Published on paper: 1998. Published online: 2024-10-11.
ISSN 1502-4873 (paper). ISSN 1891-5396 (electronic).
doi: https://doi.org/10.5324/fn.v19i0.6007.

Methods for live-trapping beaver (Castor spp.)

Rosell, F. & Kvinlaug, J.K.

Rosell, F. & Kvinlaug, J.K. 1998. Methods for live-trapping beaver (Castor spp.). - Fauna norv. Ser. A 19: 1-28.

Effective live-trapping of beaver (Castor spp.) has been and will continue to be necessary for introductions, re-introductions, translocation for the preservation of populations, removal of nuisance beaver, and to obtain animals for fur breeding, zoological gardens and research. The aim of this study was therefore to review the existing knowledge about live-trapping through a literature study, contact with individuals involved in live-trapping, and personal experience. Before starting live-trapping, the area used by the beaver should be determined by careful reconnaissance. Beaver are usually captured either in unbaited traps placed at sites frequently visited by beaver, or in traps baited with castoreum or an aspen twig. Human scent on traps and around the trap site may be reduced by adding mud, water or scent. Usually Bailey or Hancock traps are used for live-trapping beaver. The Hancock trap is preferable because of its greater catch efficiency and versatility. Other traps reviewed are the Breathe Easy trap, Scheffer-Couch trap and different types of cage traps. Other methods used for live-trapping of beaver are snares (often considered highly effective), the Byelorussian trapping method, nets and seines, landing nets, pits and enclosures. Capture methods involving the destruction of lodges/dens and dams have often been employed in the past. Such methods require special permission in most countries and are usually not to be recommended. The Eurasian beaver (C. fiber Linnaeus, 1758) is reportedly more difficult to live-trap than its North American counterpart (C. canadensis Kuhl, 1820). New, effective methods for live-trapping of beaver also need to be developed.

Key words: Bailey trap, beaver, Breathe Easy trap, Byelorussian trapping method, cage traps, Castor canadensis, Castor fiber, enclosures, Hancock trap, live-trapping, nets, pits, Scheffer-Couch trap, seines, snares.

Frank Rosell (to whom correspondence should be addressed), Telemark College, Department of Environmental Sciences, N-3800 Bø, Norway. Phone: (47)35952762, e-mail: Frank.Rosell@hit.no
Jan Kåre Kvinlaug, Hedmark College, Department of Forest and Resource Studies, Evenstad.

INTRODUCTION

In 1922, two Eurasian beavers (*Castor fiber* Linnaeus, 1758) were sent to Sweden to re-introduce the species, which had been absent since the 1870s (Vevstad 1989, Nolet & Rosell 1998). These individuals were trapped in pits in Løddesøl in Aust-Agder, Norway, and marked the beginning of the beaver export from southern Norway. In the years to follow, beaver were trapped in the south, in the vicinity of the Nidelv river in inner Agder, and set out again in several counties in Norway to help the beaver population spread (Vevstad 1989).

After the first world war, there was increasing interest in beavers outside of the traditional core areas as well. In 1925-32 and 1952-65, nine translocations of a total of 40 beaver were carried out in Norway, but most of these failed because too few beaver (2-6) were introduced (Myrberget 1967). Requests for animals for re-introductions also came to the Norwegian authorities from other countries. From 1922-39, 80 Norwegian beavers were released at 19 locations in Sweden (Hartman 1995a) and from 1935-37, 17 beaver were released in Finland. A rough

estimate of today's population of "Norwegian" beaver in Scandinavia is 50 000 in Norway, 100 000 in Sweden in 1995, and only 1 000 in Finland in 1995 (Hartman 1995b, Rosell et al. 1996, Lahti 1997). Norwegian beaver have also been released in Switzerland and Latvia (Owesen 1979, Rosell & Parker 1995).

At about the same time that capture and translocation of beavers started in this country, the same thing also happened in the USA. There the aim was to spread the North American beaver (*C. canadensis* Kuhl, 1820) after its dramatic reduction as the result of intensive hunting. There was also interest in raising beaver in captivity for fur. Several kinds of traps for live-trapping were developed to need the need to capture living individuals (Bailey 1927).

As of today (1998), the beaver has still not re-established itself in all parts of its previous range in Norway. At the same time, hunting is allowed in other parts of the country where the beaver seems to be well established (see map in Rosell & Parker 1995). Thus, release of beaver to help its re-establishment is still relevant. In Finnmark, especially, there is interest in releasing beaver again after several unsuccessful previous attempts (Peik Bendixen pers. comm., Tom E. Ness pers. comm.). Efforts are also being made in Great Britain to re-introduce the beaver, especially in Scotland (Macdonald et al. 1995, Collen 1997), and in Romania (Troidl & Ionescu 1997). Nolet & Rosell (1998) also suggested that one should study the possibilities for re-introducing the beaver in Denmark and Italy (see Fischer Andersen 1997).

There is, and there will continue to be, a need for effective live-trapping of beaver for introductions, re-introductions, translocations, fur production, zoological gardens and research. The aim of this study was therefore to review the existing knowledge about live-trapping through a literature study, contact with individuals involved in live-trapping, and personal experience.

NORWEGIAN LEGISLATION

According to "Forskrift om bruk av fangstredskaper" (Regulations on use of trapping equipment) of July 2, 1990, live-trapping of beaver is forbidden in Norway. Dispensations may be given from this prohibition, however, for trapping for research purposes or as part of a program of planned translocation or export. Such dispensations can only be given by the Directorate for Nature Management, and only then under the condition that the trapping is done by well-qualified persons. The live-trapping methods must comply with §19 on humane hunting practices, and the Animal Protection Act §2 which states that (unofficial translation): *the animals are to be handled well, taking into account the animal's instincts and natural requirements, such that it doesn't suffer unnecessarily.* The Ministry of Agriculture has also issued "Forskrift om forsøk med dyr" (Regulations for research experiments with animals) (Jan. 15, 1996) in accordance with the Animal Protection Act. Live capture of beavers will also come under these regulations, and must therefore be approved ahead of time by the national committee for animal research.

Some of the trapping methods described below require destruction of the beaver lodge/den (see definition below) and/or beaver dams. This requires special permission in most countries, and is forbidden by the Wildlife Act §3 in Norway. A dispensation from the law is required before such methods can be used.

MONITORING THE TRAPS

The Wildlife Act §6 specifies that for live-trapping of other animals which is allowed in Norway, the traps must be checked at least once a day. Monitoring the traps once a day is too little when trapping beaver in cold weather. Bradt (1938) recommends that the traps be checked in the evening and at midnight as well as at dawn (see also Hensley 1946, Rosell & Parker 1996). If young beaver are kept more than 4-5 hours in a trap that is partly submerged, they can die of hypothermia. This depends, of course, not only on the type of trap, but also the time of year and the temperature. Older beavers tolerate low temperature better than young ones, and can manage longer without becoming hypothermic. Macarthur & Dyck (1990) found that young beaver (4-7 months old) became chilled faster in water temperatures of 1-12 °C than animals more than 1 year old. Beavers should also be avoided from prolonged exposure to the sun (Hill 1982).

TRAP PLACEMENT

Before starting live-trapping, the area used by the beaver should be determined by careful reconnaissance to locate the best trap site. It is important, for example, to find the beaver's daytime lair. This will usually be a hut, but a beaver may also occupy an area temporarily or more or less permanently without a visible hut. A hut can be constructed in several ways, either by making a chamber in a pile of collected branches and mud/soil (lodge), or by digging out a chamber in soil and then placing branches over it (den). Beaver can also occupy hollows in the soil (burrows) or rock screes, or take shelter under bushes and trees, stumps and stones (Dalane 1977a, Frank Rosell pers. obs.). In addition to the daytime lair it is important to determine the beaver's area of activity. Fresh tracks and signs usually reveal such an area of activity and may consist of newly barked sticks, newly felled trees, newly built or rebuilt dams, scent markings (heaps of mud, grass, leaves, sticks, etc. scraped together near the water's edge), beaver trails, and recently used canals or ditches (see Rosell & Parker 1995). It is also a good idea to map the beaver's swimming pattern and any currents in the trapping area. It is common, for example, for the beaver to swim downstream in the watershed in the strongest current, and upstream in the calmer parts with weaker current (Uhlenhaut et al. 1977).

There are two main principles for placement of traps. One can either lure the beaver to the trap using scents and/or various types of bait (active trapping), or place the trap in the path of the beaver (so-called "traffic traps", passive trapping). Many of today's traps can be used - and are used - as both traffic traps and with bait and/or scents. It is often effective to combine the two trapping principles. The most important sites for passive trapping will be where the animals get out of the water and walk over land to their felling sites. Possible sites for traffic trapping are thus in the water in the immediate vicinity of such a "landing," at the beach edge, or on land on the beaver trail itself. The trap can also be placed just under the water surface in a stream, ditch or canal. This hides the trap and may prevents other terrestrial animals from being captured (see below). A very effective method for setting up a traffic trap is to first tear down part of a beaver dam, and then make a ca. 50 cm wide and 30 cm deep opening in the upper part of the dam. The trap is placed behind the dam, just upstream from the leakage. When the beaver comes swimming to repair the damage to the dam, it will meet the trap (Bradt 1938). It is important to be aware that if one makes a hole in the dam, the water level behind it will sink (Couch 1942). When trapping one individual as described above, another individual can come afterwards and repair the hole so that the water level returns to normal. If this possibility hasn't been taken into account, the trapped individual may drown. Because beavers have a very strong instinct to repair holes in dams, this method is very effective and can be repeated night after night in a colony until all individuals are trapped (Bradt 1938). However, beavers may include the trap in their reconstruction before being caught (Bruce Schulte pers. comm.)! Also, the beavers interest in keeping dams intact varies between seasons. A dam torn down during summer might not be repaired until fall, if even then. It is also important to be aware of possible changes in water level in the spring (snow melting, for example), during heavy rainstorms, and in regulated and tidal areas.

BAIT

Trapping by baiting is most appropriate for larger rivers and lakes without dams or canal systems. Here it can be difficult to find good places to set traffic traps, and it is most effective to lure the beaver to the trap. Baiting is also necessary if one is to trap the remaining beaver young after the mother has been trapped. These will not respond to damaged dams or follow trails looking for food (Bradt 1938).

The best bait will depend to some extent on the location of the trap. Nevertheless, a clear favourite many places seems to be leafy branches of aspen (*Populus* spp.) (Bailey 1927, Simonsen 1973). Branches of rowan (*Sorbus aucuparia*), birch (*Betula* spp.) and willows (*Salix* spp.) are also highly preferred food (Simonsen 1973, Nolet et al. 1994). Other baits that can be used are fresh bark from preferred tree species (Uhlenhaut et al. 1977), apples (Hodgdon 1978, Smith & Peterson 1988), and grain and carrots (de Almeida 1987). Hodgdon (1978) carried out trials to find out what was the most preferred food, and thus the best bait. The beavers preferred branches and shoots of aspen (*P. trémuloides*) in the summer, while apples were the most popular food from August

and throughout the autumn. By cutting the apples in half, so that there were two surfaces emitting odours, the interest in apples was even greater.

SCENT

Olfactory communication is likely to be important for beaver since they have poorly developed long-distance acoustic communication (with the exception of tail-slapping), and are primarily nocturnal and thus less reliant on visual communication (Wilsson 1971, Schulte 1993). Beaver possess two pairs of organs used in scent marking (Hodgdon 1978, Walro & Svendsen 1982, Valeur 1988). These are located in two cavities between the pelvis and the base of the tail, and consist of two castor sacs and two anal glands. Both castoreum from the castor sacs and/or oil from the anal glands are secreted onto small piles of mud and debris close to the water's edge (Wilsson 1971, Svendsen 1980b, Rosell & Nolet 1997, Rosell & Bergan 1998, Rosell et al. 1998), though castoreum is probably used the most (Bollinger 1980, Tang et al. 1993, Schulte et al. 1994).

Castoreum has been used as a lure in beaver trapping for a long time (see, for example, Simon & Brown 1948). One can also find synthetic scents for sale which allegedly lure beavers. The basis for these scents is usually extract of the beaver's own scent, castoreum (Hill 1982). If one doesn't want to buy scent, it is possible to make it from dried or fresh castor sacs from beavers (Dalane 1977a, Frank Rosell pers. obs.). It is thought that using such a strongly scented secretion will probably reduce the suspicious scent of humans on the traps, and that the beaver will detect the scent of "another" beaver and be lured to investigate this new "individual" more closely (see, for example, Dalane 1977a, Schulte 1993, Sun 1996). The scent can be used alone as a lure in traps, or it can be used with bait. Scents can often be used effectively on traps set up as traffic traps, to lure beavers to the trap (Grasse & Putnam 1950). It is especially effective to make an artificial scent mound in the vicinity of an existing scent marking, and put a trap near these (Weaver et al. 1985). Since beaver is a territorial animal (Nolet & Rosell 1994) and reacts strongly to foreign scents in its territory (see for example Rosell & Nolet 1997), these artificial scent markings will be thoroughly investigated by the family members in the colony (Rosell, unpublished). The scents should be renewed every second or third day (Weaver et al. 1985).

