NIBIO
NORSK INSTITUTT FOR BIOØKONOMI

Den Grenseløse pukkellaksen

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Verdens vanndag: Norsk vannforening

Forskningsparken – Oslo Science Park 202430320


Russland
Pasvikelva
Svanhovd

Hvordan sprer arten seg?

Vil pukkellaks endre adferd etter hvert?

Hvilken påkjenning gir den til våre økosystemer?

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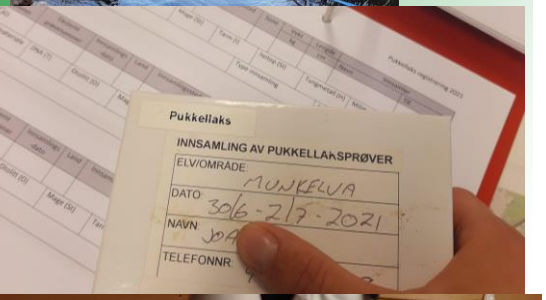
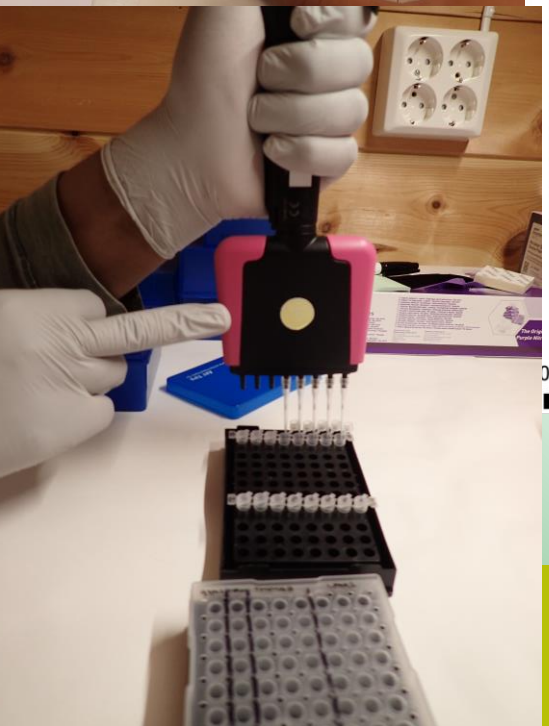
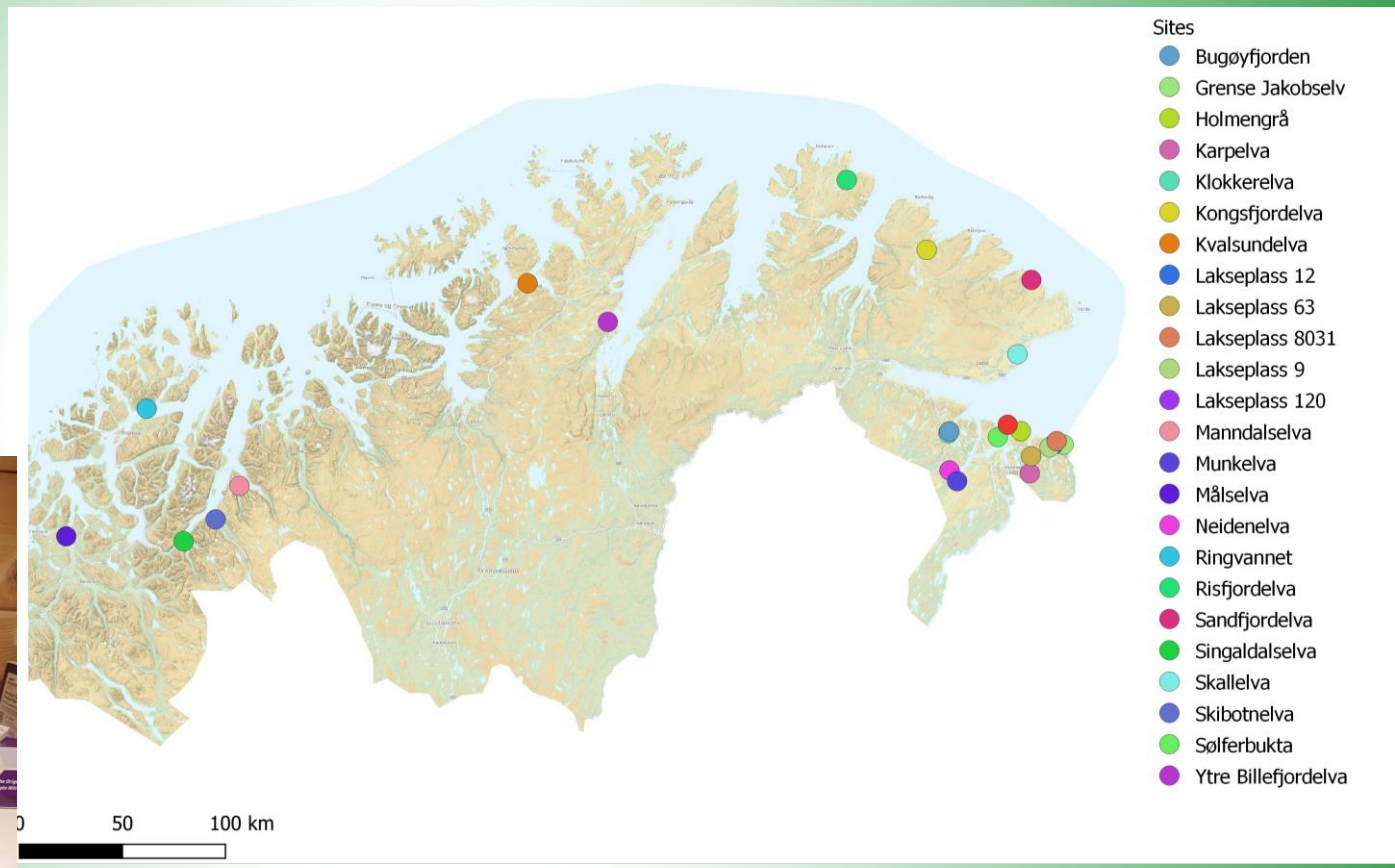
Pukkellaks innsamlet av frivillige - folkeforskning i 2023







«Responsen på vår henvendelse om hjelp til innsamling har vært STOR og KJEMPEVIKTIG!!»

Tusen takk til alle som har bidratt!!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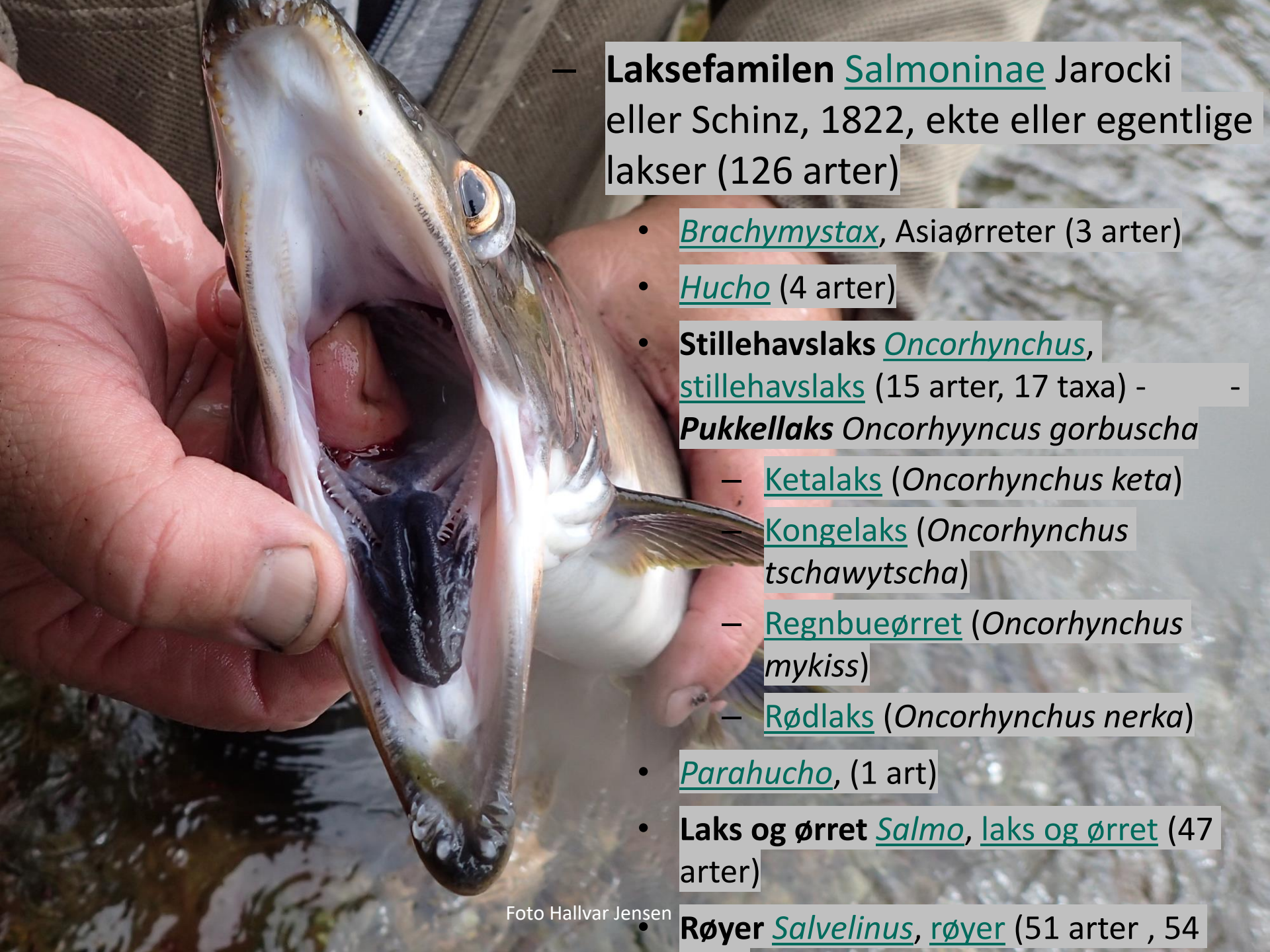


