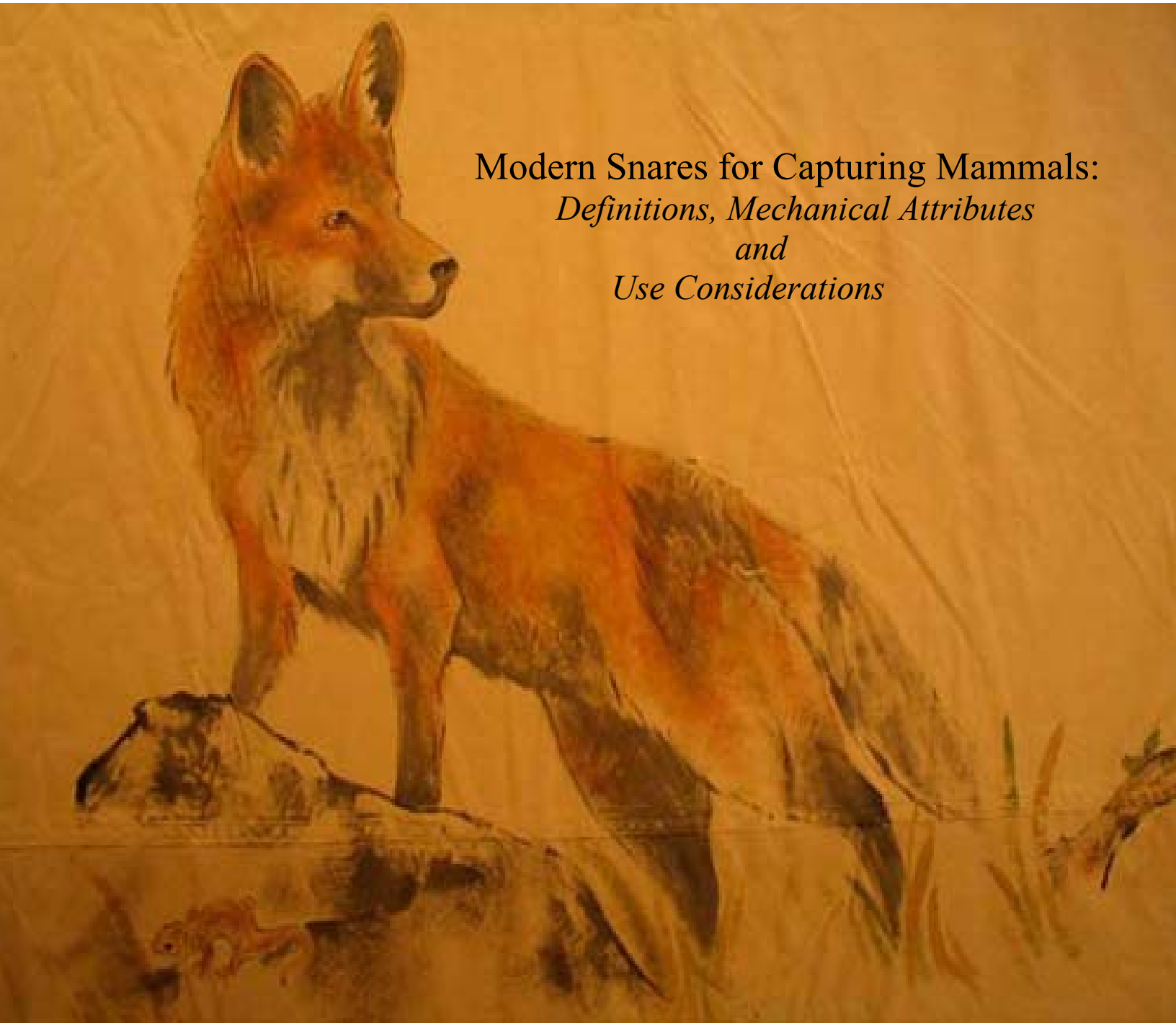

Modern Snares for Capturing Mammals:
Definitions, Mechanical Attributes and Use Considerations

ASSOCIATION of FISH & WILDLIFE AGENCIES

Association of Fish and Wildlife Agencies
Furbearer Conservation Technical Work Group

2009

ACKNOWLEDGMENTS

This document was produced by the Association of Fish and Wildlife Agencies (AFWA) Furbearer Conservation Technical Work Group, in consultation with representatives from trapping organizations and snare manufacturers. The U.S. Department of Agriculture (USDA) provided funding for trapping BMP research and development. We also wish to acknowledge the contributions of numerous state fish and wildlife agency personnel. We especially acknowledge Dr. John Erb of the Minnesota Department of Natural Resources, Forest Wildlife Populations and Research Group for serving as primary author on this document. We acknowledge Alan Huot for providing numerous photos. Cover illustration used by permission of Nomadics Tipi Makers.

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"Modern Snares for Capturing Mammals" is primarily intended as a reference document for resource professionals, but may have utility in various educational forums. Our goals are to offer definitions of snares and snare components, describe the various types of and uses for snares, and discuss various factors that may influence important snare performance attributes. While some discussion focuses on user-controlled variables, this document is **NOT** intended as a snaring 'How To' guide, nor does it recommend specific snares or snare components. The appropriate design and use for a snare will vary depending on species, time and location, and multiple designs may accomplish the same objective. Furthermore, additional scientific data on snare performance is necessary before wide-ranging comparisons of different snare designs can be made. As such, we hope this document stimulates continued research and development of snaring systems. Depiction of, or reference to, specific snares or snare components does not constitute a recommendation or endorsement by AFWA. This document may be updated periodically and updates will be posted at the AFWA furbearer website (www.fishwildlife.org/furbearer.html).

Modern Snares for Capturing Mammals: *Definitions, Mechanical Attributes, and Use Considerations*

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INTRODUCTION

Snares represent one of the oldest devices used for capturing animals. Their use dates back thousands of years, as evidenced by their depiction in cave drawings. While some snares are concealed under dirt or snow, snares are most commonly placed along existing animal travel routes, or along the anticipated path of travel an animal may use when approaching bait or other attractant. They can be, and historically were, designed or deployed to capture animals by the neck, torso, leg, or foot. While the basic principles behind snare use have changed little through time, the physical and mechanical options for snare design have greatly expanded, and snares remain a popular capture device among licensed fur trappers, animal damage control professionals, and increasingly among wildlife biologists.