Smith & Peterson (1988) found that castoreum was most effective in the spring, and somewhat effective in the autumn. Even so, they recommend using this scent only as a last attempt to capture an especially "difficult" individual. The effect of the substance is short-term, apparently because of learning. On the other hand, young beaver can be captured repeatedly with scents. Sun & Müller-Schwarze (1998) play-backed secretion on 6 consecutive days and found that there is no adaptation in beaver response to anal gland secretion from strangers. However, for castoreum from strangers there is a habituation process. Therefore we suggest that anal gland secretion should be used to re-trap beavers. Hodgdon (1978) found that scents work selectively. Males were over represented in scented traps in the spring, and scents together with baits increased the chances of trapping an entire family group.

REMOVING SCENTS

The beaver has a well-developed sense of smell (Schramm 1968). The scent of humans represents danger, as it does for other wild animals. Other scents which beaver can't identify, such as metal or oil, will make them suspicious and on guard. Most traps used today are made of materials with scents the beaver will not recognise. One must therefore try to remove these scents. The best way to do this is to boil new traps (Havdahl 1995) in water with caustic soda added and rinse them well in pure water afterwards. They should then be boiled in water to which birch bark, pine bark (*Pinus sylvéstris*), spruce bark (*Pícea ábies*) or a few handfuls of anthill have been added (Havdahl 1995). Be aware that some traps need grease on their moving parts to work well, and boiling will remove the grease. If it is not possible to boil the traps for this reasons, or because of practical problems with their size, the traps should stand outside in wind and weather for some time before use. One can also rub the equipment with scents from the castor sacs. It is probably not as necessary to remove scents from traps that are going to stand under water (Lars Wilsson pers. comm.). To our knowledge, the ability of beaver to "smell" things under water has not been determined. However, a possible problem with submerged traps is

that substances (e.g. grease and oil) from the trap might rise to the water surface and into the air, where the scent could be picked up by beavers. When setting up a trap, a person will always leave scents behind on land where they have walked. The scent can be minimised by walking around as little as possible, and also by rinsing off the ground around the trap with water.

CATCHING/INJURING ANIMALS OF OTHER SPECIES

With all kinds of trapping there is a problem with catching/injuring animals of other species than intended. When choosing bait, as well as placement of the trap, the possibilities of trapping unwanted species must be considered. A Bailey trap e.g., will slam shut with great force with no regard to whether it is a beaver, duck, pike (*Esox lucius*), fisherman, dog (*Canis familaris*), canoeist, roe deer (*Capreolus capreolus*), deer (*Cervus* spp. or *Odocoileus* spp.), moose (*Alces alces*), porcupine (*Erethizon dorsatum*), muskrat (*Ondatra zibethicus*) or otter (*Lutra* spp.) that trigger it off. However, if this is considered, accidents rarely happens. For example, researchers in New York State and Washington State in USA, which have trapped >130 beavers, have only once trapped another species (a unharmed raccoon (*Procyon lotor*)) using Hancock traps. They have also tried Bailey traps and the only species in the traps were beavers (Bruce Schulte pers. comm., Lixing Sun pers. comm.). The Swedish beaver researcher Göran Hartman once trapped two ducks in one Bailey trap, but both could be released unharmed (pers. comm.). However, a grey heron (*Ardea cinerea*) was not as lucky.

Fishermen and canoeists may be easily informed about the trapping by a sign. A sign informing that live-trapping is performed, with the address of the institute carrying out the trapping, and a telephone number to a contact person should always be placed near the trap site and on the trap.

LEARNING/FEAR OF TRAPS

Beavers learn to avoid suspicious things if they have been trapped before, and become more difficult to trap again later (Grasse & Putnam 1950). Experience has also shown that the capture frequency per trap-day declines rapidly after the first animal has been caught. The remaining animals seem to be much more on guard, and in some cases they may leave the locality. The chances of trapping an animal are then also reduced, and it may be a good idea to temporarily move the trap to another site to give the animals a chance to calm down. The traps can later be moved back and the trapping resumed (Dalane 1977a, Hammerson 1994).

Müller-Schwarze et al. (see Hammerson 1994) noted that trapping with Hancock traps (more on this later) were very effective at the start with one capture per 2-3 trap-nights, but that the beavers tended to avoided the traps later. The average for the entire summer was one beaver capture per 12 trap-nights. Young animals were easier to trap than the adults.

Grasse & Putnam (1950) noticed that the effectiveness of trapping with visible equipment was reduced in areas where trapping had been done before. This is supported by Hodgdon's results (1978). Bradt (1938) went so far as to say that traps should always be placed under water because beavers are suspicious of all visible foreign objects. Foreign objects under water, on the other hand, don't seem to bother the animals. Lars Wilsson, who has observed beaver behaviour in the immediate vicinity of Bailey traps, reports that beavers are extremely suspicious of foreign elements such as fences made of old branches and logs, materials which do not interest them (pers. comm.). Bruce Schulte follow the procedure with Hancock traps of leaving them closed with bait at a site for a night or two in the location he plan to set. This can lure beavers to place, climb over trap get reward and perhaps overcome trap-shyness. However, this does not work when time is of essence and you can't afford a night or two of no trapping (pers. comm.).

THE BEST SEASON FOR TRAPPING

The best time to live-trap beaver is during spring and autumn. The beaver's area of activity is easy to locate in the autumn. This is also the time of year when dams are built and repaired, and are therefore constantly being visited by beaver. In the spring, after being shut in most of the time in the lodge/den because of ice and snow, the animals become more active and are easier to catch. A

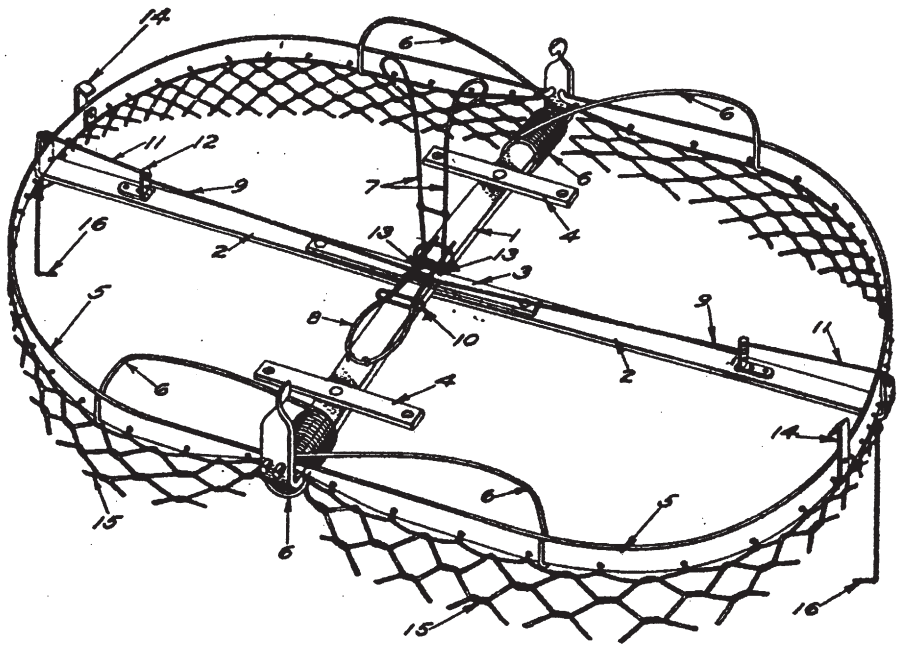

Figure 1
Illustration of the Bailey live trap. 1-Base bar; 2-Crossbar; 3-Top crossbar; 4-Short crossbar; 5-Trap jaw; 6-Coil spring; 7-Trigger; 8-Trigger spring; 9-Trigger wire; 10-Trigger collar; 11-Trigger bar; 12-Hinged trigger loop; 13-Trigger grip; 14-Clasping hook; 15-Wire mesh; 16-Safety hook (reprinted from Stubbe et al. 1995).

fresh aspen branch will probably taste especially good to the beaver then, and the animals will find their way to the traps more often (see Smith & Peterson 1988, Schulte 1993, Sun 1996). One disadvantage of trapping in the spring can be variation in water level in some watersheds due to snow melt (see above). Live-trapping may also be effective in summer, because low water level allows some types of traps to be used over a greater area. Late summer (July-Aug.) is the season during which the young come out and are not shy, and are much easier to catch (see below). However, yearlings and adults will not do much of any kind of construction work like building/repairing dams, lodges or food caches. Further, during summer they will feed on all sorts of plants and herbs, and not repeatedly come to the same tree or small stand of trees, like they do during spring and autumn. This will certainly affect the chances of a beaver coming to the very spot where a trap is set.

TYPES OF TRAPS AND TRAPPING METHODS

The Bailey trap

Origin. The Bailey trap is one of the most widely-used traps for live capture of North American beaver (Figure 1) (Buech 1983). This trap was developed in connection with the North American work with raising and setting out beaver in the 1920s. It soon became evident that one needed an effective way to trap living, wild individuals. Beaver researcher Vernon Bailey was granted a patent for the trap in 1926. It has later been improved several times. The original version was made of steel, but after only a few years this was replaced by aluminium alloy (Bradt 1938). The trap is made and sold by Tomahawk Livetrap Company, PO Box 323, Tomahawk, WI 54487 (orders: 1-800-272-8727, customer service 1-715-453-3550). The trap weighs about 12 kg (Rosell 1976).

Set-up. Instructions for setting and using the trap are provided by Bailey (1927). While loading the trap a helmet is recommended since the trap can accidentally fold together and injure the operator (Taylor 1970). The trap can be placed under water at about 30 cm depth, or it may be placed deeper if it is built up and put on stones, etc. The trap requires an area of about 1 m^2 of a large, flat area on which it can be stand securely (Rosell 1976). One can also bind the trap to branches or logs placed over the stream, canal or ditch (Rosell & Parker 1996). What is important is that the top of the trigger should be about 5 cm under the water surface. The trigger is flexible and can be extended or shortened as needed (Bailey 1927). Before loading the trap at the site, one must be sure that the trap will protrude at least 15 cm over the water surface after it has been sprung. This is so that the trapped individual can get its head above the water and breathe (Couch 1942). One should also ensure that rocks and other items near or under the trap don't interfere with its function. Finally, one should see that the trap sits securely and can't tip over when it is sprung, or due to movement by the trapped beaver (Couch 1942). The trap should be secured with ropes or wire, or poles can be driven into the bottom to anchor it. If a trap tips over with a beaver inside, the beaver may drown (Bradt 1938, Grasse & Putnam 1950). Anchoring is extremely important to keep the pivoting arm perpendicular to the main frame. Unless the trap is anchored along both axes, the pivoting arm of the trap may work its way into a position parallel to the main frame, and the trap will fall onto its side. In this position, the trap is usually submerged and a trapped beaver would drown (Buech 1983).

The trap can be used as a traffic trap, or with bait. The bait is placed such that the beaver will move over the trap to get to it, or it can be placed directly in the trigger (Bailey 1927). Fences to guide the beaver over the trap can also be built (Couch 1942) (but see comments about this above).

Advantages. The Bailey trap is one of the better traps for capturing shy animals because it is not visible over the water, and it is also good as a traffic trap in water. Hodgdon (1978) felt that this trap was easier for inexperienced users to set up than the Hancock trap, for example (but see comments below).

Disadvantages. One disadvantage is that the Bailey trap can sometimes be sprung by sticks and branches which the beaver drags to the lodge/den or feeding place. These can spring the trap too early so that the animal may not be properly enclosed. Sticks and the like can also keep the trap from closing properly, allowing the beaver to get out (Bradt 1938) (see also comments below). Grasse & Putnam (1950) report that beaver of one year of age or older often get caught in the jaws of the Bailey trap, but usually squirm out to freedom or back into the trap, with only minor bruises. When the trap folds together and the beaver is caught, the animal is held partly under water until it is released again (often the next morning). This can lead to substantial heat loss and discomfort for the animal (Grasse & Putnam 1950) (see also comments above).

The trap must either be placed in shallow water or built up so that it stands at the correct height in relation to the water surface (Hodgdon 1978). The Bailey trap is heavy and difficult to handle (Rosell 1976, Lars Wilsson pers. comm.). It is difficult for one person to handle and use the trap alone (Davis 1984), but it is possible if the person has experience (Frank Rosell pers. obs.).

Effectiveness. When we evaluate the efficiency of different trap models by comparing published figures on catch per no. of trap-nights on the following pages one must remember that knowledge and experience of the trapper will have a great effect on the trapping results. Another factor that must be accounted for in these calculations is that there are just a few trapping "hot spots" in a specific beaver territory. When traps are set at these sites, further traps will probably not add much to increase the efficiency. There is probably no linear relationship between no. of traps and no. of catches. Species (*C. fiber* versus *C. canadensis*) (see below), seasonal and topographical differences may also effect the trapping results.

According to Hodgdon (1978), it is important when judging the effectiveness of a trap to distinguish between beavers that have been captured before or not. Hodgdon's results (1978) suggest that the Bailey trap is equally effective in capturing both kinds of individuals. One condition for this is that the trap is placed correctly so that nothing unusual is visible to the beaver. Hodgdon (1978) found that the Bailey trap captured one beaver per 10 trap-nights for previously trapped beaver, and one beaver per 12 trap-nights for beaver that haven't been trapped before. Busher (1975) reported 4.3 trap-nights per capture, but did not differentiate between capture and recaptu-

re. Hodgdon (1978) captured a total of 236 individuals in trapping trials over a five-year period, and 50 % of the sprung traps contained beaver (see Buech 1983). The capture rate increased after improving the trap as described by Buech (1983). After two years of trapping trials, 75 % of 73 sprung traps contained beaver.