- **Laksefamilen** Salmoninae Jarocki eller Schinz, 1822, ekte eller egentlige lakser (126 arter)
  - *Brachymystax*, Asiaørreter (3 arter)
  - *Hucho* (4 arter)
  - **Stillehavslaks** *Oncorhynchus*, stillehavslaks (15 arter, 17 taxa) - - ***Pukkellaks*** *Oncorhyyncus gorbuscha*
    - Ketalaks (*Oncorhynchus keta*)
    - Kongelaks (*Oncorhynchus tschawytscha*)
    - Regnbueørret (*Oncorhynchus mykiss*)
    - Rødlaks (*Oncorhynchus nerka*)
  - *Parahucho*, (1 art)
  - **Laks og ørret** *Salmo*, laks og ørret (47 arter)
  - **Røyer** *Salvelinus*, røyer (51 arter , 54

Foto Hallvar Jensen

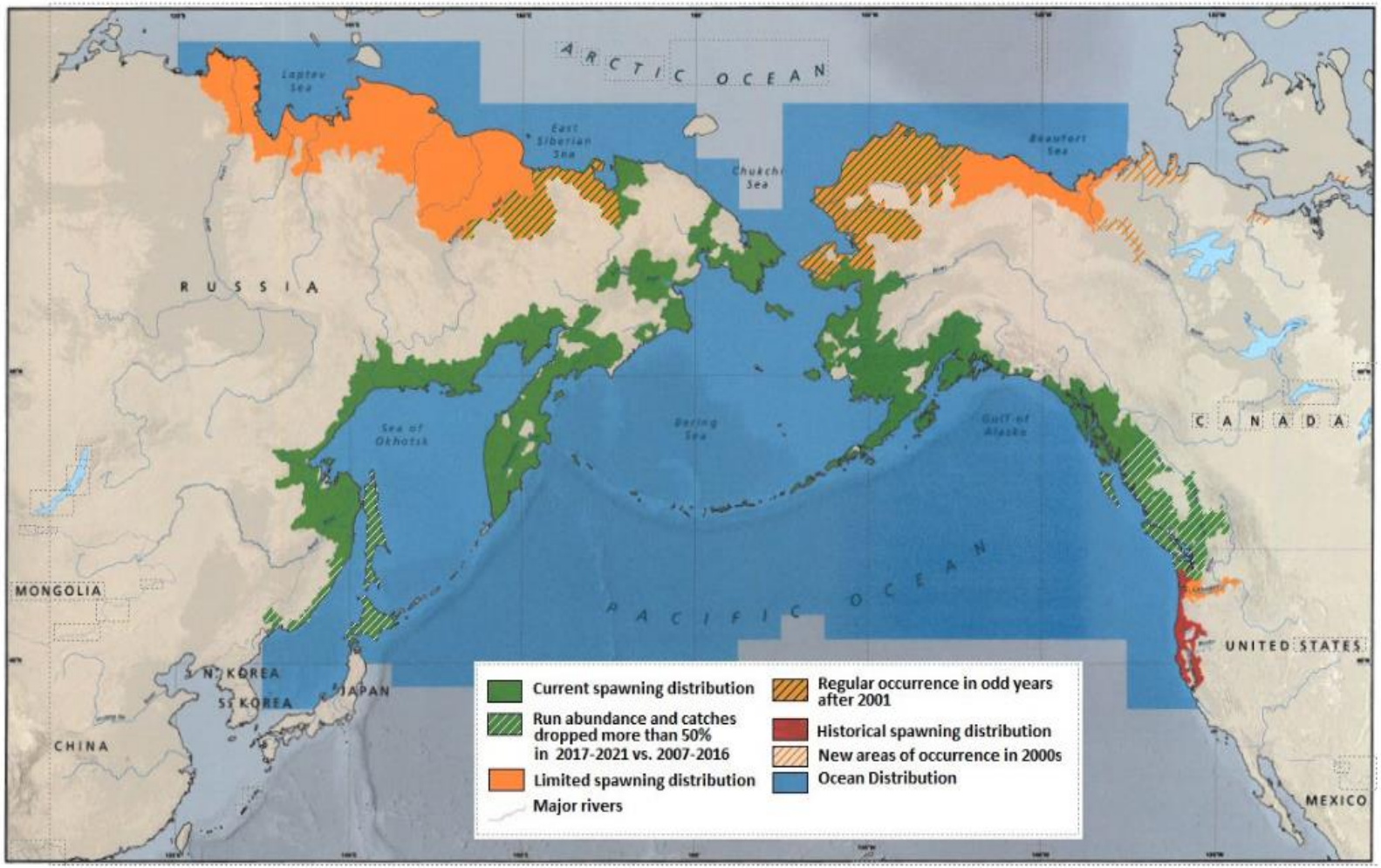
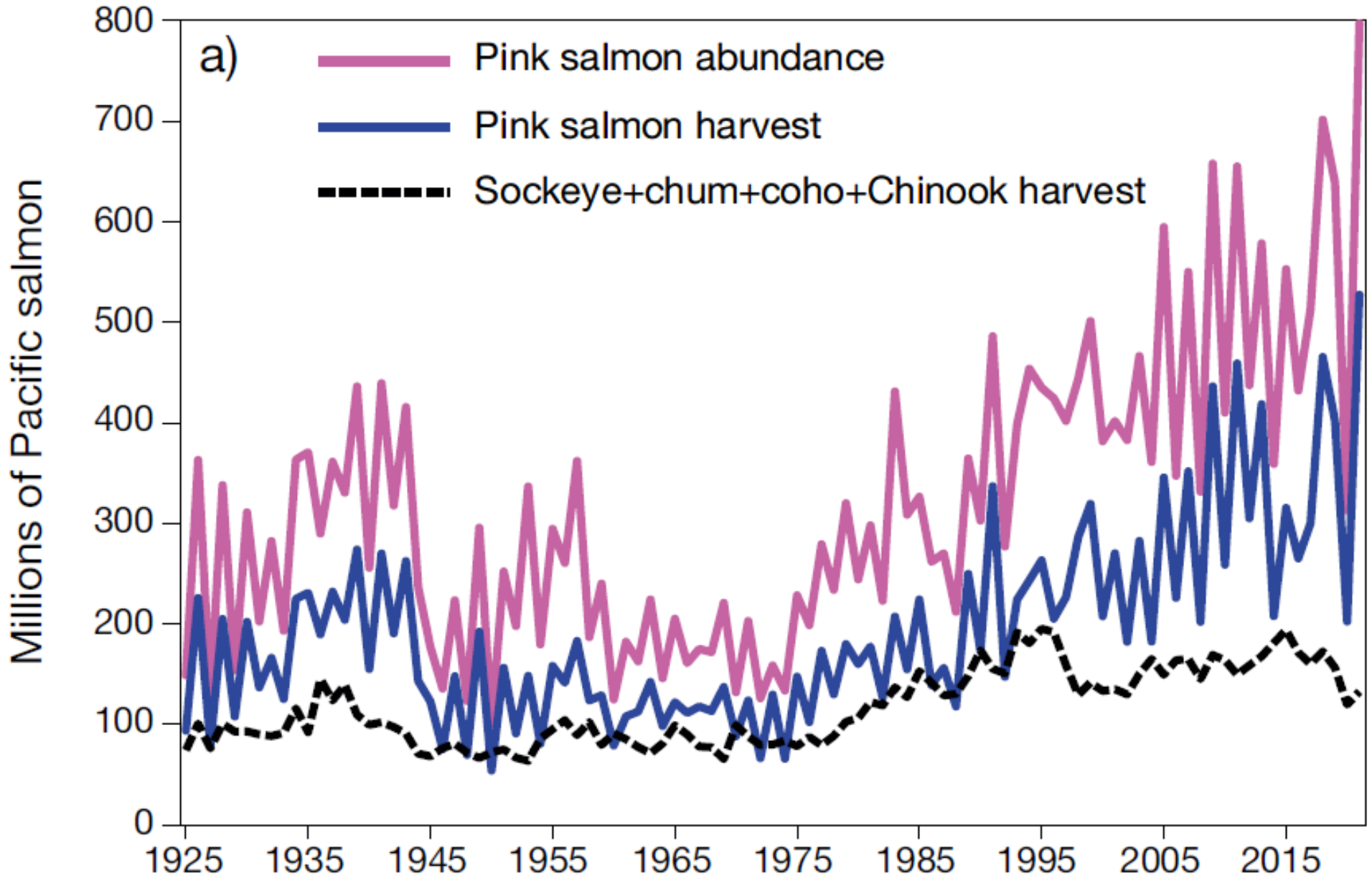


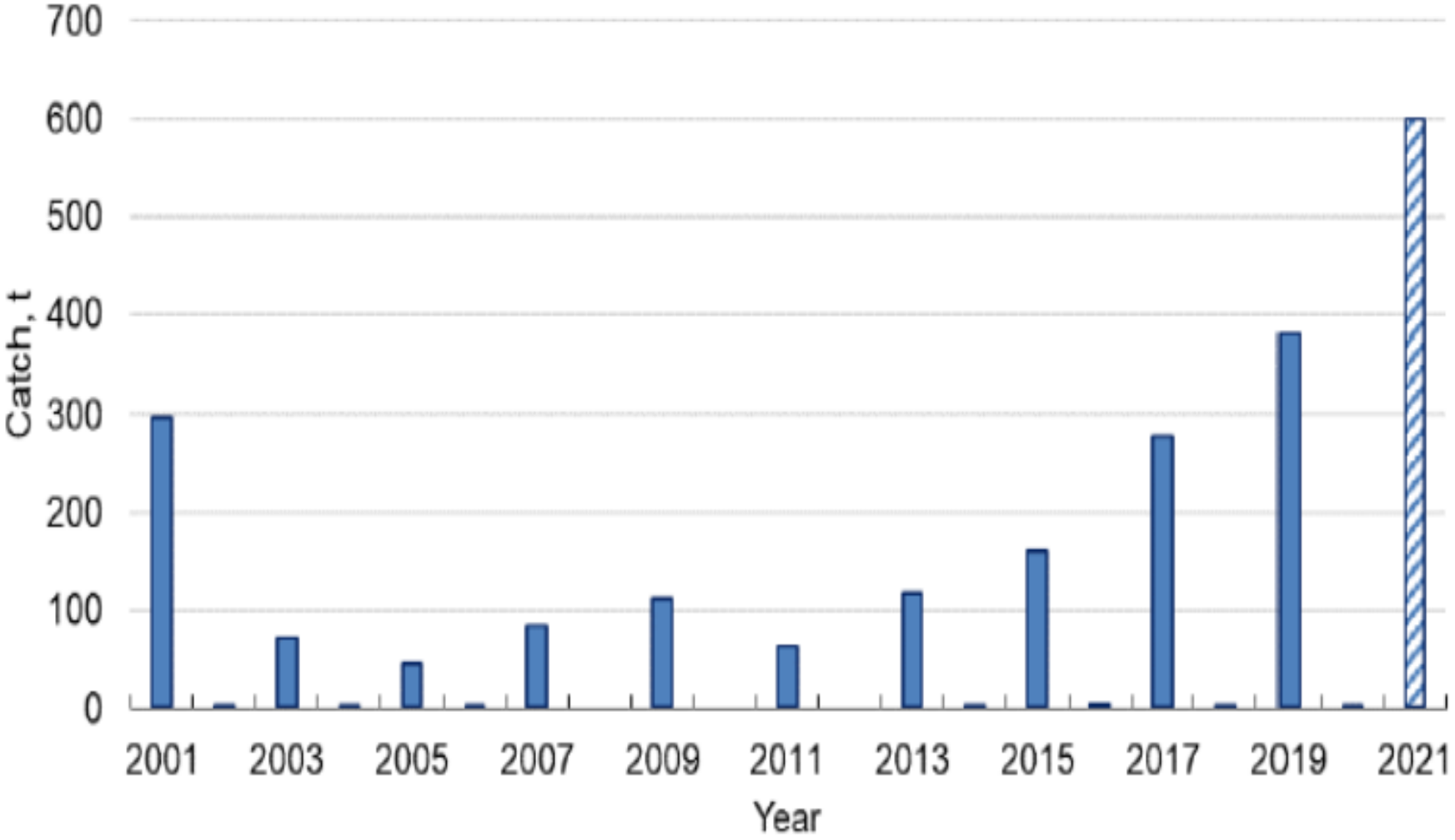
Figure 1. Pink salmon distribution (Augerot 2005) updated based on the recent reports on its penetration to the Arctic (Golub and Golub 2011; Dunmall et al. 2013; Farley et al. 2020; Stafford et al. 2022).

