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Monitoring of the Pasvik-Inari-Pechenga brown bear (*Ursus arctos*) population in 2019 using hair traps

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TITTEL/TITLE

Monitoring of the Pasvik-Inari-Pechenga brown bear (*Ursus arctos*) population in 2019 using hair trap

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SAMMENDRAG/SUMMARY:

Sammendrag

Siden 2005 har populasjonen av grenseoverskridene brunbjørn (*Ursus arctos*) i Trilateral Park Pasvik-Inari-Pechenga (Norge-Finland-Russland) blitt overvåket ved å bruke genetiske analyser av hår og ekskrement-prøver samlet inn opportunistisk i felt. En mer systematiske metode med hårfeller hvert fjerde år ble i 2007 startet opp for å samle inn bjørnehår til genetisk analyse. Metoden består i å sette ut 56 hårfeller med luktstoff i Norge, Finland og Russland i et 5 x 5 km2 rutenett (totalt ca. 1400 km2). Dette prosjektet ble gjentatt i 2011, 2015 og nå i sesongen 2019 med 58 ruter og ved bruk av samme metode som i 2007. I 2019 sesongen ble det samlet inn 182 prøver, der 66 av disse var fra Finland, 59 fra Norge og 57 fra Russland. For 144 (79,1 %) av de 182 hårprøvene var det positivt resultat i den bjørne-spesifikke analysen, og en komplett DNA profil kunne bestemmes for 136 av de positive prøvene. Det ble totalt påvist 47 forskjellige bjørner (25 hunner og 22 hanner). Av disse 47 individene var 24 påvist i tidligere år, mens 23 var til nå ukjente bjørner. Totalt ble det påvist 20 bjørner i Finland, 14 bjørner i Norge og 16 bjørner i Russland. Når vi sammeligner resultatet med de

tre tidligere års hårfelle prosjekter (2007: 24 bjørner, 2011: 20 bjørner og 2015: 26 bjørner), kan vi konkludere med en betydelig økning fra tidligere med en nesten dobling av antallet bjørner innenfor det definerte kjerneområdet på ca. 1400 km innen trilateralområdet til Pasvik-Inari-Pechenga.

Summary

Since 2005, the population of the trans-border brown bear (*Ursus arctos*) in Trilateral Park Pasvik-Inari-Pechenga (Norway-Finland-Russia) has been monitored by using genetic analyses of hair and faeces collected opportunistically in the field. A more systematic method using hairtraps every fourth year was initiated in 2007 to collect brown bear hairs for genetic analysis. The method consists of 56 hair traps in Norway, Finland and Russia in a 5 x 5 km2 grid cell system (1400 km2). The project was repeated in 2011, 2015 and now in the season of 2019 with 58 squeres, using the same methodology as in 2007. In 2019, a total of 182 samples were collected, where 66 samples came from Finland, 59 samples from Norway, and 57 samples from Russia. In the bear specific analysis, 144 (79,1 %) of the 182 hair samples were positive. A complete DNA profile could be determined for 136 samples. In total, 47 different bear individuals were detected (25 females and 22 males). Of these 47 bears, 24 of bears were detected in previous years, while 23 were previously unknown bears. In total, 20 bears were detected in Finland, 14 bears in Norway and 16 bears in Russia. When comparing the number of 47 bears with the results from the previous years of hair trapping projects (2007: 24 bears, 2011: 20 bears and 2015: 26bears), we conclude that 2019 show a substantial increase and an almost doubling of the number of bears detected within the defined core area of 1400 km2 of the tri-lateral area of Pasvik-Inari-Pechenga

LAND/COUNTRY:	Finland, Norway, Russia
FYLKE/COUNTY:	Lapland län, Troms-Finnmark fylke, Murmansk Oblast
KOMMUNE/MUNICIPALITY:	Ivalo, Sør-Varanger, Pechenga
STED/LOKALITET:	Inari,Øvre Pasvik,Pechenga

GODKJENT /APPROVED	**PROSJEKTLEDER /PROJECT LEADER**
Snorre B. Hagen	Hans Geir Eiken
NAVN/NAME	**NAVN/NAME**

Abstract

Since 2005, the population of the trans-border brown bear (*Ursus arctos*) in Trilateral Park Pasvik-Inari-Pechenga (Norway-Finland-Russia) has been monitored by using genetic analyses of hair and faeces collected opportunistically in the field. A more systematic method using hairtraps every fourth year was initiated in 2007 to collect brown bear hairs for genetic analysis. The method consists of 56 hair traps in Norway, Finland and Russia in a 5 x 5 km2 grid cell system (1400 km2). The project was repeated in 2011, 2015 and now in the season of 2019 with 58 squares, using the same methodology as in 2007. In 2019, a total of 182 samples were collected, where 66 samples came from Finland, 59 samples from Norway, and 57 samples from Russia. In the bear specific analysis, 144 (79,1 %) of the 182 hair samples were positive. A complete DNA profile could be determined for 136 samples. In total, 47 different bear individuals were detected (25 females and 22 males). Of these 47 bears, 24 bears were detected in previous years, while 23 were previously unknown bears. In total, 20 bears were detected in Finland, 14 bears in Norway and 16 bears in Russia. When comparing the number of 47 bears with the results from the previous years of hair trapping projects (2007: 24 bears, 2011: 20 bears and 2015: 26bears), we conclude that 2019 show a substantial increase and an almost doubling of the number of bears detected within the defined area of 1400 km2.

Svanvik, 07.04.2020

Benedicte Beddari & Hans Geir Eiken

Content

1 Introduction

Estimation of the number of brown bears (*Ursus arctos*) in an area is notoriously difficult, since this animal is elusive and observations can lead to biased estimates. Therefore, genetic methods based on non-invasive genetic sampling of hairs and feces have been established to estimate bear abundance and numbers in both restricted and larger areas. In the recent past, so called hair traps or hair snares have shown their effectiveness in systematic collection of biological samples, especially from large carnivores like bears and wolverine. Evenly distributed over a research area, hair traps are successful in sampling more elusive and shy individuals, such as female bears (e.g. Woods et al. 1999; Mowat and Strobeck 2000; Romain-Bondi et al. 2004, Kendall 1999; Bellemain et al. 2005; Thompson 2004, Waits & Paetkau 2005; Kendall et al. 2005, 2008a, 2008b; Kendall et al. 2009). Since 2005, NIBIO Svanhovd (formerly Bioforsk Svanhovd) has applied these methods in the monitoring of brown bear populations in Norway, Finland, Russia and Sweden (e.g. Smith et al. 2007; Smith et al. 2008; Wartiainen et al. 2008; Eiken et al. 2009a, 2009b, 2011, Kopatz et al. 2011, Kopatz et al. 2012a).

In 2007, 2011 and 2015 a tri-lateral project was conducted to monitor and estimate the minimum size of the brown bear population inhabiting the core protected areas of Pasvik (Norway), Inari (Finland) and Pechenga (Russia). Using hair traps, samples were collected systematically over a two month period, in a study area of 1400 km^2. The hair trap study in 2007 resulted in 196 hair samples. which lead to the identification of 24 unique bears (10 females, 14 males, Smith et al. 2007). In 2011, the project resulted in 88 samples and identification of 20 unique bears (12 females and 8 males; Kopatz et al. 2011). While in 2015, 26 unique bears (17 females and 9 males: Aarnes el al. 2015) were identified.

In 2019, we have replicated the monitoring action done in the three previous studies. The objectives of this fourth hair trap project were to obtain a new estimate on the minimum number of brown bears in the trans-border area of Pasvik-Inari-Pechenga and to identify possible changes in bear numbers and bear activity during a new four year period. The use of the same methodology facilitated a direct comparison of the results from previous years, thus allowing for more reliable assessment of possible changes and their biological significance. This hair trap project represents the continuing and international collaboration of monitoring and research of the trans-border population of brown bears by Finnish, Norwegian and Russian managers and scientists.

2 Materials and methods

2.1 Permits

For Norway, permissions to conduct this project were obtained from The Finnmark County Governor (Fylkesmannen i Finnmark), Finnmarkseiendommen (FeFo, public land administrators) and the leading board of the Øvre Pasvik National Park (Øvre Pasvik nasjonalparkstyre). Any permits in Finland and Russia were given by their authorities, if needed.