Fleming (1977) captured 25 individuals during 196 trap-nights, giving an effectiveness of 7.8 trap-nights per beaver. This was without improvement of the trap. In Sweden, the effectiveness of the Bailey trap was very poor. The Bailey trap was used in two periods (100 trap-nights from October to the start of December, and 41 trap-nights from April to May), but only 3 and 1 animal were trapped (Lavsund 1977). At Faxälven in Sweden, however, 97 beavers were captured in two Bailey traps over the course of a few years (the number of trap-nights is unknown) (Lars Wilsson pers. comm.).

Buech (1983) points out two remaining weaknesses with the Bailey trap: 1) it doesn't close fast enough because of weak springs, and 2) the trap can be sprung by beaver that are not all the way inside the trap. The trap should be made larger to compensate for the centring problem, and/or changing the configuration of the trigger so that it is tripped only when a beaver is centred in the trap.

Other comments. Davis (1984) trapped beaver using the Bailey trap and snares (see below). A total of 48 beavers were trapped alive over 2 099 trap-nights. Two beavers died in the Bailey trap due to drowning or a sudden increase in water level due to rain, or because of shock. Two beavers died during snare trapping. The Bailey traps were more effective than the snares, but more difficult for one person to handle. According to Lars Wilsson, it isn't necessary to remove the scent of humans from the Bailey trap before using it (pers. comm.). This is because the trap is placed completely under water and probably doesn't give off much scent. However, the beach edge where the trappers had walked when setting up the trap was rinsed with water to remove scents (see also Rosell & Parker 1996).

In Norway the trap has been used in the Kristiansand Museum's beaver studies. It was found acceptable, but the release mechanism was considered somewhat complicated (Peter Valeur pers. comm.). Syvertsen (1976) trapped 3 animals in the Bailey trap from May to July in Lillesand municipality. He found that the Bailey trap functioned reasonably well, but that it required careful installation and camouflage to work well. Rosell & Parker (1996) also tried to capture the Eurasian beaver with 4 Bailey traps at 2 different localities in Bø municipality, Telemark county from Oct. 8 to Nov. 11, 1996. The Bailey traps were used for 90 trap-nights, but only one beaver (and one stick) were captured. The animal that was trapped managed to escape because the closure mechanism hadn't closed the trap completely. The beavers became wary of the area around the traps and walked up on land to avoid them, as their tracks in the snow confirmed. Rosell & Parker (1997) used 8 Bailey traps at 14 different localities, in Bø municipality from July 7 to Oct. 19, 1997. This year they trapped 10 beavers (7 males and 3 females) during 203 trap-nights (Figure 2a). More experience is needed with the Bailey trap before it is possible to judge its suitability for live-trapping of the Eurasian beaver in Norway (Rosell & Parker 1996, 1997). The Swedish beaver researcher Göran Hartman has also experience with the Bailey trap (Hartman 1994).

The Hancock trap

Origin. This trap is from the USA and was made by C. L. Hancock at the end of the 1930s as an alternative to the Bailey trap (Hodgdon 1978). Today the trap is made and sold by Hancock Traps Company, Inc., P.O. Box 268 Custer, South Dakota 57730-0268, USA (telephone: 1-605-673-4128). The trap weighs about 16 kg (Lixing Sun pers. comm.).

Set-up. In this type of trap the springs that release the trap have to be set using some force. If the operator is unlucky and loses hold of the trap while doing this, there is a danger that the trap can snap shut and injure the operator. A helmet is therefore recommended while setting up the trap (Taylor 1970, Novak 1987a). The trap is set on dry land and then may be placed in the water. The part that is visible above the water surface is fastened with a rope to a stone, tree, branch or a peg pushed into the ground (Figure 2b). This is to prevent the trap from turning over when it snaps shut (Smith & Peterson 1988, Lixing Sun pers. comm.). It is important that the trap be set up correctly so that it can't slide out into deep water and drown the trapped individual (Grasse & Putnam 1950, Shelton 1966).

Figure 2a
Bailey live trap with captive Eurasian beaver in the Bø-River, Norway (photo by Frank Rosell).

Figure 2b
Hancock live trap baited with aspen. Note the sign, and that the trap is securely tied to a sturdy anchor stake (photo by Frank Rosell).

Grasse & Putnam (1959) found that the trap works best if the part of the trap that emerges above the water surface is camouflaged. This was especially true at sites that had been trapped previously. Smith & Peterson (1988) camouflaged the Hancock trap and used it as a traffic trap along the beaver's usual routes, both in water and on land.

Advantages. The Hancock trap isn't sprung as easily as the Bailey trap by branches dragged by the beaver, since these don't push hard enough to release the trap. Usually, one of the beaver's back feet must push on the release plate for the trap to spring. It can also be used in deeper water since it "lifts" the beaver up out of the water when it is released. This means that the beaver is less submerged in water and less subject to heat loss (Grass & Putnam 1950, Hodgdon 1978). The trap can be used in several kinds of locations (Taylor 1970, Brooks 1977), and is not as dependent on being placed at a particular water depth to function correctly as the Bailey trap (Buech 1983). The trapping effectiveness is good, with almost 100 % of the sprung traps containing beaver (Grasse & Putnam 1950, Hodgdon 1978).

Disadvantages. One disadvantage of the Hancock trap is that half of the trap is visible over the water, and this means that it is not very suitable for catching shy beaver. Furthermore, it is not suitable for use in canals and streams (Grasse & Putnam 1950). The trap doesn't close properly if it sits at a slight angle, and the movement when the trap shuts can make it tend to fill with debris such as branches and twigs (Hodgdon 1978). The Hancock trap is designed to be used primarily with bait or scents to lure the beaver, not as a traffic trap (Grasse & Putnam 1950). Successful trapping depends on being able to attract the beaver to the trap, and this requires experience (Hodgdon 1978).

Effectiveness. During 266 trap-nights, Fleming (1977) trapped 73 individuals with the Hancock trap, or 1 beaver per 3.6 trap-nights. Hodgdon (1978) reports a trapping effectiveness of 1 individual per 14.1 trap-nights for individuals who had not been trapped previously (based on 128 animals). The capture rate 18.6 trap-nights per capture (based on 108 animals) for individuals who had been trapped before. Hodgdon (1978) explains this difference as being due to the beaver becoming "trap-shy."

Smith & Peterson (1988) use Hancock traps with aspen (*P. trémuloides*), apples or both as bait. Castoreum was also used, and it was most effective in the spring. They captured 394 beavers in 60 colonies during three trapping seasons (fall and spring). During the autumn, 291 beaver were trapped, and of these 29 were also captured in a previous autumn. In spring, 66 beaver were trapped, and 42 of these were recaptures from the previous fall. Eight beavers were trapped more than twice and in different seasons. The total number of beaver trapped, excluding recaptures, was 323. Three beavers died during the trapping. Smith et al. (1994) trapped 118 beaver during 660 trap-nights, or one individual per 5.6 trap-nights.

Novak (1987a) reports that the Hancock trap is preferred for live-trapping in the USA because of its efficiency and versatility. Novak (1987b) found that one could increase the trapping frequency of the Hancock trap by extending the trigger by about 15 cm. This improvement was made by using two stiff steel wires as a "release fork".

Other comments. Both professor Dietland Müller-Schwarze in New York state and Dr. Lixing Sun in Washington state in the USA use Hancock traps in their beaver research (Figure 2c). In New York more than 348 animals were trapped and earmarked (148 were trapped more than once) in 82 colonies from 1984-96 (each spring and summer 1984-96 and autumn 1985, 1989-91 and 1993) (Sun et al. 1998, see also Schulte 1993 and Sun 1996). There was one mortality using these traps in a 5-year period (Lixing Sun pers. comm.). In that case the trapper didn't set the release mechanism properly and the trap shut when something other than a beaver foot touched the release plate. The trap fell over the animal's back. It is thus important to set the spring such that it is only released when a beaver sets one of its back feet on the release plate. In Austria the Hancock trap is used by Dr. Johanna Sieber, and she has trapped more than 40 individuals. Beavers have also been trapped with Hancock live-traps in the Netherlands (Nolet & Baveco 1996), and in Sweden (Hartman 1994).

Currently we have also started to use Hancock traps at Telemark College in Bø, and will compare its effectiveness with the Bailey trap. We will also try to develop a more effective trapping method by luring the beaver to the trap using concentrated aspen scent on the trap, and by putting or splashing mud on the traps to reduce the

Figure 2c
The first author beside a North American beaver captured in a Hancock trap, Washington state, Ellensburg, USA (photo by Bjørnar Hovde).

human scent and improve the camouflage. This will probably increase the effectiveness of the traps (Bjørnar Hovde pers. comm.).

The Scheffer-Couch trap

Origin. This trap was developed by Scheffer and Couch in the 1930s in the USA as an alternative to the ubiquitous Bailey trap (see illustration on page 17 in Kvinlaug 1997). The construction was a modification and improvement of existing strike traps (Couch 1942). There is little available literature about this kind of trap, and it is not in use today (Novak 1987b). A detailed set of instructions for use and an order list can be found in Couch (1942).

Set-up. Before setting up the trap, it should be checked out on site to ensure that it is working properly. The movable parts should be greased to prevent corrosion and ensure smooth function. Otherwise, the placement and methods for using the trap are the same as for the Bailey trap (Couch 1942).

Disadvantages. This trap is no longer for sale, there is little literature available about its use, and it is very complicated to construct if one is not a specialist.

Effectiveness. Little is known about the trap's capture effectiveness.

Landing nets, etc.

Landing nets are a tool used by Aslak Harstveit in Åmli, Aust-Agder, Norway (pers. comm.), and he judges them very positively. Harstveit started live-trapping for export in 1954. Before him, other people in the community did the trapping. These captured beavers in their hands or in burlap bags when the beavers were on land (Aslak Harstveit pers. comm.). Harstveit also did this at first (see also Hodgdon 1978). The landing net is shaped like

a common landing net for fishing, but it is bigger and stronger to be able to accommodate a beaver. The net is fine-meshed and made of sturdy plastic netting. Steel netting has also been used, but then there is a greater chance of injuring the animal (Aslak Harstveit pers. comm.). The procedure can vary somewhat. One method is to hold the net under the water surface in front of the exit to the lodge/den, while an assistant tries to get the beaver to leave the lodge/den in various ways. One can scare the beaver out of the lodge/den by stomping or hopping on top of it, or by shouting and pushing sticks or the like down into the lodge/den or ground. This will usually not be enough to get the beaver out of the lodge/den. More drastic measures will then have to be taken, such as tearing or digging a hole in the back of the lodge/den. If the beaver hasn't come out by the time the hole is finished, one can send in a dog that will get the beaver out. One can also dry out the dammed-up area by tearing down the dam or digging out the stream, then send dogs into the lodges/dens to drive the beavers out into daylight where they can be easily caught (Hill 1982, Aslak Harstveit pers. comm.). The main disadvantage of such drastic measures is that they are so much work. Also, the beaver lodges/dens and dams will be damaged by making holes in them, although these will usually be quickly repaired by other animals that move in. It can be an effective method, though, since it is possible to capture an entire family at one time. Rosell & Parker (1997) caught one adult beaver (20 kg) in a landing net when it come out from a hole in the bank.

Brooks (1977) used small metal hoops, with one meter cone nets attached and placed it over the lodge exits. He trapped several kits and two adults with this method and found it successful. This method requires quick responses by the net tender and the use of a scube diver when the exits are deeper than the hoop net handles are long. There where no instances when beaver acted aggressively toward the diver underwater.

Using a landing net to catch very young beavers can be very effective, since these are usually not very shy before they are about 2 months old (Figure 2d) (Frank Rosell pers. obs.). One can glide around in a rowboat or canoe and "scoop" up the young with the net. Bailey (1927) suggests that one person paddle, while another sits in front on watch with a net. Beaver young normally don't swim fast, and they can't take as long dives as their parents (2-3 minutes maximum). If one sees young animals that dive it is possible to follow them and try to catch them when they come up again (Bailey 1927, Frank Rosell pers. obs.).

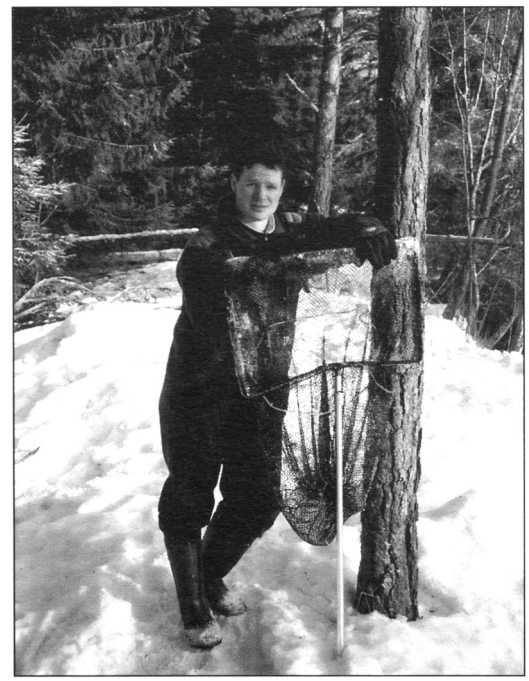

Figure 2d
Landing net (photo by Frank Rosell).

