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The Search for Acceptable Animal Traps

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Abstract: For centuries, trappers, inventors, naturalists, and biologists have searched for animal traps that met a variety of criteria, such as efficiency and durability. And, for at least the last century, individuals and organizations have fostered a movement that declares traps as inhumane, adding another criterion to the search. Trapping animals for fur, particularly for European markets, played an important role in the history, exploration, and settlement of North America, depressing the populations of some furbearer species almost past the point of recovery. Recovery of animal populations depressed through trapping, market hunting, and habitat loss became one of the first major partnership efforts among U.S. states and federal agencies in the developing science of wildlife management. Regulated trapping continues to be an important means for managing abundant furbearer populations, although the vagaries of fur markets and restrictive legislation in a number of states have made this an increasingly difficult task. For more than 50 years, scientists at the USDA Wildlife Services National Wildlife Research Center and its predecessors have engaged in cooperative research to improve animal traps and trapping systems. In the past decade, a series of actions culminated in the establishment of a national program to evaluate traps according to several criteria, including international standards for animal welfare, in order to develop guidelines for best management practices for trapping furbearers. This paper will briefly review the history of U.S. federal trap research and the status of the cooperative trap testing program.

Key Words: animal capture, trap, snare, capture device, control methods, coyote, furbearers

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INTRODUCTION

Few problems have been as intriguing to humans, perhaps since the dawn of time, than how to capture wild animals. Our ancestors used animals and animal parts for food, medicine, clothing, shelter, tools, and construction materials, and later, after the capture and domestication of some species, for hunting, herding, guarding, transportation, power for work, and for companionship. These uses continue today. Animal capture was a driving force in the lives of hunter-gatherers, and as crop and livestock agriculture developed, a host of problems with animal depredations provided further reason for our ancestors to investigate methods of animal capture and control. In many cultures, folklore, folk literature, and tradition provide a rich history of these efforts.

Likewise, few sayings are as widely familiar to Americans as Emerson's description of the rewards of creativity, "If a man can write a better book, preach a better sermon, or make a better mouse trap than his neighbor, though he build his house in the woods, the world will make a beaten path to his door." Thousands of inventors have tried to "make a better mouse trap" and many other kinds of traps for different animals. Hellwig and Drummond (1994) identified more than 6,300 (5,200 U.S.) patents for animal traps. Gerstell (1985), speaking of steel traps alone, believed more than 350 million traps of various kinds were used in North America from 1630 to 1980. Numerous trappers, trap makers, and trap manufacturing companies, small and large, have solved problems of animal capture, profited from their innovations, left their marks on history, and laid groundwork for others to make improvements.

Trapping had a central role in the exploration and settlement of North America and in the early recognition that animal populations in some habitats could be exploited almost to the point of extinction (Sandoz 1978, Russell 1979). Trapping was likewise important in the early development of the unique American approach to wildlife management, with wildlife held in trust for the people by state governments, which derive this authority under the reserved powers in the U.S. Constitution (Batcheller et al. 2000). A number of excellent reviews or resource publications are available that recount some of the history of trap development, manufacture, and use, including Bateman (1973), Drahos (1951a), Gerstell (1985), Organ et al. (2001), Schorger (1951), and Young (1941).

TRAPPING IN WILDLIFE MANAGEMENT IN NORTH AMERICA

Trapping has played a central role in the developing profession of wildlife management in the United States (Organ et al. 2001). Efforts to regulate trapping and hunting began in colonial times and by 1880 all of the states had game laws; federal regulatory authority was first established by the Lacey Act in 1900 (Leopold 1933). Early efforts to relocate trapped animals to restore extirpated furbearer populations began on a small scale in the early 1900s. Capture of animals as part of wildlife research programs provided wildlife scientists an ability to study wildlife ecology, population structure, behavior, and food habits, and gave rise to a new science of wildlife population estimation. Beginning in the 1960s, use of the newly available equipment for wildlife telemetry provided a new stimulus for scientists to learn to capture

and release wildlife species without affecting their health or survival.

State licensing of trappers and hunters provided both a means to regulate wildlife harvests and a means to collect funds for wildlife management. With the passage of the Pittman-Robertson Act in 1937, a long-term mechanism was put in place to fund wildlife management and wildlife research as a state-federal partnership, helping to establish wildlife management as a science-based profession.