North Pacific Anadromous Fish Commission Technical Report No. 21, 2023



Ruggerone et al 2023 **From diatoms to killer whales: impacts of pink salmon on North Pacific ecosystems**

ICES 2022. Working Group on North Atlantic Salmon (WGNAS).



Nominal Pink salmon catches in Murmansk region in 2001-2021. Catch for 2021 is provisional (Prusov and Zubchenko , 2021).

Tabell registrerte fangster av pukkellaks pr land pr år ICES. 2022. Working Group on North Atlantic Salmon (WGNAS).

NASCO area	Jurisdiction	Year	No. of fish
NAC	Canada	2017	4
NAC	Canada	2019	5
NAC	Canada	2021	14
NEAC	Denmark	2017	10
NEAC	Denmark	2021	8
NEAC	Faroe Islands	2017	1
NEAC	Faroe Islands	2019	6
NEAC	Faroe Islands	2021	7
NEAC	Finland*	2017	2874
NEAC	Finland*	2019	5327
NEAC	Finland*	2021	49500
NEAC	France	2017	3
NEAC	France	2021	4
NEAC	Germany	2017	2
NEAC	Germany	2019	1
NEAC	Germany	2021	1
WGC	Greenland	2017	6
WGC	Greenland	2018	4
WGC	Greenland	2019	78
WGC	Greenland	2021	62
NEAC	Iceland	2017	79
NEAC	Iceland	2018	1
NEAC	Iceland	2019	251
NEAC	Iceland	2021	339
NEAC	Ireland	2017	36

Tabell registrerte fangster av pukkellaks pr land pr år ICES. 2022. Working Group on North Atlantic Salmon (WGNAS).

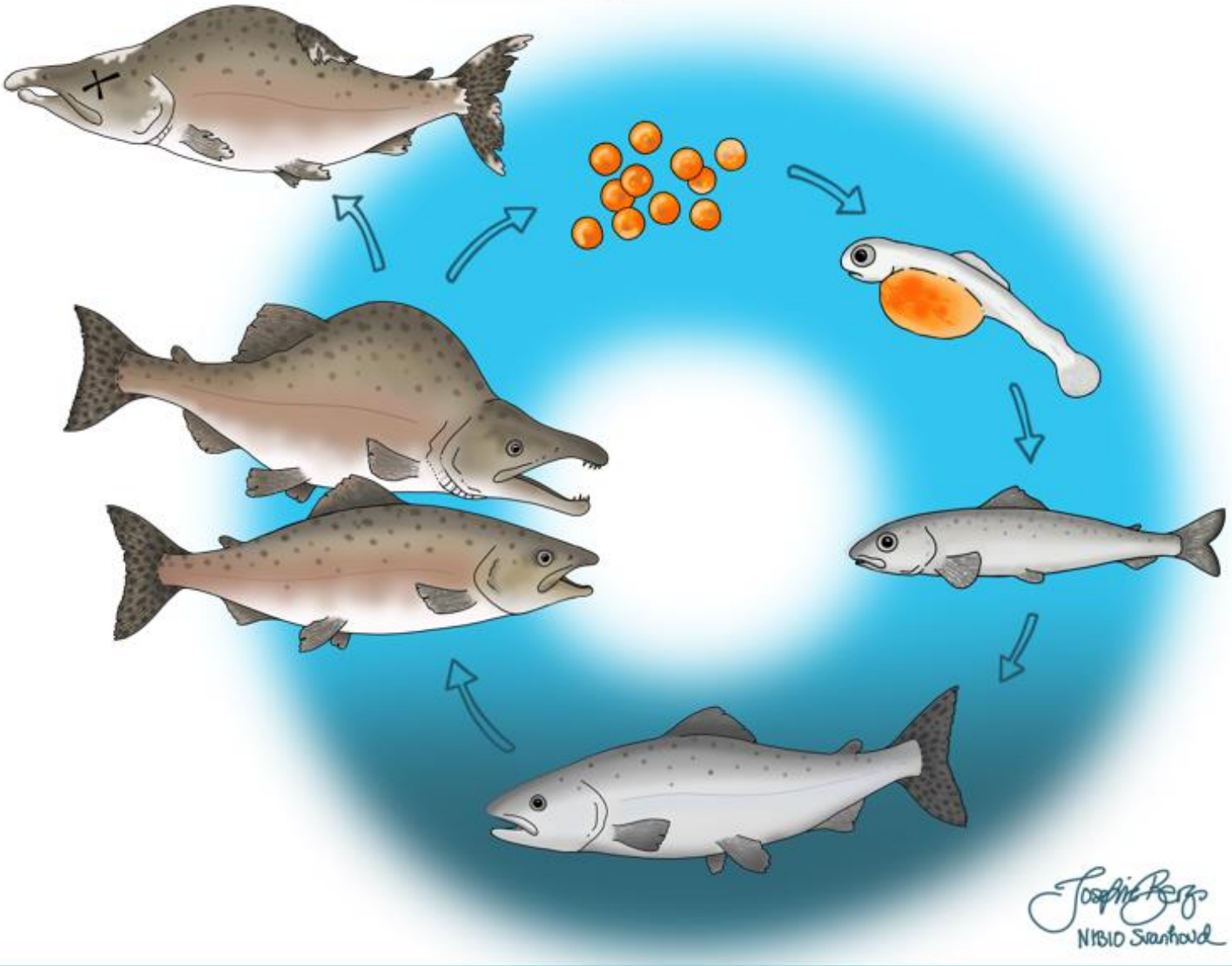
NASCO area	Jurisdiction	Year	No. of fish
NEAC	Ireland	2019	11
NEAC	Ireland	2021	45
NEAC	Netherlands	2017	3
NEAC	Netherlands	2021	6
NEAC	Norway	2017	11654
NEAC	Norway	2019	14633
NEAC	Norway	2020	254
NEAC	Norway	2021	151437
NEAC	Russia (north-west)**	2017	220000
NEAC	Russia (north-west)**	2019	223529
NEAC	Russia (north-west)**	2021	352941
NEAC	Sweden	2017	44
NEAC	Sweden	2019	5
NEAC	Sweden	2021	70
NEAC	UK (EandW)	2017	208
NEAC	UK (EandW)	2018	1
NEAC	UK (EandW)	2019	3
NEAC	UK (EandW)	2021	26
NEAC	UK (Northern Ireland)	2017	2
NEAC	UK (Northern Ireland)	2019	3
NEAC	UK (Northern Ireland)	2021	3
NEAC	UK (Scotland)	2017	122
NEAC	UK (Scotland)	2019	19
NEAC	UK (Scotland)	2021	173

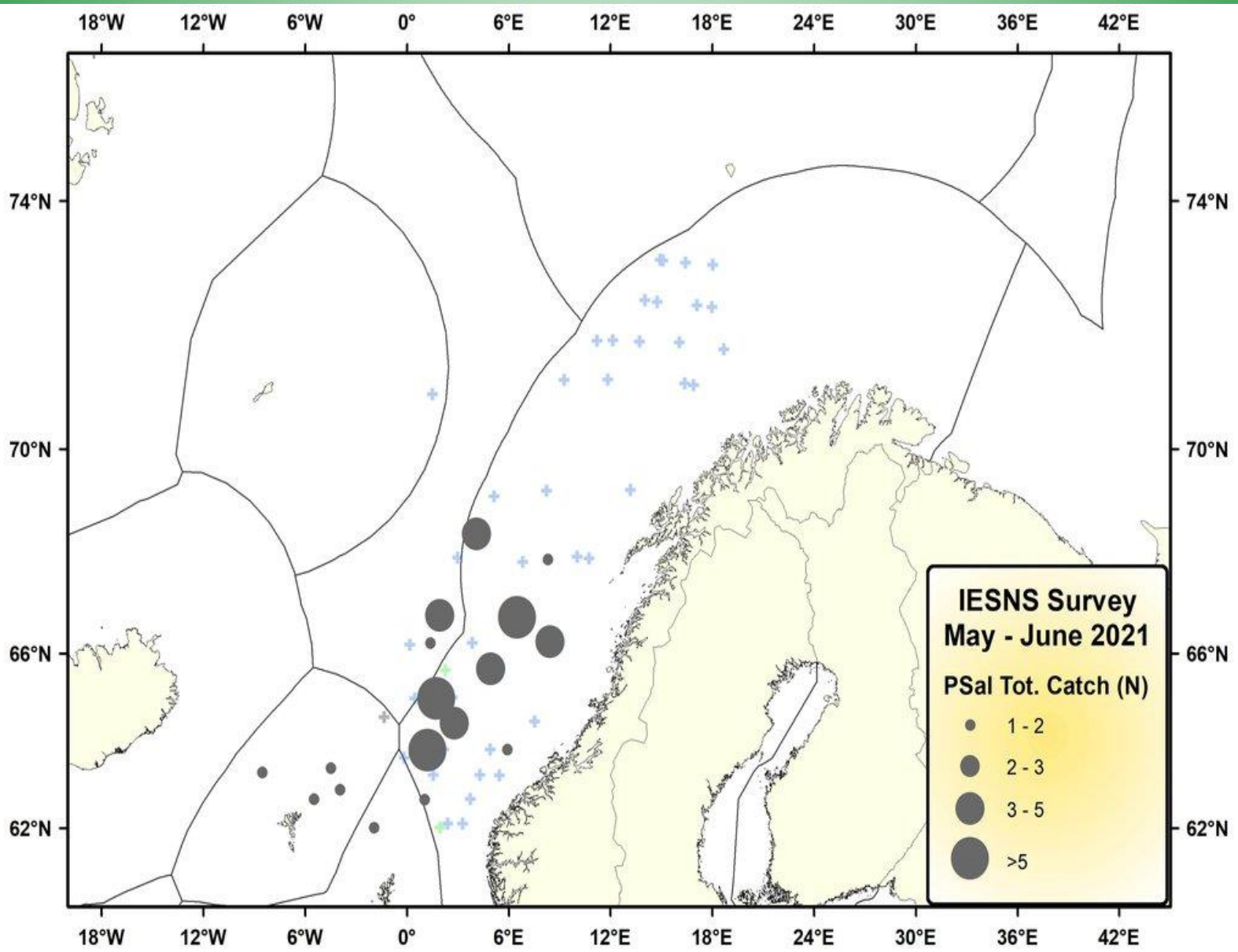
* Figures for Finland are for Tana/Teno.

