset) No. 4 Newhouse (tooth jaws, offset) No. 4 Newhouse (tooth jaws, custom)	During 1968-85, 375 adult gray wolves and 175 juvenile wolves were captured in northern Minnesota for radio-telemetry studies. Gray wolves captured in a custom-made foothold trap (No. 14 longspring) with offset, toothed jaws had fewer injuries than those caught in three other trap types (including another toothed-trap jaw but with a smaller offset). Dental injury in all three trap types was usually restricted to premolars; damage to canines and carnassials was uncommon.

Schultz et al. (1996)	No. 4 and No. 14 Newhouse, with modifications	During 1979-1995, 116 live-captures of 107 wolves were made in central and northern Wisconsin. Traps were checked every 24 hours or more often depending on weather conditions. All traps were equipped with drags and some were modified with the Paws-I-Trip pan tension system. Traps with modified No. 14 jaws caused the least amount of injury to adult wolves, with only 15% of captured animals having moderate to severe injuries. The No. 4 Newhouse with modified jaws was recommended for capturing wolf pups. The Paws-I-Trip system proved to be effective in reducing the capture of nontarget species.

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TRAP RESEARCH AND PERFORMANCE DATA SUMMARY

LYNX *(Felis lynx)* *December 2, 1996*

Reference	Trap	Results
Proulx et al. (1995)	Modified 330	The standard 330 Conibear was compared to the same device equipped with 2 clamping bars in a compound test. The standard 330 failed to render 3 of 8 captured animals irreversibly unconscious in $\leq$ 3 minutes. The modified Conibear killed 8 of 8 lynx in $\leq$ 3 minutes and was considered a humane device for trapping lynx. This modified 330 Conibear can be expected to render $\geq$ 70% of captured lynx irreversibly unconscious in $\leq$ 3 min ($P<0.05$).
Mowat et al. (1994)	Box trap Fremont foot snare No. 3 Victor soft catch	Field tests in -40 - 0°C in southwest Yukon; 205 lynx captures were made in 3 devices. Capture efficiency did not vary significantly among trap types. Freezing limbs were a problem with padded traps. Modified Fremont foot snares caused least injury and is recommended for live capture of lynx.

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Reference	Trap	Results
Gilbert (1981a)	Conibear 120 Gabry Bionic Gabry Challenger Vital	Controlled tests conducted in Ontario in indoor and outdoor pens. Any type of set can be effective for this species (not trap shy). Marten should be struck within 10 cm of front of head. Conibear trigger should be placed on top for effective strike location. Vital trap killed marten quickly in runway sets, but was less effective in cubby sets because animals entered cubby with their heads and/or necks held higher than nimals entering runway sets.
Gilbert (1981b)	Vital	Controlled tests conducted in Ontario in indoor and outdoor pens. Vital passed approach test; in runway sets, corneal reflex gone in ≤17 sec. (n=3). Vital proved unsatisfactory in cubby sets (n=3); all animals were euthanized.
Novak (1981)	Conibear 110 Conibear 120 modified Conibear 110 modified Conibear 120	Controlled tests conducted in Ontario using enclosures. Two marten caught in Conibear 110 and 1 caught in Conibear 120 on land were released from traps after 5 minutes. One marten caught in modified Conibear 110 (jaws bent inward) was released after 5 minutes; 1 marten caught in modified Conibear 120 (jaws bent inward and 18kg springs) killed in 3 min. 40 sec.
Barrett et al. (1989)	C120 Magnum	Field test in northern Alberta using elevated box sets. 87% of marten had single head/neck strike; 12% received double strikes. C120 Magnum as efficient as standard traps for harvesting marten. C120 Magnum also suitable for muskrats, mink, weasels, and red squirrels.

Proulx et al. (1989a)	C120 Magnum	Compound test at Vegreville, Alberta. Thirteen of 14 marten caught in C120 Magnum had an average time to unconsciousness of ≤68 sec.; the remaining animal was euthanized after 3 minutes. 77% of the animals were unconscious before observer arrived. Double strikes recorded for 6 of 14 animals.
Proulx et al. (1989b)	Standard Conibear 120 C120 Mark IV	Compound test at Vegreville, Alberta. Time to unconsciousness in preselection tests using anaesthetized animals was ≤40 sec. for 5 of 6 marten. In actual kill tests 4 out of 6 marten lost consciousness in ≤162 sec.; 2 were euthanized after 5 min. Test results also reported for C120 Mark IV trap (extra bars welded on trap jaws). 4-prong pitchfork trigger design was best for properly positioning marten in trap.
Rowsell (1989)	LDL	Field test on trapline in Ontario. Trap consistently inflicted serious trauma resulting in rapid death (<3 min) (n=4).
Novak (1990)	LDL Kania C120 M trap boxes of various designs	Field test on traplines in Ontario to compare efficiency and incidental catch rates for various types of sets using a variety of traps. "Trapper's box" on a horizontal pole was the best set, i.e. most efficient with fewest non-targets which were mostly flying squirrels.
Naylor and Novak (1994)	Conibear 120 C120 MAX Havahart Model 1079 (wire box)	Field test on traplines in Ontario to compare efficiency and selectivity of traps for marten. Conibear 120 set in wooden boxes caught the greatest number of martens/100 trap nights (TN). Conibear 120 set in wire boxes caught fewer incidentals/100 TN,but also caught fewer martens/100 TN. Sets on ground were more selective than sets in trees and had a similar capture efficiency, but marten pelts taken from ground sets were >3 times as likely to be damaged by mice. C120 and C120 MAX exhibited similar selectivity, but C120 caught about twice as many martens/100 TN. Problem with C120 MAX trigger configuration noted. Wire box trap and C120 had similar selectivity, but box traps were less efficient for catching martens.