Cage traps

There are many variants of this kind of trap. The traps are relatively large and can be placed on beaver trails, in canals, along the beach or in shallow water. In Bavaria, Germany, Gerhard Schwab has a lot of experience with different models of cage traps. Since spring 1996 nuisance beavers are trapped as a management tool using cage traps set on land. In spring 1996, traps available from studies trapping other species were used. As these traps had different disadvantages (too small, too instable, problems with the locking system), he developed the "Bavarian beaver trap". The trap is about 1.8x0.6x0.6 m, can be dismantled in 4 parts for transport and space-saving storage and be handled by one person. The

Figure 2e
The "Bavarian beaver trap". Note the trigger board in the middle of the trap (photo by Gerhard Schwab).

weight is about 30 kg (Figure 2e). The trap is build and sold by Alfred Schaflitzl, Augsburger Weg 52, D-86668 Karlshuld, Germany (phone and fax 08454-2577, mobile phone 0172-8400953). The side parts of the trap don't extend to the end as in other cage traps, but end with the trap doors to save some kg's. The doors end about 5 cm above the floor to allow some space for branches and beaver tails. Sometimes, the doors of the older traps didn't lock when branches prevented the door from closing. A small bolt does also help to prevent the opening of a not completely closed door. One door has a hook to keep the door open when the trap is set by one person. The trigger board is made of waterproof plywood. The upper and lower part of the trigger system are reversed, solely due to safety reasons. If an unauthorised person triggers the trap, the upper part of the system moves upward and might hurt the person, this risk is reduced by putting the shorter part on the upper side. Based on the experiences in the last trapping season, new traps will have 2 modifications: 1) they will not be dismantlable, as storage room and staff for trapping has become available, this also makes the trap cheaper (price now about $300); and 2) there will be an additional connection between floor and ceiling at the four corners, as the frame of the ceiling can be bend. This may happen if a trap, with a beaver inside, is carried by holding the trap. So far the Bavarian beaver trappers have trapped 108 beavers in 31 sites since 1996, and 82 of them were trapped during October 1997 to March 1998. The first beavers, in most cases, in the trap are the youngs from last year. In one village (Pförring) they trapped 34 beavers in about 100 trap nights. However, in other places the trapping success where extremely low. The trapping success varied with beavers (some smarter than others), weather (the beaver activity decrease in bad weather), location (it's quite easy to trap beavers when they are used to feed in a corn field) and trappers (as beavers: some smarter than others and more eager to remove the beavers) (Gerhard Schwab pers. comm.).

Two other cage traps are described by Uhlenhaut et al. (1977). The Russian cage trap is made from a wooden frame covered by a fine steel netting (Figure 3a). The average trapping effectiveness with this trap is one individual per 16 trap-nights (Uhlenhaut et al. 1977). Another kind of cage trap is the so-called "central-Asian round trap" (see photoes on pages 202-203 in Stubbe et al. 1995) (Uhlenhaut et al. 1977). The trap has a diame-

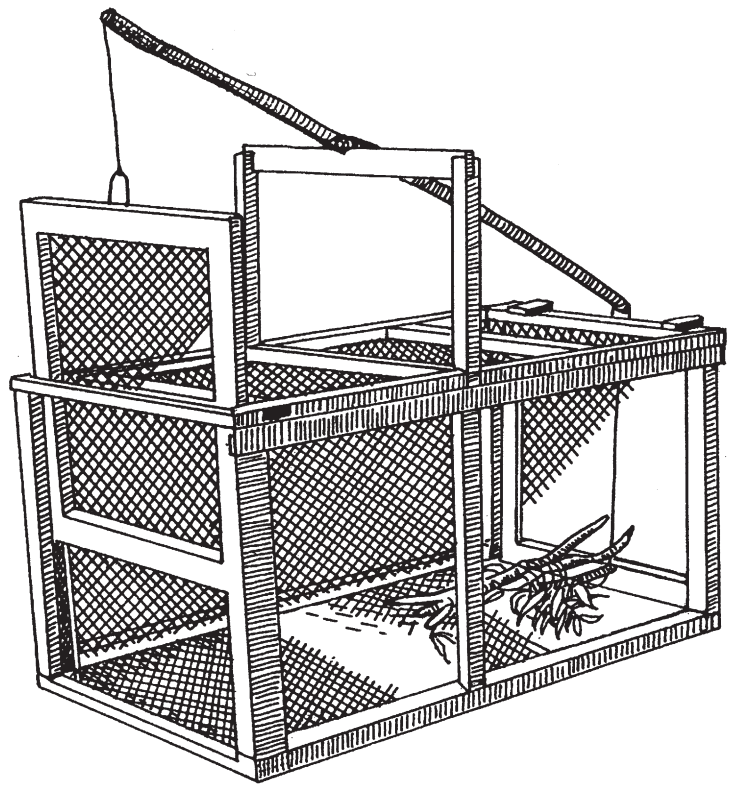

Figure 3a
The Russian cage trap (reprinted from Uhlenhaut et al. 1977).

ter of 50 cm, is 1.2 m long and is made of 8-10 mm steel wires, soldered together. One end of the trap is closed, while the other has a spring trap door made of netting. This is pushed open and held open with a hook. The hook holding the door is released by a wire coming from the release mechanism inside the trap, and the door is snapped shut by a powerful spring. This trap is placed on land as a traffic trap, or may be baited. Uhlenhaut et al. (1977) recommends camouflaging the trap. There are several advantages to this trap: it captures well, requires little work, and doesn't injure the animals. It is also easier to handle than other cage traps. There is little quantitative information about the capture efficiency of this type of trap. Uhlenhaut et al. (1977) reports that 13 animals were captured in this trap, with 4 of them captured in the same trap over a period of 6 nights.

The Norwegian variety is Måbuholts cage trap, made by Oddvar Måbuholt in Drangedal, Telemark. This is a solid box covered with mink netting (Figure 3b). The dimensions of the box are 1.05x0.4x0.4 m. There is a falling trap door in one end. The trap was used to capture and translocated living beavers by forest officer Haakon Danevad in Drangedal. A substantial number of beaver have been captured in this trap (Dalane 1977b).

The tunnel trap is a Swedish trap made by Sven Carmland in Värmland (Figure 3c). It weights about 20 kg (Rosell 1976). The trap has proven particularly effective when placed in narrow passages that the beaver has to follow, such as drains and ditches (Dalane 1977b). The capture effectiveness of the tunnel trap was very low in Sweden in relation to amount of work. From October to the start of December (282 trap-nights) and from April to May (104 trap-nights) the tunnel trap captured only 1 and 2 beavers. The activity pattern of the beavers was often disturbed by the traps, and the beavers avoided them (Rosell 1976, Lavsund 1977).

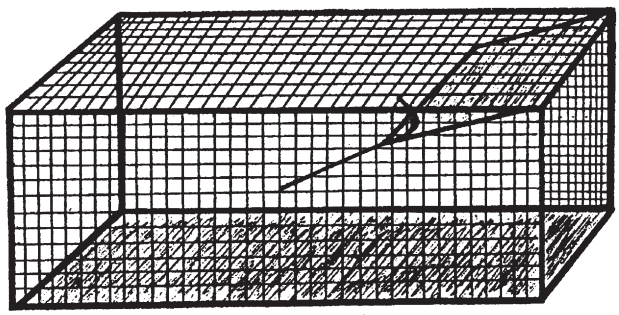

Figure 3b
Måbuholt's cage trap - a Norwegian live-trap. Note the falling door in one end which is released when a beaver back touch the stick in the middle of the trap (redrawn after Dalane (1977b) by Øyvind Steifetten).

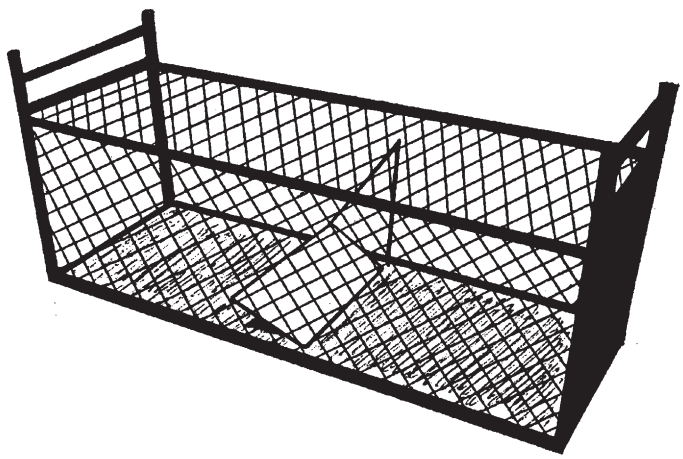

Figure 3c
The beaver tunnel - a Swedish live-trap. There is a falling door in one end which is released by a thread when the beaver step on the trigger plate inside the trap (redrawn after Dalane (1977b) by Øyvind Steifetten).

The Finnish model is called a wooden trap. It consists of a cage with a falling sliding door in one end which is released by a thread when the beaver goes into the trap to eat branches of deciduous trees. This trap isn't a traffic trap; one must use bait to lure the beaver to the trap (Rosell 1976). The cage is made of heavy iron wire netting and the entrance has a framework of wood in which the falling door slides. The door has a wooden frame and is covered by the same kind of iron wire netting as the rest of the cage. The trap has to be placed on land as the wooden construction can't tolerate immersion in water. The weight is about 15 kg (Rosell 1976).

Nets and seines

Origin. Nets and seines of various sorts have long traditions in beaver-trapping. Fries (1943) cites several historical sources and describes how beavers were trapped in old Europe. The most common method was to stretch a net in front of the exit of the lodge/den, then drive the beaver out by digging out the lodge/den or letting dogs into it. These sources also use of wide mesh nets that were set out in the water as for fishing, to catch beavers.

Certain Indian tribes in North America caught beavers

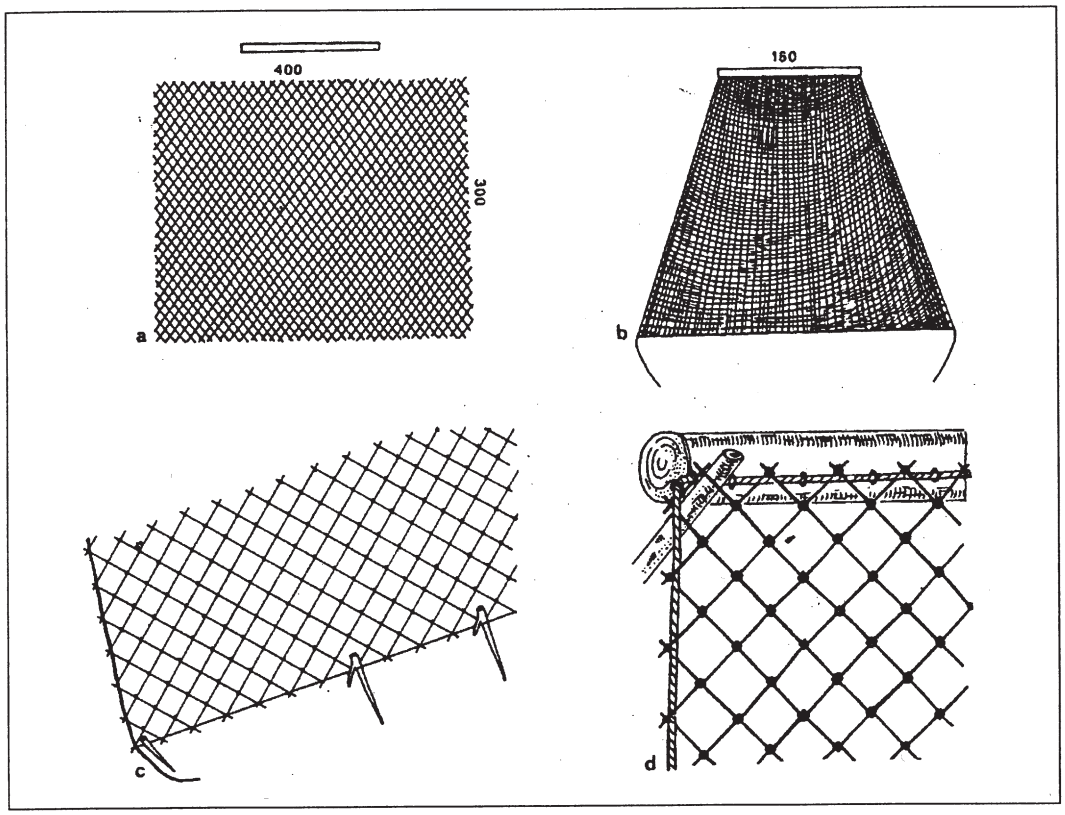

Figure 4a
The basic material for the seine is a netting 3x4 m long and with a 3x3 cm size of mesh (a). A line runs through each long edge of the net, and one of the long edges of the net is fastened with the line to a log or pole about 1.6 m long and 5 cm thick (b). The log should be as dry as possible so that it floats. A pull line is run through each mesh opening in the short ends of the net (c), and the line from each end of the net is attached to the corresponding end of the floating pole (d) (reprinted from Uhlenhaut et al. 1977).

using nets. They first sank the water level around the lodges/dens by draining away the water, then sat up nets in front of the entrances, broke down the lodge/den and drove the beavers out into the nets (Ellis 1750).

