Snow tracking: a relevant method for estimating otter Lutra lutra populations

Author: Sulkava, Risto

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Snow tracking: a relevant method for estimating otter *Lutra lutra* populations

Risto Sulkava

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Densities of otter *Lutra lutra* populations are difficult to measure. However, otters have to move between ice-free feeding areas in winter, and for this reason finding otter tracks is easy during the winter season. Snow tracking has been used for estimating the total population of otters in a 1,650 km^2 study area in central Finland since 1985 by the use of three methods. Using the home-range mapping method (HMM), all rivers, especially rapids and other possible feeding areas for otters, were studied carefully. Otter individuals were identified by size, age and course direction of the tracks, and the census was controlled by two revisits to possible feeding areas a few days after the first tracking. After the revisits, no further individuals were found in any of the 16 river systems. HMM gives exact estimates of the total population of otters, and in 2002/03, 52 otters (including 11 litters and 16 cubs altogether) lived in the study area. Litters are usually found while snow tracking, and the method therefore also supplies information on the productivity of the population. Using the segment method (SM), all shorelines of rivers and streamlets were divided into segments, and each segment was searched for otter tracks. The population estimate was mean number of animals determined from observed fresh signs in the sampled segments, and extrapolated across all segments in the study area. When the population was estimated by the positive segments found in SM, 59 otters were found; almost the same number as was estimated by using the HMM (52 otters). I also used a faster sampling method; the one-visit census (OVC). Only the most easily reachable otter sites of all possible home ranges were investigated within a few days. The number of permanent OVC sites was 111, and all sites were visited two to four days after the last snowfall. Using the OVC, about 50% of otters estimated by using the HMM were found in every sampling. The OVC method is cheap and reliable, and is therefore a useful tool for monitoring otter populations in large northern areas, such as for example in Finland, Sweden, Russia and Canada, given that infrastructures, i.e. roads, exist.

Key words: census, Lutra lutra, monitoring, otter, population, reproduction, snow tracks

Risto Sulkava, University of Joensuu, Department of Biology, Joensuu, Finland - e-mail: risto.sulkava@pp.inet.fi

**Present address: Aaponkaari 3, FIN-42800 Haapamäki, Finland*

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Monitoring of rare species, such as for example otter *Lutra lutra* populations, is important (e.g. Foster-Turley et al. 1990, Rassi et al. 1992, Anon. 1994, Stjernberg & Väisänen 1998). However, all techniques used for estimating the population size of free-living semiaquatic mammals, such as otters, prove difficult to use. A basic field survey method for estimating the presence of otters is based on the occurrence of spraints (i.e. faeces) and other signs. Studies based on this so-called standard method have been carried out in many areas (e.g. Jenkins & Burrows 1980, Macdonald & Mason 1982a, 1982b, Conroy & French 1987, Cronström 1989, Delibes 1990, Kemenes 1991, Mason & Macdonald 1991, Lode 1993, Sulkava & Storrank 1993, Brzezinski et al. 1996). The field survey is recommended as the best method of investigating the distribution and possibly the relative abundance of otters over large areas (Macdonald & Mason 1994, Mason & Macdonald 1987, IUCN 2000), but it does not supply information about the actual size or vitality of the population. Other possible methods for estimating otter populations, such as radioactive isotopes (^{65}Zn; Kruuk et al. 1980, Knaus et al. 1983, Arden-Clarke 1986, Crabtree et al. 1989), chalk-dusted track boards (Humphrey & Zinn 1982), latrines (Rowe-Rowe 1992), dens or holts (Kruuk et al. 1989), radiotelemetry (Green et al. 1984, Testa et al. 1994), mark-recapture techniques (Melquist & Hornocker 1983), DNA typing of spraints (Jansman et al. 2001) or scent stations (Linhard & Knowlton 1975), are useful in special studies, but not for large-scale monitoring. Estimates of abundance based on fur-harvest data or questionnaires and interviews are usually either impossible or unreliable (e.g. Mason & Macdonald 1986). Direct censuses are possible only in small areas in some marine habitats (Ruiz-Olmo 1993, Kruuk 1995, Udevitz et al. 1995).