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Reference	Trap	Results
Gilbert (1976)	Simulated "Killing"	Lab tests on anesthetized mink (n=12) to determine the minimum energy forces necessary to cause immediate death when delivered to the neck. Threshold value = 430 cm kg for a neck blow. The threshold value for a chest strike was 520 cm kg (n=6). No clamping force applied. Mink killed by a chest strike appeared to succumb quicker than those hit on the neck.
Benn (1981)	Killing trap simulator	Lab tests on anesthetized animals. Mink neck area killing force = 1.9 kg m/sec. Time to death increased as testing proceeded caudally along the neck. No animals died when a 4.0 kg m/sec impact force struck C7 - T1. Holding force of 150 N resulted in suffocation in all animals struck on C1, C2 area. The addition of holding force together with impact force seems to promote faster death.
Gilbert (1981a)	Conibear 120 Gabry Bionic Gabry Challenger Vital	Controlled tests conducted in Ontario in indoor and outdoor pens to determine probable strike locations; traps wired in set position so that they could be triggered, but not closed. Runway or blind sets most effective for mink.

Gilbert (1981b)	Vital Improved Vital Conibear 120 Askins 1 version of C120 Askins 2 version of C120	Controlled tests conducted in Ontario in indoor and outdoor pens. Best strike location with Vital was 10 cm from nose, behind ears. Vital did not have enough energy to kill mink. Improved Vital (n=5) resulted in an avg. time to unconsciousness (ATTU) of 69 ± 43 sec. for 4 mink (1 was euthanized after 180 sec.). Conibear 120 had clamping force of 275 N; the 2 mink caught were euthanized after 180 sec. Three mink caught in Askins 1/C120. All were double strike, but 2 animals euthanized after 180 sec. One mink unconscious after 96 sec. Three mink caught in Askins 2/C120. One was euthanized after 180 sec.; ATTU for the other 2 was 70 sec. Ten percent of the strikes with this trap expected to be unsatisfactory.
Novak (1981)	#1½ Victor Long Spring, Mohawk (small), Conibear 110, 120, modified C110, modified C180 with pan trigger	Controlled tests conducted in Ontario using enclosures. Mink (n=4) died in 1.75 to 3.5 minutes when caught in drowning sets using #1½ Victor LS. Of the 5 mink trapped with the small Mohawk, 1 died in 30 sec., and 4 were released after 5 min. All 6 mink trapped with Conibear 110 on land were released after 5 minutes. Four of 7 mink caught in Conibear 120 set on land were killed in 15 - 20 sec.; 3 were released after 5 min. One of 5 mink caught in modified Conibear 110 (jaws bent inward) on land died in 1.5 min.; 4 were released after 5 min. One mink (n=2) caught in modified (jaws bent inward and 18 kg spring) Conibear 110 trap on land was killed in 2.0 minutes; the other was released after 5 min. Seven mink caught in land sets with modified C180 traps that had pan triggers and jaws bent inward were killed in ≤6 sec. Recommended all Conibear traps should have jaws bent inward and be supplied with safety releases.
Gilbert and Gofton (1982)	#1½ Victor Long Spring #2 Victor Long Spring	Controlled lab tests in aquatic tank using a drowning set. The average time to cessation of struggling was 2 min. 3 sec. (n=13); EEG loss occurred in an average of 4 min. 27 sec. (n=12). EKG loss took place after an average of 8 min. 27 sec. (n=9). Only 1/13 showed injury (minor laceration). 9/13 wet drowned; 3 did not; 1 unknown.

Zelin et al. (1983)	Simulated "Killing"	Controlled lab tests on anesthetized animals; determined mean kill thresholds using 335-g striking bar; 10-minute time to death test period employed. With no holding force, the thresholds for head (n=6), neck (n=8), thorax (n=16), and abdomen (n=6) strikes on mink were 1.3, 1.9, 2.4, and 4.3 kg•m/sec, respectively. For thorax strikes, the mean threshold obtained was much less with a holding force of 100-300 N than without it. The impact momentum threshold to kill mink struck on the head within 10 minutes was zero with holding forces of 100-300N. The presence of holding forces as high as 300 N had little effect on the magnitude of the mean threshold for neck strikes. The mean threshold for head strikes of mink was relatively unaffected by the use of striking bars of different masses (236 g vs. 335 g).
Proulx et al. (1990)	C120 Magnum with pan trigger (66 x 69 mm)	Compound test at Vegreville, Alberta. Passed kill test for 3-minute threshold. Avg. time to unconsciousness $<72 \pm 24$ sec. (n=9).
Proulx and Barrett (1991)	Bionic with 6 cm bait cone (bait on top of spring)	Compound test at Vegreville, Alberta. Passed kill test for 3-minute threshold. Avg. time to unconsciousness $<60 \pm 26$ sec. (n=9).
Proulx and Barrett (1993)	C120 Magnum with pan trigger Conibear 120 a variety of #1 and #1½ legholds (long spring, coil spring, Soft Catch)	Field test on traplines in B.C. and Newfoundland. C120 Magnum (C120M) captured as many mink as the Conibear 120 (C120) and standard legholds. In B.C., the C120M and C120 captured similar numbers of mink and non-target animals. In Newfoundland, C120M and leghholds caught a similar number of mink, but legholds caught more non-targets. C120M recommended as humane device for mink. Need to experiment with pan tension for C120M expressed. Double strikes occurred for 29 of 30 mink caught in C120M.