Seines

Set-up. The basic material for the seine was a netting 3x4 m long and with a 3x3 cm size of mesh. A line runs through each long edge of the net, and one of the long edges of the net is fastened with the line to a log or pole about 1.6 m long and 5 cm thick. The log should be as dry as possible so that it floats. A pull line is run through each mesh opening in the short ends of the net, and the line from each end of the net is attached to the corresponding end of the floating pole (Figure 4a) (Uhlenhaut et al. 1977). The long edge of the net without the log is solidly anchored on the beach with heavy plugs driven into the ground. About 50 cm on each end is free and not anchored. The net is stretched up vertically using wooden sticks pushed into the bottom. The two outermost sticks that hold the end of the net and the pole, should be heavier. When the net is set up it should be 30-50 cm under the water surface and should look like a trapezium when viewed from above. The operator waits under cover with the pull lines in his hand (Figure 4b). When a beaver has swum into the seine with its whole body, the

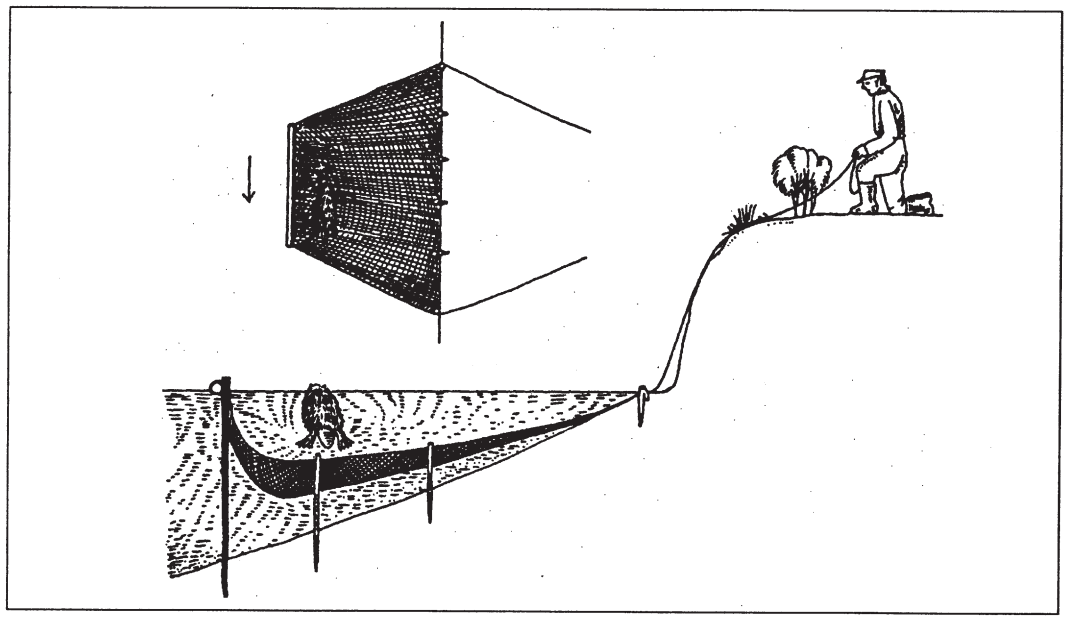

Figure 4b
When the net is set up it should be 30-50 cm under the water surface and should look like a trapezium when viewed from above. The operator waits under cover with the pull lines in his hand (see text for further details) (reprinted from Uhlenhaut et al. 1977).

lines are given a powerful pull. The beaver will then immediately dive down into the net, the edge of the net pops up vertically (Figure 4c), the log glides over the sticks the net is fastened to, and after more powerful pulling the log will reach land in a matter of a few seconds (Figure 4d). At this point the seine is closed like a sack. The trapper now hurries over to the log, sits on it, pulls out the plugs and draws the beaver up onto land. The seine is wound around the post, or the draw line is wound around it to shut it, to keep the beaver from escaping (Figure 4e) (Uhlenhaut et al. 1977).

Advantages. This is a relatively inexpensive and technically uncomplicated way to trap, and the animals are seldom injured (Uhlenhaut et al. 1977).

Disadvantages. Setting up the seine requires a lot of work and a thorough preliminary reconnaissance of the trapping locality.

Effectiveness. Uhlenhaut et al. (1977) reports, without noting the time period, that 12 beavers were trapped using the seine method. In the USA Brooks et al. (1980) also used seines when other methods failed, but mention nothing about trap effectiveness.

Nets

In North America, large nets have been placed "around" the beaver lodges/dens and the animals driven out. The net reach from the water surface to the bottom, to prevent beavers get over or under them (Gregg & Carberry 1957, Brooks 1977). However, this method was difficult to implement because of uneven bottom terrain allowing for escape routes and because beaver frequently did not become entangled (Brooks 1977).

In the former Soviet Union and Poland, floating nets were used to live-trap beaver. This is not the usual wide-mesh fish netting, but a type of net actually composed of three nets mounted "on top of" each other. In the middle or inside there is a wide-meshed netting with 30 x 30 cm mesh. On the outside on each side there is fine-meshed netting with 3x3 cm mesh. Floaters are attached on the top and weights on the bottom. The net is 4 m high, and

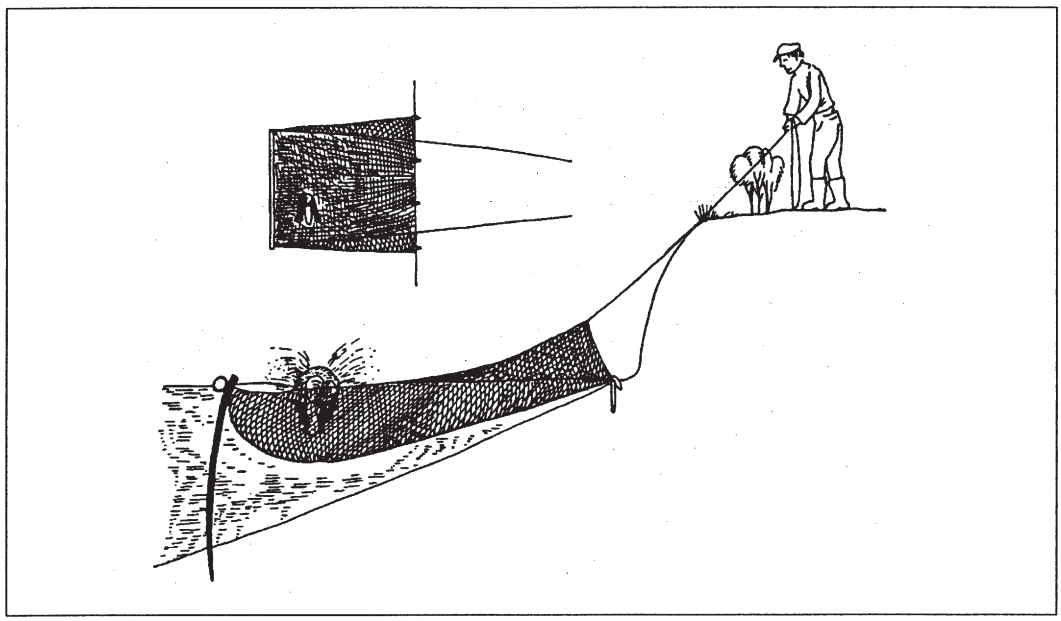

Figure 4c
When a beaver has swum into the seine with its whole body, the lines are given a powerful pull. The beaver will then immediately dive into the net, and the edges of the net pops up vertically (reprinted from Uhlenhaut et al. 1977).

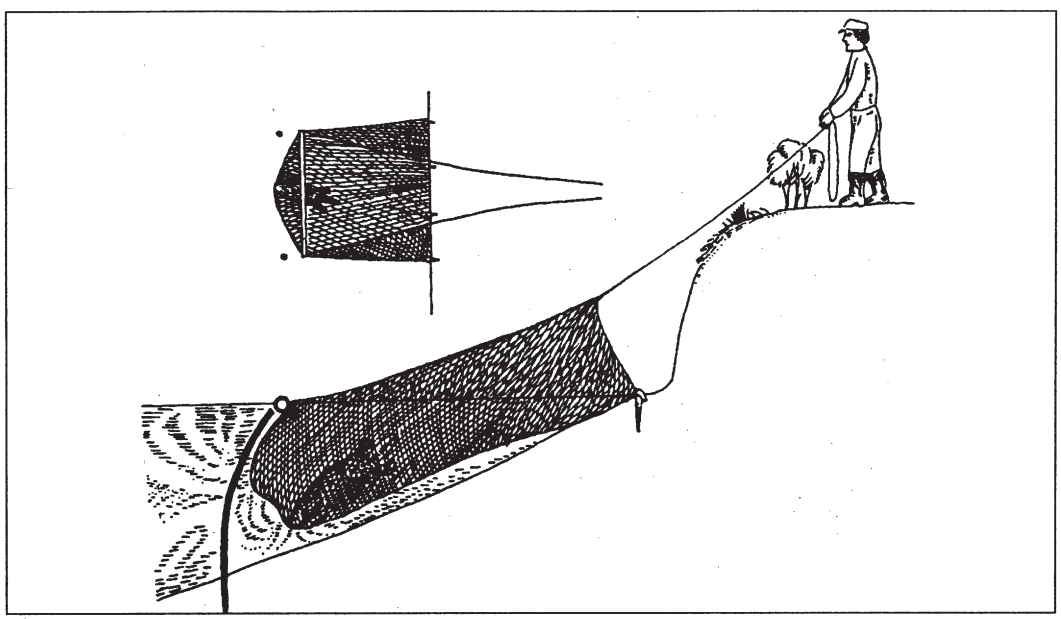

Figure 4d
The logs glides over the sticks the net is fastened to, and after more powerful pulling the log will reach land in a matter of few seconds (reprinted from Uhlenhaut et al. 1977).

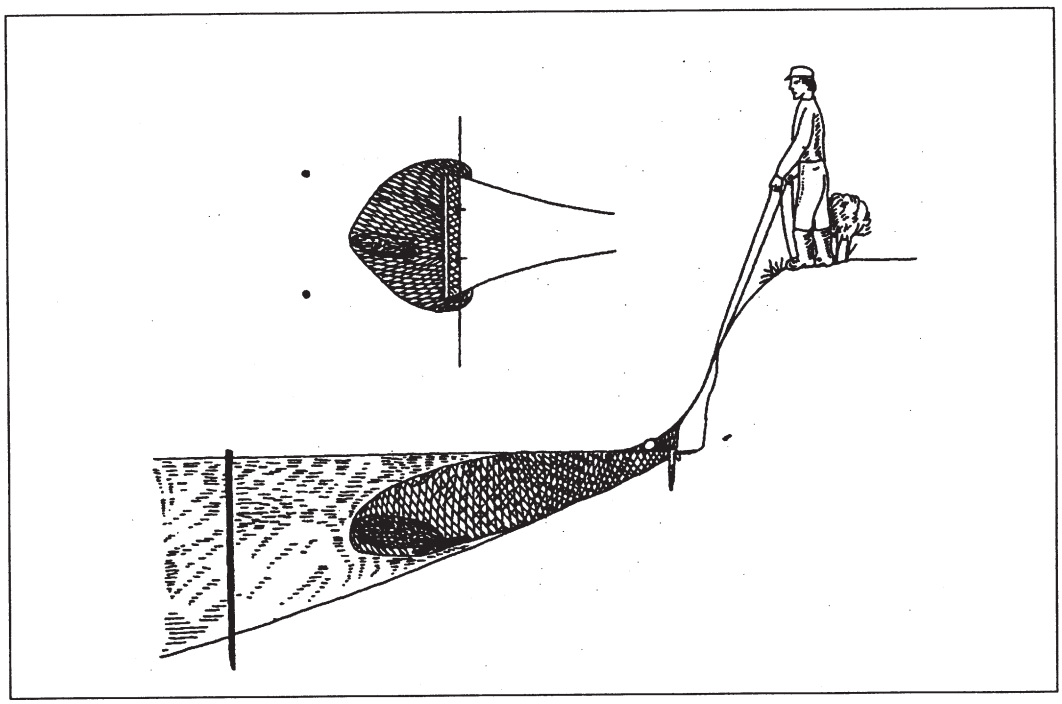

Figure 4e
At this point the seine is closed like a sack. The trapper now hurries over to the log, sits on it, pulls out the plugs and draws the beaver up onto land. The seine is wound around the post, or the draw line is wound around it to shut it, to keep beaver from escaping (reprinted from Uhlenhaut et al. 1977).

must therefore be used in deep water (see illustration on page 25 in Kvinlaug 1997 (Uhlenhaut et al. 1977, Zurowski 1979).

In principal, the pull net is used the same way as a fishing net. It is stretched across the water at a place where one expects beaver to come swimming. One difference from net fishing is that the trapper must stand watch and pull the net in to land as soon as the beaver enters it, or else the beaver will drown. The principle behind the use of different mesh sizes is the same as the so-called "troll net". The beaver catches on and pulls the fine-meshed net through an opening of the wide-meshed net, and thereby get very entangled and immobilised (Uhlenhaut et al. 1977).