2.2 Study Area

The location of the study area was in the border area of Norway, Finland and Russia (approximately 69.4° North and 29.8° East). The study area was divided into square grid cells of 5 km x 5 km, resulting in 58 cells. For the three different countries, the location of the 58 cells were as follows: 23 cells were within the Finnish jurisdiction (Lapland, Inari municipality), 20 within the Norwegian jurisdiction (Finnmark, Sør-Varanger), and 18 cells within the Russian jurisdiction (Murmansk, Pechenga, Fig 1). An exception to this, Norway and Russia had hair traps in three of the cells simultaneously (K7, K8 and J10, Fig. 1), on each side of the border. Hence, the total number of hair traps in the 2019 project were 61 operating within 58 cells.

This area is dominated by both arctic and northern boreal ecosystems, with a landscape created by a mosaic of peatland and forest. Areas without forest growth can be described as low arctic and sub-arctic, whereas below the tree line you will find the north boreal forest type, characterized by large areas of downy birch (*Betula pubescens*) and Scots pine (*Pinus silvestris*).

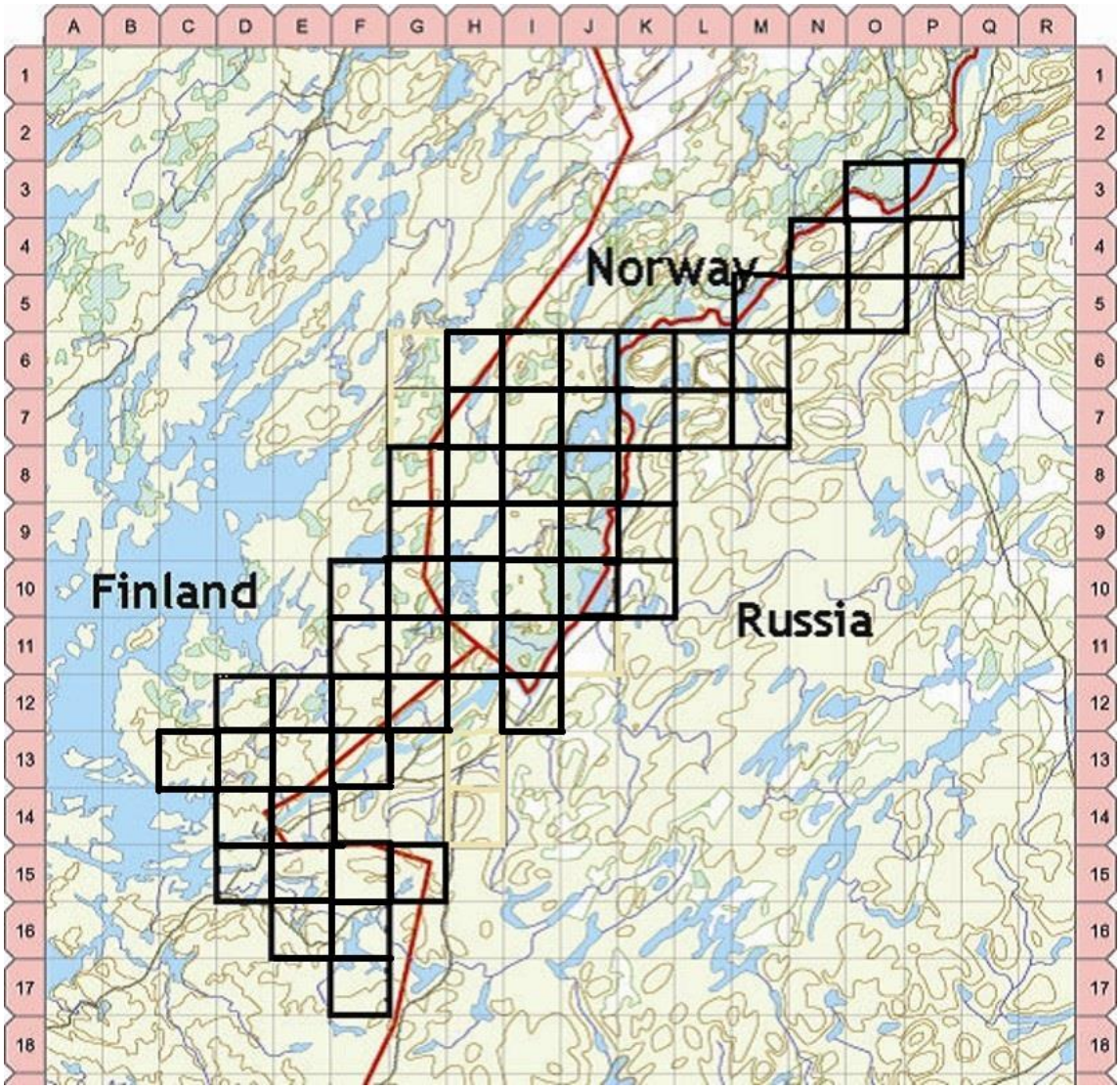

Figure 1: The trans-border study area includes areas in Norway (Øvre Pasvik), Finland (Inari) and Russia (Pechenga). The study area was divided in 58 cells à 5 km x 5 km with one hair trap in each (two hair traps located in K7, K8 and J10, one on each side of the Norwegian and Russian border). Hair traps were moved to a second location within the same square half-way through the collection period (after four weeks).

2.3 Sampling Collection

Between the 11- 14th of June 2019 we initiated the project, by installing one hair trap within each of the 58 grid cells in the study area (two traps in cell K7, K8 and J10, one on the Norwegian side and one on the Russian side). A hair trap was built of barbed-wire, stretched tight between trees, approximately 40 cm above ground, to create an encircled area of about 5x 5 m (25-30m^2). In the middle of the encircled area, a small pile of peat, moss and logs were arranged to apply a strong smelling scent-lure (1.5 L). This scent-lure was made of groundfish waste, mostly heads, mixed with cattle blood. The mixture was allowed to ferment for several months until it became a liquid. As a thin liquid, the scent lure was ensured to attract bears without providing any food rewards. When transporting the scent-lure it was kept in airtight containers of 1.5 L. The idea behind the barbed-wired area was to force the bears to leave hair on the wire when climbing over or under to investigate the scent-lure (Fig 2). There has not been any reports on injuries due to the barbed wire in other hair trapping studies in Norway or other countries (e.g. Woods et al. 1999, Mowat and Strobeck 2000; Kopatz et al. 2011 & 2012a).