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Prepared by: George Hubert, Jr., Illinois DNR

Reference	Trap	Results
Palmisano and Dupuie (1975)	Victor #1½ Long Spring (LS) Victor #2 LS Conibear 220	Field test in Louisiana. Conibear appeared superior to footholds for taking muskrats in flooded marshes. 5.3 muskrats/100 trap nights (TN) with Conibear compared with 1.5 muskrats/100 TN for footholds.
Gilbert (1976)	Simulated "Killing"	Lab tests on anesthetized muskrats (n=23) to determine the minimum energy forces necessary to cause immediate death when delivered to the neck. Threshold value = 58-63 cm kg for a neck blow. The threshold value for a chest strike was 155 cm kg (n=9).
Linscombe (1976)	Victor #2 LS Conibear 220	Field test in Louisiana. No difference between number of muskrats caught with #2 LS and Conibear 220 in either fresh or brackish marsh.
Penkala (1978)	#1 LS #1 Jump #1 Stoploss Conibear 110 modified Conibear 110 (jaws bent inward 1/2")	A total of 1,402 trap nights (TN) expended during this field study in New Jersey. Overall capture rate = 1 muskrat/21 TN. Conibear 110 had highest efficiency. Modified Conibear 110 slightly less efficient. Footholds sig. less efficient than Conibears. All traps set at den entrances.

Novak (1981)	Conibear 110 Conibear 120 Victor #1½ LS	Controlled tests conducted in Ontario using enclosures. Muskrats (n=10) died in 2 min.-5 min. 15 sec. when trapped in drowning sets with the #1½ LS. Death occurred in 1 min. 30 sec.-4 min. using Conibear 110 set underwater (n=4). 3/5 muskrats caught in Conibear 110 on land died in 3 min. 15 sec.-6 min. 30 sec.; the remaining 2 were released after 5 min. 4/7 muskrats caught in Conibear 120 on land died in 1 min. 15-sec.-3 min.; the remaining 3 were released after 5 min. 6/6 muskrats caught in modified Conibear 110 (18 kg spring) on land died in 50 sec.-3 min. 20 sec.
Gilbert and Gofton (1982)	#1½ Victor Long Spring (LS) Submarine	Controlled lab tests in aquatic tank. Of the 11 muskrats caught in #1½ LS using a platform drowning set, 6 had no injuries, 1 had a broken humerus, and 4 had lacerations and abrasions. The average time to cessation of struggling was 3 min. 34 sec.; EEG loss occurred in an average of 4 min. 3 sec. The two muskrats trapped in floating log sets and the 3 caught in submarine traps took longer to cease struggling and lose their EEG ($P<0.05$). A total of 9 muskrats "wet" drowned, and 7 did not.
Parker (1983)	#1 Victor Stoploss (SL) #1½ Victor Long Spring (LS) Conibear 110	Field study in New Brunswick. A total of 810 muskrats caught in 5,938 trap nights (TN). Foothold traps more productive in autumn than in spring ($P<0.05$); productivity of Conibear did not differ between seasons. A higher percentage of muskrats were dead in Conibear traps (98%, n=227) versus foothold traps (88%, n=583). No nontarget catches with Conibear used in underwater burrow and runway sets.
Zelin et al. (1983)	Simulated "Killing"	Controlled lab tests on anesthetized animals; determined mean kill thresholds using 335-g striking bar; 10-minute time to death test period employed. With no holding force, the thresholds for head (n=7), neck (n=7), thorax (n=8), and abdomen (n=9) hits of muskrats were 0.58, 1.4, 0.49, and 3.7 kg.m/sec, respectively. With a holding force of 100 N, no momentum was necessary to kill muskrats (n=4) within 10 min.

McConnell et al. (1985)	Victor #1 VG Stoploss Victor #1 VG Stoploss Soft Catch (SC) (w/ padded jaws)	Field test in New Jersey using float/house sets with stakes placed in deep water to drown muskrats. SC trap caused sig. less (P=0.08) damage to limbs of trapped muskrats than SL. No sig. diff. (P=0.05) in ability of SC (n=49) trap versus SL (n=48) trap to capture and hold muskrats.
HTRDC (1988)	Cosey Davies Snare Northwoods (Fenn)	Field test in Canada. Eleven percent of muskrats taken in Cosey (n=38) were alive (inefficient); may be useful if made more powerful. Davies took 6 animals in 65 trap nights (TN); needs work. Northwoods 50-75% as effective as stop loss trap; 11 catches, 29 sprung traps in 178 TN. Recommended further testing and development of all 3 traps.
Lacki et al. (1990)	Havahart Tomahawk (both w/ double doors)	Field test in Canada. A total of 16 muskrats caught in Havahart compared with 60 in Tomahawk; Tomahawk sig. more effective.

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Prepared by: George Hubert, Jr., Illinois DNR

TRAP RESEARCH AND PERFORMANCE DATA SUMMARY

NUTRIA *(Myocastor coypus)* *February 19, 1997*

Reference	Trap	Results
Palmisano and Dupuie (1975)	Victor #1½ Long Spring (LS) Victor #2 LS Conibear 220	Field study in Louisiana. Victor #2 LS caught significantly more nutria than Conibear 220 ($P<0.01$). Overall catch rate for Conibear = 2.4 nutira/100 trap nights (TN) compared with 4.8/100 TN for #2. No diff. between #2 and #1½ LS for catching nutria. Of the nutria taken in #1½ and #2 traps (n=67), 91% remained alive and 29.9% were released. 21/23 (91.3%) of the nutria caught in Conibear 220 were dead, 2 (8.7%) were alive, and none was released. Nutria apparently avoided Conibear 220 when used in trail sets.
Linscombe (1976)	Victor #2 LS Conibear 220	Field study in Louisiana. Trail sets used in fresh and brackish marsh. #2 LS caught significantly more nutria in fresh ($P<0.01$) and brackish ($P<0.05$) marsh. Trigger positioned on top for Conibear. Total trap nights (TN) = 10,671 for #2 LS and 7,567 for Conibear 220. Overall average catch rate = 18.5 nutria/100 TN for #2 LS and 12.29 nutria/100 TN for Conibear 220. Of the nutria caught in the Conibear 220, 9.7% of the adults and 10.7% of the immatures were alive when the traps were checked. An average of 69% of the immature nutria caught in #2 LS were alive and most could be released.
Robicheaux and Linscombe (1978)	Victor #1½ LS Victor #2 LS Conibear 220 Tomahawk #206	Field study in Louisiana. Leghold traps were most efficient for capturing nutria (8/100 trap nights [TN]).
Baker and Clarke (1988)	Cage trap (85 x 25 x 25 cm) with single drop door	Field study in Great Britain. Traps set on rafts (1 x 2 m or 1.5 x 0.6 m) caught significantly more nutria than traps set on land; raft traps caught about half the number of non-target animals per unit effort compared with land traps.