Snow-tracking has been used in otter studies in Sweden (Erlinge 1967, 1968, Kjellander & Mortensen 1985, Aronson 1995), Canada (Reid et al. 1987), Finland (Skaren & Kumpulainen 1986, Skaren & Jäderholm 1987, Sulkava & Sulkava 1989, Sulkava 1993, Kauhala 1996, Sulkava & Liukko 1999, Storrank et al. 2002,), Belarus (Sidorovich 1991, Sidorovich & Lauzhel 1992, Sidorovich 1997), Germany (Klenke 1996, 2002, Hertweck et al. 2002), Poland (Sidorovich et al. 1996), the Czech Republic (Simek 1996, 1997, Simek & Springer 1998), Austria (Kranz & Knollseisen 1998) and Slovakia (Kadlecik & Urban 2002). The results of these studies gave much new information, and occasionally it was possible to estimate the actual number of otters (Reid et al. 1987, Sulkava 1993, Aronson 1995, Simek 1996, Kranz & Knollseisen 1998, Simek & Springer 1998, Hertweck et al. 2002, Klenke 2002).

In my paper, I describe three different snow-tracking methods and their practical implementation. The aim of my study is to produce practical guidelines for otter monitoring in snowy conditions. The main aim of all three snow-tracking methods described, i.e. the home-range mapping method (HMM), the segment method (SM) and the one-visit census (OVC) method, is to estimate the population size of otters for monitoring purposes.

Study area

The study area, covering about 1,650 km^2, is situated in central Finland (62°16'N, 24°27'E). The area includes three main water systems, many small rivers and streamlets and numerous lakes (Fig. 1). Most of the streams are $<$ 5 m wide. The total length of the rivers and streamlets in the study area is about 750 km. Of these, about 6 km of the total length are made up by rivers that are $>$ 20 m wide, and 34 km of the total length are made up by rivers that are 5-20 m wide. The total length of shorelines of lakes and ponds is approximately 1,300 km, and water covers about 12% of the surface of the area. Dystrophic waters are typical in the study area, but some oligotrophic and eutrophic waters are also found. All rivers flow mainly through areas dominated by coniferous forests. Forests make up 68% of the study area, but there is also some agricultural land (approximately 5%), peat land (10%) and settlements. There are some 20,000 inhabitants in the area.

In the study area, the temperature generally drops below -20°C, sometimes to -35°C, in winter. The long-term mean temperature is -2.3°C in November, -9.8°C in January and -4.9°C in March (Finnish Meteorology Institute 1997). In a typical winter, the period of snow cover lasts from the end of November to late April, and during that period all lakes and most rivers are covered by ice. The mean depth of snow is 5 cm in November, 35 cm in January and 51 cm in March (Finnish Meteorology Institute 1997). The mean thickness of ice in lakes is 15 cm in November, 30 cm in January and 50 cm in March (Finnish Meteorology Institute 1997).