Nets have also been used by Dr. Dietrich Heidecke in Germany, who has trapped 58 beavers for re-introduction into the Netherlands during 1988 and 1994 (see Nolet 1994, Nolet et al. 1997). This method is very effective when the net is placed on the bottom of small rivers and streams (Vilmar Dijkstra pers. comm.).

In Norway, attempts have been made to trap beaver with wide-meshed salmon netting in Åmli, Aust-Agder. When the beaver saw the net they turned right around or swam under it. Some of them swam into the net, but they didn't get caught in it and thus got away (Aslak Harstveit pers. comm.).

The Breathe Easy trap

Origin. The "Breathe Easy" trap is a relatively new device and its use is still experimental (Figure 5) (Randy Dibblee pers. comm.). The company (Breathe Easy Trap Inc., RR # 3 Truro, Nova Scotia, Canada, B2N 5B2, phone: 902 897-4058) that sells it provides a one page

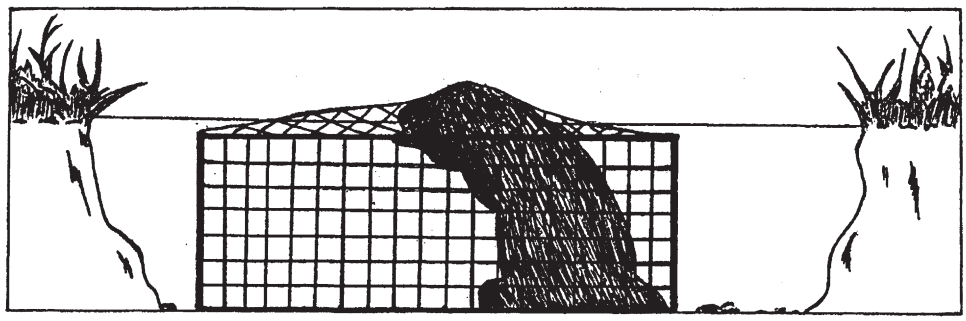

Figure 5
The Breathe Easy trap (drawn by Øyvind Steifetten).

brochure with suggested sets (see below). The traps can also be ordered from Brian Ettinger or Jim McAfee at: Fur-a-Fee, 115 Brunswick St., Truro, Nova Scotia, Canada, B2N 4P6, phone: 902 895-2511 or fax: 902 893-7061 (Peter Collen pers. comm.).

Set-up. This trap is completely submersible for trapping beaver and otter. So that it may not be detected by sight and smell, you simply blind set the trap allowing 1-2" (2.5-5.0 cm) of water over the top of the cage. It is important that this depth be maintained, so that small animals may settle on the perch area and raise the flexible mesh top above water to breathe easy. Adult beaver can raise the mesh by standing on the bottom of the trap. Try to set the trap in an area to avoid muskrat travel because the muskrat may trip the trap and escape through the large top mesh. In many cases, trap may not need to be completely submerged to catch beaver but it should be in some water and sticks put across the top of both doorways so that it is hidden from view but the doors remain three-quarters of the way open. If the beaver is to be trapped in deep water, the trap may be hung by wire in the travelway maintaining the 1-2" of water over the top mesh and sticks or small softwood trees must be placed under the trap to prevent the beaver from diving too deep and missing the trap. Rings may also be attached to the four corners of the cage in order to feed sticks through to easily suspend it in deep waterway.

When setting the trap the first step is to gently raise the door with a very jiggly motion so to ease the flexible bars and chains to stay up above the gate support hooks. Do not force! Step two is to position trip mechanism rod point into indentation on rotatable shaft connected to trip wires. This is found on the rotatable shaft which holds the trigger. By setting this mechanism you activate the trigger and lock the door open. The second door is set by connecting the longest movable rod to the trip mechanism found at the side of the first door.

The animal enters the trap and trips the triggers set in the centre thus dropping the doors simultaneously.

Advantages. The trap is not easily detected by sight or smell.

Disadvantages. Most of the beavers body is held under water and this can lead to substantial heat loss and discomfort for the animal (see also comments above). The trap may also be very vulnerable to a small increase in water level, which will drown the beaver.

Effectiveness. Little is known about the trap's capture effectiveness. Randy Dibblee's colleagues found that it worked well when they trapped two individuals during September 1997. Randy Dibblee feel it will be an improvement over the Bailey trap (pers. comm.).

Snares

Origin. This method comes from Canada, but its inventor is unknown. The method is described by Grawe (1980), Gilsvik (1983), David (1984), Weaver et al. (1985) and others (Figure 6a-f). The material needed to build snares are: woven flexible galvanised aircraft

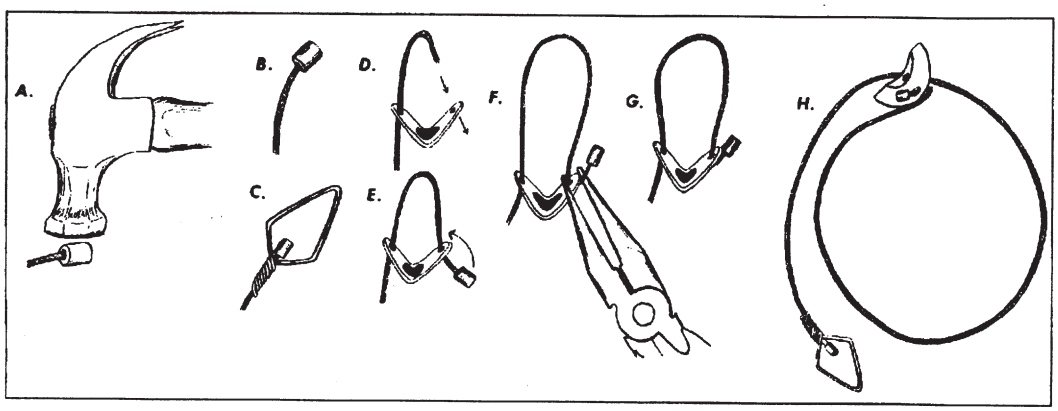

Figure 6a*
Snare assembly procedure (A-H). Snare components used: stop button (A, B), swivel (C), snare lock (D) and galvinized aircraft cable (D).

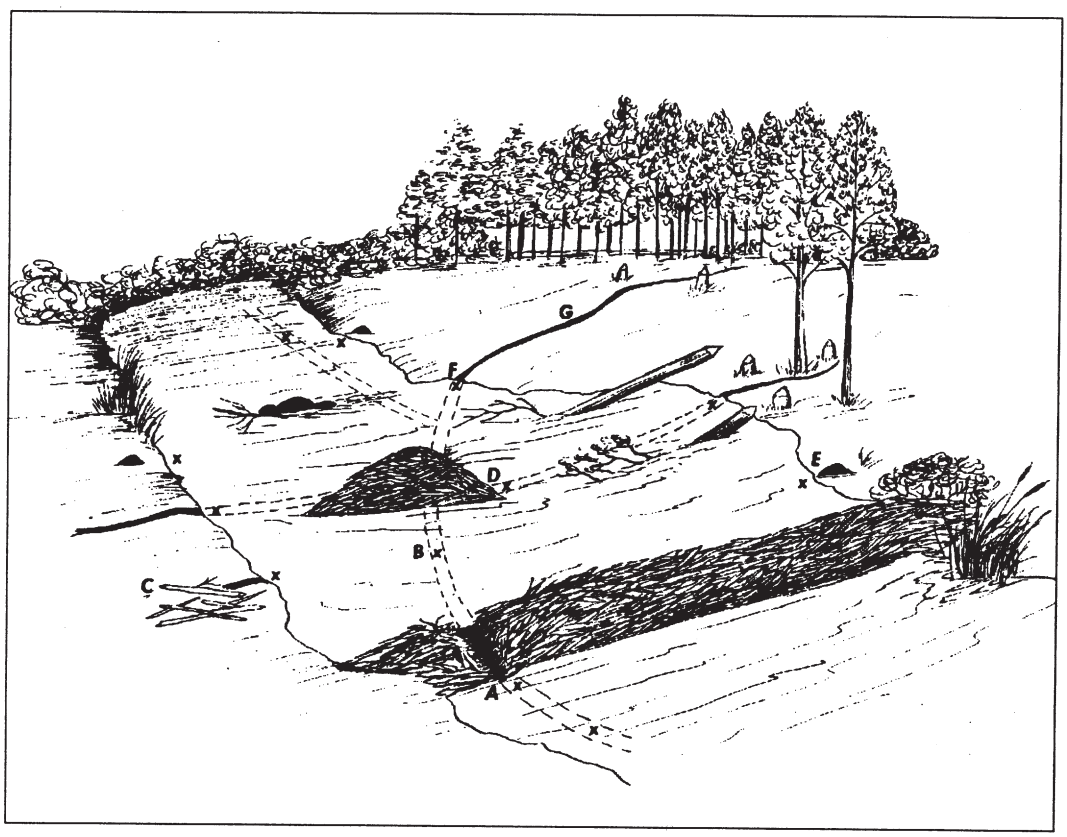

Figure 6b*
Sites for snare sets within a beaver colony (X=snare placement): A. dam crossing; B. bottom runs; C. feeding station; D. underwater lodge entrance; E. scent mound; F. slide; G. land trail.

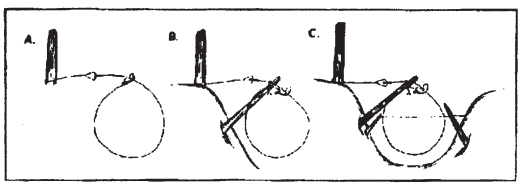

Figure 6c*
Marking a run set: A. snare securely tied to a sturdy anchor stake; B. support stick and bobbypin for proper snare positioning; C. completed set with guide sticks.

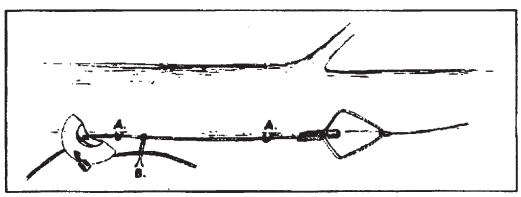

Figure 6d*
Enlargement of dive stick attachment: A. staples; B. bobbypin.

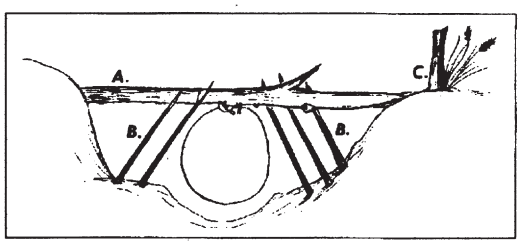

Figure 6e*
Dive set: A. dive stick; B. guide sticks; C. anchor stake for snare attachment.

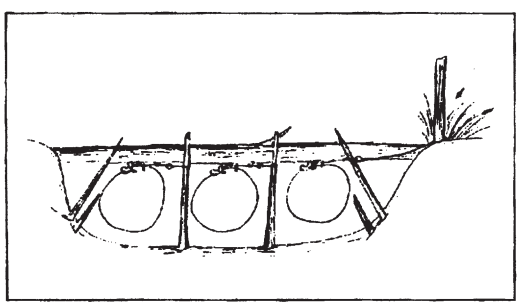

Figure 6f*
Multiple dive set.

***Figures 6a-f:** Reprinted from the Southern Journal of Applied Forestry (Weaver et al. (1985), vol. 9, no. 3, p. 143-144) published by the Society of American Foresters, 5400 Grosvenor Lane, Bethesda, MD 20814-2198. Not for further reproduction.

cable, stop buttons, snare lock, snare swivel, hammer and cable-cutting pliers (Weaver et al. 1985). Today snares is made and sold by e.g. Hawbaker and Co., Fort Loudon Pa (Dale H. Arner pers. comm.).

Set-up. The snare can be set up as a traffic trap under water in places where one expects beavers to come swimming. Snares can, of course, also be rigged on land, for example on beaver trails. The snare doesn't kill the beaver, but when improperly mounted the animal can drown if the snare is under water. The snare must be fastened such that it allows the beaver to get to land or to shallow water. The snare should also be well anchored. An especially effective method is to use a snare mounted in shallow water together with an artificially scent mound at the edge of the water (see above). The snare should be placed such that the beaver has to swim into the snare when approaching the scent mound to investigate it.

Advantages. Snares are inexpensive, simple to make, light and easy to transport. They are also easy to install and, not least, safe for those who handle them (Hill 1982). Studies have shown that snares are an effective way to capture living beavers (Weaver et al. 1985). Snares are more versatile than many other kinds of traps; they can be used as traffic traps or with bait, on land and in water. There are also few injuries to the animals (Davis 1984). The animals stay completely calm when they are caught in a snare (Dale H. Arner pers. comm.). Lars Wilsson (pers. comm.) has talked to many North American trappers who consider snaring to be clearly the best trapping method. Also professor Dale H. Arner (pers. comm.) from Mississippi state University prefer the snares, after a long experience with also the Hancock trap. Snares are more species-specific than other kinds of traps, capturing fewer animals of other species (Weaver et al. 1985). Nevertheless, the available literature indicates that traps are preferred to snares by most trappers and researchers.