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Prepared by: George Hubert, Jr., Illinois DNR

Reference	Trap	Results
Berchielli and Tullar (1980)	Blake & Lamb #1½ Coil Spring (CS) Ezyonem leg snare	Field test in New York. #1½ CS caught 15 opossums in 19 visits compared with 1 capture in 6 visits for the Ezyonem; this difference was significant (P>0.05). No self-mutilation observed in any of the opossums caught in #1½ CS (n=15). Injuries between trap types were not compared due to lack of captures in Ezyonem (n=1). No injuries observed in 67% of the opossums caught in the #1½ CS; fractures recorded in 20% of the opossums examined (n=15).
Turkowski et al. (1984)	Victor #3 NM (with and without prototype pan tension devices)	Field test in California, New Mexico, Oregon, Texas, and Utah. Shear-pin device (n=27) and leaf spring (n=32) excluded 100% of opossums from traps compared with a 0% exclusion rate when no pan tension device was used (n=39). Improved pan tension devices performed better than prototypes. Coyote capture efficiency for traps equipped with improved pan tension devices varied from 86-94% that of the standard trap.
Linscombe and Wright (1988)	Victor #1½ Soft Catch (SC) Victor #1½ CS	Field study in Georgia, Louisiana, Minnesota, Mississippi, New York, and Texas. No difference in numbers of opossums caught in different trap types (P=0.70; n=148 for SC and n=138 for CS.
Nettles et al. (1990)	Victor #2 CS Victor #2 CS with padded jaws	Field test in Washington. Significantly less leg damage (P<0.01) observed in opossums caught in padded jaw trap (n=14) compared with those caught in standard #2 trap (n=13). Average injury scores were 36 and 220 points, respectively, for the padded and the standard trap. Leg amputations and compound fractures occurred more often in unpadded trap.

Phillips and Gruver (1996)	Victor #3 Soft Catch (SC) Victor #3 NM #4 Newhouse (all equipped with Paws-I-Trip pan tension device)	Field study in 8 western states. Paws-I-Trip device successfully excluded 100% (n=2) of opossums that visited SC traps, and 75% (n=20) of those that visited #4 Newhouse traps. Coyote capture rates for Paws-I-Trip equipped traps were: #3 SC = 81.8%, #3 NM = 91.0%, and #4 Newhouse = 87.2%.
Hill (no date)	#2 CS #2 CS w/ offset jaws Conibear 120 Conibear 220	Field test in Alabama. Standard #2 CS more efficient than #2 CS with offset jaws. Bone fractures observed in 44% of opossums caught in #2 CS (n=18) compared with 16% of those caught in #2 CS offset (n=19). Similar numbers of opossums caught in Conibear 220 and Conibear 120 traps when placed in boxes on ground (1/17.5 trap nights [TN], n=37, 648 TN for Conibear 220; 1/19.4 TN, n=26, 508 TN for Conibear 120). Conibear 220 trap box caught fewer opossums (1/18.6 TN, n=22, 410 TN) when set 1 meter above ground (open end down) compared with Conibear 220 trap box set on ground (1/7.4 TN, n=34, 320 TN). Conibear 220 trap boxes set on ground caught more opossums (1/9.4 TN, n=34, 320 TN) compared with #2 CS used in dirt-hole sets (1/14.2 TN, n=23, 327 TN).

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Prepared by: George Hubert, Jr., Illinois DNR

Reference	Trap	Results
Gilbert (1976)	Simulated "Killing"	Lab tests on anesthetized raccoons (n=11) to determine the minimum energy forces necessary to cause immediate death when delivered to the neck. Threshold value = 575 cm kg for a neck blow. No pelt damage occurred at 1,037 cm kg. The threshold value was ca. 1,150 cm kg for a chest strike (n=8).
Linscombe (1976)	Victor #2 Long Spring (LS) Conibear 220	Field test in Louisiana in fresh and brackish marsh habitat. #2 Victor more efficient than Conibear 220 in brackish marsh for capturing raccoons, but no difference in efficiency in fresh marsh was detected.
Berchielli and Tullar (1980)	Blake & Lamb #1½ Coil Spring (CS) Ezyonem leg snare	Field study in New York. #1½ CS caught 17 raccoons in 28 visits compared with 1 capture in 22 visits for the Ezyonem and was more efficient ($P<0.01$). Self-mutilation observed in 37% of raccoons caught in #1½ CS (n=30). Injuries between trap types were not compared due to small sample size for Ezyonem (n=1). Raccoons caught in CS had fewer injuries when traps were covered with sifted soil.
Gilbert (1981)	Conibear 220 Vital Gabry Bionic Gabry Challenger	Controlled tests conducted in Ontario in indoor and outdoor pens. Approach tests only; n=2 for each trap; raccoons consistently placed forefeet into ground level sets at the same time or before their heads; most traps triggered by the feet. Conibear 220 used in dog-proof box with trigger prongs separated by 7 cm and joined by monofilament line ensured good strike location.