Historically, snares were constructed of various plant or animal fibers, and lacked reliable mechanisms (i.e., locks) that not only allowed loop formation and smooth loop closure, but also prevented the snare loop from easily re-opening once the animal stopped applying pressure. As a result, snares either had to be tended with great frequency in order to dispatch captured animals shortly after capture, or set in a manner that would facilitate rapid death (e.g., use of 'spring poles'). Otherwise, live-restrained animals would frequently be able to break or chew through the snare and escape. With the advent of metal snare components (wire, locks, swivels, etc), both the efficiency and versatility of modern snares have improved. Users now have greater flexibility to use snares as either live-restraining or killing devices, and a variety of options are available that can influence various performance attributes (injury reduction, rapidity of death, capture efficiency, selectivity, etc.).

In spite of numerous improvements, laws and regulations in some states still prohibit use of snares, often dating back 50 - 100 years. Past concerns were frequently based on the belief that snares were highly effective but indiscriminate capture devices that allowed little user control of the capture outcome (e.g., live-restraint versus death). This led to concerns that snares could

facilitate over-harvest of furbearer populations, and could negatively impact other game populations (e.g., deer). While the goals of harvest selectivity and population conservation certainly remain important in modern wildlife management, many of the premises underlying past concerns are either less relevant today, or new options exist for minimizing those concerns.

Recently, there has been renewed interest by natural resource agencies to better understand snares as a device for capturing mammals. This interest has arisen for several reasons, including continued development of new designs or mechanical options for snares, evolving state regulations governing snare use, the development of Best Management Practices for trapping, and increased potential for use in wildlife research. While these developments have highlighted the potential versatility and humaneness of snares, they have also highlighted the need for increased awareness of modern snares amongst resource professionals, and the need to standardize terminology used for describing snares and snare components. The lack of familiarity and language consistency has produced confusion among the various constituents and ultimately hindered efforts to increase awareness of modern snares.

SNARE COMPONENTS

Before offering descriptions and definitions of snare components, we first offer a basic definition of a snare. While our definition of a snare emphasizes wire as the primary material used in the construction of modern snares, we acknowledge that more 'primitive' materials (e.g., plant or animal fibers) may still be used in some situations or locations, and that alternative modern materials could be developed or used in the future.

Snare - a type of capture device that uses a loop of wire, stranded wire, or wire rope designed and set to close around the neck, torso, foot or leg of an animal.

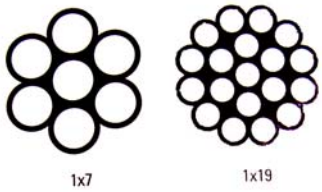
While we are unaware of any official standard for describing or defining snare components, where possible we have adopted definitions that are generally consistent with industry language. We recognize our definitions do not supplant any current language used in individual state policies or laws. Nevertheless, we encourage states to adopt consistent language to minimize confusion amongst snare manufacturers, snare users, and natural resource agencies.

Snare Cable

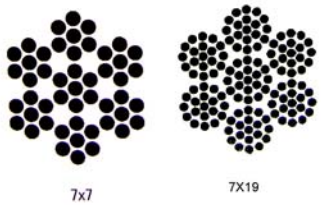
The material that forms the loop of a snare and extends to the point at which the snare is anchored is frequently referred to as the snare 'cable'. Modern snare cable is typically constructed with some type of wire (e.g., galvanized or stainless steel). The cable forms the primary component to which most other components are attached. We offer the following definitions to clarify both the material and design of modern snare cable.

Wire - a continual span of metal that has been produced by compression and elongation of larger diameter metal rods.

Strand - an assembly of multiple wires that are helically wound around an axis, fiber, or wire center.

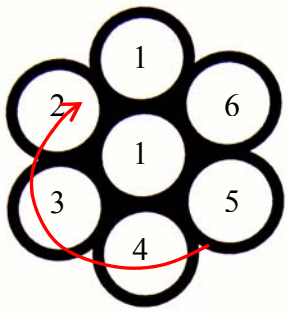


While single-wire snare designs have been used in the past, and are still commonly used for snaring snowshoe hares, most current snare designs employ multi-wire construction. The common convention for labeling these multi-wire designs is: # of strands times the # of wires per strand. For example, 7 X 7 means the design is composed of 7 strands, with 7 wires per strand, yielding a total of 49 wires. Such material is often categorized by the number of strands:



Single-Strand construction - composed of a single strand; often referred to as '**stranded wire**'. Examples most familiar to trappers include 1X19, and 1X7. *We emphasize that "single-strand" does NOT equate with "single-wire".*

Multi-Strand construction - composed of multiple strands; often referred to as '**wire rope**' or '**cable**'. Examples familiar to trappers include 7X7, and 7X19.



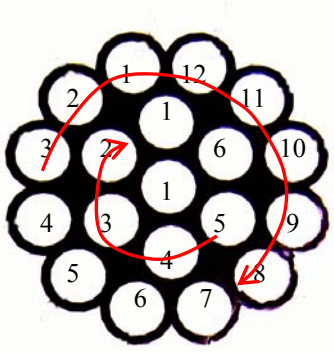
1X7

Note: Within the trapping community, both single-strand and multi-strand material is generically referred to as 'cable'. Hereafter, we use the term 'cable' to denote any *multi-wire* design.

The above strand definitions describe differences in overall cable construction. However, it is also important to understand differences in construction of an individual strand.

Single-Layer Strand – strand with only 1 layer of wires helically wound around the axis, fiber, or wire center.

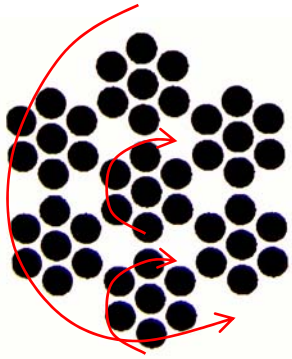
This strand construction is used, for example, in 1X7 stranded wire and in each individual strand for 7X7 wire rope. In 1X7 and 7X7, the 7-wired strand(s) are constructed with a '**1-6 single-layer'** design**,** meaning 6 wires helically wound around 1 center wire.



1X19

Two-Layer Strand – strand with 2 separate layers of wires helically wound in opposite directions around the axis, fiber, or wire center.

This construction is used, for example, in 1X19 stranded wire and in each of the seven strands of 7X19 wire rope (not shown here). In both, the 19-wired strand(s) are constructed with a '**1-6-12 two-layer'** design, meaning a center wire with 6 wires wound around it one direction, and 12 more wires wound in the opposite direction.