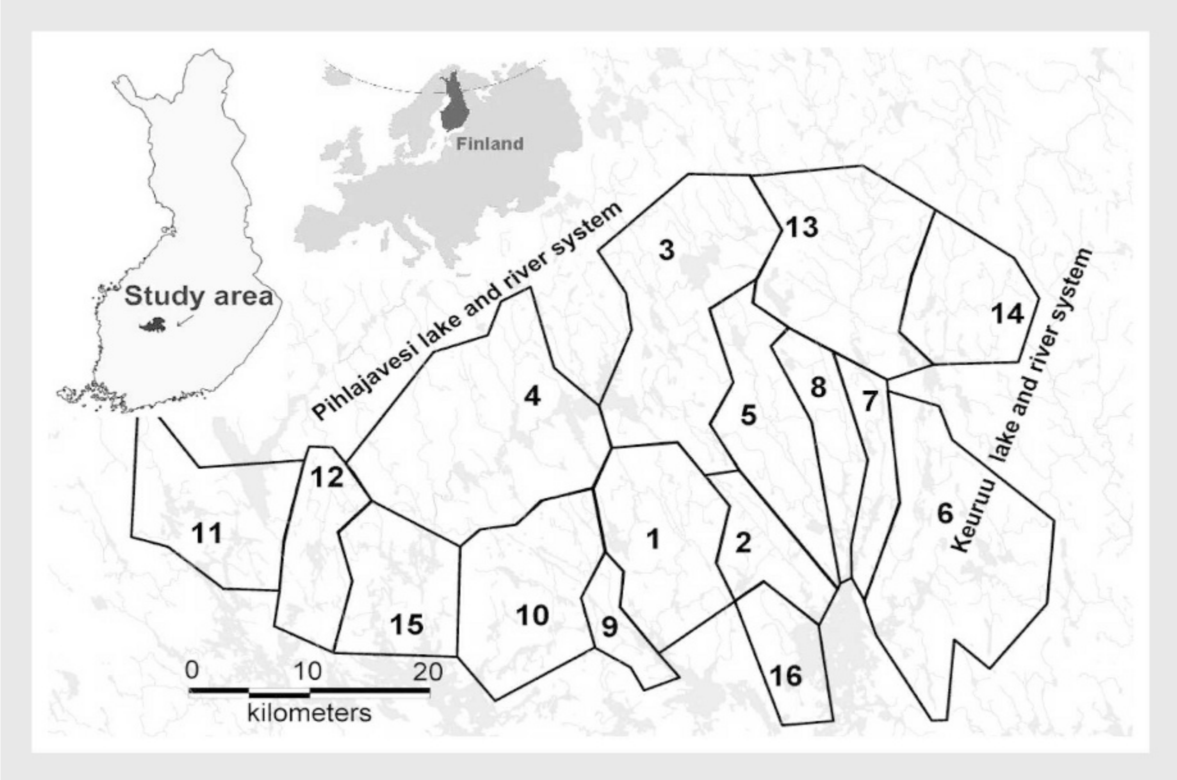

Figure 1. Location of the study area in Finland. Straight lines with numbers inside indicate watersheds or other borders between the different areas, and lakes are shown in grey.

Material and methods

In Finland, otter studies were initiated in 1984, and movements, home range, sprainting activity and number of otters have been studied mostly by use of snow tracking (Sulkava & Sulkava 1989, Sulkava 1993, Sulkava & Liukko 1999). The basic requirement for snow tracking is of course snow that remains on the ground for a sufficiently long time period. Ice on lakes is also useful for tracking, whereas fast-melting sleet without ice formation on the water is insufficient, especially when using the HMM. For HMM, suitable ice and snow cover is essential. Ice must cover all lakes and most of the rivers, and there must be total snow cover. In my study area, suitable conditions for HMM last for at least five months of the year.

I used ANOVA and Student's t-test to test for differences between movements of different otter groups or between weather conditions, and Pearson correlation test for testing correlation between the estimates of population sizes found by using the HMM and OVC methods. ANOVA for repeated measurements (ANOVAR) was used for testing possible changes in population, and also for differences between results obtained using the OVC and HMM methods. The 16 different water areas (see Fig. 1) were used as subareas in this testing. The same subareas were also used in ANOVAR when testing differences between finds of fresh or old tracks in OVC and the total population estimated by HMM.

To monitor otter populations, it is important to know how and where the otters move during the different seasons. Tracks in fresh snow were followed during two or more successive days to determine the lengths of movement, and were measured on a map (1:20,000). The size of tracks separates individuals, and we stopped tracking when it became impossible to identify individuals.

In my study area, all individuals moved within their home range throughout the year (Sulkava 1993, Sulkava & Storrank 1993). As most of the streams and all lakes are covered by ice during winter, otters have to move over large areas in their search for food. All individuals also moved in all kinds of flowing waters, from the smallest streamlets to large estuaries. However, large lakes act as barriers between home ranges, because the ice cover completely seals off the water, so that otters cannot find any prey in lakes in winter (Sulkava 1996 and own unpubl. data).

The aim of the HMM is to conduct a census of all individuals in the study area. The work starts by identifying all the separate river and lake systems in an area. All waterfalls, rapids and other places that were not covered by ice, as well as all waters with potential tunnels below the ice, were examined carefully during suitable ice and snow conditions. The otter individuals found were identified on the basis of size, age and course direction of the tracks, and areas without tracks were divided between individuals. This is only possible when the lakes and most of the rivers are totally covered by ice.

It was quite easy to distinguish between different individuals, because there were many small lakes and ponds, and in most cases only one to three otters or one litter lived in one river. The different river systems (see Fig. 1) are isolated from one another by large lakes or watersheds. Most otters lived in one river system during the whole winter. Sometimes they could, however, move between systems, and therefore investigations proceeded systematically from one river to another, and the study period was kept as short as possible.

Usually, not all individuals were found during the first survey. Some may have moved between rivers or along very small streamlets, or used tunnels under the ice. Therefore, after the first survey, all feeding areas were revisited briefly two-three days later, and again some days later. During these revisits, new locations of otters found earlier were easily discovered, as well as any new individuals from small streamlets or other secondary areas which had come to the feeding areas. By carrying out these revisits, it became possible to find out the approximate location of all otters along a river, and so all otter individuals could be found within one week in one river system or systems that were close to each other. Estimating the otter population of a larger area was possible when the investigation advanced systematically from one river to another. The same or nearly the same method has been used in Sweden (Aronson 1995), Belarus (Sidorovich 1997) and the Czech Republic (Simek & Springer 1998).