Novak (1981a)	Novak foot snare #2 coil spring w/ offset jaws #4 double long spring (DLS) with offset jaws	Field study in Ontario. Capture rate = 57% for foot snare (64/113), 76% for footholds (26/34); no injuries to 40/49 raccoons caught in foot snare compared with 11/22 raccoons taken in foothold traps.
Novak (1981b)	Conibear 220 Conibear 330 Mohawk modified Conibear 280	Controlled tests conducted in Ontario using enclosures. 3/5 raccoons caught in Mohawk trap escaped; the other 2 died in 4-5 minutes. 5/5 raccoons caught in 330 Conibear were removed from trap after 5 minutes; none died because trap jaws remained 3-4 cm apart after trap was fired. 3/5 raccoons caught in 220 Conibear died in 90-210 seconds, and 2 were released after 5 minutes. 3/5 raccoons caught in modified 280 Conibear with pan trigger died in 75-175 seconds, and 2 were released after 5 minutes. The pan trigger proved ineffective for catching raccoons because traps discharged prematurely due to the animals' walking pattern.
Zelin et al. (1983)	Simulated "Killing"	Controlled lab tests on anesthetized animals; determined mean kill thresholds using 335-g and 807-g striking bars; 10-minute time-to-death test period employed. With no holding force, the thresholds for head (n=8) and neck (n=7) hits of raccoons were 3.4 and 3.3 kg.m/sec, respectively, using the 335-g striking bar. The effect of a 100-N holding (clamping) force (n=10 for head and n=3 for neck catches) was sufficient to eliminate the need for an impact momentum. Mean kill thresholds using the 807-g striking bar with no holding force were 4.6 and 5.7 kg.m/sec for head (n=6) and neck (n=6) hits, respectively.

Tullar (1984)	Victor #1½ CS Victor #1½ prototype padded CS (both models had light springs - 40 lbs. vs. 70 lbs. std.)	Field study in New York. Injury scores did not differ between trap types; 8 of 9 raccoons caught in padded trap had injury score ≤15; 7 of 14 raccoons caught in unpadded trap had injury score ≤15; 23.5% (n=17) of the raccoons caught in unpadded trap had injuries due to self-mutilation. Dirt-hole set used.
Moore and Kennedy (1985)	Tomahawk wire cage Havahart wire cage	Field investigation. Capture success (n=57) highest in autumn/winter; success higher with higher temperature; negative correlation with precipitation.
Linscombe and Wright (1988)	Victor #1½ CS Victor #1½ Soft Catch (SC)	Field study in Georgia, Louisiana, Minnesota, Mississippi, New York, and Texas. The SC trap caught fewer raccoons than the CS (n=339, P=0.05). Data from trappers setting primarily for foxes and bobcats indicated no diff. in raccoon captures (n=63 SC, n=62 CS) with the 2 trap types (P=0.92).
Olsen et al. (1988)	Victor #1½ CS Victor #1½ SC	Field study in Georgia, Louisiana, Minnesota, Mississippi, New York, and Texas. Raccoons in NE U.S. showed no difference in amount of damage between traps (n=25 SC, n=35 CS). Raccoons in SE U.S. had sig. less damage in SC; 35/75 (47%) caught in SC had an injury score ≤15 compared with 22/98 (22%) caught in CS.
Saunders et al. (1988)	Victor #1½ SC Victor #1 SC prototype	Field test in British Columbia during September using flat, shallow water, and cubby sets. Sig. less damage to raccoons (P<0.05) with the #1 SC (n=12) compared to raccoons caught in the #1½ SC (n=10) in a 24-hr. period or less. Mean 24-hr. damage score for #1 SC = 5 compared to 10 for #1½ SC.

Nettles et al. (1990)	Victor #1½ CS Victor #1½ CS with padded jaws (spring mechanism identical)	Field study in Maryland conducted during winter. A total of 20 raccoons captured in each trap type; no sig. difference in injury scores between trap types; self-mutilation occurred in both traps. Mean leg damage scores for raccoons alive at time of trap check were 164 (standard CS, n=7) and 202 (padded CS, n=12).
Tullar and Phillips (1990)	Victor #1 CS Victor #1 SC prototype Victor #1½ CS Victor #1½ SC	Field study in New York using land sets. The catch per visit rate for the #1 CS was not sig. different from that of the #1½ CS. Padded traps of both sizes were sig. less effective for catching raccoons than standard traps. #1 CS traps (n=90) caused sig. less injury than #1½ CS (n=51); padded traps of both sizes failed to sig. reduce injury to trapped raccoons (#1 SC n=17; #1½ SC n=30). #1 size traps sig. reduced the incidence of self-mutilation compared with #1½ size.
Hubert et al. (1991)	Victor #1½ SC Montgomery #11 DLS	Two-year field study in Illinois using non-drowning water sets. Capture rate with #11 DLS was sig. higher than with #1½ SC (147 versus 96/1,000 trap nights). Mean injury score for raccoons captured in #11 DLS (n=108) averaged 1.2 times that for those caught in the #1½ SC (n=67); this difference approached significance (P=0.054). Self-mutilation of trapped limb was observed in 29% (n=99) of the raccoons examined, and was not influenced by trap type (P=0.22).
Proulx (1991)	EGG Conibear 220 Box	Field test in Quebec and British Columbia; 251 raccoons captured. EGG (n=98) held >79% of raccoons for ≤24 hours without serious injury. Capture efficiency of EGG trap similar to that of box trap (n=36) in British Columbia. EGG trap was as capture-efficient as Conibear 220 (n=117) early in season in Quebec, but later in season its efficiency declined.
Heydon et al. (1993)	Standard #1½ Padded #1½	Field study in Ontario. Raccoons caught in unpadded trap (n=20) had sig. more injuries to legs than those taken in padded traps (n=10).