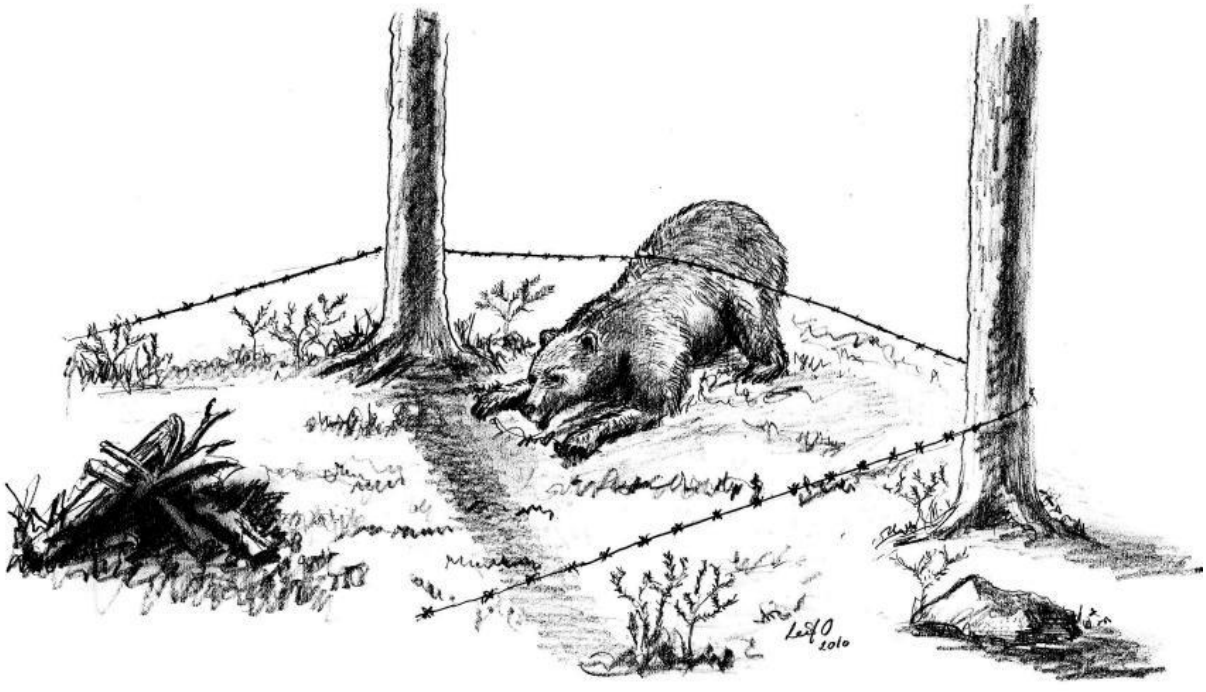

Figure 2: Illustration of a hair trap set-up and how ideally a bear act when approaching the trap with scent lure inside. (Illustration: Leif Ollia)

Every second week from first installed, all hair traps were checked for hair samples (Table 1). Each barbed-wire knot and the inside of the encircled area were carefully inspected for samples. All hair samples found were placed in separate paper envelopes. It was important to maintain the same level of attraction throughout the sampling period, so a new scent-lure of 1.5L was applied after each visit. Half-way through the collection period (four weeks in), the hair traps were moved to a second location within the same grid cell (Table 1). Experience and other studies show that the probability of detecting more bears in an area is greater if you translocate the hair traps during the sampling season (Mowat and Strobeck 2000; Boulanger et al. 2006). After two months (Mid-August), the sampling periode was over, and the traps were removed from the sites (Table 1).

Figure 3: To the left: Leif Ollila and Benedicte Beddari working on the hair trap. To the right: Vetle Lindgren carring equiptment during field work. (Photo: To the left: Hans Geir Eiken, to the right: Benedicte Beddari)

Table 1: Schedule and sessions of the hair trap project in the area of Pasvik-Inari-Pechenga in 2019.

Day 1	Set-up	Scent-lure
Day 14	1st check	Inspection for hair samples, refill scent-lure
Day 28	2nd check	Inspection for hair samples Translocation/scent-lure
Day 42	1st check	Inspection for hair samples, Scent-lure

2.4 DNA Method

DNA-extraction

DNA was extracted from the hair samples using DNeasy Blood and Tissue Kit (Qiagen). Before the extraction, the hair samples were inspected and the roots from 1 to 10 hairs (depending on the number of roots available) were cut and transferred to a 1.5 ml Eppendorf tube containing 180 µl ATL Buffer. If the sample consisted of fine hairs or hairs matted together the entire straw or a 0.3 - 0.5 cm wide

section of the matted hair, respectively, were transferred to the tube. Extraction of the DNA from the hair samples then followed the protocol "Purification of total DNA from animal tissues (Spin-Column protocol)" as described by the manufacturer except from a modified elution volume in step 7. DNA was eluted in a reduced volume of 30 µl or 50 µl elution buffer. The volume of elution buffer was reduced to 30 µl when the sample contained 1 to 3 hairs or matted hairs, and 50 µl when containing 4-10 hairs. DNA extractions is further described in Eiken et al. 2009 as well as Smith et al. 2007.

Analysis of DNA profiles and sex

Genetic analysis of STRs (short tandem repeats) on the brown bear followed a modified protocol from Taberlet et al. (1997). We used eight different genetic markers, Mu05, Mu09, G10L, Mu10, Mu23, Mu50, Mu51 and Mu59, to construct DNA profiles (Paetkau and Strobeck 1994, 1995; Paetkau et al. 1995; Taberlet et al. 1997; see Eiken et al. 2009 and Andreassen et al. 2012). Four additional STR-markers, G1D, G10B, Mu15 and G1A (Andreassen et al 2012), were used for all previously unidentified brown bear individuals identified in this project. Sex determination was based on the X-and Y-specific DNA sequences of the amelogenine gene (Yamamoto et al. 2002). For some samples however, showing ambiguous results for this sex determination test, a second test for molecular sexing were applied (Bidon et al 2013). This is a bear-specific test showing three bands for males and one for females.

The PCR protocol, capillary electrophoresis and the determination of DNA profiles and comparisons with DNA profiles in Svanhovd Genetic database have been described (Tobiassen et al. 2011, Andreassen et al 2012). However, modifications have been made to the PCR protocol as a multiplex PCR approach has been implemented in this project (Fløystad et al 2019). Also, the laboratory no longer holds an ISO/IEC 17025 accreditation, but still follows the same guidelines making the results directly comparable with earlier work. All procedures were done in accordance to the guidelines of the analysis of forensic animal material, recently published by Linacre et al. (2011).

Figure 4: To the left: Ida Fløystad working on samples from hair traps. To the right: A sample from the hair trap ready for cutting. (Picture to the left: Alexander Kopatz, to the right: NIBIO archive)

3 Results

A total of 182 hair samples were collected during the study period, resulting in the identification of 47 unique bears across Norway, Finland and Russia (Table 2). We detected 14 unique bears in Norway, 20 bears in Finland and 16 bears in Russia. Out of 47 bears 44 bears were only detected in one country. However, 1 individual was detected in both Norway and Finland, while 2 individuals were detected in both Norway and Russia (Table 2).

3.1 Sampling and success rate

A total of 182 hair samples were collected during the study period; 66 from Finland, 59 from Norway and 57 samples from Russia. Of these 182 hair samples, 144 (79.1 %) came out as positive in the brown bear specific analysis. The success rates for a positive result in the bear specific analysis for each of the countries were as follows; 83,3 % (55 samples) in Finland, 62,7 % (37 samples) in Norway and 78,9 % (45 samples) in Russia (Appendix: Table A1).

3.2 DNA Identification

A complete DNA profile could be determined for 136 of the positive samples (94,4 %) (Appendix: Table A1). For each country 96, 4 % of the positive samples in Finland, 94,6 % in Norway and 93,3 % in Russia could be given a complete DNA profile. Five of these 136 samples were mixed samples with hairs originating from two different individuals. The result showed 47 unique DNA profiles representing 25 female bears and 22 male bears (Table 2).

When searching the genetic database of bear individuals from Norway, Sweden, Finland, and Russia, a complete match was detected for 24 of the 47 genetic profiles. The remaining 23 were not found in the database. This means that 24 bears were known from previous years of monitoring, whereas 23 of the individuals were bears not previously registered (Appendix: Table 1A). The new individuals were given names and added to the database.

Table 2: Brown bears (n=47) detected by hair traps 2019 in Pasvik-Inari-Pechenga (Norway, Finland and Russia). Information on the identity code (ID), sex (F = females, M = males), country and no. of grid cell of detection, the years of previous registration and if previous identified for each of the 47 individuals is given in the table below.