Norge 2023: 249.496 pukkellaks

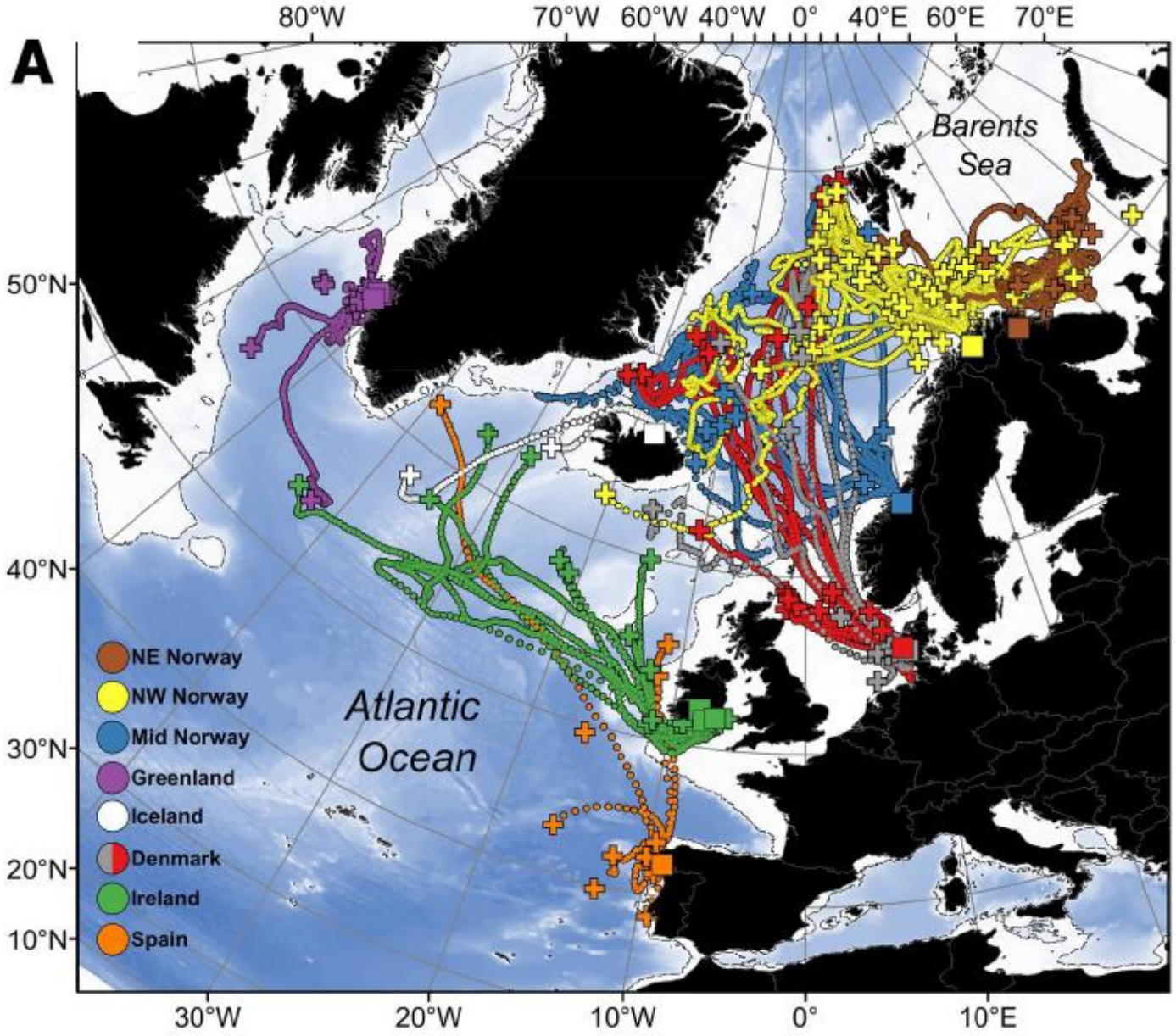
** Russian numbers estimated from t caught; assume a mean weight of 1.7 kg per fish as per ICES (2018b) . Russian data for 2018 and 2020 not currently available but catches were relatively much lower than 'odd-years' as per graph in Prusov and Zubchenko (2021).

Livssyklus





Dei grå rundingane viser pukkellaks-fangstane på maitoktet. Kryssa viser kor fartøya har tråla (desse er ikkje komplette for 2021). (Illustrasjonar: Valantine Anthonypillai)

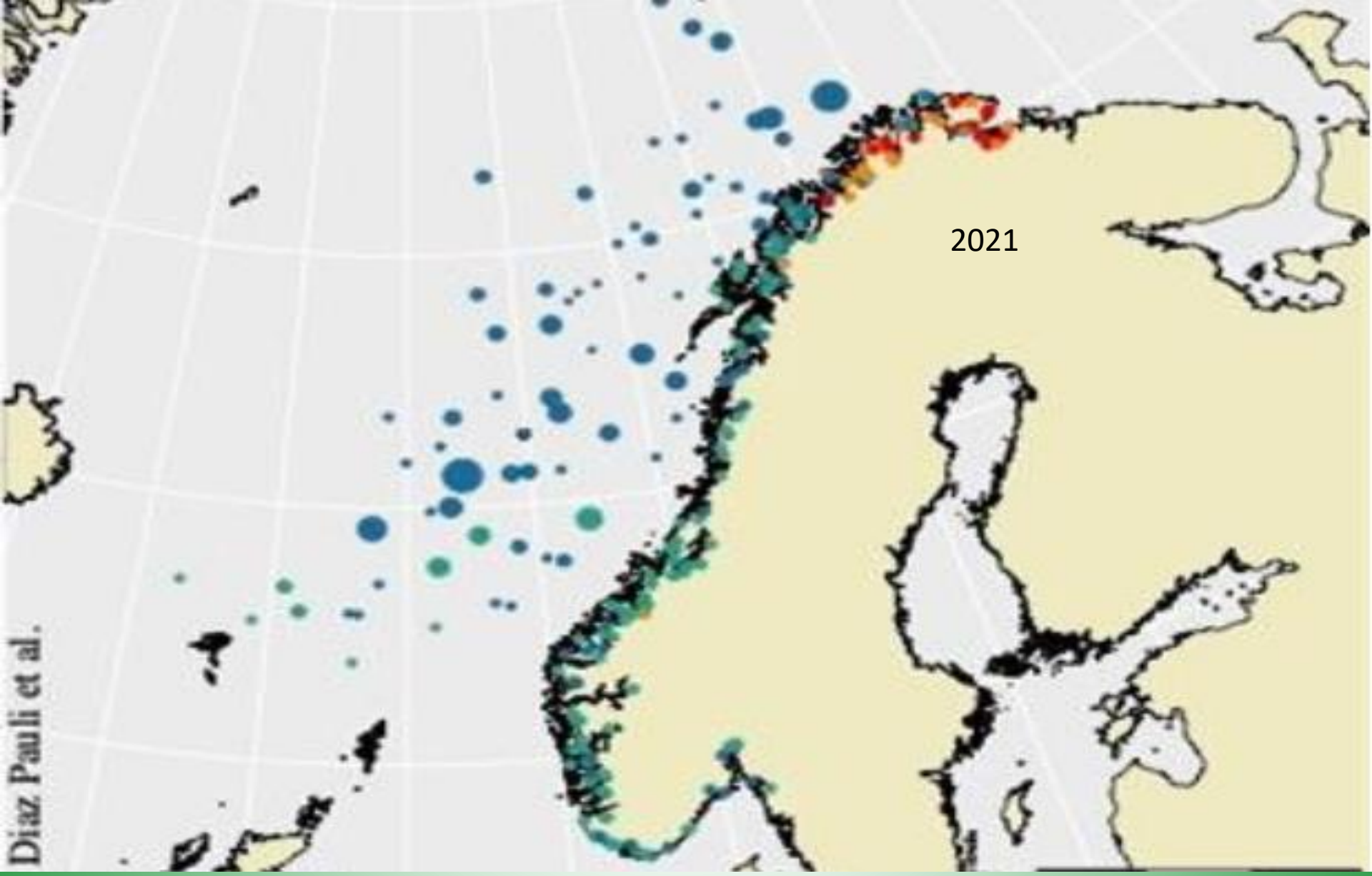


ICES. 2022. Working Group on North Atlantic Salmon (WGNAS).

Figure 1.10 Migrations of Atlantic salmon tagged in eight different geographic areas: release locations post tagging are shown by squares, estimated daily geographic location of 105 salmon is shown by circles and crosses show the pop-up location of the tags. Dashed line represents the 500 m depth contour with darker blue indicating increasing depth (re-produced from Rikardsen *et al*. 2021).