It was possible to distinguish the tracks of a female and her cubs at the beginning of winter. Usually, it was impossible to distinguish between tracks of females and one-year-old males, whereas tracks of adult males could be identified at any time. This made it possible to identify litters and males. Differences in track size between different females were also useful for separating individuals. Because litters could be identified and because they also moved widely in winter, snow tracking made it possible to estimate the reproductive status of the population.

The total otter population was also estimated in 1998/99, but by use of the SM as described by Reid et al. (1987). According to this method, all shorelines of rivers and streamlets are divided into numbered 500-m long segments. The segments are divided on riverbanks and streamlets only, and not the shorelines of lakes as they are not possible feeding areas for otters in winter because they are covered by ice. A total of 1,522 segments was numbered, and a random sample of 205 segments was selected for the survey. Each segment was searched for fresh otter tracks, which were evaluated as either less or more than 24 hours old. Estimation of age was made by fall of snow, white frosting and unfrozen scats. Individuals were distinguished from each other by size and direction of the tracks. The population estimate was mean number of animals in the sampled segments or positive segments extrapolated across all segments in the study area.

When estimating populations using the OVC method, 111 permanent study sites were selected in the study area (Fig. 2). The sites were near bridges and other places easy to access by road; in other words, the selection of study sites was based mainly on existing infrastructure. When selecting the study sites (from 1:50,000 maps), in the case of two possible sites close to each other on the same river, the first one was selected. All the sites were combined into three groups, and each group, i.e. 30-40 study sites, was investigated in one day, and the entire study area was investigated in three days. The distance between study sites usually varied between one and five km on each watercourse.

At each study site we searched for otter tracks over a distance of 20-600 m of riverbed. The length of the search depended on ice cover and other physical characteristics of the watercourse. For example, where there were open rapids, a longer distance was needed than for an inlet totally covered by ice. We usually found otter tracks within the first 100 m if an otter had been at the study site (R. Sulkava, unpubl. data). Less than 5% of tracks were found by searching a distance of > 400 m (R. Sulkava, unpubl. data). Also in the standard method de-