Disadvantages. Snares require care during mounting to ensure that captured individuals don't drown. If the snare is mounted such that the animal remains in water, there is a danger of heat loss in cold water (see above). Another possible problem with snare trapping is that the animals are relatively unprotected against attack by predators while they are caught in the snare (see Kile et al.

1996, Rosell et al. 1996). Frequent monitoring of the snares can probably reduce this problem.

Effectiveness. Hill (1982) and Mason et al. (1983) found that snares were at least as effective as the most effective killing trap on the market (such as the Conibear trap, which is also used in Norway).

The Byelorussian trapping method

Origin. The Byelorussian trapping method has proven very effective in the former Soviet Union. From the end of the 1920s and up to 1977, more than 12 300 beavers were trapped and translocated using this method (Uhlenhaut et al. 1977).

Set-up. This is an active trapping method requiring teams of 5-6 people. The underwater exits of the beaver lodge/den are blocked with a net or with a kind of self-tripping cage trap called the Byelorussian beaver trap (see photo on page 194 in Stubbe et al. 1995). The lodge/den is dug up, or else a dog (for example, a dachshund or beagle) with a muzzle (so as not to injure the beaver) is sent in to drive the beaver out into the traps (Uhlenhaut et al. 1977, see also Zurowski 1979). When trapping in the larger rivers and beaver dams, three layers of nets (described below) are used in front of the entrances rather than cage traps. One person from the trapping team watches the traps from a boat. As soon as a beaver enters a trap this is pulled up into the boat and a new one is immediately set out (Uhlenhaut et al. 1977).

Advantages. The advantage with this method is that whole family groups can be captured quickly and effectively (Uhlenhaut et al. 1977).

Disadvantages. This method can only be used in relatively shallow water. Good visibility into the water is essential. This means that the water must be clear and winds light or absent. If all of the entrances can't be covered, or two animals come out at once, some animals will get away. The beavers or the dog may also be injured. However, destruction of a lodge/den is disadvantageous in most cases and are usually not to be recommended.

Effectiveness. This method can be much more effective than other methods (Uhlenhaut et al. 1977). From the end of July to the end of September 1964, for example, 570 individuals were trapped by a trapping team in Byelorussia (Djoshkin & Safonow 1972). Zurowski (1979) trapped on the average 1-1.5 beavers per day using this method.

Pits

Origin. Pit traps are one of the oldest methods used by humans to trap wild animals. There have been many different kinds of such traps. A good example is our ancient ancestors' use of pit traps for reindeer, which one can still see the remains of in many Norwegian mountain areas (Lier-Hansen 1994).

Set-up. In more recent times, Bailey (1927) describes how one can trap beavers in pits. The pit must be on land, along a beaver trail. The pit should be wide enough for an adult individual to fall down into it easily, but not unnecessarily large. Bailey suggests a diameter of about 1 m so that the beaver has room to turn around in the bottom of the pit. The depth of the pit should be about 1 m, but not deeper; otherwise, the animal can be injured when it falls into the trap. A layer of birch sprigs, hay or the like in the bottom is also recommended. If the pit is dug in soft soil, the bottom and wall's should be covered with planks or metal sheets to keep the beaver from digging its way out. Another method is to use a barrel (for example, a 200 l oil barrel) that can be dug into the ground so that the top is even with the beaver path. Soil removed from the pit should be removed from the trapping area, and one should try to disturb the vegetation and soil around the pit as little as possible. Bailey (1927) recommends placing larger branches and sticks from the sides of the pit toward the middle, and thin branches covered with grass and leaves in the middle where the beaver will fall through.

Advantages. The method is simple, inexpensive and easy to use.

Disadvantages. The disadvantage of this method is that it is a lot of work to make the pit, and it can't be moved. The beaver can be injured when it lands in the pit, but this will depend on the pit's size and how it is made.

Effectiveness. It is unclear how effective this trapping method is.

Enclosures

This method is described by Bailey (1927). The enclosure is built at the edge of the water or beach at a strategic spot where there is evidence of beaver activity. Bailey (1927) states that the enclosure should be about 2.5 m in diameter, have a 1.5 m high net, and that the netting should be small-meshed and strong enough to hold the beaver (wide chicken netting should be suitable). In addition the netting is held up by 7-8 solid fence poles. The bottom edge of the netting is dug about 5 cm into the ground and soil filled in around it. Likewise, the top 15 cm of netting should be folded in and downward to make an overhang. At the entrance there should be double doorposts if the closure is going to be a falling door. One customary way of arranging the release mechanism is that the beaver itself pulls on the bait in the enclosure and releases the door, or the trapper can release the door by pulling a string from a hiding place when the beaver enters the trap (see illustration on page 31 in Kvinlaug 1997).

To lure the animal into the enclosure one must first feed it preferred food. The food is placed first in the water in front of the enclosure, then a little closer to the entrance, and finally further and further into the enclosure. When the beaver (or preferably the whole beaver family) has gotten into the habit of going onto land and eating the food placed there, it is time to prepare the release mechanism. The enclosure should include objects the beavers can hide in or under so that they calm down after being captured. This may be bushes, artificial lodges, etc.

Advantages. The advantage of using this method is that one can trap many beavers (a family group) at the same time. It is relatively easy to build, and the cost of materials is low.

Disadvantages. The disadvantage of the method is that it is time-consuming to build such an enclosure, and it is not movable. It also takes time to get the beavers gradually accustomed to eating in the enclosure. In the meantime it is a lot of work to collect food and set it out.

GOALS AND METHODS

It is important to be aware that different goals for trapping will be served best by different methods for live-trapping. For example, what animals are to be caught (kits, yearlings, subadults or adults)? Are the animals to be used for research, or for translocation? Active trapping methods in which lodges/dens or dams are damaged are definitively unsuitable for trapping research animals, since one has seriously disturbed the animals' environment and stressed them. In trapping for research one should use methods that disturb and upset the population being studied as little as possible. It is also advantageous to use methods that require as little as possible human activity before, during and after the capture.

When trapping for introduction or reintroduction to other areas, the main objective is to catch many individuals in a short period of time, preferably whole family groups at once. Such translocations require capturing a pair of the proper age and sending these away together. By trapping family groups one can easily select the animals to be relocated and set the rest free, or relocate all of them. It may take several days to trap a pair when using methods that only capture one beaver at a time. It will often be necessary to set out several pairs in the same area. For economic reasons it is therefore preferable to capture and transport as many as possible at once. Another reason for capturing the individuals needed as quickly as possible is that the time in captivity must be held to a minimum.

CONCLUSIONS

Depending on the goal of the trapping (research or relocation), the locality, etc., some trapping methods will be more suitable than others. Bailey- and Hancock traps are the most commonly used methods for live-trapping of beaver today. In the USA the Hancock trap is considered by many to be the more effective of the two. This is supported by the studies by Brooks (1977) in which the Hancock trap proved to be significantly better under the same conditions. The Hancock trap can be used in a wider range of situations, is faster to set up, lifts the beaver up out of the water and reduces the animal's heat loss. Active trapping methods (such as digging out or destroying lodges/dens) may be effective, but they are

"brutal" and stress the individuals in the colony. These methods may provide many animals, but the results after relocation are often poor. Therefore, destruction of a lodge/den is disadvantageous in most cases and are usually not to be recommended.

Other trapping methods should also be tried out in Norway. Snares are at least as versatile as Hancock traps. In addition they are inexpensive, give few injuries, are light and compact, are selective, and have proven to be effective. One interesting variant of active trapping is "scooping" very young beavers with landing nets from a boat. If the research problem is dependent of young animals this would appear to be a very favourable method. More trials should also be done with pull nets on the bottom of streams and rivers. This has proven very effective in other countries.

The North American beaver is known for being relatively easy to capture, both in Conibear traps (killing) or live-traps, while the Eurasian beaver is easy to trap in Conibear traps but is not easy to live-trap (Göran Hartman pers. comm., Bart Nolet pers. comm.). It is well known among wildlife biologists that North American species often are less shy and thereby easier to trap than their European counterparts. For example, the Eurasian pine marten (*Martes martes*) is more difficult to live-trap compared with the American marten (*M. americana*) (Brainerd 1997). The hypothesis is that many European species have been suffering from an intense hunting pressure by man for many more generations than their American counterparts. The European species have thereby been experiencing a high evolutionary pressure to evolve a shy behaviour.

Live-trapping of beaver will probably be necessary in future research, to maintain populations, to translocate animals that have led to conflicts with people (damage), and for re-introductions to new areas or countries (Nolet & Rosell 1998). There is a clear need to develop better methods for live-trapping of beavers.

ACKNOWLEDGEMENTS

We thank Faye Benedict, Frode Bergan, Göran Hartman, Howard Parker and one anonymous referee for valuable comments on an earlier draft, and Øyvind Steifetten for the drawings. The study was supported financially by Telemark College, Norway.

SAMMENDRAG

Metoder for levendefangst av bever

Alt etter formål med fangsten (forskning eller forflytting av dyrene), fangstlokaliteten osv. vil noen fangstmetoder være bedre egnet enn andre. Bailey- og Hancockfellene er de mest brukte metodene til levendefangst av bever i dag. I USA er Hancockfellen av mange regnet for å være den mest effektive av de to. Dette støttes av studier utført av Brooks (1977) hvor, under like forhold, Hancockfellene var signifikant bedre. Hancockfellen kan brukes på flere lokaliteter, settes raskere opp, den løfter beveren opp av vannet og reduserer underkjøling av dyrene. Aktive fangstmetoder (som river/ødelegger hyttene) kan være effektive, men er "brutale" og stresser individene i kolonien som blir rammet. Metodene gir mange dyr, men resultatet etter omplassering er ofte dårlig. Ødelegging av hytter er derfor ufordelaktig i de fleste tilfeller og er vanligvis ikke å anbefale.

Det bør også prøves ut andre fangstmetoder i Norge. Snarer er vel så allsidige som Hancockfellen. De er dessuten billige, gir lite skader, er lette og kompakte, selektive og har vist en god effektivitet. En variant av aktiv fangst som er aktuell, er "håving" av årsunger fra båt. Hvis man trenger unger dyr til å løse et forskningsproblem synes dette å være en svært interessant metode. Man bør også prøve å legge ut nett i bunnen av bekker og elver. Dette har vist seg å være svært effektivt i andre land.

Den nordamerikanske beveren er kjent for å være relativt lett å fange i både Conibearfeller (drepende) og levendefeller, mens den eurasiske er lett å fange i Conibearfeller, men ikke i levendefeller. Det er imidlertid vel kjent blant viltbiologer at nordamerikanske arter ofte er mindre sky og derfor lettere å fange enn europeiske arter. For eksempel er den eurasiske måren (*Martes martes*) vanskeligere å fange levende enn den nordamerikanske måren (*M. americana*). Hypotesen går ut på at mange europeiske arter har vært utsatt for intensiv jakt over mange flere generasjoner enn de nordamerikanske artene. De europeiske artene har derfor, gjennom evolusjonen, utviklet en mer sky atferd.

Levendefangst av bever vil være nødvendig i mye av fremtidens forskning, ved bevaring av populasjoner, ved omplasseringer av dyr som har ført til konflikter (skade) med mennesker, samt til gjeninnføringer til nye områder eller land. Det er opplagt et behov for utvikling av bedre metoder for levendefangst.

REFERENCES

Bailey, V. 1927. Beaver habits and experiments in beaver culture. - U.S. Dept. Agr. Bull. 21: 1-39.

Bollinger, K.S. 1980. Scent marking behavior of beaver (Castor canadensis). - M.S. thesis, University of Massachusetts, Amherst.

Bradt, G.W. 1938. A study of beaver colonies in Michigan. - J. Mammal. 19: 139-162.

Brainerd, S.M. 1997. Habitat selection and range use by the Eurasian pine marten (Martes martes) in relation to commercial forestry practices in southern boreal Scandinavia. - Ph.D. thesis, Agricultural University of Norway, Ås.

Brooks, R.P. 1977. Induced sterility of the adult female beaver (Castor canadensis) and colony fecundity. - M.S. thesis, University of Massachusetts, Amherst.

Brooks, R.P., Flemming, M.W. & Kennelly, J.J. 1980. Beaver colony response to fertility control: evaluating a concept. - J. Wildl. Manage. 44: 568-575.

Buech, R.R. 1983. Modification of the Bailey live trap for beaver. - Wildl. Soc. Bull. 11: 66-68.

Busher, P.E. 1975. Movements and activities of beaver, Castor canadensis, on Sagehen Creek, California. - M.S. thesis, San Francisco State University, San Francisco.

Collen, P. 1997. Review of the potential impact of re-introducing Eurasian beaver Castor fiber L. on the ecology and movement of native fishes, and the likely implications for current angling practices in Scotland. - Scottish Natural Heritage Review No 86.

Couch, L.K. 1942. Trapping and transplanting live beaver. - U.S. Fish Wildl. Serv. Conserv. Bull. 30.

Dalane, E. 1977a. Fangst av bever som pelsvilt. - Pp. 76-78 in Lavsund, S. (ed.). Proceedings from the Nordic symposium on the beaver 1975. Institute of Forest Zoology, Research Notes No. 26.

Dalane, E. 1977b. Redskaper til beverfangst. - Pp. 74-75 in Lavsund, S (ed.). Proceedings from the Nordic symposium on the beaver 1975. Institute of Forest Zoology, Research Notes No. 26.