Figure 2. Pink salmon distribution in the Northeast Atlantic in 2001. Areas where pink salmon occurred and spawn regularly in odd years are highlighted by green, areas of adult pink salmon occurrence with limited or unknown spawning success are highlighted by orange.

Figure 3. Pink salmon distribution in the Northeast Atlantic in 2021. Areas where pink salmon occurred and spawn regularly in odd years are highlighted by green, areas of adult pink salmon occurrence with limited or unknown spawning success are highlighted by orange.



Kart som viser utbredelsen av pukkelaks i Norskehavet og norske elver. Størrelsen på sirklene I havet indikerer antall individer fanget. Mens fargen på elvene angir mengde fanget. © Diaz Pauli et al.

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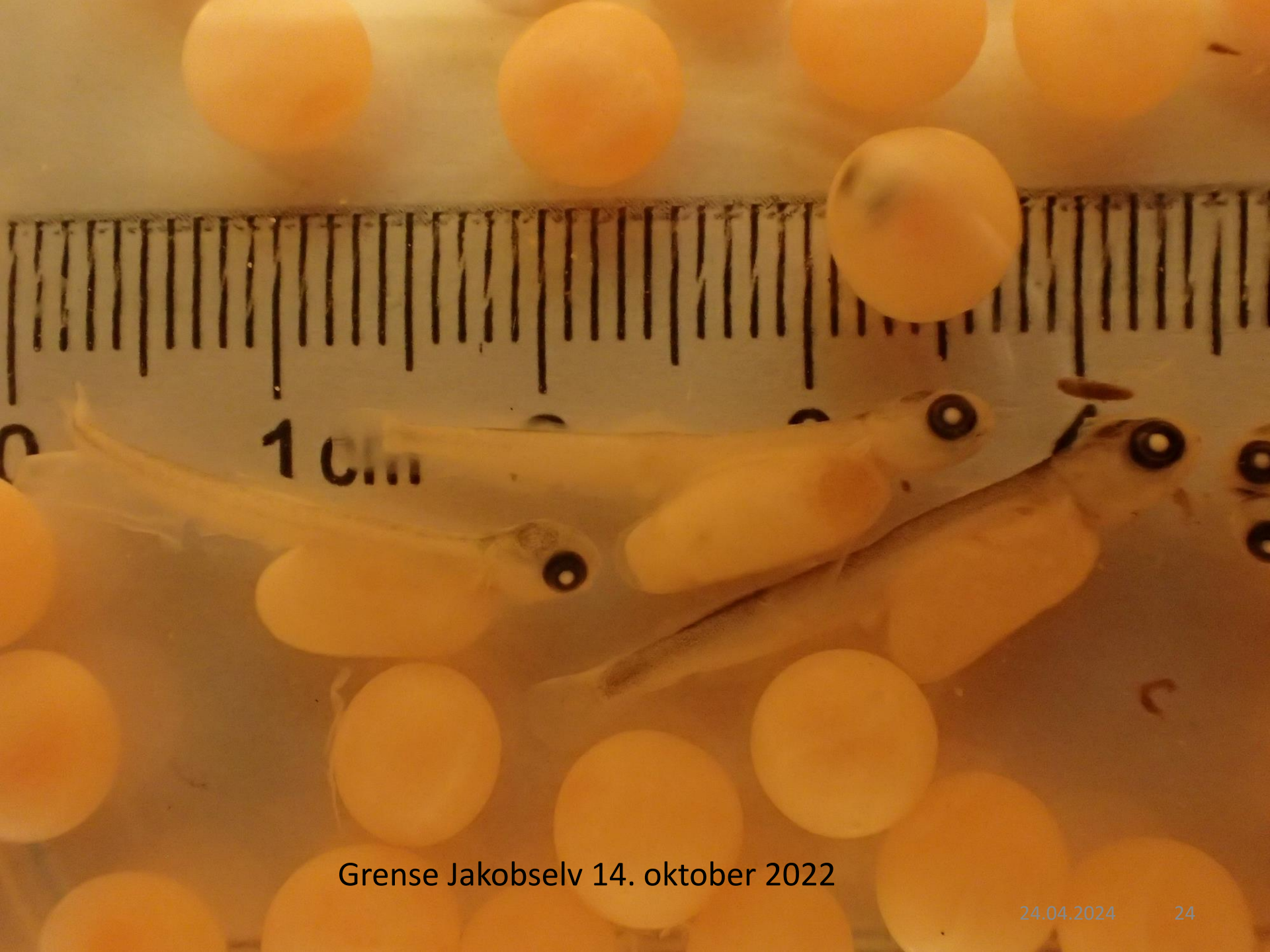
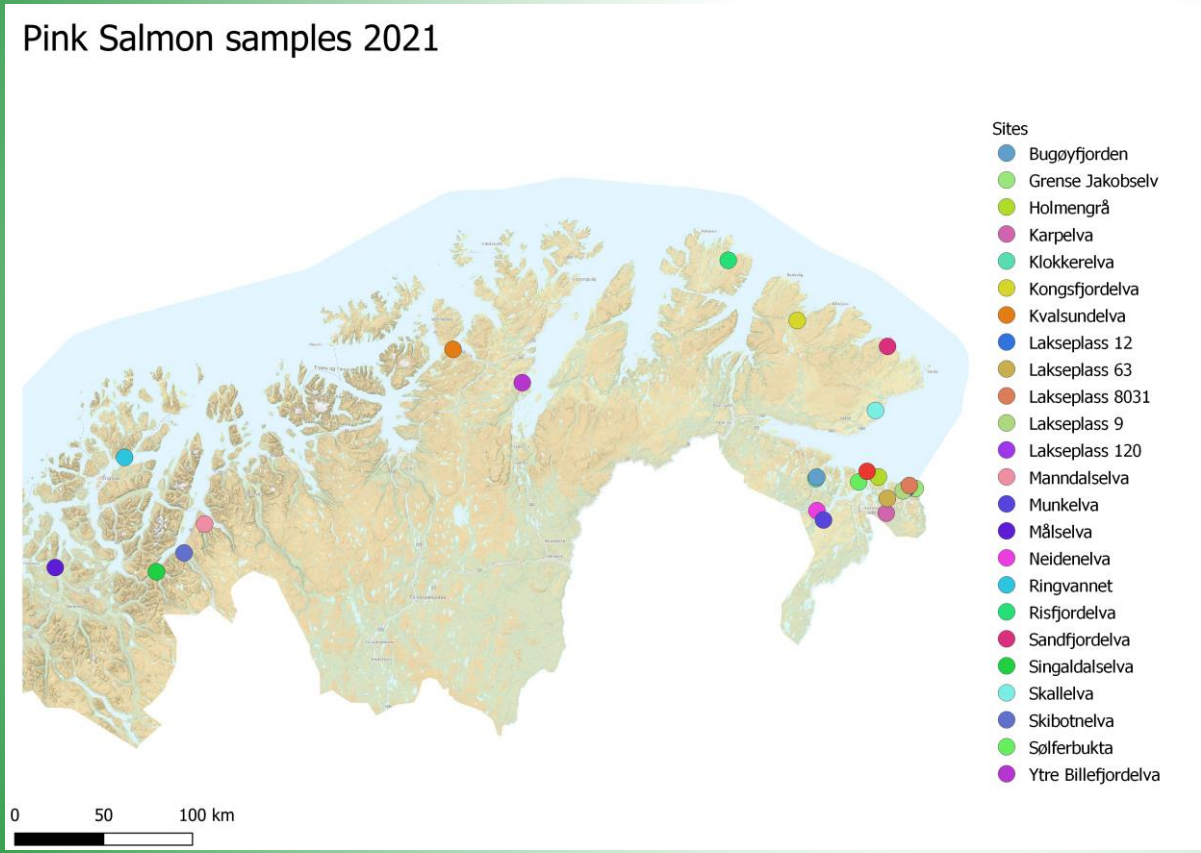
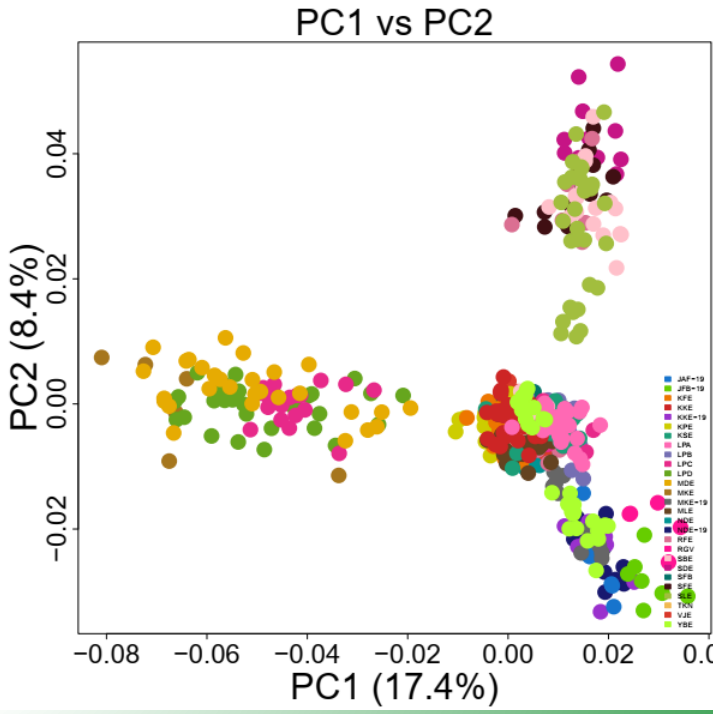
For å utvikle eggene fra gyting til klekking, så trenger pukkellakseggene 400- 450 døgngrader.