Proulx et al. (1993)	EGG Victor #1½ SC	Compound test conducted in Alberta. 9/9 raccoons captured in EGG trap held without serious injury for 12 and 24 hours (range of injury scores = 0-20); 9/9 raccoons captured in SC held without serious injury for 12 hours (range of injury scores = 0-40; 8/9 raccoons captured in SC sustained minor injuries over a 24 hour period, but 1 self-mutilated the captured limb (injury score = 120).
Kern et al. (1994)	Victor #1½ CS Victor #1½ w/ laminated jaws Butera #1½ w/ offset jaws Victor #1½ w/ padded jaws	Field test in Wyoming using terrestrial sets and 24-hr. trap check interval. The median injury scores for the offset jaw trap (5.0, n=4), laminated jaw trap (5.0, n=2), padded jaw trap (5.0, n=7), and standard trap (35.0, n=8) were not significantly different (P=0.41). Only leg injuries evaluated.
Proulx and Drescher (1994)	Conibear 280 (in standard and modified versions), Sauvageau 2001-8	Controlled lab tests on immobilized animals in Alberta. Conibear 280 (n=6) rendered 3 raccoons struck in neck region irreversibly unconscious in $\leq$3 minutes; 2 others lost consciousness in 194 and 195 sec.; 1 was euthanized after 5 minutes. Sauvageau 2001-8 (n=3) rendered 1 raccoon struck in the neck unconscious in 58 sec.; 2 others were euthanized after 5 minutes. A modified Conibear 280 with a clamping bar on the top striking jaw rendered 6/6 raccoons struck in neck region irreversibly unconscious in 182 to 270 sec. All traps would fail preselection test unless the minimum time to loss of consciousness was increased to 4 min.
Sabean and Mills (1994)	Conibear 160 (BMI)	Average time to unconsciousness for 4/5 raccoons was 172 sec $\pm$ 16 sec.; 1 animal was euthanized; trap would have failed 1994 draft ISO test standard. Lab test performed in Nova Scotia on raccoons immobilized with ketamine.

Hubert et al. (1996)	EGG Victor #1 CS	Field test in Illinois using non-drowning water sets and 24-hour trap check interval. EGG (n=63) captured raccoons more efficiently than #1 CS (n=37); 94% of raccoons showed no oral injuries; whole body injury scores for raccoons caught in CS (n=40) were sig. higher than EGG and averaged 116 compared to an average of 68 for the EGG (n=62). Incidence of self-mutilation sig. lower with EGG.
Hill (no date)	#2 CS #2 CS w/ offset jaws Conibear 120 Conibear 220	Field test in Alabama. Efficiency of standard #2 CS similar to #2 CS with offset jaws. Bone fractures observed in 62% of raccoons caught in #2 CS (n=13) compared with 40% of those caught in #2 CS offset (n=5). More raccoons caught in Conibear 120 compared with Conibear 220 when placed in boxes on ground (1/14.4 trap nights [TN], n=35, 508 TN for Conibear 120; 1/30.8 TN, n=21, 648 TN for Conibear 220). Conibear 220 trap boxes set on ground caught more raccoons (1/64 TN, n=5, 320 TN) compared with Conibear 220 trap box set 1 meter above ground (open end down) (1/137 TN, n=3, 410 TN). Conibear 220 trap boxes set on ground caught a similar number of raccoons (1/64 TN, n=5, 320 TN) compared with #2 CS used in dirt-hole sets (1/54 TN, n=6, 327 TN).

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TRAP RESEARCH AND PERFORMANCE DATA SUMMARY

RIVER OTTER *(Lontra canadensis)* *February 19, 1997*

Reference	Trap	Results
Northcott and Slade (1976)	Bailey live trap Hancock live trap	Field study in Newfoundland. Bailey ineffective for live-trapping animals; catch rate = 0.17 otters/100 trap nights (TN). Hancock set unbaited in slides; catch rate = 0.6 - 1.3 otters/100 TN. Control of human scent important.
Melquist and Hornocker (1979)	#2 Coil Spring (CS) #3 Jump Hancock various others	Field study in Idaho. Little injury to otters captured in #2 CS (n=5), but at least 35 escapes were recorded. Otters captured in #3 Jump (n=5) had injuries ranging from slight swelling in toes to broken legs. Hancock trap found to be effective (captures=21) when minor modifications were made.
Shirley et al. (1983)	Victor #11 Double Long Spring (DLS)	Field study in Louisiana.
Route and Peterson (1988)	Hancock	A total of 41 otters captured in 1,686 trap nights in Minnesota using Hancock traps. Few injuries recorded. Trap nights/otter captured = 13.9 in spring (n=22) compared with 72.6 in fall.
Serfass et al. (1996)	Modified Victor #1½ Soft Catch (SC) Victor #11 Double Long Spring (DLS)	Field study in eastern United States (Pennsylvania and Maryland). Modified SC traps used to capture 29 otters. Capture rate = 0.57, 60.3 trap nights/otter). Among adult otters, 1 (3.7%) caught in SC sustained injuries requiring an amputation (a single digit) in comparison to 12/17 (70.6%) taken in #11 DLS. No difference in frequency or severity of dental injuries to otters between trap types. SC traps modified by replacing 1 factory installed spring with a #2 spring and adding a segment of anchor chain ranging from 0.5 to 1.25 m in length. Traps checked daily.