7X7

In either single-strand designs with 2-layer construction (e.g., 1X19) or multi-strand designs (e.g., 7X7, 7X19), it is possible for the '**lay**' of the wires to occur in both clockwise and counter-clockwise directions. Lay can include both the direction wires are helically wound within a strand and the direction individual strands are helically wound in multi-strand cable.

Lang lay - design where all the strands or wires are helically wound in the same direction. An example includes 1X7 (single-strand, single-layer construction).

Regular or alternate lay - design where the strands or wires are helically wound in both directions. Examples include 7X7, 1X19, and 7X19.

Lang lay cable is typically *not* recommended in applications that involve excessive rotation because individual wires may be more apt to separate during twisting, or may separate easier if an animal bites on the cable. Wire separation predisposes the cable to breakage. Thus, it may not be as suited to snaring applications where the intent is to live-restrain an animal, or if used in such situations, might require larger diameter cable or appropriate swiveling. This highlights the importance of understanding the cable design – design can influence various functional attributes. To further illustrate how design can influence potential performance, and for comparative purposes only, the table below shows approximate breaking strength for 24 examples.

	Breaking Strength (lbs)			
DIAMETER	**1X19**	**7X19**	**1X7**	**7X7**
3/16"	**4700**	**4200**	**3990**	**3700**
5/32"	**3300**	**2800**	**2940**	**2600**
1/8"	**2100**	**2000**	**2100**	**1700**
3/32"	**1200**	**1000**	**1200**	**920**
5/64"	**800**	**?**	**800**	**650**
1/16"	**500**	**480**	**500**	**480**

Note: these are approximations for galvanized wire designs based on static load testing. Breaking strength for stainless steel is typically comparable, or slightly less. Numbers will vary depending on manufacturer or grade.

While there will be some minimum breaking strength necessary for a given species or application (live-restraining versus killing), final choice of design may be most driven by other performance attributes or user preference. For example, cable design also influences attributes such as flexibility and surface smoothness. For a given diameter, the more wires, the more flexible the material, and the more strands, the 'rougher' the outer surface. These in turn can affect snare loop shape (e.g., oval versus round), speed of initial loop closure, resistance to loop closure as the loop gets smaller, abrasion-resistance, fatigue resistance, etc. *Overall, the physical options users may consider in a 'cable' include the diameter, design (e.g., 7X7, 1X19), and material (e.g., galvanized, stainless steel).*

The material used to form the snare loop is only 1 component of a snare. Other components for which definitions are warranted include snare locks, loop stops, swivels, and breakaway devices.

Snare Locks

Snare locks are used for 2 purposes: 1) to create and maintain a loop; and 2) to prevent the loop, after closure upon an animal, from re-opening to a diameter that allows the desired animal to escape. The type of snare lock used may also be an important feature in determining the lethality of a snare. We note that a snare does not have to have a mechanically separate lock incorporated into the design to constitute a snare. In some locations or situations (e.g., rabbit snares, under-ice beaver snares), the snare loop may be formed and held in place by simply threading the cable through a small loop or knot in the end of the cable. While such 'lock-less' snares may have reduced holding efficiency, they are successfully used in some situations.

There are a multitude of snare locks currently available, and undoubtedly many more to be developed. Numerous examples are shown in the adjacent figure. For snares incorporating a locking device, we offer the following definitions to more specifically classify the array of existing snare locks:

Relaxing Lock – a snare lock that allows the snare loop to release constriction pressure on the captured animal when the cable is not taut (e.g., when the animal stops pulling).

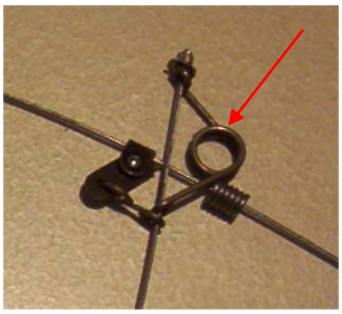
Positive Lock – a snare lock that **neither** allows the snare loop to release constriction pressure on the captured animal, **nor** is capable of applying additional closing force, when the cable is *not* taut.

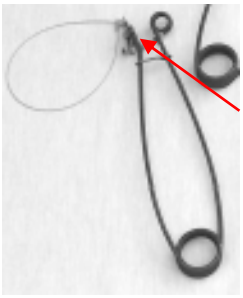
Power-Assisted Lock – a snare lock that uses a built-in or external feature or mechanical device that continues to provide a closing force when the cable is not taut (i.e., after the animal stops pulling).

Lock Definition Caveats

- With the exception of locks that are power-assisted, it is not always possible to classify a lock based on visual appearance. Locks that appear similar may perform differently, and locks that appear different may perform similarly.
- The actual performance of a lock is based not only on the design of the lock itself, but on the size or design of the cable to which it is attached. For example, depending on lock design, a lock may perform as a relaxing lock on a 1/16" cable, but as a positive lock on a larger diameter cable (such as 3/32"). Some locks may be designed or intended for use with specific cable sizes and/or designs.
- Some locks (e.g., traditional washer locks) may be placed on the 'cable' in different configurations, possibly yielding different performance.
- Any alteration of a lock from its manufactured condition may affect performance. Examples include changing the angle of any bends in the lock, the size or shape of the holes or slots through which the cable passes, or filing 'teeth' into the binding surface of a lock.
- Under normal field application, numerous external factors may affect the ability of a lock to perform as designed. For example, if a significant bend or kink forms in the cable just outside the lock position, if the lock becomes bound in the animal's hair, or if the animal cannot release tension on the cable due to 'entanglement', a relaxing lock may not be able to 'relax' as designed.

Most snare locks currently available would be considered positive locks, though many locks can be converted to power-assisted locks by the addition of a spring or other powering device. Three examples of power-assisted locks are shown below.



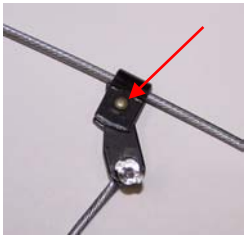


Breakaway Devices

Breakaway devices are used to improve the selectivity of a snare, and can be designed in many ways. They can be incorporated into the snare lock (as a component or as the structural material itself), or as an attachment to the snare lock or cable. Breakaway devices are typically rated based on the amount of force necessary to cause the loop to 'break' or release (e.g., a 285 lb. S-hook). The desired rating is based on both the minimum rating necessary to hold the desired animal, and the maximum rating allowable for release of other animals. As such, the need for breakaway devices, and the desired rating if used, will vary in different areas of the country, and may involve trade-offs between achieving desired selectivity and maintaining acceptable efficiency for the intended species.