ID	Sex	Country of detection in 2019	Detected in grid cell no.	Previous detection (year and country) N-Norway,F-Finland, R-Russia	Previous identified
FI111/LL68	F	NOR,FIN	G10,J8,I10	2010-2019 (N) 2019 (F)	Yes
FI183/LL53	M	FIN	F16	2015 (N), 2019 (N, F)	Yes
FI218/LL63	F	FIN	F11,F13	2017-2018 (N) 2019 (F)	Yes
FI222/LL56	F	FIN	C13	2017 (N) 2019 (F)	Yes
FI64/LL21	F	FIN	E12,F13	2007 (N) 2007 (F) 2017 (N) 2019 (F)	Yes
LL47	F	FIN	C13,D14	2015(F) 2019(F)	Yes
LL50	M	FIN	F17,F15	2019 (F)	No
LL51	F	FIN	F17,E16	2019 (F)	No
LL52	M	FIN	F16	2019 (F)	No
LL54	F	FIN	E16	2019 (F)	No
LL55	M	FIN	C13	2019 (F)	No
LL57	F	FIN	E12	2019 (F)	No
LL58	F	FIN	G15	2019 (F)	No
LL59	M	FIN	G15	2019 (F)	No
LL60	F	FIN	G15,D15	2019 (F)	No
LL61	M	FIN	F15	2019 (F)	No
LL62	M	FIN	G15,F15	2019 (F)	No
LL65	M	FIN	G12	2019 (F)	No
LL66	M	FIN	F13	2019 (F)	No
LL67	F	FIN	E14	2019 (F)	No
FI123/LL43/MO50	M	NOR,RUS	K7,O4	2011 (F) 2011 -2014 (N) 2015 (N, R) 2016-2019 (N), 2019 (R,N)	Yes
FI181	F	NOR	I6	2015 (N) 2017-2019 (N)	Yes
FI201	F	NOR	J6	2016 - 2019 (N)	Yes
FI211/LL64	F	NOR	J6	2016 (N) 2019 (N, F)	Yes
FI229	M	NOR	J6,I7	2018-2019 (N)	Yes
FI234	F	NOR	J8,I11,H11	2018-2019 (N)	Yes
FI235	M	NOR	I11,H11,I10	2018-2019 (N)	Yes
FI236	M	NOR	H11,I10	2018-2019 (N)	Yes
FI247	M	NOR	H8	2018-2019 (N)	Yes
FI250	M	NOR	J8	2018-2019 (N)	Yes
FI260	M	NOR	J7	2019 (N)	No
MO47/FI238	F	NOR	J10	2015 (R), 2017 (R.) 2018-2019 (N)	Yes
MO84/FI259	F	NOR,RUS	K7,K6	2019(R, N)	No
FI105/MO15	M	RUS	M6,M5	2010 (N) 2011 (R, N) 2015 (R) 2017-2019 (N, R)	Yes
FI223/MO78	M	RUS	O4	2017 (N), 2018-2019 (R)	Yes
FI233/MO87	M	RUS	O5,M6	2018 (N) 2019 (R)	Yes
MO46/FI254	F	RUS	K9	2015(R) 2019 (N)	Yes
MO79	F	RUS	O4,P4,O5	2018-2019 (R)	Yes
MO81	F	RUS	N4,M7	2018-2019 (R)	Yes
MO85	M	RUS	O4	2019 (R)	No
MO86	F	RUS	P4	2019 (R)	No
MO88	M	RUS	M5	2019 (R)	No
MO89	F	RUS	K9	2019 (R)	No
MO9	F	RUS	K8	2007-2008 (R), 2015 (R) 2019(R)	Yes
MO90	F	RUS	J10,K9	2019 (R)	No
MO91	M	RUS	K9	2019 (R)	No
MO92	F	RUS	K9	2019 (R)	No

3.3 Indiviuals and location

In total, 35 of the 58 grid cells contained hair samples with positive results for brown bear. The number of bears found in each cell ranged from 1 to 5. Most of the cells detected 1-3 bears, while two cells detected 4 individuals (G15 and O4) and 1 cell detected 5 individuals (K9) (Fig. 5).

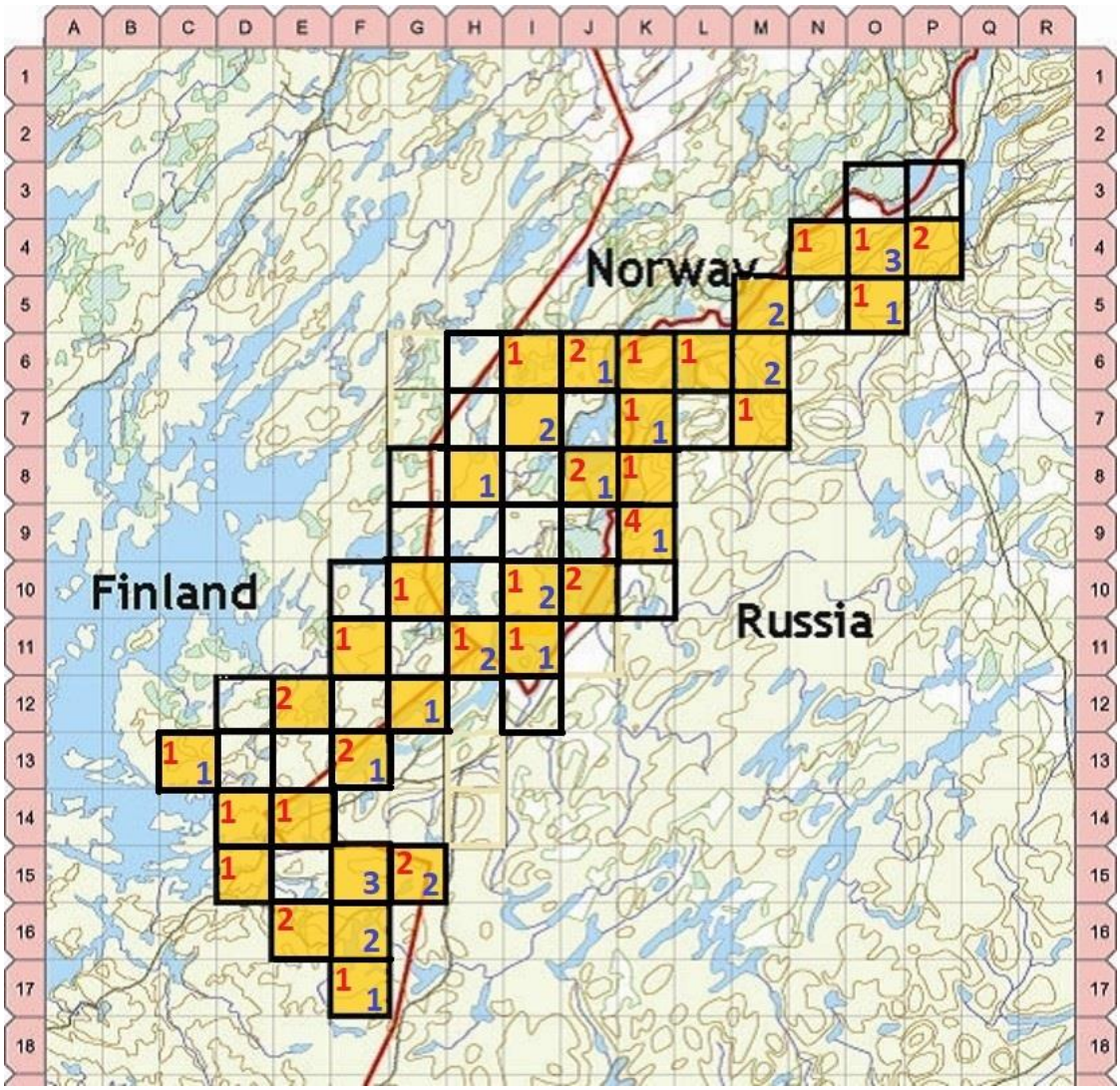

Figure 5: Brown bears detected in the hair trap project of 2019 in the trans-border area of Pasvik (Norway), Inari(Finland) and Pechenga (Russia). The study area is divided into 5 km x 5 km grid cells. The number represents the number of individual bears identified in each of the 58 cells, and the sex is indicated by colour (red = females, blue = males).

In Finland 20 unique individuals were detected; 11 female and 9 male bears (Table 2, Fig 6). Six of these individuals were previously known bears, whereas 9 of them were previously unknown bears. In Norway, 14 unique bears were found, 7 males and 7 females and 12 of the bears were previously registered in the data base, while 2 were added as new bears. In Russia 16 individual brown bears were found, and 9 of these bears were females and 7 were males. Of these 16 bears, 8 bears were previously registered individuals, whereas 8 were new bears (Table 2, Figure 5, Appendix: Table A).

Three of the 47 brown bears identified were detected in more than one country: 1 individual was detected in both Norway and Finland (individual FI111/LL68, Fig. 6), while 2 individuals were detected in both Norway and Russia (individual FI123/LL43/MO50 and Mo84/FI259, Fig. 6, Table 2, Appendix: Table 1A).