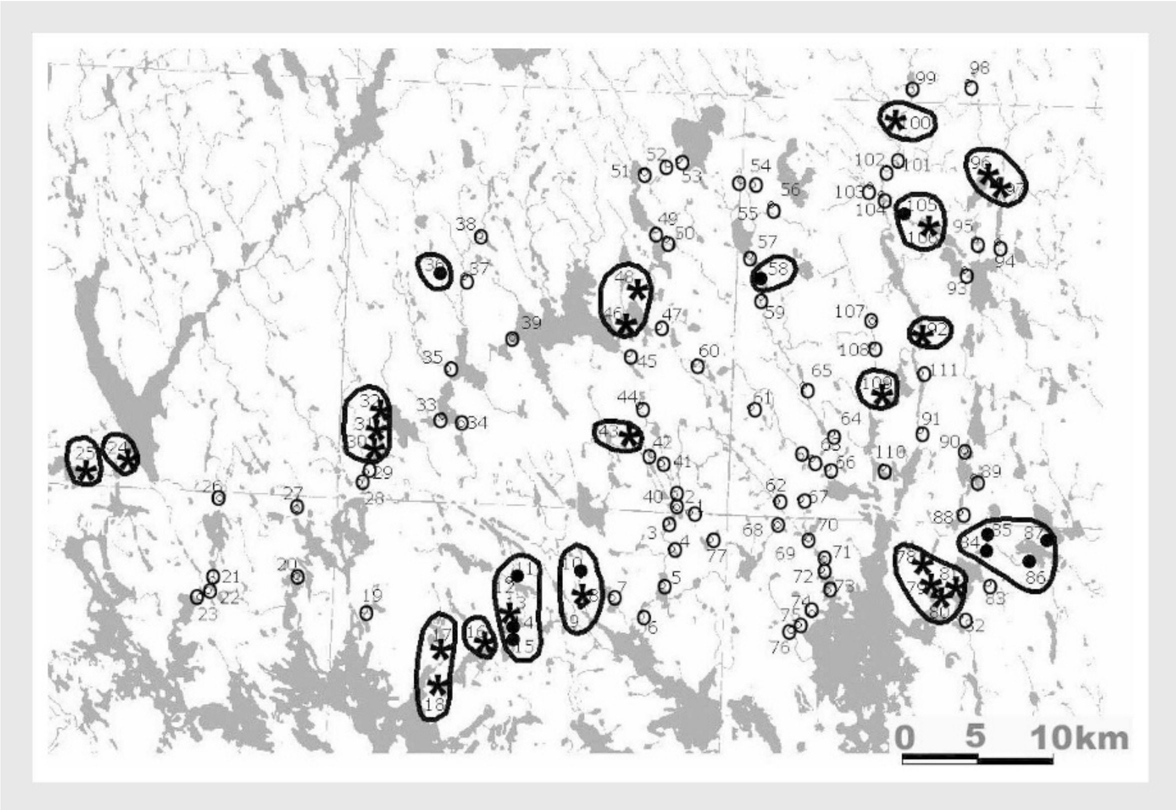

Figure 2. Tracks and individual otters found during the OVC in 1998. ○ indicates no tracks, ● indicates old tracks, ∗ indicates fresh tracks, and — drawn around the positive sites indicates that one individual or one litter was present.

scribed by Mason & Macdonald (1991), > 90% of the sites were recorded as positive within the first 600 m. The same is true for snow tracking. One must remember that the aim of the OVC method is not to find all otters, but the proportion of otters that live in the area.

Field work was carried out within 2-4 days after the last snowfall, thus making it possible to estimate the age of the tracks. Only tracks younger than the previous snowfall were used. Physical conditions, weather and presence of other species (e.g. the American mink *Mustela vison*) were noted. Data on age, size and course direction of the tracks were noted at each positive site. Individuals were distinguished from each other by age, size and course of the tracks. When it was not possible to distinguish between individuals in any other way, an empty area between individuals was also searched for; i.e. in these cases an extra study site between possible individuals was examined. For instance, if tracks were found in two streams separated by a lake without tracks, the individuals were most probably two different animals (see Fig. 2). The

Table 1. Mean length of daily movements (in km) by different groups of otters in winter, total length of tracking (in km) and number of field days. Animals of unknown sex or age are included in the calculations of mean length of moves.

	Mean length of		Total length of	Number of
	Daily movement (km)	± SD	tracking (km)	field days
Male	5.46	3.46	169.2	31
Single	4.59	2.66	385.8	84
Litter	3.08	1.87	243.4	79
Mean	4.12	2.67	798.4	-

Table 2. Mean length of daily movements (in km) of otters under the following weather conditions in winter: number of days with temperatures < -20°, temperatures > -1° and snow depth of > 20 cm, and all these factors (28, 20, 26 and 194, respectively). Only loose snow, in which an otter sinks, has been taken into account in the thickness of snow cover.

Weather	Mean length of		Total length of tracking	Number of field
condition	Daily movement (km)	± SD	(km)	days
Temperature < -20°C	3.64	2.16	94.7	26
Temperature > -1°C	5.09	2.5	101.8	20
Snow depth > 20 cm	4.28	2.88	119.8	28
All	4.12	2.67	798.4	194

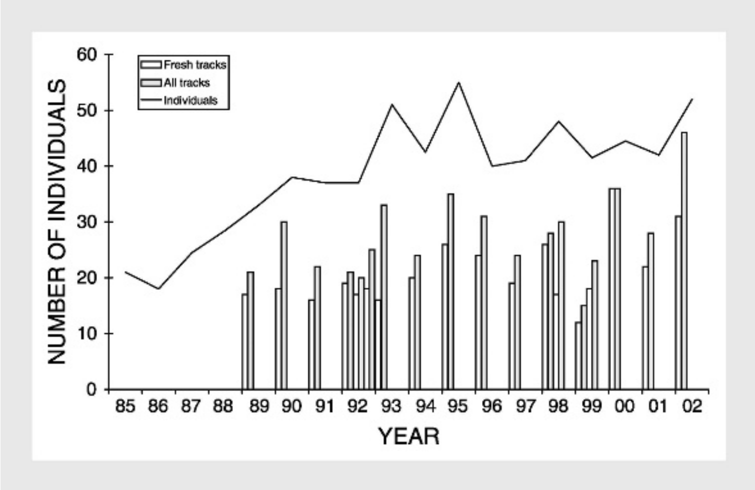

Figure 3. Total population of otters in the study area during 1985-2003. The line (—) shows the number of otters estimated by the home-range mapping method (HMM), and bars represent the population as estimated by use of the one-visit census (OVC) method, with either all tracks (■) included or with only fresh tracks (□) included.

minimum number of individual otters at each site or sites near others was estimated using the described criteria.