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Prepared by: George Hubert, Jr., Illinois DNR

RED FOX *(Vulpes vulpes)* *December 2, 1996*

Reference	Trap	Results
Novak (1981)	Novak leg snare No. 4 Victor long spring No. 2 Victor coil spring	The Novak leg snare was compared with 2 types of leghold traps under field conditions in southern Ontario. One hundred-eleven red foxes were captured. The capture rate was 89% for the foot snare and 85% for the leghold traps. No differences were found among animals which discharged traps, capture rate or escape rate. Ninety-eight percent of the animals captured in foot snares had either no marks or just rubbed skin or nicks on their legs as compared to 48 percent of animals caught in leghold traps. Animals caught in either foot snares or legholds did not damage their teeth by biting on the traps. Results indicated that the foot snare was as effective as the leghold trap in capturing furbearers, and greatly reduced injuries.
Rowsell et al. (1981)	Power snare Non power snare	Eighteen foxes were studied in the laboratory to see if snares could produce a humane death. The power snares appeared to have the only potential to produce rapid death in foxes. It is possible that the more rigid cartilage in the trachea of foxes may make them more difficult to constrict under pressure. This study questioned the effectiveness of producing a humane death to foxes using snares.
Englund (1982)	Swedish leg snare No. 2 Victor long spring No. 3 Victor long spring	During the study, 1,374 red foxes were trapped in Sweden using standard No. 2 and No. 3 long spring traps while 154 were trapped in traps coated with plastic and 123 in leg snares. The frequency and severity of dental injuries from leghold traps was less for foxes captured in plastic-coated traps, while leg injuries remained the same. The plastic legsnare was able to virtually eliminate all trap-related injuries.

McConnell (1982)	No. 1 ½ coil spring No. 2 coil spring Box trap	Total of 9 red foxes were captured during 181 trap nights. Leghold devices were found to be more efficient, more selective, and cost less than box traps which were determined to be inefficient. The standard No. 2 coil spring was found more productive than the No. 2 coil spring with offset jaws.
Tullar (1984)	No. 1 ½ Victor coil spring	Sixteen red foxes were captured in Columbia County, New York. The foot-damage scores indicated that the padded traps caused significantly less damage than the unpadded traps.
Stevens (1986)	Treadle snare Bow snare Gin trap	Twenty-one foxes were captured in Australia using snares and traps. Foxes caught in the snares suffered bruising in the area where the cable was located, while gin-trapped foxes suffered lacerations, swelling and disjointed bones. Traps were more efficient during this study, but produced more damage to trapped legs.
Berchielli and Tullar (1988)	Ezyonem leg snare No. 1 ½ coil spring	Fifteen red foxes were trapped using coil spring traps and 2 were captured in the leg snares. The leg snare was less effective than the coil spring trap. The leg snare did not appear to be more humane than the coil spring trap since both produced similar trap-related injuries.

Kreeger et al. (1990)	No. 1 ½ Victor Soft Catch No. 1 ½ standard coil spring	Objectives of the study were to examine the behavioral, physiological, endocrine, biochemical and pathological responses of both free-ranging and captive North Dakota red foxes caught in unpadded and padded-jaw foothold traps as well as to compare such responses with those of untrapped foxes. Foxes caught in unpadded traps (n=10) had higher physical injury scores to the trapped limbs than foxes caught in padded traps (n=11) (P<0.005). Heart rate and body temperature increased rapidly after foxes were caught, but returned to mean pretrapped levels after 80 minutes. Mean time spent physically resisting the trap in an 8-hour period was 17.8 +/- 6.7 (SE) and 13.3 +/- 0.3% for foxes caught in unpadded and padded traps, respectively (P=.033). Trapped foxes generally had higher levels of adrenocorticotropin, *B*-endorphin, and cortisol and lower levels of thyroxine and insulin compared to control foxes (P<0.05). Foxes caught in unpadded traps had higher cortisol, but lower *B*-endorphin values than foxes caught in padded traps (P=0.05). Trapped foxes also had higher levels of bilirubin, lactate dehydrogenase, alkaline phosphatase (ALP), and aspartate aminotransferase (AST) than control foxes (P<0.05). Foxes caught in unpadded traps had higher values for ALP, AST, and gamma-glutamyl transpeptidase than foxes caught in padded traps (P<0.05). Trapped foxes also had higher leukocyte counts than nontrapped foxes with a significant neutrophilia and leukopenia (P<0.05). Trapped foxes had higher incidences of adrenal gland and kidney congestion as well as adrenal gland, lung, and heart hemorrhage relative to control foxes (P<0.05). Most of the changes were consistent with the physical exertion of resisting the trap, and none appeared life-threatening. Overall, padded-jawed traps causes less trauma to red foxes than unpadded traps.

Linscombe and Wright (1988)	No. 1 ½ Victor Soft Catch No. 1 ½ standard coil spring	Total of 10,586 trap nights showed no difference between visitation rates between the padded and unpadded traps. Ninety-eight red foxes were captured in Arizona, Georgia, Kansas, Louisiana, Minnesota, Mississippi, New York, and Texas during this study. Unpadded traps were more efficient in the northern states, but no difference was detected in the southern states.
Olsen et al (1988)	No. 1 ½ Victor Soft Catch No. 1 ½ standard coil spring	Thirty red foxes were captured in the padded trap, while 48 were captured in the standard trap. The padded trap caused less foot damage than the standard trap. Only 7% had $\geq$ 50 points of damage with the padded trap, but 38% had $\geq$ 50 points of damage from the standard trap.
Proulx and Barrett (1990)	King power snare Mosher power snare Olecko power snare	Fifteen red foxes were tested with killing snares in a pen situation at Vegreville, Alberta. This study showed that power snares have the potential to render neck-captured red foxes irreversibly unconscious within 6 minutes. With more powerful springs and different types of cables and locks, this time period may be reduced to 5 minutes.
Kern et al. (1994)	No. 1 ½ Victor coil spring No. 1 ½ Victor laminated No. 1 ½ Butera offset No. 1 ½ Victor Soft Catch	Four models of 1½ size traps were field tested during [illegible] trap nights on 4 traplines to capture furbearers in northeastern Wyoming and southeastern Montana. Two hundred forty-three red foxes were captured using the traps tested. Selectivity, efficiency, and catch rate were all found to be similar on 3 of 4 trap lines. Efficiency and catch rates were significantly lower for the padded trap on one trapline where more precipitation and heavier soil types were present. Traps were evaluated using the draft ISO trap standards and all traps, except the standard 1½ Victor, passed for red fox. The Soft Catch, Butera offset and laminated traps caused significantly less injury than the standard trap.