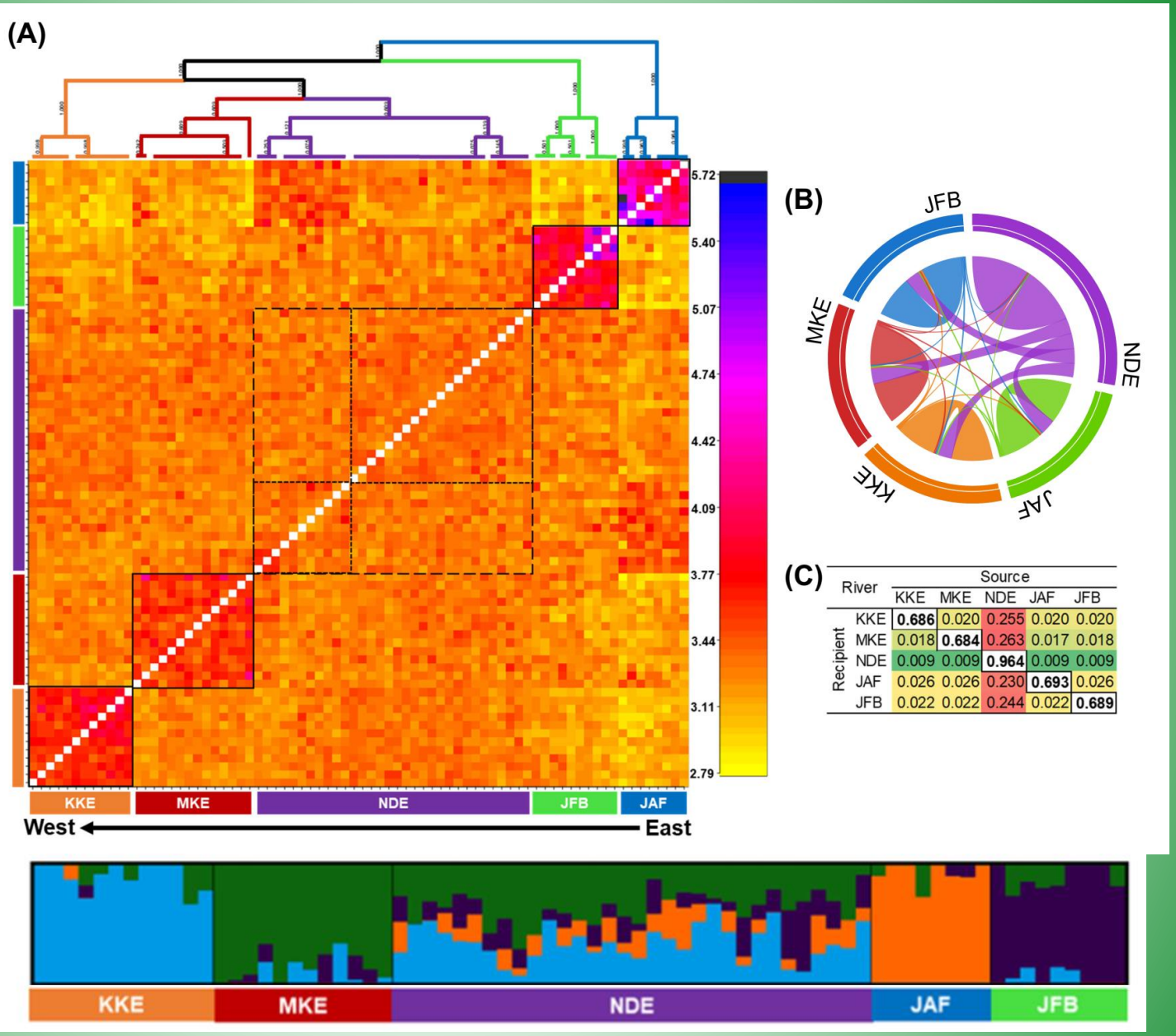


Grense Jakobselv 14. oktober 2022


Pink Salmon samples 2021
Sites
Bugøyfjorden
Grense Jakobselv
Holmengrå
Karpelva
Klokkerelva
Kongsfjordelva
Kvalsundelva
Lakseplass 12
Lakseplass 63
Lakseplass 8031
Lakseplass 9
Lakseplass 120
Manndalselva
Munkelva
Målselva
Neidenelva
Ringvannet
Risfjordelva
Sandfjordelva
Singaldalselva
Skallelva
Skibotnelva
Sølferbukta
Ytre Billefjordelva
0
50
100 km


PC1 vs PC2
PC2 (8.4%)
0.04
0.02
0.00
−0.02
−0.08
−0.06
−0.04
−0.02
0.00
0.02
PC1 (17.4%)

2019 gyterene



Maduna et al 2024 Ecological niche modelling and population genomics provide insights into the geographic and demographic 'explosion' of a non-indigenous salmonid. Diversity and distribution 30(3).

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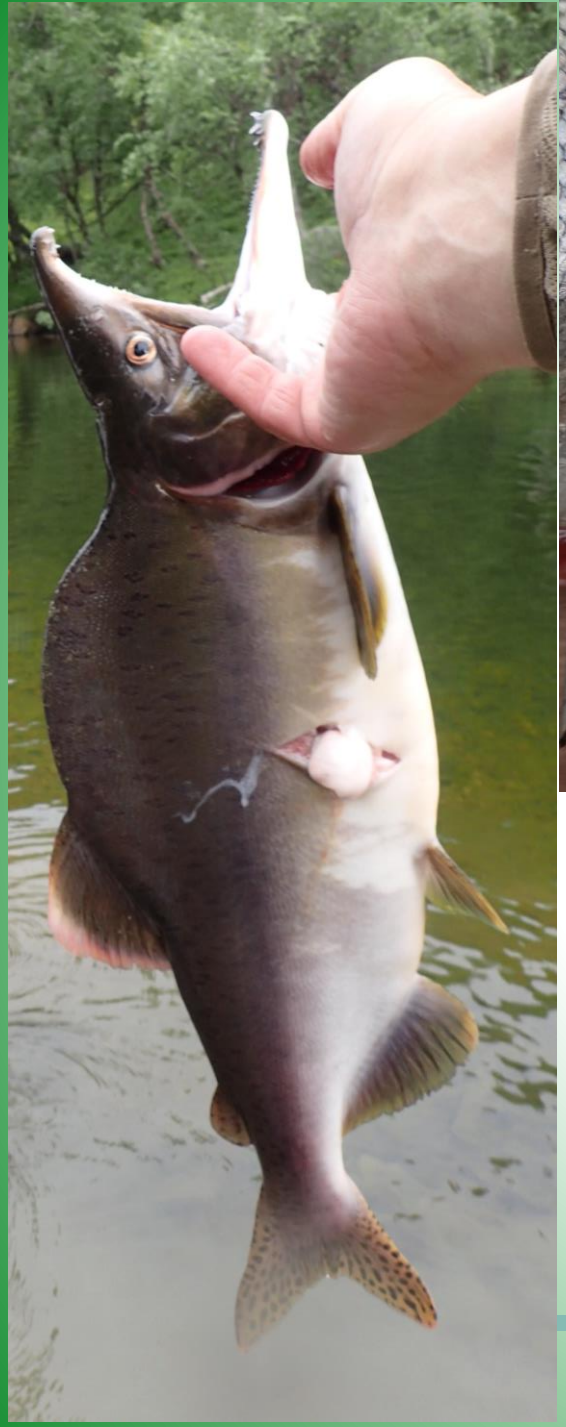
Foto: Juho Matti Vuolteenaho

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cm


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Elvas villsvin..!!
Foto: Juho Matti Vuolteenaho


Foto: Juho Matti Vuolteenaho


Pukkellaks : elvas villsvin ….

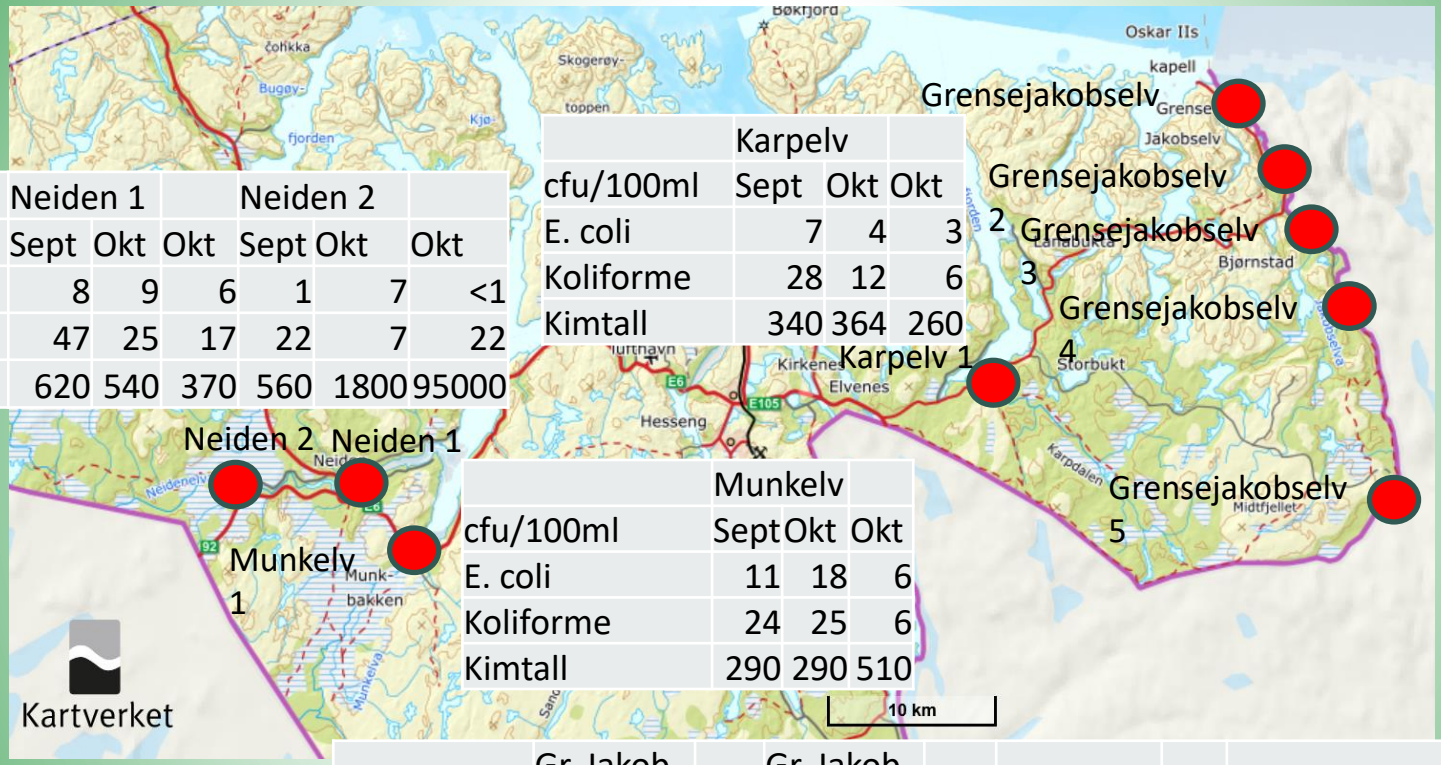
Foto: Juho Matti Vuolteenaho

Bakterieinnhold i elvevann September 8.& 9., Oktober 14. og 31. 2021

	Neiden 1			Neiden 2		
cfu/100ml	Sept	Okt	Okt	Sept	Okt	Okt
E. coli	8	9	6	1	7	<1
Koliforme	47	25	17	22	7	22
Kimtall	620	540	370	560	1800	95000