The still-controversial efforts by state and federal agencies to manage predators and injurious species to protect agriculture, livestock, game species, and public health using regulated hunting, trapping, and baiting with toxicants brought numerous trappers into the developing profession of wildlife management. Growth of the nuisance wildlife control industry in the 1990s (Fall and Jackson 1998) allowed many trappers to turn avocation to vocation. Public interest and participation in trapping and hunting provided state agencies the ability to set wildlife harvest targets to sustain healthy wildlife populations that could never be achieved without direct public involvement. Trapping continues as an important means (often the only available means) of animal capture for many of the endangered species recovery, protection, and management programs developed in the past 25 years. Trapping—public, private, and commercial—is one of the most highly regulated of all outdoor activities (Organ et al. 2001) and an essential part of modern wildlife management (Boggess et al. 1990, Andelt et al. 1999).

Trapping continues to have an important economic impact in the U.S. and to provide a lifestyle on which many rural peoples still depend. Boggess et al. (1990) reported 500,000 trappers in the U.S. and 100,000 in Canada, 25,000 to 30,000 local fur buyers, and 250,000 persons involved in production, marketing, processing, and manufacturing, exclusive of those employed in fur ranching. U.S. trade associations reported 160,000 state-licensed trappers and approximately 220,000 other individuals employed in the nuisance wildlife and pest control industries in 2000. According to the Fur Information Council of America (<http://www.fur.org>), in 1990 the U.S. fur trade provided an economic benefit of more than \$4.4 billion and supported over 100,000 jobs; in 1998, U.S. retail fur sales were \$1.21 billion.

CONCERNS ABOUT ANIMAL CAPTURE

Much has been written about the history of the modern animal rights and environmental movements. Considerable trap research and development efforts have been motivated by desires to find capture systems that would satisfy such groups and gain clear public acceptance without sacrificing the essential features that are necessary for effective animal capture and restraint (Robinson 1943, 1959; Casto and Presnall 1944, Drahos 1951b, Gentile 1987). Many of the organizations that today claim to represent the broader animal welfare and environmental interests in the U.S. had their origins in

anti-trap movements that began in the early 1900s; opposition to trapping continues to be a prominent part of the environmental movement's agenda (Gentile 1987). Motivations of the individuals that support such organizations differ widely (Kellert 1981); many have argued, particularly with regard to trapping, that much of the public sentiment opposing the use of traps derives from the extensive disinformation efforts in which some groups engage. Nonetheless, a considerable fraction of the public join trappers and wildlife professionals in a sincere concern for the well being of animals and animal populations. State and federal wildlife agencies have increasingly developed better means to explain their programs to the public, to accept full public input in developing wildlife management regulations, and to address public concerns on issues such as trapping that are identified by the growing field of human dimensions research in wildlife management (Batcheller et al. 2000). Two findings from recent opinion surveys suffice to identify why these concerns are of high importance to those engaged in animal capture or wildlife management research that requires its use. Duda and Young (1998) found 59% of the American public opposed *legal* trapping (emphasis added). Muth et al. (1998) in surveys of professionals in wildlife and fisheries management (that's us!) found 46.1% favored outlawing the use of leghold traps.

If animal capture is to continue as an option for wildlife research, wildlife damage management, and wildlife management to maintain healthy furbearer populations in the future, mechanisms must be found through public education, trapper education, and the development of new methods, materials, and capture devices that bring public acceptance to traps, trappers, and trapping (Batcheller et al. 2000, Andelt et al. 1999). In 2000, the International Association of Fish and Wildlife Agencies (IAFWA)—an organization composed of state wildlife agencies—initiated a process to identify national conservation needs. Included among the first of the important needs identified was the development of new wildlife capture systems for carnivores and other furbearing animals.

This paper will describe some of the efforts in trap research and development, evaluation, and improvement by briefly summarizing work by federal scientists at the U.S. Department of Agriculture's National Wildlife Research Center (NWRC) and its predecessor organizations over the past several decades on restraining devices for coyotes. In using this approach to illustrate research progress, chiefly for reasons of space limitation, there is no intent to diminish the extensive research by inventors, individual trappers, and private corporations, or by other scientists around the world, all of whom have made substantial and critical contributions in devising and producing the modern tools of animal capture. Mention of trade names or commercial products is for identification and does not constitute endorsement or

recommendation by the author or the U.S. Department of Agriculture.