We illustrate breakaway devices with several examples below, but discuss applications and issues later (see pp. 21-22). *Importantly, presence of some breakaways cannot be determined visually (e.g., slide-off ferrules or some shear pins).*

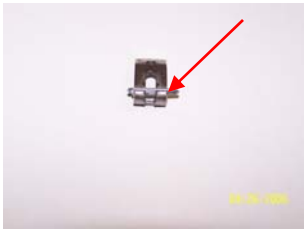
Breakaway Device – any device incorporated into a snare or snare component that allows the loop to break open, and an animal to escape completely free of the snare, when a specified amount of force is applied.



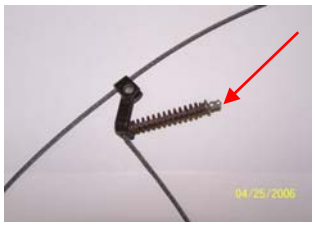
Shear Pin

J-hook

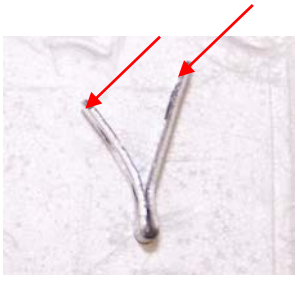
S-hook



Shear Pin



Ferrule that slides off



Lock material that shears

Issues and Concerns with Measuring or Recommending Breakaway Force

We note that more research data is necessary to determine the minimum poundage rating necessary to hold different animals of interest, and the maximum rating allowable to release any animals that are to be avoided. There are 2 additional concerns about breakaway measurements:

- Currently there is no standardized methodology for measuring breakaway force. Because snares, or snare parts, are manufactured, used, and sold by numerous individuals and companies, a standardized methodology for measuring breakaway tension would minimize the inconsistencies that currently exist.

- When breakaways are required by law, or advertised by manufacturers, the protocol used to rate the breakaway is often not specified. Specifying a number without a protocol for how it's measured may not be useful, and if required by law, is difficult to enforce. The same exact device measured in two distinct ways could yield substantially different breakaway ratings.

We believe a standardized protocol is desirable, considering 3 important features:

- To be accessible to the greatest number of potential users, the testing approach should be as mechanically simple and inexpensive as possible.

- The protocol must not only specify the measuring apparatus, but also any important snare specifics during testing such as loop size or the material to which the loop is attached during testing (e.g., a steel pipe).

- The measuring apparatus and testing protocol should not contribute to significant variability in results. When testing multiple devices of identical design, observed variation in results should be attributable primarily to variability or inconsistency in the breakaway device itself.

Considering the factors above, **we recommend the use of a static load test** for rating breakaway devices. A static load test uses non-moving weight or non-jolting force applied to the snare.

There are numerous ways to design a static load test. Provided the principle of a static non-jolting force is maintained, most testing designs should provide acceptably comparable results. However, there may still be some trade-offs between the sophistication or cost of a testing system and the resulting precision. Because the acceptable cost and desired precision will vary depending on the situation or entity involved in the testing, herein we do not recommend a specific testing apparatus, with 1 exception: some research has shown that the diameter of the snare loop during testing will influence breakaway ratings. Hence, for standardization, **we recommend the snare loop be cinched around a 2-inch steel pipe during testing. We note that a "2-inch pipe" has an actual outside diameter of ~ 2.4 inches, while the inside diameter varies depending on wall thickness of the pipe.**

We do not believe, *for a static load test*, that the length of the snare will have any appreciable influence on breakaway ratings. While snare cable can stretch when tension is applied, the potential is quite low that any stretching will occur for the typical snare lengths used and loads applied, and any stretching that may occur is not likely to be a noteworthy component of breakaway variability. **We acknowledge, however, that after a breakaway device is rated, subsequent field testing to evaluate efficiency and selectivity for a specific application (e.g., capture wolves but release moose) should always report the length of snare tested, as snare length will have an impact on efficiency and selectivity.**

Although we only recommend one component of the static load test (i.e., cinch the loop around a 2-inch steel pipe), we do discuss 2 possible testing methods as a way to illustrate possible approaches.

1) Use of weights – the snare is suspended from a rigid anchoring point, with the snare loop cinched around a 2" steel pipe. Attached to and hanging below the steel pipe is a 'load tray' upon which weights of the desired increment are sequentially placed until the breakaway device releases. The breakaway poundage rating is the sum of the load tray weights, the weight of the tray, and the weight of the steel pipe. In such a design, it is important to ensure that weights are gently placed, not dropped, on the load tray. Upon release, the weight tray will drop, requiring careful safety considerations.

2) Use of slow-pull devices and load scales – in this type of design, the testing apparatus could be positioned vertically or horizontally. On 1 end is a stationary device used to generate tension on the snare. Examples include a hydraulic cylinder, an electric winch, or a ratcheting pulley. Attached to this force-generating mechanism is a device to quantify the amount of force being exerted. Examples include a heavy-duty spring scale or more sophisticated digital strain gauge or load cell. The anchor end of the snare is then attached to the measuring scale, while the snare loop is cinched around a 2" steel pipe (with pipe attached to a fixed point). As tension is **slowly** increased, the measuring scale should preferably record the maximum force upon breaking, rather than requiring a person to read it during the test. Because there will be tension on the snare upon release, appropriate safety is warranted.

We note that there will be some amount of breakaway variability attributable to quality control during breakaway manufacturing. Manufacturers or researchers involved in determining a rating for a particular breakaway device should consider an appropriate sample size for quantifying variability, and if applicable, those involved with determining compliance with breakaway recommendations or laws must consider how much variation is acceptable.

Loop Stops

A loop stop is a device that is attached to the snare cable to prevent the loop from either opening or closing beyond a specified point. They can be placed either inside or outside the loop, thereby determining either a minimum or maximum loop circumference. Loop stops are considered optional snare components, and while used most commonly to influence selectivity, they can also influence snare lethality and efficiency (see pp. 17, 20, 21, and 22).

Minimum Loop Stop – a device incorporated *inside* the snare loop that prevents the loop from *closing* beyond a specified circumference.

The term "**deer stop**", commonly used by many, should be considered a specific application for a minimum loop stop (i.e., a stop that prevents loop closure smaller than the diameter of a deer's leg).

Maximum Loop Stop - a device incorporated *outside* the snare loop that prevents the loop from *opening* beyond a specified circumference.

Swivels

Swivels are often incorporated into a snare to prevent the wires or strands in a cable from kinking or separating, and ultimately breaking, if an animal twists or rolls. While they are primarily intended to improve capture efficiency of snares (see p. 22), they may play a role in other snare performance measures (see p. 18).