	Karpelv		
cfu/100ml	Sept	Okt	Okt
E. coli	7	4	3
Koliforme	28	12	6
Kimtall	340	364	260

	Munkelv		
cfu/100ml	Sept	Okt	Okt
E. coli	11	18	6
Koliforme	24	25	6
Kimtall	290	290	510



	Gr. Jakob 1			Gr. Jakob 2			Gr. Jakob 3			Gr. Jakob 4			Gr. Jakob 5		
cfu/100ml	Sept	Okt	Okt	Sept	Okt	Okt	Sept	Okt	Okt	Sept	Okt	Okt	Sept	Okt	Okt
E. coli	4	84	4	9	33	2	9	6	5	15	4	3	6	<1	10
Koliforme	72	87	10	32	33	10	22	12	7	5	4	5	10	11	11
Kimtall	420	630	380	360	480	280	310	2600	280	220	120	260	450	120	430

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Kimtall CFU/100ml

	GrJ1	GrJ2	GrJ3	GrJ4	GrJ5	GrJ6	GrJ7	Karpelv	Munkelv	Neiden 1	Neiden 2
29.04.2022	7300	4800		10000	5500	19000		11000	18000	30000	4400
30.05.2022	2400	1100			8100			5500	3400	30000	12000
14.06.2022	30000	8700	5800	5200	3500	1800	30000	8500	30000	30000	30000
21.07.2022	29000	30000	27000	24000	28000	30000		30000	30000	30000	30000
24.08.2022	30000	9200	4900	3000	7300	5700		5700	9700	1600	3100
30.09.2022	1500	4000	13000	140	3700	7600		26000	30000	6800	3400
31.10.2022	8900	7000	1700	1300	3200	3700		13000	30000	5400	4000
08.09.2021	**42000**	**38000**	**310**	**22000**	**45000**			**34000**	**29000**	**62000**	**56000**
13.10.2021	**63000**	**48000**	**260000**	**12000**	**12000**			**36400**	**29000**	**54000**	**18000**
31.10.2021	**38000**	**28000**	**28000**	**26000**	**43000**			**26000**	**51000**	**37000**	**9500000**

Clostridium perfingens CFU /100ml

	GrJ1	GrJ2	GrJ3	GrJ4	GrJ5	GrJ6	GrJ7	Karpelv	Munkelv	Neiden 1	Neiden 2
29.04.2022	0	0		0	0	0		0	0	0	0
30.05.2022	0	0			0			0	0	0	0
14.06.2022	0	0	0	0	0	0	0	0	0	0	0
21.07.2022	3	7	4	2	1	6		15	17	7	4
24.08.2022	0	0	0	0	0	0		0	0	0	0
30.09.2022	0	0	0	0	0	0		0	0	0	0
31.10.2022	0	0	0	0	0	0		0	0	0	0

8 &9 September 2021 *31. October 2021*

	pH	Total Fosfor	Fosfat (PO4-P)	Total Nitrogen	Ammonium (NH4-N)	Ammonium (NH4-N)	Nitrat (NO3-N)	Løst organisk karbon (DOC)	Kjemisk oksygenforbruk (KOFCr)	Biokjemisk oksygenforbruk (BOF) 5 d	Fritt ammoniakk (NH3)
Prøve		mg/l	µg/l	mg/l	µg/l	mg/l	µg/l	mg/l	mg/l	mg/l	mg/l
Gr	7,0	0,0089	2,3	0,10	11		<5,0	2,9	9,6	<3	0,03
Jakob 1	6,9	0,01	6,3	0,12	17	<0,10	<5,0	3,2	5,9	<3	0,00
Gr	6,9	0,010	2,4	0,11	9,1		<5,0	3,1	8,7	<3	0,02
Jakob 2	7	0,0081	5,6	0,089	13	<0,10	11	3,3	6,5	<3	0,00
Gr	6,9	0,010	2,2	0,12	7,3		<5,0	3,3	9,4	<3	0,01
Jakob 3	7,1	0,0095	2,5	0,11	16	<0,10	9,3	3,3	6,3	<3	0,00
Gr	6,9	0,011	2,4	0,13	8,6		<5,0	3,2	9,2	<3	0,01
Jakob 4	6,9	0,0099	3,2	0,099	12	<0,10	<5,0	3,5	5,7	<3	0,00
Gr	6,9	0,0083	2,3	0,13	7,9		<5,0	3,9	12	<3	0,01
Jakob 5	6,8	0,01	3	0,09	25	<0,10	15	3,9	7,2	<3	0,00
	6,9	0,012	2,4	0,14	6,8		<5,0	4,7	12	<3	0,01
Karp	7	0,0091	6,4	0,13	18	<0,10	<5,0	4,3	9,2	<3	0,00
	7,1	0,012	2,8	0,11	<5,0		<5,0	3,0	9,8	<3	0,00
Munk	6,8	0,0085	4,3	0,13	12	<0,10	18	4	6,5	<3	0,00
Neiden	7,1	0,013	2,5	0,17	12		6,1	3,2	11	<3	0,03
1	7	0,018	7,3	0,2	7,3	<0,10	10	3,8	7,2	<3	0,00
Neiden	7,1	0,010	2,1	0,14	15		<5,0	3,1	11	<3	0,04
2	6,9	0,016	11	0,18	13	<0,10	13	4	7,9	<3	0,00

Fritt ammoniakk NH3 mg/l

	8 sept 2021	31 oct 2021	24 apr 2022	21 July 2022	24 aug 2022	30 sept 2022	31 oct 2022
GrJ1	0,03	0,00	0,00	0,04	0,02	0,00	0,00
GrJ2	0,02	0,00	0,00	0,00	0,02	0,00	0,00
GrJ3	0,01	0,00	0,00	0,03	0,04	0,01	0,00
GrJ4	0,01	0,00	0,00	0,04	0,03	0,01	0,00
GrJ5	0,01	0,00	0,00	0,02	0,06	0,00	0,00
Karp	0,01	0,00		0,06	0,11	0,00	0,00
Munk	0,00	0,00		0,01	0,01	0,00	0,01
Neid1	0,03	0,00		0,03	0,03	0,00	0,00
Neid2	0,04	0,00		0,07	0,04	0,01	0,01

Tungmetaller i kjøtt fra pukkellaks høsten 2021 mg/kg muskel

	Li	Mg	Al	V	Cr	Fe	Co	Ni	Cu	Zn	As	Se	Mo	Ag	Cd	Hg	Pb
Karp 1	0,0029	270	0,13	0,0011	<LOD	2,4	0,0016	<0,008	0,43	5,3	0,78	0,25	0,0018	<0,00016	0,0004	0,021	<0,0006
Karp 2	0,0024	290	0,13	0,0006	<LOD	2,3	0,0021	<LOD	0,38	3,6	0,85	0,27	0,0023	<LOD	0,0005	0,025	<LOD
Karp 3	0,0036	280	0,90	0,0027	<LOD	1,6	0,0017	<LOD	0,35	4,5	0,72	0,29	0,0016	<LOD	0,0003	0,019	<0,0009
Karp 4	0,0024	260	0,078	0,0007	<LOD	3,7	0,0023	<LOD	0,57	4,2	1,0	0,25	0,0031	<LOD	0,0007	0,027	<0,0008
Karp 5	0,0046	270	0,071	0,0005	<LOD	2,5	0,0015	<LOD	0,46	3,9	1,0	0,27	0,0021	<LOD	0,0005	0,024	<0,0006
Karp 6	0,0023	290	0,085	0,0008	<LOD	2,1	0,0019	<LOD	0,44	3,7	1,3	0,28	0,0019	<LOD	0,0005	0,021	<0,0008
Karp 7	0,0029	260	0,083	0,0006	<LOD	2,7	0,0024	<LOD	0,53	4,5	0,86	0,25	0,0024	<0,00018	0,0004	0,023	<LOD
Karp 8	0,0023	300	<0,06	0,0008	0,023	1,6	0,0017	<LOD	0,29	3,7	0,71	0,27	0,0019	<LOD	0,0003	0,015	<LOD
Karp 9	0,0036	200	<LOD	<0,00038	<LOD	1,9	0,0027	<LOD	0,41	4,3	1,0	0,24	0,0014	<LOD	0,0007	0,021	<LOD
Karp 10	0,0015	260	0,13	<0,00037	<LOD	2,9	0,0027	<LOD	0,54	4,6	0,84	0,27	0,0018	<LOD	0,0005	0,024	<0,0007
Karp 11	0,0029	280	0,06	0,0009	<0,018	2,3	0,0019	<LOD	0,47	4,1	0,98	0,28	0,0018	<0,0002	0,0004	0,027	<LOD
Karp 12	0,0032	260	0,051	0,0006	<LOD	2,3	0,002	<0,01	0,45	3,8	0,67	0,22	0,0022	<LOD	0,0005	0,018	<LOD
Karp 13	0,0028	270	0,093	0,0008	<LOD	2,6	0,0018	<LOD	0,49	3,9	1,3	0,26	0,0024	<LOD	0,0006	0,033	<0,0006
Karp 14	0,0012	280	0,071	0,0004	<LOD	2,2	0,0023	<LOD	0,44	4,4	1,0	0,25	0,002	<LOD	0,0003	0,020	<0,0006
Karp 15	0,0036	270	<0,06	0,0006	<LOD	2,7	0,0019	<LOD	0,42	3,9	1,2	0,29	0,002	<LOD	0,0004	0,022	<LOD
VJ 20	0,0080	160	12	0,0011	<LOD	4,1	0,004	<0,013	0,55	11	0,29	0,21	0,0016	0,00027	0,016	0,025	0,0051
VJ 21	0,0068	190	1,7	0,0007	<LOD	2,0	0,0026	<LOD	0,41	4,3	0,4	0,27	0,0009	<0,00019	0,0027	0,036	0,002
VJ 22	0,0095	190	0,28	0,0009	<LOD	1,6	0,0021	<LOD	0,35	4,1	0,49	0,26	0,00096	<0,00024	0,0010	0,029	<0,0009