Davis, J.R. 1984. Movement and behavior patterns of beaver in the Piedmont of South Carolina. - M.S. thesis, Clemson University, Clemson, SC.

De Almeida, M.H. 1987. Nuisance furbearer damage control in urban and suburban areas. -Pp. 996-1006 in Novak, M., Baker, J.A., Obbard, M.E. & Malloch, B. (eds.). Wild furbear management and conservation in North America. Ontario Ministry of Natural Resources, Toronto.

Djoshkin, W.W. & Safonow, W.G. 1972. Die biber der alten und neuen welt. - Die Neue Brehm-Bücherei, Wittenberg Lutherstadt.

Ellis, H. 1750. Reise nach Hudsons Meerbusen in den Jahren 1746 und -47. Göttingen.

Fischer Andersen, I. B. 1997. Reintroduktion af bæveren (Castor fiber) til Danmark? En konsekvensanalyse. - Københavns Universitet, Zoologisk Museum, København.

Flemming, M.W. 1977. Induced sterility of the adult male beaver (Castor canadensis) and colony fecundity. - M.S. thesis, University of Massachusetts, Amherst.

Forskrift om bruk av fangstredskaper. 1990. - Issued by Direktoratet for Naturforvaltning July 2, in accordance with Act nr. 38 on wildlife of May 29, 1981.

Forskrift om forsøk med dyr. 1996. - Issued by Landbruksdepartementet Jan. 15, 1996 in accordance with Act nr. 73 on animal protection of Dec. 20, 1974.

Fries, C. 1943. Bäverland. - Nordisk Rotogravyr, Stockholm. (In Swedish).

Gilsvik, R. 1983. Understanding snares. - Fur-Fish-Game 11: 20-21 and 56-57.

Grasse, J.E. & Putnam, E.F. 1950. Beaver management and ecology in Wyoming. - Bull. 6. Wyoming Game and Fish Comm.

Grawe, A.M. 1980. Snaring methods. - Spearman Publ. Co. Sutton, Nebraska.

Gregg, P.A. & Carberry, W. 1957. Taking live beaver with nets. - Newfoundland Dep. Mines. Agr. and Resources, Mimeo.

Hammerson, G.A. 1994. Beaver (Castor canadensis) ecosystem alterations, management, and monitoring. - Natural Areas Journal 14: 44-57.

Hartman, G. 1994. Ecological studies of a reintroduced beaver (Castor fiber) population. - Ph.D. thesis. Swedish University of Agricultural Sciences, Uppsala.

Hartman, G. 1995a. Patterns of spread of a reintroduced beaver Castor fiber population in Sweden. - Wildl. Biol. 1: 97-103.

Hartman, G. 1995b. Population development of European beaver in Sweden. - Pp. 21-22 in Ermala, A. & Lahti, S.(eds.). Proceedings of the 3rd Nordic beaver symposi-um. Finnish Game and Fisheries Research Institute, Helsinki.

Havdahl, S. 1995. Pelsdyrfangst med feller. - Sør-Trøndelag Fylkeslag, Norges Jeger- og Fiskeforbund. Course compendium. (In Norwegian).

Hensley, A.L. 1946. A progress report on beaver management in California. - California Fish and Game 32: 87-99.

Hill, E.P. 1982. Beaver (Castor canadensis). - Pp. 256-281 in Chapman, J. A. & Feldhamer, G. A. (eds.). Wild mammals of North America: biology, management, and economics. John Hopkins University Press, Baltimore and London.

Hodgdon, H.E. 1978. Social dynamics and behavior within an unexploited beaver (Castor canadensis) population. - Ph.D. thesis, University of Massachusetts, Amherst.

Kile, N.B., Nakken, P.J., Rosell, F. & Espeland, S. 1996. Red fox, Vulpes vulpes, kills a European Beaver, Castor fiber, Kit. - Can. Field-Nat. 110: 338-339.

Kvinlaug, J.K. 1997. Levendefangst og utsetting av bever. - Avdeling for skog- og utmarksfag. Høgskolen i Hedmark, Evenstad. Report. (In Norwegian).

Lahti, S. 1997. Development of populations, distribution problems and prospects of finnish beaver populations. - P. 14 in Pachinger, K (ed.). Proceedings of the 1. European beaver symposium, Bratislava, Slovakia, September 15 to 19, 1997. Institute of Ecology, Faculty of Natural Sciences Comenius University. Bratislava, Slovakia.

Lavsund, S. 1977. Olika bäverjaktmetoder i Sverige. - Pp. 79-81 in Lavsund, S. (ed.). Proceedings from the Nordic symposium on the beaver 1975. Institute of Forest Zoology, Research Notes No. 26.

Lier-Hansen, S. 1994. Villrein & villreinjakt. - Landbruksforlaget, Oslo. (In Norwegian).

Macarthur, R.A. & Dyck, A.P. 1990. Aquatic thermoregulation of captive and free-ranging beavers (Castor canadensis). - Can. J. Zool. 68: 2409-2416.

Macdonald, D.W., Tattersall, F.H., Brown, E.D. & Balharry, D. 1995. Reintroducing European Beaver to Britain: nostalgic meddling or restoring biodiversity? - Mammal Rev. 25: 161-200.

Mason, C.E., Gluesing, E.A. & Arner, D.H. 1983. Evaluation of snares, leg-hold, and Conibear traps for beaver control. - Proc. Ann. Conf. Southeast. Fish and Wildl. Agencies. - 37: 201-209.

Myrberget, S. 1967. The Norwegian population of beaver, Castor fiber. - Meddelelser fra Statens viltundersøkelser series 2, nr. 26.

Nolet, B.A. 1994. Return of the beaver to the Netherlands: viability and prospects of a re-introduced population. - Ph.D. thesis, University of Groningen, Netherlands.

Nolet, B.A. & Baveco, J.M. 1996. Development and viability of a translocated beaver Castor fiber population in the Netherlands. - Biol. Conserv. 75: 125-137.

Nolet, B.A., Broekhuizen, S, Dorrestein, G.M. & Rienks, K.M. 1997. Infectious diseases as main causes of mortality to beavers Castor fiber after translocation to the Netherlands. - J. Zool., London 241: 35-42.

Nolet, B.A., Hoekstra, A. & Ottenheim, M.M. 1994. Selective foraging on woody species by the beaver (Castor fiber), and its impact on a riparian willow forest. - Biol. Conserv. 70: 117-128.

Nolet, B.A. & Rosell, F. 1994. Territoriality and time budgets in beavers during sequential settlement. - Can. J. Zool. 72: 1227-1237.

Nolet, B.A. & Rosell, F. 1998. Come-back of the beaver Castor fiber: an overview of old and new conservation problems. - Biol. Conserv. 83: 165-173.

Novak, M. 1987a. Traps and research. - Pp. 941-969 in Novak, M., Baker, J.A., Obbard, M.E. & Malloch, B. (eds.). Wild furbearer management and conservation in North America, Ontario, Ontario Ministry of Natural Resources.

Novak, M. 1987b. Beaver. - Pp. 283-312 in Novak, M. Baker, J.A. Obbard, M.E. & Malloch, B. (eds.). Wild furbearer management and conservation in North America, Ontario. Ontario Ministry of Natural Resources.

Owesen, A. 1979. I beverskog. - Gyldendal Norsk Forlag, Oslo. (In Norwegian).

Rosell, S. 1976. Metoder för bäverjakt. - Skogshögskolans avd. for vertebratekologi, Uppsala. Examination paper. (In Swedish).

Rosell, F. & Bergan, F. 1998. Free-ranging Eurasian beavers, Castor fiber, deposit anal gland secretion when scent marking. - Can. Field-Nat. 112: 532-535.

Rosell, F., Bergan, F. & Parker, H. 1998. Scent-marking in the Eurasian beaver (Castor fiber) as a means of territory defense. - J. Chem. Ecol. 24: 207-219.

Rosell, F. & Nolet, B.A. 1997. Factors affecting scent-marking behavior in Eurasian beaver (Castor fiber). - J. Chem. Ecol. 23: 673-689.

Rosell, F. & Parker, H. 1995. Beaver management: present practice and Norway's future needs. - Telemark College, Bø in Telemark, Norway. (In Norwegian with English summary).

Rosell, F. & Parker, H. 1996. Levendefangst av bever (Castor fiber). - Telemark College, Bø in Telemark, Norway. (In Norwegian).

Rosell, F. & Parker, H. 1997. Levendefangst av bever (Castor fiber) i 1997. - Telemark College, Bø in Telemark, Norway. (In Norwegian).

Rosell, F., Parker, H. & Kile, N.B. 1996. Causes of mortality in beaver (Castor fiber & canadensis). - Fauna 49: 34-46. (In Norwegian with English summary).

Schramm, D.L. 1968. A field study of beaver behavior in East Barnard, Vermont. - M.S. thesis, Dartmouth College. Hanover, N.H.

Schulte, B.A. 1993. Chemical communication and ecology of the North American beaver (Castor canadensis). - Ph.D. thesis, State Univ. New York, Syracuse.

Schulte, B.A., Müller-Schwarze, D., Tang, R. & Webster, F.X. 1994. Beaver (Castor canadensis) responses to major phenolic and neutral compounds in castoreum. - J. Chem. Ecol. 20: 3063-3081.

Shelton, P.C. 1966. Ecological studies of beavers, wolves, and moose in Isle Royale National Park, Michigan. - Ph.D. thesis, Purdue University, Lafayette. Ind.

Simon, J.R. & Brown, R.C. 1948. Castors and Castoreum. - Wyoming Wild. Life 12: 14-16.

Simonsen, T.A. 1973. Beverens næringsøkologi i Vest-Agder. - Meddelelser fra Statens Viltundersøkelser, ser. 2, nr. 39, 1973. (In Norwegian).

Smith, D.H. & Peterson, R.O. 1988. The effect of regulated lake levels on beaver in Voyageurs National Park, Minnesota. - U.S. Dep. of Interior, National Park Service, Research/Resources Managment Report MWR-11. Midwest Regional Office, Omaha, Nebraska.

Smith, D.W., Trauba, D.R. & Anderson, R.K. 1994. Black bear predation on beavers on an island in Lake Superior. - Am. Midl. Nat. 132: 248-255.

Stubbe, C., Ahrens, M., Stubbe, M. & Goretzki, J. 1995. Lebendfang von Wildtieren : Fangtechniken - Methoden - Erfahrungen. - Deutscher Landwirtschaftsverlag, Berlin, GmbH. (In German).

Sun, L. 1996. Chemical kin recognition in the beaver (Castor canadensis): behavior, relatedness and information coding. - Ph.D. thesis, State University of New York, Syracuse.

Sun, L. & Müller-Schwarze, D. 1998. Beaver response to recurrent alien scents: scent fence or scent match? - Anim. Behav. 55: 1529-1536.

Sun, L., Müller-Schwarze, D. & Schulte, B. A. 1998. Dispersal pattern and effective population size of the beaver. - J. Mammal. In press.

Svendsen, G.E. 1980. Patterns of scent-mounding in a population of beaver (Castor canadensis). - J. Chem. Ecol. 6: 133-148.

Syvertsen, K. 1976. Undersøkelse av bever (Castor fiber) i Agder-fylkene - Sør-Norge. Populasjonstetthet, aldersbestemmelse, reproduksjon og aktivitet. - Hovedfagsoppgave, University of Bergen. (In Norwegian).

Tang, R., Webster, F.X. & Müller-Schwarze, D. 1993. Phenolic compounds from male castoreum of the North American beaver (Castor canadensis). - J. Chem. Ecol. 19: 1491-1500.

Taylor, D. 1970. Growth, decline, and equilibrium in a beaver population. - Ph.D. thesis, University of California, Berkeley.

Troidl, C. & Ionescu, G. 1997. Beaver project Romania - a reintroduction with special focus on anthropic factors. - P. 29 in Pachinger, K (ed.). Proceedings of the 1. European beaver symposium, Bratislava, Slovakia, September 15 to 19, 1997. Institute of Ecology, Faculty of Natural Sciences Comenius University. Bratislava, Slovakia.

Uhlenhaut, K., Stubbe, M., Piechocki, R. & Dawaa, N. 1977. Der lebendefang des Flussbibers (Castor fiber L. 1758). - Arch. Naturschutz u. Landschaftsforsch, Berlin 17: 211-222.

Valeur, P. 1988. Territorial behavior as factor in regulation of populations in beaver. - Fauna 41: 20-34.

Vevstad, A. 1989. Fangstmannsminne, Aslak Harstveit fortel til Andreas Vevstad. - Åmli municipality, Vest-AgderNorway. (In Norwegian).

Walro, J.M. & Svendsen, G.E. 1982. Castor sacs and anal glands of the North American beaver (Castor canadensis): their histology, development, and relationship to scent communication. - J. Chem. Ecol. 5: 809-819.

Weaver, K.H., Arner, D.H., Mason, C. & Hartley, J.J. 1985. A guide to using snares for beaver capture. - Southern J. Appl. For. 9: 141-146.

Wilsson, L. 1971. Observations and experiments on the ethology of the European beaver (Castor fiber L.). - Viltrevy 8: 115-306.

Zurowski, W. 1979. Preliminary results of European beaver reintroduction in the tributary streams of the Vistula river. - Acta Theriol. 24: 85-91.