In-line swivels may be used instead of, or in conjunction with, end swivels, and may be particularly useful in situations where there is concern that the anchoring system, or vegetation between the anchor and the animal, could cause the end swivel to become effectively inoperable. The closer the in-line swivel is to the animal, the more likely it will retain its intended effectiveness.

End Swivel **-** a device incorporated at the point where the snare is attached to a stake, tree, or other anchoring point that allows the snare to freely rotate if the animal twists or rolls.

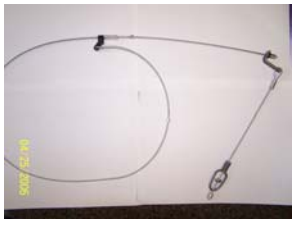
In-line Swivel – a device incorporated *between the anchoring point and the opened snare loop* that allows the snare to freely rotate if the animal twists or rolls.

Many swivel designs are currently available, and a few examples are shown below.

End swivel

In-line swivel

In-line swivel



End and In-line swivel

SNARING SYSTEM COMPONENTS

In addition to the components that make up the actual snare, some *snaring systems* utilize additional components designed to achieve specific performance goals (e.g., targeting a specific capture area on the animal, improving killing power, improving efficiency, etc). Many, but not all, of these designs have been developed for specialty purposes in wildlife research or animal damage control settings. In particular, components have been developed to power-activate loop closure or directionally-propel snares onto an animal or a specific part of an animal's body.

Snare-Activation

The vast majority of snares in use today are 'activated' simply by the animal moving through the snare. However, some specialty snaring systems now rely on power-activation, typically to increase the speed of loop closure or to directionally propel the snare onto an animal's body. We differentiate snare activation based on whether loop closure utilizes only the movement of the animal, or whether it also utilizes a powering mechanism.

Power-Activated Snare – a snare on which the loop closure (speed or direction) is initiated or augmented by some type of powering device (e.g., a spring).

For power-activated snares, some type of pushing or pulling force applied by the animal typically serves to trigger the powering mechanism. Four examples are shown below.

Belisle foot snare

RAM Power Snare

Fremont foot snare

Collarum®

Passively-Activated Snare – a snare on which the initial loop closure is solely a function of the animal's movement.

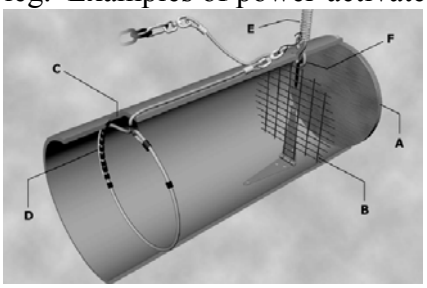
While the 4 examples shown above all incorporate power-activation, the snaring systems differ significantly in their intended use and performance (e.g., intended capture location, killing versus live-restraint). *We emphasize the important distinction between a power-activated snare and a power-assisted snare lock.* Power-activation is used only to control the speed and/or direction in which the snare loop is initially propelled or closed on the animal. A power-assisted lock is intended to increase killing power of a snare by applying constriction pressure on the loop when the cable is not taut. Snares may have power activation, power-assisted locks, neither, or both. For at least one snaring system – the RAM power snare - the same mechanism used to power-activate the snare also serves as the power-assisted lock (i.e., it is intended as a 'killing snare'). In other cases the power-activation components may 'fall free' from the snare, relying on a snare

lock to maintain loop closure - examples include the Belisle, Aldrich, or Fremont foot snares, or the Collarum® neck snare.

Capture Area

With respect to capture location, we reiterate that snares can be designed or deployed to capture animals by the neck, torso, leg, or foot. The most commonly used snares have no specific mechanical features designed to facilitate capture of an animal by only one specific body portion. Depending on user-controlled deployment details, the snare could be used to capture the desired animal by the foot, leg, neck, or torso. For example, a snare set above, but close to, the ground may facilitate leg or foot capture as an animal walks through, while the same snare set suspended higher off the ground over a trail may facilitate capture of an animal by the neck or torso. The appropriate or possible catch location (foot, leg, torso or neck) may vary by species, location, intended outcome (killing versus restraining), injury-potential during live-restraint, or concerns over fur damage (torso captures may result in more fur damage). Users can influence the likelihood of catching an animal by a specific body portion by considering such factors as: 1) loop size; 2) height of the loop off the ground or compacted snow; 3) loop orientation; and 4) natural or unnatural 'guides' to direct animal movement. In addition, some specialized snaring systems are now available that rely on additional mechanical components or other features specifically designed to facilitate capture of an animal by a particular body area.

Specialty foot snares are typically designed with power activation and are often concealed under the dirt or snow. When an animal pushes or pulls a trigger with its foot, a throwing arm or other mechanism raises or closes the snare over the animal's foot or leg. Examples of power-activated foot snares include the Aldrich, Belisle, M15, and Fremont foot snares (some shown on previous page). At least one *passively-activated* 'reach-in' type of foot snare has also been developed for bears (RL04, shown at right). In order to reach bait, the animal must pull on a mechanism that manually closes the snare loop. The design could likely be modified for use on other species.



Another specialty snaring system (Collarum®; shown on previous page) has been developed with the intent of ensuring restraint of an animal, specifically a canid, by the neck. It operates similar to many foot snares, using power activation and concealment under dirt or snow. It relies on an exposed bite and pull trigger with scent or bait applied to it. The trigger serves both to provide power-activation and center the animal's head over the concealed snare. When pulled, it releases a 'throwing' mechanism that propels and closes the cable over the animal's neck. The mechanically separate power-activation mechanism then falls away from the snare.

DESCRIBING MODERN SNARES

With the development of new technology and awareness of the varied designs and intended uses for snares has come an increase in the desire to classify or characterize snares. A snare or

snaring system can be characterized by its mechanical attributes or some performance attribute. For purposes of describing a snare or snaring system, it is easier to differentiate devices based on mechanical definitions or features.

Relying on the definitions and discussion above, we suggest describing a snare or snaring system based on the method of activation (power versus passive), lock type (but see caveats on p. 5), and any additional specialized features designed for a specific purpose (e.g., for capture by the leg). For example, a basic snare might be described as a "passively-activated snare with a relaxing lock", while a specialized snare or snaring system might be described as a "power-activated snare, with a positive lock, specifically designed for live-capturing a bear by the foot".