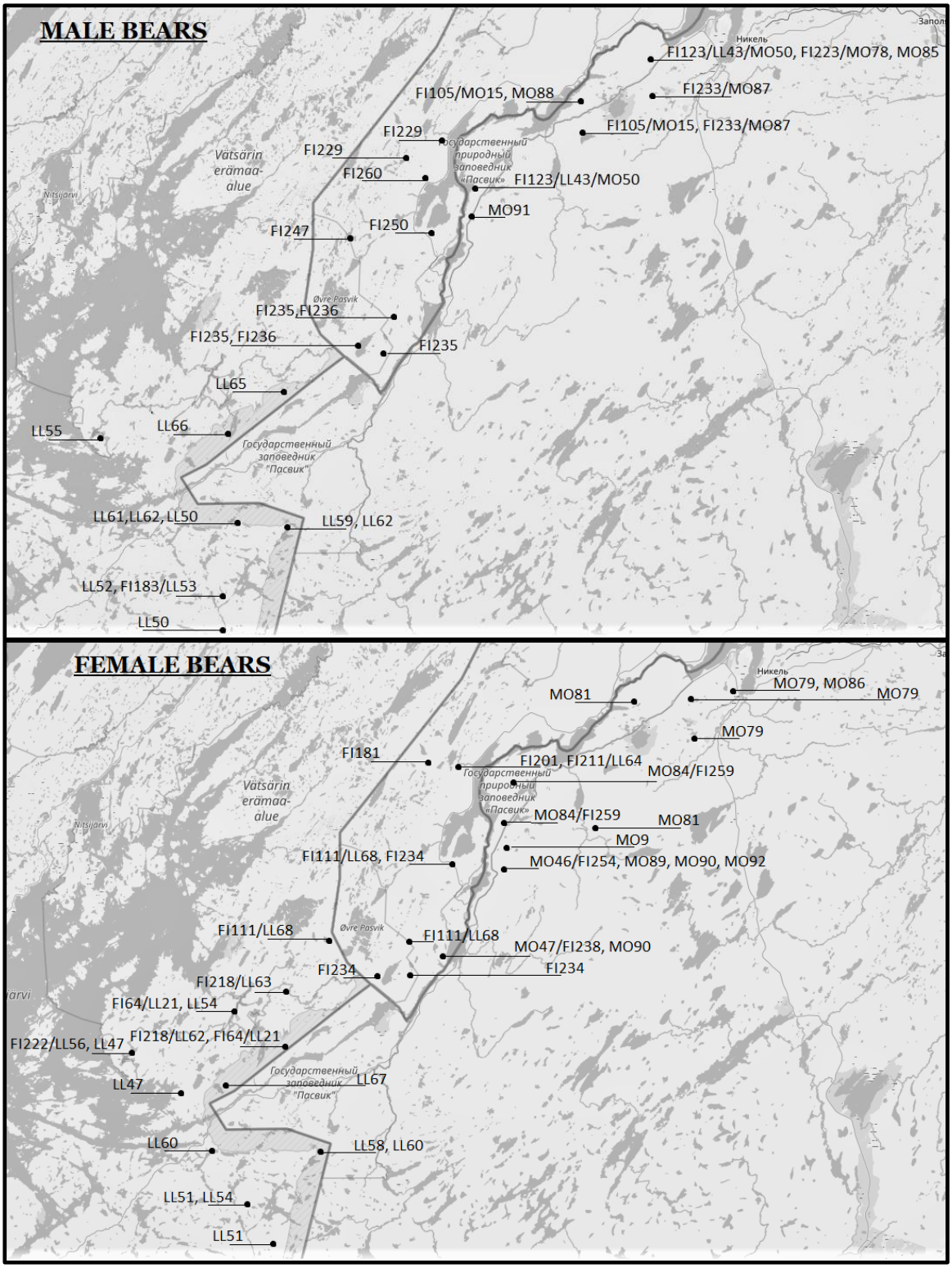

Figure 6: Identity and sex for the 47 unique brown bears documented by hair traps in 2019 in Pasvik-Inari-Pechenga (Norway, Finland and Russia). Males are shown in the upper map, and females in the lower map. The black dots indicate the geographical locations of the hair traps.

3.4 Comparing results from 2007, 2011, 2015 and 2019.

The monitoring effort in 2019 (58 grid cells) was excecuted as a close replication of the three previous studies in 2007 (56 cells), 2011 (56 cells) and 2015 (53 cells). In Russia, an expansion of 8 grid cells relative to 2015 was performed , where 3 of the cells were shared between Norway and Russia. Alltogether, this resulted in 61 hair trap stations operated within 58 cells for the whole project in 2019 (Table 3).

When comparing result from the three previous years of hair trap projects, 2019 yeilded the highest number of individuals identified, with 47 unique bears (Table 3). In contrast, 2019 collected the second lowest sample size. In 2007, 196 samples were collected in the hair traps, with 129 (66%) successfully genotyped, resulting in the identification of 24 individuals (10 females, 14 males; Smith et al. 2007). In 2011, 88 hair samples were collected, of which 56 (64 %) were successfully genotyped, identifying 20 individuals (12 females and 8 males; Kopatz et al. 2011). The project in 2015 collected the higest sample size of 209. This gave 158 (76%) successfully genotyped samples, identifying 26 bears (17 females and 9 males).

Table 3: A comparison of sample numbers and induviduals identified from the hairtrap projects in 2007, 2011, 2015 and 2019 in Pasvik-Inari-Pechenga (Norway, Finland and Russia).

Year	Country	No. of grid cells	No. of samples collected	No. of individuals identified
2007	Norway	23	124	9
	Finland	23	56	9
	Russia	10	16	6
	Total	56	196	24*
2011	Norway	20	66	11
	Finland	26	14	7
	Russia	10	8	6
	Total	56	88	20*
2015	Norway	20	147	16
	Finland	23	20	5
	Russia	10	42	9
	Total	53	209	26*
2019	Norway	20	59	14
	Finland	23	66	19 (20)
	Russia	18	57	14 (16)
	Total	61**	182	47*

* Unique profiles, does not include individuals detected in more than one country. The number inside the brackets indicates how many bears were detected in total, including the bears detected in more than one country.

** 58 uinque grid cells. Three of the cells were utilized by Norway and Russia simultaneously (K7,K8 and J10).

4 Conclusions

A total of 144 (79,1 %) of the 182 hair samples collected during this hair trap project were positive in the bear specific analysis, and a complete DNA profile could be determined for 136 of these samples. 47 unique individuals were detected (25 females and 22 males) and this is the highest number of bears detected since the start of hair trapping in 2007. 24 of these bears were previously registrered, whereas 23 were new bears. Three of the bears were detected in more than one country; 1 was detected in both Norway and Finland, while 2 of the individuals were detected in both Norway and Russia. In total, 20 bears were detected in Finland, 14 bears in Norway and 16 bears in Russia. When comparing the number of 47 bears with the results from the previous hair trap projects (2007: 24 bears, 2011: 20 bears and 2015: 26bears), we can conclude that the results from this years project showed a substantial increase, almost a doubling of the number of bears detected, within the defined core area of 1400 km2 within the tri-lateral area of Pasvik-Inari-Pechenga.

5 Acknowledgment

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Appendix

Table A 1: All collected hair samples in the project, the results of the brown bear DNA analysis and the determination of individual identity.