TRAP RESEARCH AND DEVELOPMENT

Concern with the quality and performance of traps is not new, although most early evaluations were undoubtedly qualitative and were unrecorded by the trap maker or are buried in old correspondence. Important features of trap performance from the trappers' standpoint have always been the ability to capture and hold animals, selectivity for the species of interest so that traps remain in service, and minimizing pelt damage incurred by restrained animals (undoubtedly highly related to our current criteria for animal welfare). A couple of examples that indicate early concern with capture efficiency and mechanical function are of interest: "We have just examined the traps you had made by Standish and I am sorry to say they are literally good for nothing, which will be of serious consequence to our next year's business..." Robert Stuart, American Fur Co., 1827, to J. J. Astor, quoted in Gerstell (1985). And, "...owing to a slight defect in their manufacture..., few beavers were caught although there were plenty... The defect in the trap consisted in the upper eye of the spring, which was so large that it did not press upon the upright parts of the jaws... the beaver were able to pull their foot out when caught..." Samuel Abbott, American Fur Co., 1841, to Ramsey Crooks, quoted in Gerstell (1985).

Sewell Newhouse and the Oneida Community are credited with bringing American traps into the modern age, moving trap-making from a blacksmith's art to factory mass production of traps with interchangeable parts and consistent quality in 1848 (Drahos 1951a, Gerstell 1985). Other trap makers began to follow the Newhouse example, and numerous trap companies emerged to market their innovations for animal capture. Linhart et al. (1986) concisely reviewed much of this early work and compiled recommendations for future trap research and development.

EVALUATION CRITERIA

Criteria used for evaluating capture devices have been both quantitative and qualitative. Drahos (1951b) and Robinson (1959) described some of the criteria used in judging acceptable traps related to inventors' prize competitions sponsored in earlier years by the National Association of the Fur Industry and the American Humane Association. Linhart and Linscombe (1988) detailed methods, criteria, and performance standards for testing steel foothold traps. Although most animals captured in restraining traps are subsequently killed and processed by the trapper (except in specific research or management where the objectives require releasing animals unharmed), injuries to animals captured in restraining traps have been the focus of many recent trap evaluation studies. Olsen et al. (1986) developed a scaling system for evaluating animal injuries, originally basing examinations only on legs. More recently,

international testing standards for mammal restraining traps, while using similar systems to assess injuries, have recommended the use of whole-body necropsy (USA-EC 1997, Anonymous 1999). Quantitative comparisons of cumulative injury scores under such systems are problematical (Engeman et al. 1997); wildlife veterinarians have increasingly been involved in such investigations to identify unacceptable injuries to animals using standardized protocols for examinations (IAFWA 1997). Among the criteria considered most important in current investigations of trap performance are efficiency, capture rate, selectivity, safety, practicability, animal welfare characteristics, mechanical function, cost, quality, durability, size, weight, and maintenance requirements. Physiological and behavioral responses of animals related to trapping and restraint are parameters of increasing interest to wildlife scientists but until recently have received limited investigation (Andelt et al. 1985, Kreeger et al. 1990, Windberg and Knowlton 1990, Shivik and Gruver 2002).

TRAP RESEARCH AT THE NATIONAL WILDLIFE RESEARCH CENTER

Most capture device research at NWRC has focused on improving operational tools for use in coyote management programs, although a variety of work with other mammal species and with birds has also been conducted. Robinson (1943) set a standard for control methods research at the laboratory, "Consideration of the selectivity, safety, humaneness, and general efficiency and economy of control methods before they are placed in operational use is a principle..." and three succeeding generations of NWRC scientists have applied this principle to their work in devising and improving capture devices. Several lines of research by NWRC scientists illustrate the types of progress in improving capture devices that can be made by sustained, systematic investigation.