Recently, the terms 'killing snare' and 'cable restraint' have arisen to differentiate snares, or more appropriately, snare performance. The latter term is used to denote snares intended to live-restrain animals. Both have utility depending on the situation or location, and clearly there is value in being able to differentiate snares based on this performance criterion. **Nevertheless, there are two challenges with pre-defining a snare according to this field performance criterion: 1) additional scientific data is needed in order to reliably evaluate whether, based only on knowledge of design features, a given snare will kill or live-restrain an animal; and 2) the killing potential of a snare is likely determined by multiple factors, including its mechanical attributes, the manner and conditions under which it is deployed, and the species captured.** For example, a passively-activated snare with a relaxing lock could be used to kill or live-restrain an animal depending on the species, and how, where, or when it is deployed. Hence, establishing *useful* definitions of a 'killing snare' and 'cable restraint' requires incorporation of all these factors. We instead focus on *discussing* all factors, both mechanical and user-determined, that may influence whether a snare kills or live-restrains an animal. We also discuss factors that may influence selectivity and efficiency.

Our discussion is intended to highlight which factors may be important, and many statements are, by necessity, speculative and comparative only. Hopefully, additional data on performance will be collected in the future, thereby improving our understanding of, and ability to predict, overall snare performance. We also emphasize that one must consider multiple performance attributes (killing potential, selectivity, and efficiency) in the selection of a snare.

SNARE PERFORMANCE

Killing versus Live-Restraining Animals

With modern snares, users now have more ability to control whether animals are live-restrained or killed. However, performance in this context is not based solely on *whether* a device kills or live-restrains an animal. As part of the process to develop Best Management Practices (BMPs) for trapping in the United States, the welfare of animals captured in killing devices of any type is based on 'time-to-death', while the welfare of animals captured in live-restraining devices is evaluated based on injury scores. While animal welfare data has been collected for some snare designs, we believe additional data is needed before reliable generalizations can be drawn. For a review of the BMP process and data collected to date, we refer the reader to the BMP documents

available at www.fishwildlife.org/furbearer.html. Following is a list of factors that may affect the probability that a snare will kill or live-restrain an animal. For each variable discussed, comparative statements are based on the assumption that "all other variables are equal."

- *Cable design* – while there are numerous cable designs manufactured, there are 4 currently used most commonly for constructing snares (1X19, 7X7, 7X19, and 1X7), with 1X19 (19 wires) and 7X7 (49 wires) most common. As a general rule, for cables of the same diameter, the fewer the number of total wires in the cable the stiffer the cable will be. While some trappers believe that stiffer cable may have greater killing potential, others disagree, and there is currently insufficient data to substantiate the importance of cable design on killing potential.

- *Capture area* – killing potential is greater for neck-snared animals than for animals captured by the leg, foot, or torso. However, as BMP data has shown, by no means does neck-capture prevent humane live-restraint of animals.

- *Cable diameter* – for a given amount of force, thinner cables will concentrate this force into a smaller area (i.e., thinner cables will have higher constriction pressure per unit area), thereby increasing killing power. For animals live-restrained, thinner cables may increase the risk of injury.

- *Lock size* – for the same reason discussed under cable diameter, locks that have less surface area *in contact with the animal* may have greater killing potential. One should consider both cable diameter and lock size when evaluating the amount of snare surface area in contact with the animal – more total surface area in contact should reduce killing potential.

- *Lock type* – Relaxing locks have the least killing potential, while power-assisted locks have the greatest killing potential. While additional research is needed to quantify the difference in killing potential between positive locks and power-assisted locks, power-assisted locks should not be used if the intent is to live-restrain an animal, and relaxing locks should not be used if the intent is to kill an animal. Readers should also review the lock categorization caveats on p. 9.

- *Minimum loop stops* – killing potential, particularly for neck-snared animals, can be reduced by incorporating minimum loop stops that prohibit the loop from constricting enough to restrict air or blood flow. We urge careful thought in determining the appropriate position to place a minimum loop stop when the goal is to live-restrain an animal. *Inappropriately* positioned minimum loop stops could be ineffective (i.e., not live-restrain), or could cause excessive injury in live-restrained animals. An excessively loose cable might repeatedly slide or turn on the animal causing abrasions or cuts, or a cable tight enough to partially restrict circulation, but not tight enough to kill, could cause extensive edema.

- *Entanglement* – While not a mechanical component of a snare, entanglement is believed to be a key variable influencing killing potential. Entanglement refers to situations where

the animal is able wrap the snare cable around objects that do not easily bend or break (e.g., larger trees and shrubs, fences, or sturdy ground objects). Entanglement increases killing potential in two ways. First, it may allow an animal to use the object to gain greater leverage when pulling, thereby allowing it to tighten the snare loop more. Secondly, it may reduce the animal's ability to release tension on the snare (e.g., if all or part of the animal becomes suspended off the ground).

- *Snare length* – longer snares have a greater potential to kill. As cable length increases, a moving animal will generate more force when the cable becomes taut, and this force will be transferred to loop constriction. Longer cables may also increase the potential of entanglement.

- *Anchoring method* – snares anchored to rigid and immovable objects *may* have greater killing potential. As an animal lunges against the solid anchor, more force will be transferred to loop constriction. However, BMP research has shown that rigid anchoring methods can work fine when the goal is to humanely live-restrain animals. Furthermore, movable anchoring points (i.e., drags) may effectively become rigid and immovable if they become wrapped around a fixed object, or may allow the animal to reach an area of entanglement. Hence, it is not always possible to predict whether a certain anchoring method will consistently influence the killing potential of a snare.

- *Anchoring height* – some research data suggests that the height at which the snare is anchored above ground could affect killing potential. Higher anchoring points may increase killing potential by causing the snare loop to tighten closer to the anterior portion of the neck, near the base of the skull, where blood vessels and the trachea may be less embedded in body tissue. However, the effect of anchoring height may be influenced by snare length. For a given anchoring height, a longer snare will reduce the angle between the animal and the anchor point, potentially reducing killing potential as compared to a shorter snare anchored at the same height.

- *Shock springs* – while shock springs are not commonly used on snares, they may reduce killing potential or injury during live-restraint. When an animal lunges, a shock spring may reduce the amount of force transferred to loop constriction, though no data exists to quantify this possible effect.

- *Swivels* – while some trappers believe swivels may reduce killing potential, there does not appear to be any consensus, and we are not aware of any data to further evaluate. Similar to foothold traps, swivels on snares may also play a role in reducing injury to live-restrained animals, but data is currently lacking to reach any conclusion.

- *Animal species* – here, we simply note that animal species differ in terms of morphology, physiology, and capture behavior. Independent of snare design, some species may be more or less prone to being killed in a snare.