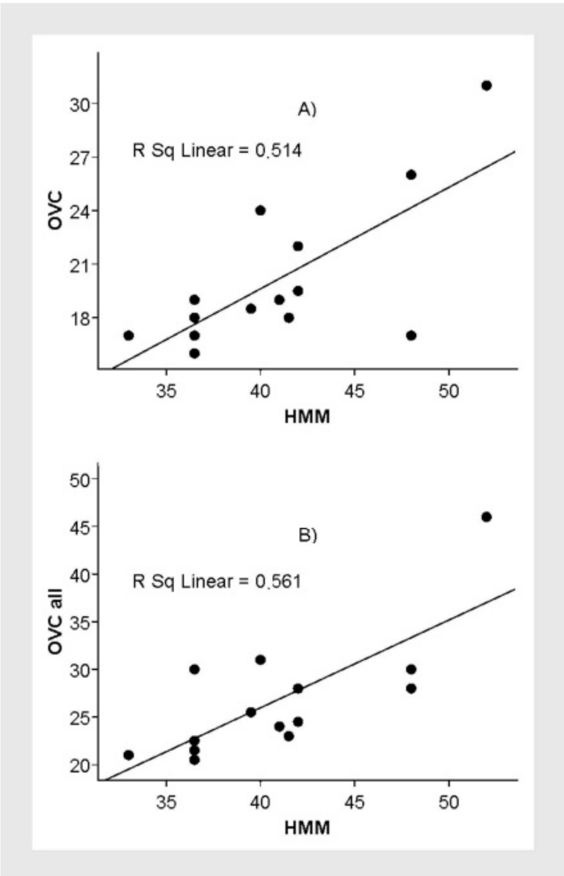

Figure 4. Correlation between population estimates obtained by use of the HMM and OVC method, respectively, with either only fresh tracks (A) included (Pearson correlation: r = 0.72, df =1, P = 0.004, N = 14), or all tracks included (B: r = 0.75, df = 1, P = 0.002, N = 14).

Positive and negative observations of otters were located on a map of the water systems (1:50,000; see Fig. 2), to estimate the minimum number of individuals in all watercourses and in the whole area. If, for example, two positive sites were found in different water systems, or the distance between sites with fresh tracks was > 10 km, there were most probably two individuals. The distance travelled by an individual otter (not males) did not usually exceed 6 km in one day (Table 1). Since the end of the 1980s, OVC investigations have been carried out every winter (see Table 4).

Results

The mean distance moved by an otter was about 4.1 km/day in winter (see Table 1). Females with cubs moved less than other otters (ANOVA: F = 12.5, P < 0.001). Sometimes otters stopped at a good feeding area and stayed there for several days, but usually they moved some kilometres every day. Snow depth did not affect otter movements (Student's t-test: t = 0.8, P = 0.26; Table 2), but when the weather was mild, the otters moved more than during very cold weather (Student's t-test: t = 2.1, P = 0.041; see Table 2).

On the basis of HMM results, the otter population in the study area increased significantly from 1985 (about 20 animals) to 1993 (about 50 animals; ANOVAR: F = 58.5, P < 0.001). After 1993, the population has varied between 40 and 50 animals (Fig. 3). In the winter of 2002/03 there were 52 otters in the study area. The density of otters was 1.2/100 km^2 in 1985/86 and 3.2/100 km^2 in 2002/03.

Table 3. Number of otters in the study area estimated by use of the HMM and OVC method during 1985-2003 with only fresh tracks included, and with all tracks included (in brackets). The percentages of otters found using the OVC method were calculated from the mean number of otters estimated. Three investigations by OVC were conducted separately in 1992/93 and two in 1998/99 and 1999/2000. The error percentages between the number of otters based on using the HMM and the OVC method were calculated as: (2B/A × 100) - 100, in which A was the number of otters based on HMM and B was the number of otters based on OVC method, with only fresh tracks included. B was multiplied by two because only about 50% of otters are found using the OVC method. The symbols in the error percentage column indicate: * that the area and the number of study sites were different in the last investigations in 1992/93, ** that the temperature was continuously < -30°C and *** that the temperature was continuously > -1°C.