Tranquilizers for Use with Traps

When radio telemetry systems became available for wildlife research in the 1960s, researchers sought improved means of capturing and releasing animals without trauma or behavioral effects. Balsler (1965) developed tranquilizer "tabs," using the drug diazepam, for use with steel traps set for coyotes, recognizing a variety of potential applications; the idea derived from early use of strychnine tabs to quickly kill animals captured in restraining traps. Although diazepam was available for research use on a limited basis, licensing restrictions and its status as a controlled substance precluded its development. A variety of other drugs suitable for animal capture were identified and tested with coyotes using criteria of oral delivery, rapid onset of tranquilization and prolonged effect, and availability for development (Savarie 1976, Savarie and Roberts 1979, Linhart et al. 1981). Ultimately, the drug propiopromazine hydrochloride was chosen for development and a

variety of formulations and delivery devices were tested further (Zemlicka and Bruce 1991). This drug has become available for restricted operational use by USDA Wildlife Services personnel under a Investigational New Animal Drug authorization from the Food and Drug Administration for coyotes (Zemlicka et al. 1997), wolves (Sahr and Knowlton 2000), and feral dogs (Fagerstone and Schafer 1998), with its principal use in capture and release programs.

Padded Traps

Rubber-padded traps, used in Europe as early as 1911, were introduced into the U.S. market in 1936 by Charles D. Briddell; his trap business was purchased by Animal Trap Company of America in 1939 and the traps were produced for a few more years (Gerstell 1985). Padded traps became of interest again in the 1960s because of their potential application in telemetry studies. Linhart et al. (1981) recounted the use of hand-made trap padding by researchers and indicated that manufacturer evaluation was underway. Linhart and colleagues began laboratory and field tests of prototype padded traps in 1983 with coyotes and found reduced injuries compared with standard traps (Olsen et al. 1986), but also substantially reduced capture rates and damage to trap pads, chains, and springs (Linhart et al. 1986). Continued testing and work with a manufacturer resulted in a fourth-generation padded trap (Woodstream Corporation's SoftCatch[®] System for coyotes introduced in 1988) that had capture rates nearly equal to standard traps and still reduced injuries (Linhart et al. 1988, Linhart and Dasch 1992, Phillips et al. 1992). Operational testing of this trap under a variety of field conditions (Phillips and Mullis 1996) and continued testing of additional commercial trap models led Phillips et al. (1996) to suggest that state-of-the-art padded jaw traps were the most significant trap modification to reduce injuries to captured coyotes.

Pan Tension Devices

Although they were uncommon, under-pan springs to prevent trap activation by smaller animals were used on some traps in the late 1800s (Gerstell 1985) and stories of trappers using willow twigs or other devices to place tension on the trap pan are well known; leaf spring devices for the same purpose were made by U.S. Biological Survey trappers and later the Animal Trap Company (Linhart et al. 1981). While such devices had a primary advantage of maximizing trap efficiency and selectivity in areas with small animal activity around trap sites, the need for coyote trapping within ranges of endangered species was also an emerging issue. Linhart et al. (1981) and Turkowski et al. (1984) examined several prototype under-pan springs, shear pin devices, and cut sections of steel tape in field studies and found that all of the devices, after improvement, could exclude a high proportion of non-target animal captures without a significant effect on coyote capture rate. Subsequently Phillips and Gruver (1996) evaluated the new Paws-I-

Trip[™] after-market pan tension system with several trap models and found high exclusion rates for designated non-target animals. A number of pan-tensioning systems are now available for traps, either incorporated in the trap design or for after-market installation.

Breakaway Snares

Phillips et al. (1990) used a biomechanical approach to develop data on the forces different species of domestic and wild ungulates could exert on snare cables in comparison to coyotes. They used this data to examine the physical characteristics of seven commercial and prototype snare locks to determine those likely to hold captured coyotes but release livestock and wildlife. Three of the devices were then field tested in operational use in several states (Phillips 1996). Although all accidentally captured livestock were released by snares in the tests, release of captured deer was less effective; about half the deer captured were unable to exert sufficient force to release the locks. The design approach may have other applications in auto-collaring of coyotes or other species for remote attachment of radio collars or aversive conditioning collars (Shivik and Martin 2000).