Both killing and live-restraining devices have merit depending on circumstances. The multiple factors that can influence killing potential illustrate both the versatility of snares, and the fact that

multiple variables must be considered when deploying a snare or designing a snare regulation for a particular outcome. *Because one snare has a feature with greater killing potential than another does not mean that one will kill an animal and the other will live-restrain.* Considering both snare design and the manner in which the snare is deployed, multiple features may be necessary to achieve the desired outcome, and there are likely multiple configurations that may be used to achieve the same outcome. Appropriate configurations vary depending on desired outcome, species of interest, location, user preference, and selectivity concerns.

Selectivity

Selectivity can be defined in different contexts. First, one can consider single-species selectivity as the ability of a snare to capture only one species. Secondly, one can consider selectivity for a suite of species that may be legally captured at a given time and place. The most important aspect of ensuring desired selectivity is to remain vigilant for the presence of animals in the area that are to be avoided. **One should always consider potential selectivity when deciding whether to increase or decrease the killing potential of a snare.** Following is a list of factors that may be useful for influencing selectivity.

- *Loop size* – while many trappers have preferred loop sizes for capturing a particular species, there is likely a range of loop sizes that may work equally as well for a given species. Modifying loop size may still allow a desired animal to be captured, while minimizing unintended capture. Loop size may be useful for minimizing capture of animals either larger or smaller than the intended species. For example, using the smallest loop size necessary to capture a fox or coyote may reduce the risk of capturing a wolf. Conversely, using the largest loop size possible to capture a beaver may minimize the risk of capturing an otter. The greater the difference in size of animals, the greater the ability to be selective.

- *Height of the loop from the ground* – as with loop size, there is likely a range of acceptable distances the loop can be positioned above the ground and still capture a particular species. Within this acceptable range, the snare loop should be positioned at a level most apt to minimize risk of capture for other animals to be avoided. Loop height may be useful for minimizing capture of animals either larger or smaller than the desired species. Raising a loop may allow smaller animals to pass under, while lowering it may allow a larger animal to step over, or the loop may simply 'brush' off the chest or leg of a larger animal. Lowering it too much, however, could result in capture of a larger animal by the leg if the animal does not jump over.

- *'Guide sticks'* - various natural or unnatural material may help guide the desired animal through the snare, and/or guide another animal over, under, or around the snare. The placement AND size or rigidity of the guide can influence animal behavior, and should both be considered. For example, a large 'jump stick' placed too high, with the snare underneath, may allow or encourage a deer to go under the stick and get caught, rather than jumping over the stick. Conversely, if the guide stick were small enough and not rigid (or if no guide stick was used), a fox or coyote may go through the snare and get

caught, but a deer may simply walk through it and brush the snare away with its chest or legs. 'Diverter wires' attached or placed perpendicular to, and over the top of, the snare loop have also been shown to reduce moose capture in wolf snares. While not as common, guide sticks can also be placed under a snare. For example, a *small diameter* stick placed under a snare might cause a fox or coyote to raise its chin and go through the snare, but may encourage a slightly smaller animal (e.g., fisher) to duck under. Knowledge of the species present and their behavior is critical in deciding whether to use a guide stick, and if so, the appropriate placement and size.

- *Bait and lures* – while effective snare use does not require use of baits or lures, they are often used to attract animals to a given area. As with all capture devices, choice of whether to use baits or lures, and if so, which one, can influence the types of animals that are attracted to a given area. Selectivity can either increase or decrease depending on bait or lure choice, and **one must consider not only whether the intended species will be attracted, but also what *other* animals will be attracted.**

- *Minimum loop stops* – by controlling minimum loop diameter, minimum loop stops can be used to selectively allow escape by animals smaller than the intended species, or allow escape of animals captured in a specific body area (e.g., leg). For example, a minimum loop stop might be used to: 1) allow for beaver capture, but an otter to escape; 2) allow for fox capture, but a fisher to escape; 3) allow for coyote capture, but a deer caught by the leg to escape. Once again, we urge careful thought in determining the appropriate position to place a minimum loop stop. One must consider not only the appropriate loop size that will allow a particular animal to typically escape, but also any potential effects of a loop stop on the captured animal (abrasions or cuts could occur if an excessively loose loop repeatedly slides or turns on the animal, and extensive edema could occur if the cable is tight enough to partially restrict circulation, but not tight enough to kill).

- *Maximum loop stops* – maximum loop stops are not necessary to control maximum loop diameter. Users can effectively control maximum loop diameter by how far they open the loop during deployment. If for any reason there is a desire to mechanically restrict the maximum loop circumference, then maximum loop stops are the primary method for doing so. For example, a maximum loop stop, by preventing the loop from being large enough to capture a deer, could be used as an alternative to "deer stops" in situations where mink snaring is of interest. In general, maximum loop stops minimize the capture of animals larger than the intended animal.

- *'Pan-tension'* – pan-, or more generally, trigger-tension, is commonly employed with foothold traps, and occasionally with body-gripping traps, to increase selectivity. Its primary application with snares is with power-activated snares. Power-activated snares often rely on a trigger, typically foot-depressed or mouth-pulled, that activates the snare. Increasing the amount of force required for activation can improve selectivity by minimizing the risk of capturing smaller or less 'forceful' animals.

- *Snare 'loading' and lock positioning* – Snare 'loading' refers to the process of altering the curvature of a portion of the snare loop in a manner that causes the snare loop to close

more rapidly once an animal's movement initiates loop closure. Snare loading, often done to improve capture efficiency, may NOT be wise in situations where there is a desire to allow smaller animals, which may still bump the snare, to pass through a snare set for another species (e.g., to allow an otter to pass through a beaver snare). The sensitivity to loop closure for passively-activated snares can also be influenced by the position the lock is placed on the loop during deployment (e.g., "11 o'clock", "12 o'clock", or "2-o'clock"). Reducing sensitivity may prevent a loop from closing if a smaller animal to be avoided goes through and bumps the snare.

- *Breakaway devices* – Breakaway devices can be designed in many ways, and numerous examples were illustrated previously. Basically, they allow the snare loop to break open and an animal to escape completely free of the snare when a specified amount of force is applied. Hence, they are used to prevent restraint of animals capable of generating more force than the animal of interest.