Winter	Estimated number of otters by HMM	Estimated number of otters by OVC	% of otters found using the OVC	Error %
1985/86	21	-	-	-
1986/87	18	-	-	-
1987/88	24-25	-	-	-
1988/89	28-29	-	-	-
1989/90	33	17 (20-22)	52 (64)	+3.0
1990/91	35-38	18 (29-31)	49 (82)	-1.4
1991/92	36-37	15-17 (21-24)	44 (62)	-12.3
1992/93	35-38	17 (20-21)	47 (56)	-6.8
	35-38	19 (21-22)	52 (59)	+4.1
	38-41	18-19 (25-26)	47 (65)	-6.3 *
1993/94	49-53	16 (33)	31 (65)	-37.3 **
1994/95	41-43	19-20 (24-25)	46 (58)	-7.1
1995/96	55	26 (35)	47 (63)	-5.5
1996/97	40	24 (31)	60 (78)	+20.0
1997/98	41	19 (24)	46 (59)	-7.3
1998/99	48	26 (28)	54 (58)	+8.3
	48	17 (30)	35 (63)	-29.2
1999/00	41-42	12 (15)	29 (36)	-42.2 ***
	41-42	18 (23)	43 (55)	-13.3
2000/01	44-45	36 (36)	81 (81)	+61.8 ***
2001/02	42	22 (28)	52 (67)	+4.8
2002/03	52	31 (46)	60 (88)	+19.2
Mean	-	-	Fresh; 48.6 (± SD 11.7) All; 64.4 (± SD 12.0)	-2.6

Along rivers, the density of otters was about 0.3/10 km river or streamlet in 1985/86 and 0.7/10 km in 2002/03. If only larger rivers, being > 5 m wide, were included, the density of otters was about 5/10 km in 1985/86 and 13/10 km in 2002/03.

In 1998/99, when using the SM, 12 otter individuals and eight positive segments (with fresh tracks) were found in the 0.5-km intervals studied. This means 0.059 or 0.039 otter/segment, respectively, with a total population estimate of 89 or 59 otters. Three litters, altogether seven cubs, were found in studied segments, and therefore the estimate of the total number of individuals was high. Excluding young otters, only five individuals were found, and the estimate was 0.024 otter/segment and 37 individuals in the whole area. At least 29 individuals were found in the studied segments as estimated from all tracks. By using the results obtained using the HMM, it was estimated that 52 otters lived in the studied area. The population estimate obtained from the proportion of positive segments, 59 otters, was almost the same.

Table 4. Number of litters estimated by using the HMM and OVC method in the study area during 1985-2003, and mean numbers of otter cubs/litter based on HMM only. The figures in brackets express that the studied surroundings of the OVC study area were included. The symbols in the OVC column indicate: * that three separate OVC investigations in 1992/93, and two in 1998/99 and 1999/2000, respectively, were included, and ** that the temperature was continuously < -30°C.

Winter	Litters based on HMM	Litters based on OVC	Mean number of cubs/litter
1985/86	3	-	1.7
1986/87	1	-	2.0
1987/88	3	-	2.3
1988/89	5	-	1.6
1989/90	4 (4)	1	1.5-1.8
1990/91	5 (5)	2	1.6-2.0
1991/92	4 (4)	1	1.8
1992/93	4 (5)	1, 2, 1 *	1.6-2.0
1993/94	9 (10)	2 **	1.6
1994/95	8 (8)	6	1.4
1995/96	10 (12)	5	1.6
1996/97	8 (9)	6	1.1
1997/98	7 (7)	1	1.1
1998/99	5 (5)	2, 2 *	2.0
1999/00	6 (6)	2, 2 *	1.7
2000/01	7 (9)	5	1.1
2001/02	5 (7)	1	1.3
2002/03	11 (16)	9	1.6
Mean	6.6 (N = 105 (119))	2.8 (N = 51)	1.55 (N = 180-185)

Population estimates obtained from HMM and OVC correlated positively, regardless of whether OVC was based on fresh or all tracks (Pearson correlation: fresh r = 0.72, df = 1, P = 0.004, N = 14, and in all r = 0.75, df = 1, P = 0.002, N = 14; Fig. 4). The estimated number of otters based on HMM and OVC shows that about half as many otters were found using the OVC method of recording fresh tracks (Table 3). This proportion remained stable throughout the study period (ANOVAR: time P < 0.001, observations P = 0.609).

Several litters are born in the study area in most years. For 1985/86-2002/03, the mean number of cubs was 1.5/litter in late autumn and a total number of 119 litters (Table 4).

Table 5. Time effort invested in field work using three different snow tracking methods, and the spraint study method (standard method including 95 study sites) in the same study area of 1,650 km^2 in central Finland, expressed as person days/survey. Each person day was set at eight hours of fieldwork.