Svanhovd Sample Number	External Sample Number	Country	Date of Sampling	Material	Grid cell number	P/N	Sex	Identity
19FH001	F17/1	Finland	27.06.2019	Hair	F17	N		
19FH002	F17/2A	Finland	14.07.2019	Hair	F17	P	M	LL50
19FH003	F17/2B	Finland	14.07.2019	Hair	F17	P	M/F	LL50 and LL51
19FH004	F17/3	Finland	28.07.2019	Hair	F17	P	F	LL51
19FH005	F17/4A	Finland	11.08.2019	Hair	F17	N		
19FH006	F17/4B	Finland	11.08.2019	Hair	F17	P	F	LL51
19FH007	F16/2A	Finland	14.07.2019	Hair	F16	P	M	LL52
19FH008	F16/2B	Finland	14.07.2019	Hair	F16	P	M	FI183/LL53
19FH009	E16/3A	Finland	28.07.2019	Hair	E16	P	F	LL54
19FH010	E16/3B	Finland	28.07.2019	Hair	E16	P	F	LL51
19FH011	E16/3C	Finland	28.07.2019	Hair	E16	P	F	LL54
19FH012	E16/3D	Finland	28.07.2019	Hair	E16	P	F	LL51 and LL54
19FH013	E16/3	Finland	11.08.2019	Hair	E16	P	F	LL54
19FH014	C13/1	Finland	29.06.2019	Hair	C13	N		
19FH015	C13/3A	Finland	27.07.2019	Hair	C13	P	F	LL47
19FH016	C13/3B	Finland	27.07.2019	Hair	C13	P	F	LL47
19FH017	C13/4A	Finland	10.08.2019	Hair	C13	P	M	LL55
19FH018	C13/4B	Finland	10.08.2019	Hair	C13	P	F	FI222/LL56
19FH019	E12/2A	Finland	13.07.2019	Hair	E12	P	F	LL57
19FH020	E12/2B	Finland	13.07.2019	Hair	E12	P	F	LL57
19FH021	E12/4A	Finland	17.08.2019	Hair	E12	N		
19FH022	E12/4B	Finland	17.08.2019	Hair	E12	P	F	FI64/LL21
19FH023	F12/2	Finland	15.07.2019	Hair	F12	N		

19FH024	E13/2	Finland	15.07.2019	Hair	E13	N		
19FH025	G15/1	Finland	01.07.2019	Hair	G15	P	F	LL58
19FH026	G15/2A	Finland	16.07.2019	Hair	G15	P	M	LL59
19FH027	G15/2B	Finland	16.07.2019	Hair	G15	P		Unknown identity
19FH028	G15/2C	Finland	16.07.2019	Hair	G15	P	F	LL60
19FH029	G15/2D	Finland	16.07.2019	Hair	G15	P	M	LL62
19FH030	G15/3A	Finland	30.07.2019	Hair	G15	P	F	LL60
19FH031	G15/3B	Finland	30.07.2019	Hair	G15	P	F	LL60
19FH032	G15/3C	Finland	30.07.2019	Hair	G15	P	F	LL60
19FH033	F15/1	Finland	01.07.2019	Hair	F15	P	M	LL50
19FH034	F15/2A	Finland	16.07.2019	Hair	F15	P	M	LL61
19FH035	F15/2B	Finland	16.07.2019	Hair	F15	P	M	LL50
19FH036	F15/4A	Finland	15.08.2019	Hair	F15	P	M	LL62
19FH037	F15/4B	Finland	15.08.2019	Hair	F15	P		Unknown identity
19FH038	D14/2A	Finland	17.07.2019	Hair	D14	P	F	LL47
19FH039	D14/2B	Finland	17.07.2019	Hair	D14	P	F	LL47
19FH040	D14/2C	Finland	17.07.2019	Hair	D14	P	F	LL47
19FH041	D15/3A	Finland	30.07.2019	Hair	D15	P	F	LL60
19FH042	D15/3B	Finland	30.07.2019	Hair	D15	P	F	LL60
19FH043	D15/3C	Finland	30.07.2019	Hair	D15	P	F	LL60
19FH044	D15/4	Finland	16.08.2019	Hair	D15	P	F	LL60
19FH045	F11/2A	Finland	19.07.2019	Hair	F11	P	F	FI218/LL63
19FH046	F11/2B	Finland	19.07.2019	Hair	F11	N		
19FH047	F11/3	Finland	02.08.2019	Hair	F11	N		
19FH048	G10/1	Finland	04.07.2019	Hair	G10	P	F	FI111/LL68
19FH049	G9/1	Finland	04.07.2019	Hair	G9	N		
19FH050	G12/2A	Finland	17.07.2019	Hair	G12	P	M	LL65
19FH051	G12/2B	Finland	17.07.2019	Hair	G12	P	M	LL65
19FH052	G12/2C	Finland	17.07.2019	Hair	G12	P	M	LL65

19FH053	G12/2D	Finland	17.07.2019	Hair	G12	P	M	LL65
19FH054	G12/2A	Finland	17.08.2019	Hair	G12	P	M	LL65
19FH055	G12/2B	Finland	17.08.2019	Hair	G12	P	M	LL65
19FH056	G12/2C	Finland	17.08.2019	Hair	G12	P	M	LL65
19FH057	G12/2D	Finland	17.08.2019	Hair	G12	P	M	LL65
19FH058	G12/2E	Finland	17.08.2019	Hair	G12	P	M	LL65
19FH059	F13/2A	Finland	17.07.2019	Hair	F13	P	F	FI218/LL63
19FH060	F13/2B	Finland	17.07.2019	Hair	F13	P	F	FI218/LL63
19FH061	F13/4A	Finland	17.08.2019	Hair	F13	P	M	LL66
19FH062	F13/4B	Finland	17.08.2019	Hair	F13	P	F	FI64/LL21
19FH063	F13/4C	Finland	17.08.2019	Hair	F13	P	F	FI64/LL21
19FH064	E14/4A	Finland	16.08.2019	Hair	E14	P	F	LL67
19FH065	E14/4B	Finland	16.08.2019	Hair	E14	N		
19FH066	E14/4C	Finland	16.08.2019	Hair	E14	P		Unknown identity
19NH058	B00068850	Norway	25.06.2019	Hair	J8	N		
19NH059	B00068851	Norway	25.06.2019	Hair	J8	P	F	FI234
19NH060	B00068852	Norway	25.06.2019	Hair	J8	P	F	FI234
19NH061	B00068853	Norway	25.06.2019	Hair	J8	P	F	FI111/LL68
19NH062	B00068854	Norway	25.06.2019	Hair	K7	P	M	FI123/LL43/MO50
19NH063	B00068855	Norway	25.06.2019	Hair	K7	P	M	FI123/LL43/MO50
19NH064	B00068856	Norway	25.06.2019	Hair	K7	P	(M)	FI123/ LL43/ MO50
19NH065	B00068857	Norway	25.06.2019	Hair	K7	P	M	FI123/LL43/MO50
19NH067	B00068865	Norway	29.06.2019	Hair	J6	P	F	FI201
19NH068	B00068866	Norway	29.06.2019	Hair	J6	P	M	FI229
19NH069	B00068867	Norway	29.06.2019	Hair	J6	P	F	FI201
19NH110	B00068873	Norway	09.07.2019	Hair	J8	P	M	FI250
19NH111	B00068874	Norway	09.07.2019	Hair	J8	P	M	FI250
19NH112	B00068875	Norway	09.07.2019	Hair	J8	P	M	FI250
19NH113	B00068877	Norway	11.07.2019	Hair	J6	P	F	FI201