White et al (1991)	No. 1 ½ Victor Soft Catch No. 1 ½ standard coil spring Box (live) trap	This study documented the physiological responses of captive-raised red foxes to capture in box (live) traps. The behavior of captured foxes was video recorded, and heart rate and body temperature were monitored via radio telemetry throughout an 8-hour restraint period. Endocrine, biochemical, hematological, and pathological samples were collected. Responses of foxes caught in box traps were compared to the responses reported by Kreeger et al. (1990) for untrapped foxes and foxes caught in padded and unpadded-jaw traps. Heart rate and body temperature increased after foxes were caught in box traps, but never significantly exceeded mean pretrapped levels. Foxes caught in box traps were physically active for 35.7 +/- 8.8 (SE)% of the restraint period. The majority of this activity consisted of pacing in the trap. Foxes caught in box traps had higher ($P<0.03$) adrenocorticotropin and cortisol values than untrapped foxes, and lower ($P<0.001$) *B*-endorphin and cortisol levels than foxes caught in foothold traps. Bilirubin, alkaline phosphatase, lactate dehydrogenase, and aspartate aminotransferase levels for foxes caught in box traps were elevated ($P<0.01$) above levels of untrapped foxes. Foxes caught in box traps had lower ($P<0.004$) alkaline phosphatase, lactate dehydrogenase, creatine kinase, and aspartate aminotransferase levels than foxes caught in foothold traps. We conclude that factors associated with limb restraint directly contribute to the trauma experienced by trapped red foxes and, therefore, foxes caught in box traps undergo less trauma than foxes that are restrained by a limb in a padded- or unpadded foothold trap.

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STRIPED SKUNK *(Mephitis mephitis)* *February 20, 1997*

Reference	Trap	Results
Berchielli and Tullar (1980)	Blake & Lamb #1½ Coil Spring (CS), Ezyonem leg snare	Field study in New York. #1½ CS caught 6 skunks in 20 visits compared with 0 captures in 13 visits for the Ezyonem, but the difference was not significant ($P>0.05$). Self-mutilation observed in 100% of skunks caught in #1½ CS (n=6). Injuries between trap types not compared due to 0 captures in Ezyonem.
Novak (1981)	Novak foot snare #2 coil spring w/ offset jaws #4 double long spring (DLS) w/ offset jaws	Field study in Ontario. Capture rate = 34% for foot snare (16/47), 97% for footholds (35/36); no injuries to 12/12 skunks caught in foot snare compared with 12/30 skunks taken in foothold traps. Self-multilation of trapped foot observed in 47% (n=30) of the skunks taken in foothold traps.
Turkowski et al. (1984)	Victor #3 NM (w/ and w/out prototype pan tension devices)	Field study in California, New Mexico, Oregon, Texas, and Utah. Shear-pin device excluded 96% of skunks (n=74) from traps compared with a 91% exclusion rate for a leaf spring device (n=96). Exclusion rate without any pan tension device was 31% (n=71). Improved pan tension devices performed even better than prototypes. Coyote capture efficiency for traps equipped with improved pan tension devices varied from 86-94% that of the standard trap.

Phillips and Gruver (1996)	Victor #3 Soft Catch (SC) Victor #3 NM #4 Newhouse (all equipped w/ Paws-I-Trip pan tension device)	Field study in 8 western states. Paws-I-Trip device successfully excluded 100% (n=34)of skunks that visited SC traps, 69.2% (n=13) that visited #3 NM traps, and 91.4% (n=35) of those that visited #4 Newhouse traps. Coyote capture rates for Paws-I-Trip equipped traps were: #3 SC = 81.8%, #3 NM = 91.0%, and #4 Newhouse = 87.2%.
Nettles et al. (1990)	Victor #2 CS Victor #2 CS with padded jaws	Field test in Washington. Leg damage scores for 31 skunks caught with padded jaw trap and 34 skunks caught with standard #2 CS did not differ (P>0.05), and averaged 197 and 171, respectively. Several high scores in both groups due to self-mutilation.

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TRAP RESEARCH AND PERFORMANCE DATA SUMMARY

WEASEL *(Mustela erminea)* *February 19, 1997*

Reference	Trap	Results
King (1981)	Gin (leghold type) Fenn (killing trap)	Field study in New Zealand. A total of 336 weasels captured with Gin trap. Of these, 41% had extensive injuries and 32% were alive when the traps were checked (?daily). Self-mutilation of trapped limb observed in 21 weasels caught in Gin trap. About 8% of 966 weasels caught in Fenn traps had extensive injuries, and only 4% were alive at time of check. Author concluded correctly set Fenn traps kill weasels more humanely than Gin traps.
Belant (1992)	"Live" traps	

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WOLVERINE *(Gulo gulo)* *December 2, 1996*

Reference	Trap	Results
Copeland et al. (1995)	Log trap	During the winters of 1992-93 and 1993-94, 12 wolverines were captured 37 times in 1,255 trapnights in central Idaho; 3 animals escaped by chewing holes in traps; no injuries noted on captured animals.

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