Tracking method	Person days needed
Home-range mapping method (HMM)	38 (two persons studied one river area/day, i.e. 16 areas and 6 days for controls)
Segment method (SM)	19
One-visit census (OVC)	3 (1 itinerary/day/person)
Standard method	17 (Sulkava & Storrank 1993)

Discussion

The fact that all otters move intensively during winter makes it easy to find individuals by use of snow tracking, and still to find otters by sampling of potential otter areas. The measured daily movements were similar to those reported from other studied areas (Erlinge 1967, Dulfer & Roche 1998, Kranz et al. 2002). The home range of a female otter or a female with cubs in central Finland was usually 20-40 km of watercourse (Sulkava 1993 and own unpubl. data). Male otters moved over larger areas.

The HMM (52 otters) and SM (59 otters) gave similar estimates when using positive segments in the SM. It seems that both methods give an accurate estimate of the otter population, but there is more uncertainty using the SM. Although an earlier spraint study using the standard method (Sulkava & Storrank 1993) gave a similar picture of the population, it must be pointed out that the population size was not estimated by an independent method that did not rely on snow tracking.

As the HMM and the SM require a great deal of time and effort (Table 5), I developed and tested a faster snow-tracking method, the one-visit census (OVC) method, in the 1980s (Sulkava 1993, Sulkava & Storrank 1993, Sulkava 1995, Sulkava & Liukko 1999, Storrank et al. 2002) to estimate the population with only one sample of potential otter areas. This method requires less work, and may allow monitoring of populations. The density estimates made by OVC correlate with those obtained using HMM, but they are systematically smaller (see Fig. 4); they made up about 50% of otters counted using the HMM (only fresh tracks included), and about 65% when all tracks were included (see Table 3). Locating all otters in the area in such a short time (using the OVC method) was impossible, but when the same proportion (i.e. the same sites) of the total study area was investigated in every survey, the size of the total population could be monitored.

The results of the OVC method depended only slightly on weather, stage of winter or the thickness of snow cover (Sulkava 1993 and own unpubl. data). Only very cold weather affects the moving activity of otters negatively, and unusual warmth increases it (Sulkava 1995; see Table 2). As the maximum time period in which old tracks can be identified varies, calculations should be more accurate if only fresh tracks are considered (see Table 3). However, all tracks (old tracks included) also reflected changes in population size (ANOVAR: time $P < 0.001$, observations $P = 0.557$), and the correlation between HMM and OVC was even better for all tracks (see Fig. 4).

Estimation of litter production is also possible using HMM (see Table 4). All litters can be recognised in autumn until January during which time it is easiest to distinguish young individuals. The best conditions for OVC investigations are between December and March, during which period it is often hard to identify young individuals. However, some litters are found in every OVC, and even this information is noteworthy. The other field survey methods, such as the standard method, seldom give any information on the reproduction of otters.

All techniques for estimating otter populations are time consuming and difficult, involving highly specialised investigators. In using the OVC method, the investigators may miss otters that do not leave tracks at a study site. It is also possible that different individuals cannot be distinguished from one another. However, when the same method is performed in the same way every year, it gives useful results for monitoring populations. There is also much less variation in the movement of otters in snow than in spraint-marking activities among otters (e.g. Mason & Macdonald 1986, Kruuk & Conroy 1987, Macdonald & Mason 1987, Conroy & French 1991, Sulkava 1993, Kruuk 1995, Romanowski et al. 1996, Romanowski & Brzezinski 1997). Also, the general visibility of snow tracks is good, and compared to spraints they are easy to identify. The standard method is so time and effort consuming (see Table 5) that in larger areas there are financial constraints on monitoring, and in addition it is difficult to obtain results which are not influenced by the investigators' experience. Of course, experience plays a role in snow tracking too, but the potential influence on results is much smaller. The OVC method is easier, faster, cheaper, and in good snow conditions more reliable than most other field methods, such as e.g. the standard method.

In conclusion, the snow-tracking method works well in studies of population densities of otters in northern areas. With the HMM, the size of an otter population and the reproduction can be evaluated with a high level of accuracy. The HMM gives good estimates of populations, but is financially demanding. The SM, and especially the OVC method, are much faster and cheaper. Snow-tracking methods are easier and more reliable than other currently used field methods in snowy conditions. Snow-tracking methods also give more information on the population and reproduction of otters. OVC is a realistic method for the monitoring of otter populations, e.g. in Finland. The method does, however, require a winter with snow and ice, and it cannot compete with the standard method in most areas.

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