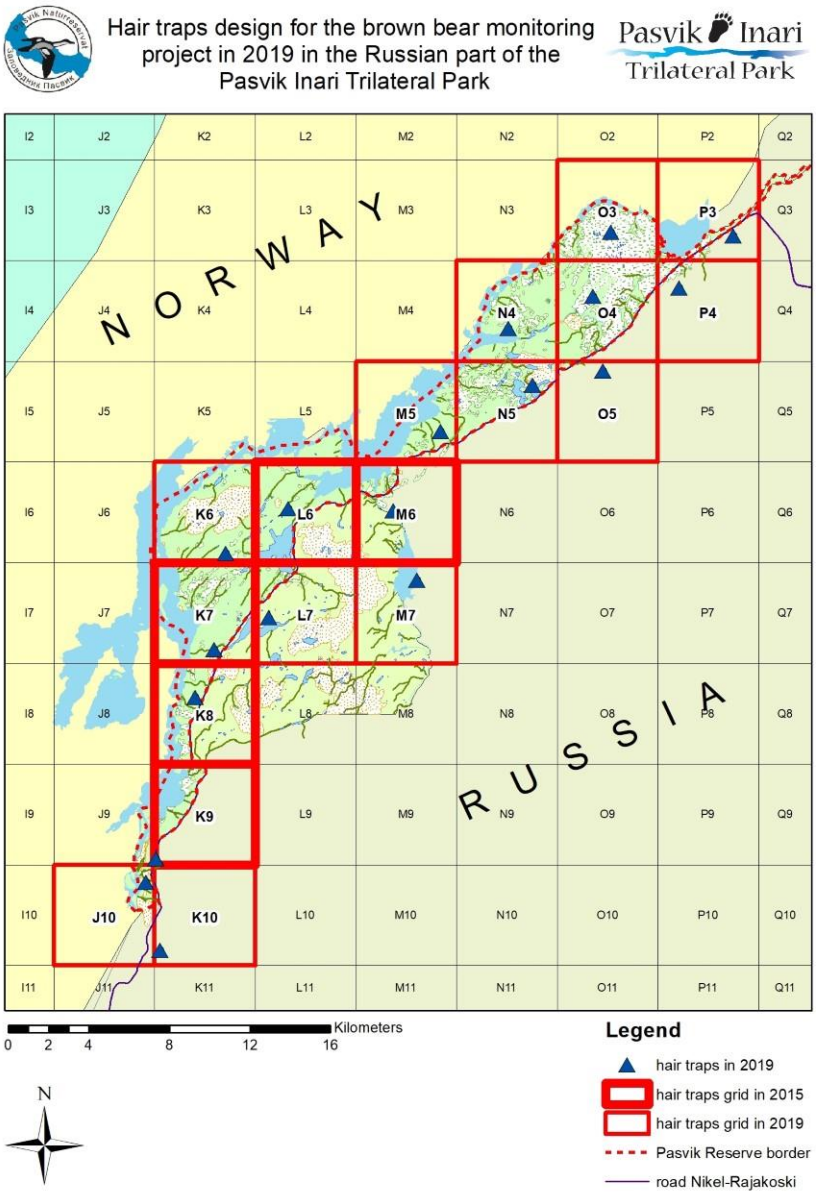
19NH114	B00068878	Norway	11.07.2019	Hair	J6	P	F	FI211/LL64
19NH115	B00068879	Norway	11.07.2019	Hair	J6	Sample contained no hairs		
19NH116	B00068880	Norway	11.07.2019	Hair	I6	P	F	FI181
19NH117	B00068881	Norway	11.07.2019	Hair	I7	N		
19NH118	B00068882	Norway	11.07.2019	Hair	I7	N		
19NH119	B00068883	Norway	11.07.2019	Hair	I7	N		
19NH120	B00068885	Norway	25.07.2019	Hair	I11	P	F, M	FI234 and FI235
19NH121	B00068886	Norway	25.07.2019	Hair	I11	P		Unknown identity
19NH122	B00068887	Norway	25.07.2019	Hair	H11	P	F	FI234
19NH123	B00068888	Norway	25.07.2019	Hair	H11	P	M	FI235
19NH124	B00068889	Norway	25.07.2019	Hair	H11	P	F	FI234
19NH125	B00068890	Norway	25.07.2019	Hair	H11	P	F	FI234
19NH126	B00068891	Norway	25.07.2019	Hair	H11	P	F, M	FI234 and FI236
19NH127	B00068892	Norway	24.07.2019	Hair	J6	N		
19NH128	B00068893	Norway	24.07.2019	Hair	J6	N		
19NH129	B00068894	Norway	24.07.2019	Hair	J6	P	F	FI211/LL64
19NH130	B00068895	Norway	24.07.2019	Hair	J6	N		
19NH131	B00068896	Norway	24.07.2019	Hair	J6	P	F	FI211/LL64
19NH132	B00068897	Norway	24.07.2019	Hair	J6	P	F	FI211/LL64
19NH133	B00068898	Norway	23.07.2019	Hair	I10	P	F	FI111/LL68
19NH134	B00068899	Norway	23.07.2019	Hair	I10	P	F	FI111/LL68
19NH135	B00068900	Norway	23.07.2019	Hair	I10	P	M	FI235
19NH136	B00068901	Norway	23.07.2019	Hair	I10	P	M	FI236
19NH137	B00068902	Norway	23.07.2019	Hair	I10	P	F	FI111/LL68
19NH138	B00068903	Norway	23.07.2019	Hair	K7	P	F	MO84/FI259
19NH139	B00068904	Norway	23.07.2019	Hair	K7	N		
19NH140	B00068905	Norway	23.07.2019	Hair	K7	N		
19NH151	B00052183	Norway	24.07.2019	Hair	J6	N		
19NH202	B00052232	Norway	25.07.2019	Hair	I11	N		

19NH258	B00052253	Norway	10.08.2019	Hair	H9	N		
19NH259	B00052254	Norway	10.08.2019	Hair	H9	N		
19NH260	B00052255	Norway	08.08.2019	Hair	I10	N		
19NH261	B00052256	Norway	07.08.2019	Hair	H8	P	M	FI247
19NH262	B00052257	Norway	07.08.2019	Hair	H8	P	M	FI247
19NH263	B00052260	Norway	07.08.2019	Hair	H8	P	M	FI247
19NH264	B00052261	Norway	07.08.2019	Hair	J7	P	M	FI260
19NH265	B00052262	Norway	07.08.2019	Hair	J7	P	M	FI260
19NH266	B00052263	Norway	07.08.2019	Hair	J7	N		
19NH267	B00052264	Norway	07.08.2019	Hair	J7	P	M	FI260
19NH268	B00052265	Norway	07.08.2019	Hair	J7	P	M	FI260
19NH269	B00052266	Norway	07.08.2019	Hair	J7	P	M	FI260
19NH270	B00052267	Norway	07.08.2019	Hair	I7,	P	M	FI229
19NH271	B00052268	Norway	07.08.2019	Hair	J10	P	F	MO47/FI238
19NH272	B00052269	Norway	07.08.2019	Hair	J10	P	F	MO47/FI238
19NH273	B00052270	Norway	07.08.2019	Hair	J10	P	F	MO47/FI238
19RH027	RU-1 N4-2	Russia	31.07.2019	Hair	N4	P	F	MO81
19RH028	RU-2 O3-2	Russia	31.07.2019	Hair	O3	N		
19RH029	RU-3 04-2	Russia	31.07.2019	Hair	O4	P	F	MO79
19RH030	RU-4 O4	Russia	31.07.2019	Hair	O4	P	F	MO79
19RH031	RU-5 O5-2	Russia	31.07.2019	Hair	O5	P	M	FI233/MO87
19RH032	RU-6 M5-2	Russia	01.08.2019	Hair	M5	P	M	MO88
19RH033	RU-7 M6-2	Russia	01.08.2019	Hair	M6	P	M	FI233/MO87
19RH034	RU-8 M7-2	Russia	02.08.2019	Hair	M7	P	M	FI105/MO15
19RH035	RU-9 O4-1	Russia	16.07.2019	Hair	O4	P		Unknown identity
19RH036	RU-10 O4-1	Russia	16.07.2019	Hair	O4	N		
19RH037	RU-11 O4-1	Russia	16.07.2019	Hair	4	P	M	MO85
19RH038	RU-12 1K6-1	Russia	18.07.2019	Hair	K6	N		
19RH039	RU-13 2K6-1	Russia	18.07.2019	Hair	K6	P	F	MO84/FI259