Hybrid Power Snares or Cable Restraints

Spring-powered footsnares of a great number of designs have long been available for coyotes and other species, but few have found wide use in relation to conventional traps. Robinson, Balsler, Linhart, and Phillips at NWRC all examined prototype devices that were suggested as potential replacements for steel traps, but few were found that warranted testing. Typical problems were too many loose moving parts, design constraints on the types of sets possible, likelihood of substantial damage by captured animals, expected difficulties in consistent performance in rangeland soils during different seasons, or the likelihood of increased animal injuries compared to conventional traps (for example, see the work of Casto and Presnall, 1944, on the Verbaill chain loop snare). The promise of such devices, if these problems could be overcome, is that they could be handled and set like traps, but are light-weight, easy to transport, might be cheaper to manufacture, and might be perceived as more humane. This has proven a challenge to inventors and manufacturers, and new patents seem to appear almost yearly. Phillips and colleagues conducted preliminary work on several power footsnares under pen conditions (recounted by Liss, 1994) and found the commercial or prototype units examined would require substantial modification or improvement before field testing would be warranted. Shivik et al. (2000) conducted field studies of four new types of spring-powered cable restraints and found promising aspects in several of the systems used. Injuries observed in whole body necropsies of captured animals were primarily dental and might be resolved by cable modifications and attached "pacifiers" to elicit displacement behavior (much like Balsler's tranquilizer "tabs"); capture efficiencies of

the devices would all require substantial improvements before routine use in predation management programs would be reasonable (Shivik et al. 2000). The activation mechanism for the Collarum[®] device was highly selective for coyotes (100%) in Shivik's study; its leash-type restraint system, combined with breakaway snare technology, may have application in auto-collaring of captured animals (Shivik and Martin 2000). We can probably expect to see wider availability and greater use of such hybrid devices in the future as research and development proceeds.

IMPROVING ANIMAL WELFARE IN U.S. TRAPPING PROGRAMS

In 1991, the European Union established a regulation prohibiting fur imports from countries that allowed the use of steel traps, which would obviously cripple an important U.S. agricultural industry and constrain private fur harvest, management of furbearer populations, and wildlife damage management. The story of how this moved from an issue of restraint of trade to a program of science-based trap testing has been recounted in detail by Hamilton et al. (1998). Building on a program initiated by state wildlife agencies in 1996 to develop voluntary Best Management Practices for trapping furbearers (Batcheller et al. 2000), the U.S. government, lacking constitutional authority for management of resident wildlife, negotiated a good-faith understanding with the European Union (EU) stating the intentions of both entities to establish programs for evaluation of traps in reference to international standards. In the understanding, in the form of an "agreed minute," both parties also noted their intentions to encourage and support research, development, monitoring, and training programs that promote the use of traps and trapping methods for the humane treatment of the 19 species identified (USA-EC 1997). The U.S. program, established in FY-1998 with funding for cooperative trap testing by state wildlife agencies through USDA Wildlife Services, involves 23 mammal species harvested for fur in 5 regions of the country (IAFWA 1997). Results of the program will be summarized in regional Best Management Practices guidelines for each species and published in technical journals. Grant support for outreach activities, educational programs, and other activities has been provided by the U.S. Fish and Wildlife Service and several private organizations; substantial direct and in-kind support has been provided by state wildlife management agencies. At this point in the program, 52 trap types have been tested for 15 mammal species in several U.S. regions with direct involvement of 32 state wildlife agencies. Cooperative work and coordination has been organized with Canada and Russia, which negotiated a separate trilateral agreement with the EU. Regular progress reports and resource materials on the U.S. program have been available through the IAFWA project website (<http://furbearermgmt.org>); the first Best

Management Practices document for trapping eastern coyotes is expected to be released in 2002. This program has been one of the most ambitious cooperative efforts in American wildlife management in many years, with two federal agencies, the state wildlife agencies, and several cooperating countries focusing on improving animal trap performance and animal welfare, while attempting to maintain our states' abilities to help manage resident wildlife by regulated trapping and fur harvest.

DISCUSSION

Do we need to capture animals in the United States? Yes, for a variety of good and important reasons that span the fabric of American society. Are the tools we have available for animal capture "acceptable" in the 21st Century? Certainly not to everyone. But until better alternative devices and techniques are identified and available, we need to continue to use what we have in the best ways possible. Will there be new tools? Of course. And, as in the past, most of the advances are likely to come from private trappers and inventors. Researchers can and must continue to play an important role in the development of capture devices by obtaining more detailed information on the behavior, physiology, and body mechanics of animals related to capture and restraint; by evaluating new tools and ideas as they become available; and by working with trappers and manufacturers to assure that the high expectations for effective capture device performance across the multiple criteria of acceptability can be achieved.

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