As with killing potential, there are multiple snare component configurations or setting methods that may be used to accomplish a particular selectivity objective. We illustrate this point with an issue that has arisen in some states. "Deer stops", often recommended to minimize capture of deer by the leg, make it impractical to use snares to capture smaller furbearers like mink or muskrats. Alternative options that may be just as effective at reducing deer capture, without effectively prohibiting mink or muskrat capture, include the use of breakaway devices or use of a maximum loop stop that mechanically prevents loops that are large enough to have a realistic probability of capturing a deer. Whether there is a need for any special selectivity features, and the appropriate configuration if so, may vary depending on location, species present, other performance needs (e.g., killing potential, efficiency), and user preference.

Snare Efficiency

As with selectivity, efficiency can be defined or computed in different ways. Similar to the definition utilized in the development of Best Management Practices for trapping, we define efficiency as the proportion of times the device captures and holds the intended animal that has activated the device. This is distinct from 'captures/trap night', a measure that is highly influenced by variations in animal population density. Because many snares are passively-activated, activation in this context means the snare has been altered by the animal from its set position. As with all capture devices, the manner in which a snare is deployed can greatly influence efficiency. In contrast to selectivity, we felt the influence of some user-controlled variables (e.g., loop size, loop height, etc) on snare efficiency is more appropriately left for specific snaring "How To" books. We acknowledge the importance of those factors, but focus more on the role that various mechanical features may play in efficiency. Again, comparative statements are based on the assumption that "all other variables are equal".

- *Cable diameter* – cable diameter can influence efficiency in two ways: 1) when an animal is live-restrained, by intent or otherwise, smaller-diameter cables have reduced breaking strengths, and may be more prone to breaking if excessive force is applied or if the live animal chews on the cable; 2) while animal sensory capabilities vary by species, some

animals may be more apt to see larger diameter cable and avoid or step through the snare, or feel it and back out of the snare prior to loop closure. Of the two concerns, preventing cable breakage should be the first priority since cable breakage often leaves the snare attached to the animal.

- *Cable design* – cable design could influence efficiency in several ways: 1) smoother, stiffer cable may facilitate more rapid *initial* closure of the snare, making it harder for the animal to sense and back out of a snare. However, stiffer cable also creates more resistance to loop closure as the loop diameter gets smaller; 2) cables with lang lay, particularly if used without swivels, will be more prone to wire separation during rotation or biting, increasing the potential for breakage; 3) for a given diameter, cables with more wires have greater fatigue resistance (more flexible), but cables with more wires may be less abrasion resistant (small wires will wear faster).

- *Lock type* – locks that slide more freely on a cable will close faster, minimizing the opportunity for an animal to back out of the snare. How freely the lock slides will depend not only on the lock type, but also on cable design (see above). Also, some lock types may not be appropriate for certain types of snares. For example, a relaxing lock is not recommended for a leg snare, as any opening of the loop will allow the snare to slide off the leg.

- *Swivels* – snare swivels may help minimize wire stress, wire separation, or wire kinking if an animal twists or rolls, thereby minimizing risk of cable breakage. Swivels are more apt to be beneficial in situations where animals are live-restrained.

- *Breakaway devices and minimum loop stops* – breakaway devices and minimum loop stops, often used to increase selectivity, can also influence efficiency. Complete separation of species based on breakaway strength or minimum loop size may not always be possible. Hence, there may be tradeoffs between selectivity (allowing escape of some species) and efficiency (preventing escape of desired species) when incorporating these devices.

- *Snare 'loading' and lock positioning* – Snare 'loading' and lock positioning were previously discussed under selectivity on p.21. They may also influence capture efficiency. *Provided the animal is correctly 'positioned' when the loop begins to close*, a more rapidly closing loop (i.e., via snare loading) may minimize the opportunity for an animal to back out of or pass completely or partially through a snare before it is appropriately restrained. By reducing the amount of animal pressure necessary to cause loop closure, positioning a snare lock in a more 'sensitive' position may also result in higher capture efficiency, p*rovided the animal is correctly 'positioned' when the loop begins to close.*

- *Passive- versus powered-activation* – power-activated snares could minimize the opportunity an animal has to back out of a snare prior to complete loop closure.

The appropriate deployment specifications (e.g., loop size, loop height, lock position, 'loading' snares, etc) for maximizing snare efficiency are best learned through snaring "How To" books and field experience. With respect to mechanical attributes that influence efficiency, one should focus on three issues: 1) particularly when live-restraining animals, use designs that minimize the chance the desired animal will break or bite through the cable; 2) use designs that facilitate smooth rapid closure when activated by the desired animal; and 3) when incorporating devices to improve selectivity, consider potential tradeoffs with efficiency. In some cases, there may be little tradeoff (i.e., there will be little loss of efficiency). In cases where a selectivity feature does reduce efficiency, the acceptable level of tradeoff may be influenced by factors such as whether animals unintentionally captured can be released alive, and the legal or biological 'status' of those animals.

CONCLUSIONS

Snares represent one of the oldest forms of animal capture devices, and the principles of snare deployment have not changed substantially. However, the mechanical attributes and options for snares have changed significantly in recent years, and will likely continue to expand. Unfortunately, the public, many resource professionals, and some trappers are not familiar with all the features and variations of modern snares. Various snare designs have been used to capture wildlife species for reintroductions or research, including such species as bears, wolves, lynx, fox, coyote, and beaver. As with any capture device, achieving the desired performance requires both experience and an understanding of mechanical attributes and options.

While much is known about *whether* specific snare features can influence a given performance criterion, there is a need for additional scientific data to better understand the *degree* to which they may do so. While additional data would allow us to refine our ability to predict snare performance, there are likely three things that won't change:

- Trappers and resource professionals need to consider all performance criteria (killing versus live-restraint, animal welfare, selectivity, and efficiency) when selecting snare designs. Changing design to influence one performance attribute may alter (positively or negatively) other performance.

- For a single performance criterion, biologists and trappers must consider *multiple* variables when striving for a desired outcome. Ignoring one variable may yield unintended results.

- There are likely multiple configurations that will accomplish the same objective. When a specific outcome is necessary or desired, biologists (and trappers) should not only familiarize themselves with any current data that exist, but should recognize where multiple configurations may be acceptable. Restricting to only one specific configuration may not be necessary, and may even be counterproductive if it limits the options users have to adapt to specific situations or locations.

There will always be a need to describe snares or snare components, and we encourage use of the terms and definitions herein. As additional performance data are collected, it may be possible to refine or strengthen conclusions regarding the influence of design on performance, which may then suggest the need to include additional definitions or categories for specific components. As with the Best Management Practices for trapping, this document may be updated periodically. Updates will be posted at the AFWA furbearer website (www.fishwildlife.org/furbearer.html).