19RH040	RU-14 K8-1	Russia	19.07.2019	Hair	K8	P	F	MO9
19RH041	RU-15 P4-1	Russia	19.07.2019	Hair	P4	P	F	MO86
19RH042	RU-16 P4-1	Russia	19.07.2019	Hair	P4	P	F	MO79
19RH043	RU-17 P4-1	Russia	19.07.2019	Hair	P4	P	F	MO86
19RH044	RU-18 P4-1	Russia	19.07.2019	Hair	P4	N		
19RH045	RU-19 P4-1	Russia	19.07.2019	Hair	P4	N		
19RH046	RU-20 P4	Russia	19.07.2019	Hair	P4	P	F	MO79 and MO86
19RH047	RU-21 M7-1	Russia	22.07.2019	Hair	M7	N		
19RH048	RU-22 M7-1	Russia	22.07.2019	Hair	M7	N		
19RH049	RU-23 M7-1	Russia	22.07.2019	Hair	M7	N		
19RH050	RU24 O5-2	Russia	14.08.2019	Hair	O5	P	F	MO79
19RH051	RU25 M7-2	Russia	14.08.2019	Hair	M7	P	F	MO81
19RH052	RU-26 K9-2	Russia	14.08.2019	Hair	K9	P	F	MO46/FI254
19RH053	RU-27 K9-2	Russia	14.08.2019	Hair	K9	N		
19RH054	RU-28 K9-2	Russia	14.08.2019	Hair	K9	P	F	MO89
19RH055	RU-29 K9-2	Russia	14.08.2019	Hair	K9	P	F	MO89
19RH056	RU-30 K9-2	Russia	14.08.2019	Hair	K9	P		Unknown
19RH057	RU-31 J10-1	Russia	12.07.2019	Hair	J10	P	F	MO90
19RH058	RU-32 J10-1	Russia	12.07.2019	Hair	J10	P	F	MO90
19RH059	RU-33	Russia	13.06.2019	Hair	O4	N		
19RH060	RU-34, 394	Russia	13.06.2019	Hair	O4	N		
19RH061	RU-35, 414	Russia	15.06.2019	Hair	K9	P	M	MO91
19RH062	RU-36	Russia	12.07.2019	Hair	K9	P	F	MO90
19RH063	RU-37	Russia	12.07.2019	Hair	K9	P	F	MO90
19RH064	RU-38	Russia	12.07.2019	Hair	K9	N		
19RH065	RU-39	Russia	12.07.2019	Hair	K9	P	F	MO92
19RH066	RU-40	Russia	13.07.2019	Hair	K9	P	F	MO9
19RH067	RU-41 wp472	Russia	13.07.2019	Hair	K9	P	F	MO9
19RH068	RU-42 wp479	Russia	13.07.2019	Hair	K9	P	F	MO9

19RH069	RU-43	Russia	16.07.2019	Hair	M6	N		
19RH070	RU-44	Russia	18.07.2019	Hair	O4	P	M	FI105/MO15
19RH071	RU-45 wp642	Russia	31.07.2019	Hair	O4	P	M	FI123/LL43/MO50
19RH072	RU-46 wp642	Russia	31.07.2019	Hair	O4	P	M	FI123/LL43/MO50
19RH073	RU-47	Russia	15.08.2019	Hair	O4	P	M	FI223/MO78
19RH074	RU-48	Russia	15.08.2019	Hair	O4	P	M	FI223/MO78
19RH075	RU-49	Russia	15.08.2019	Hair	O4	P	M	FI223/MO78
19RH076	RU-50	Russia	15.08.2019	Hair	O4	P	M	FI223/MO78
19RH077	RU-51	Russia	15.08.2019	Hair	O4	P	M	FI223/MO78
19RH078	RU-52	Russia	15.08.2019	Hair	O4	P	M	FI223/MO78
19RH079	RU-53	Russia	15.08.2019	Hair	O4	P		Unknown identity
19RH080	RU-54	Russia	15.08.2019	Hair	O4	P	M	FI223/MO78
19RH081	RU-81	Russia	19.08.2019	Hair	K6	P	F	MO84/FI259
19RH082	RU-82	Russia	19.08.2019	Hair	K6	P	F	MO84/FI259
19RH083	RU-83	Russia	19.08.2019	Hair	L6	P	F	MO84/FI259

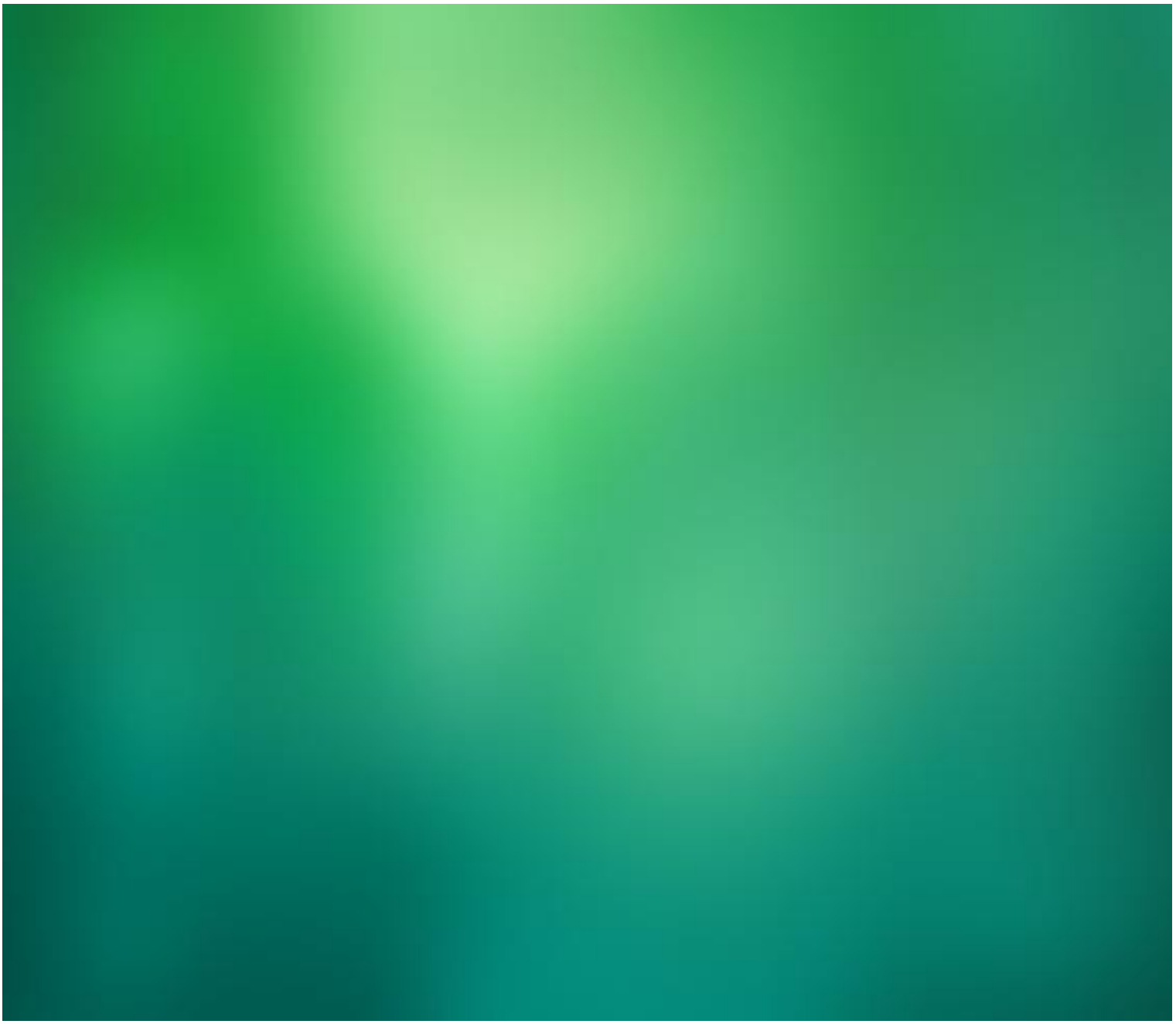
Table A 2: The square grid cells on the Russian side



NIBIO
NORWEGIAN INSTITUTE OF
BIOECONOMY RESEARCH

NIBIO - Norwegian Institute of Bioeconomy Research was established July 1 2015 as a merger between the Norwegian Institute for Agricultural and Environmental Research, the Norwegian Agricultural Economics Research Institute and Norwegian Forest and Landscape Institute.

The basis of bioeconomics is the utilisation and management of fresh photosynthesis, rather than a fossile economy based on preserved photosynthesis (oil). NIBIO is to become the leading national centre for development of knowledge in bioeconomics. The goal of the Institute is to contribute to food security, sustainable resource management, innovation and value creation through research and knowledge production within food, forestry and other biobased industries. The Institute will deliver research, managerial support and knowledge for use in national preparedness, as well as for businesses and the society at large.
NIBIO is owned by the Ministry of Agriculture and Food as an administrative agency with special authorization and its own board. The main office is located at Ås. The Institute has several regional divisions and a branch office in Oslo.



Cover photo: Alexandre Kopatz during field work in Øvre Pasvik 2015

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