Cu Kobber: 0,5 mg/kg kroppsvekt/dag As Arsen: 0,3-8 µg/kg kroppsvekt/dag

1 mg (milligram) = 1000 µg (mikrogram)

Tungmetaller i rogn fra pukkellaks høsten 2021 mg/kg rogn

	Li	Mg	Al	V	Cr	Fe	Co	Ni	Cu	Zn	As	Se	Mo	Ag	Cd	Hg	Pb
Karp 1	0,0043	610	0,05	0,0021	0	17	0,013	0,011	4,9	25	0,32	1,8	0,0045	0,0067	0,0010	0,0024	0,0008
Karp 2	0,010	640	0,06	0,0014	0	18	0,02	0	4,3	25	0,34	2,0	0,0048	0,0049	0,013	0,0026	0
Karp 4	0,0040	630	0,04	0,0016	0	18	0,013	0,008	6,5	28	0,40	1,8	0,008	0,026	0,018	0,0045	0,0006
Karp 5	0,0062	570	0,071	0,0013	0,016	14	0,012	0,009	2,9	22	0,38	1,5	0,0051	0,0017	0,0016	0,0028	0,0007
Karp 7	0,0046	600	0	0,0014	0	13	0,01	0,01	2,4	21	0,32	1,7	0,0041	0,0015	0,0007	0,0021	0,0007
Karp 10	0,0021	660	0,05	0,0010	0	14	0,013	0,01	5,0	21	0,34	1,7	0,0038	0,0076	0,0039	0,0023	0
Karp 11	0,0063	620	0,062	0,0020	0	17	0,016	0,008	4,7	23	0,30	1,8	0,0047	0,0047	0,0041	0,0033	0,0006
Karp 12	0,0061	510	0,04	0,0018	0	16	0,015	0,012	3,1	23	0,30	1,6	0,0047	0,0023	0,0040	0,0018	0,0006
Karp 13	0,0022	510	0,04	0,0013	0	17	0,014	0,009	2,9	24	0,55	1,4	0,0035	0,0008	0,0034	0,0033	0,0006
Karp 14	0,0021	560	0,05	0,0017	0	15	0,013	0,01	5,2	38	0,33	1,4	0,0048	0,0096	0,0022	0,0021	0,0007
VJ	0,0078	1000	0,33	0,0024	0,013	21	0,023	0,007	5,9	41	0,57	2,8	0,0082	0,0081	0,0033	0,0041	0,0031

Pb Bly: 1,5 mg/voksen person /uke
Cu Kobber: 0,5 mg/kg kroppsvekt/dag
As Arsen: 0,3-8 µg/kg kroppsvekt/dag

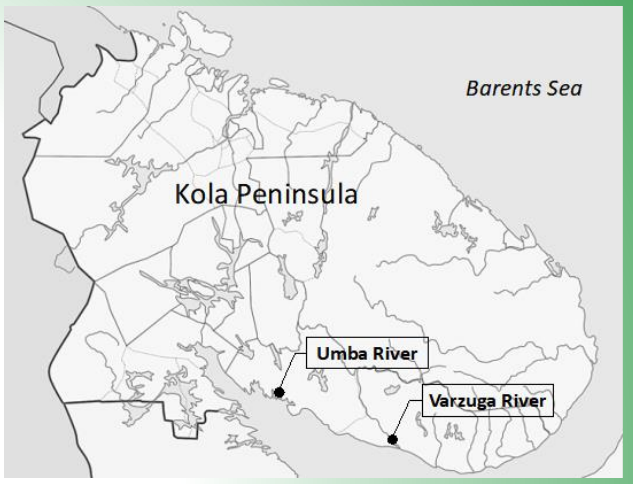
Cd Kadmium: 21 µg/person/ dag
Ni Nikkel: 0,250 mg/dag
Ag Sølv: 7 µg per person/dag

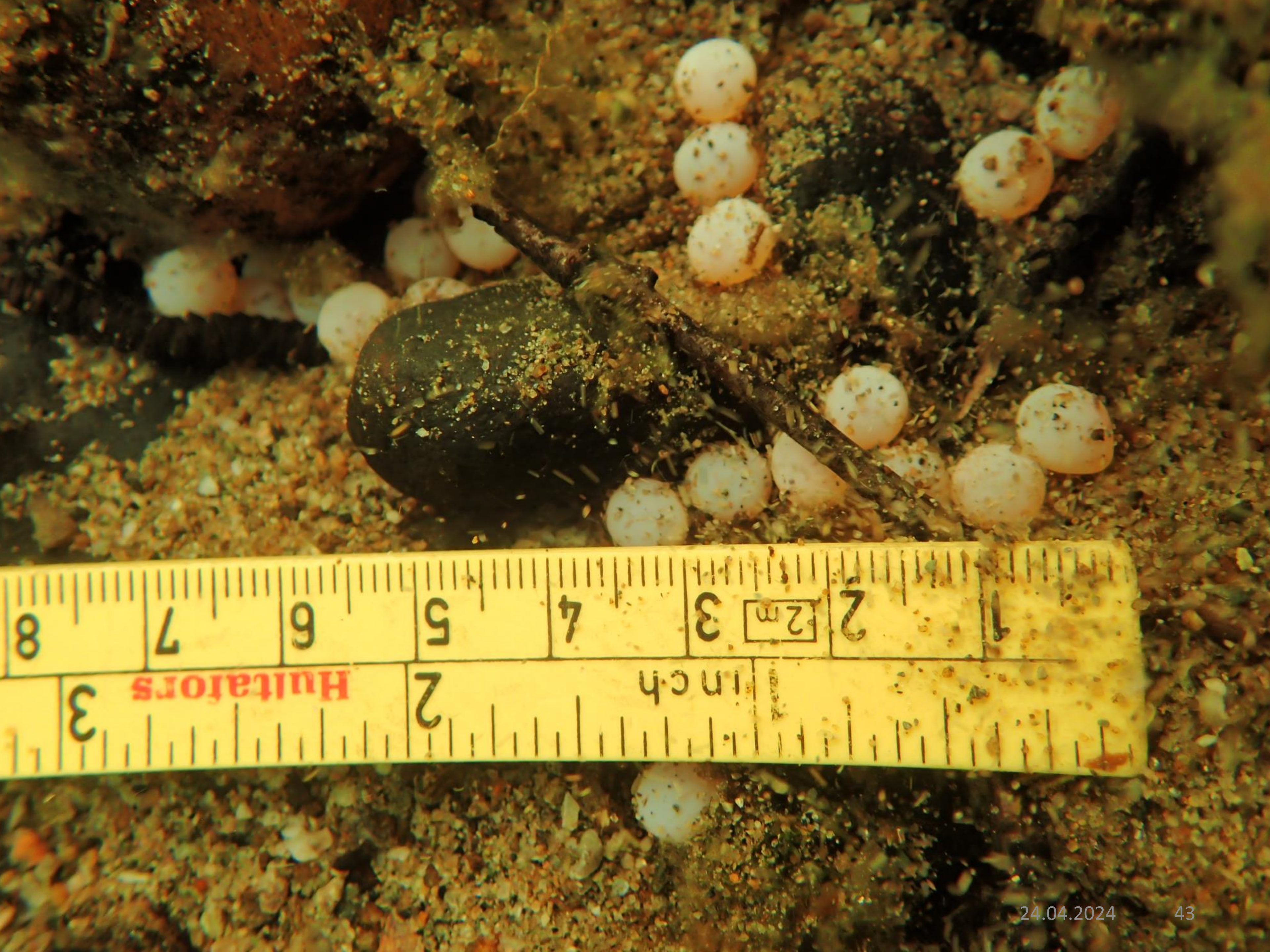
1 mg (milligram) = 1000 µg (mikrogram)

Khristoforova et al 2022 Heavy Metal Content In Pink Salmon From The Euro-Arctic And Sakhalin-Kuril Regions

Table 2 - Comparison of trace element content in organs and tissues of pink salmon from the Sakhalin-Kuril and Euro-Arctic regions, µg/g wet weight.

Organs and tissues	Zn	Cu	Ni	Cd	Pb	
Reydovaya River (Iturup Island), fish weight range 1278-2362 g.						
Muscles	1,96±0,08	0,24±0,08	0,12±0,01	0,14±0,012	0,67±0,05	
Liver	3,14±0,07	0,32±0,03	0,18±0,01	0,21±0,018	0,96±0,04	
Male gonads	3,09±0,05	0,33±0,07	0,18±0,01	0,19±0,034	0,89±0,01	
Roe	3,01±0,08	0,29±0,04	0,15±0,04	0,18±0,035	0,84±0,05	
Firsovka River (Sakhalin Island, Gulf of Patience) (2018), fish weight range 602-1732 g.						
Muscles	1,93±0,28	0,58±0,20	0,37±0,11	0,06±0,014	0,75±0,26	
Liver	3,28±0,85	0,59±0,14	0,34±0,09	0,69±0,13	0,96±0,19	
Male gonads	1,87±0,33	0,40±0,13	0,29±0,15	0,05±0,05	0,64±0,14	
Roe	2,13±0,31	0,48±0,18	0,21±0,06	0,04±0,01	0,51±0,13	
Umba River (Kola Peninsula), fish weight range 671-1424 g.						
Muscles	5,03±0,71	0,76±0,111	0,96±0,40	0,03±0,04	0,27±0,12	
Liver	33,76±5,03	55,57±23,62	1,01±0,37	0,82±0,53	0,31±0,09	
Male gonads	13,51±1,29	0,88±0,18	0,99±0,23	0,06±0,06	0,46±0,13	
Roe	23,06±7,14	5,34±1,25	1,14±0,35	0,02±0,03	0,29±0,06	
Varzuga River (Kola Peninsula), fish weight range 886-1561 g.						
Muscles	6,38±1,22	0,98±0,43	0,81±0,26	0,007±0,002	0,16±0,05	
Liver	57,18±23,98	41,60±18,63	0,92±0,26	0,23±0,103	0,19±0,04	
Male gonads	18,09±6,23	3,84±1,23	0,82±0,23	0,006±0,001	0,15±0,12	
Roe	13,29±3,94	0,75±0,30	1,08±0,22	0,03±0,009	0,41±0,12	




Hultafors
inch
2m

Trepigget stingsild *Gasterosteus aculeatus*

funnet 28. Juli 2021 i Grense Jakobselv.

Vannprøvetaking i Tanavassdraget

Foto Juho M. Vuolteenaho

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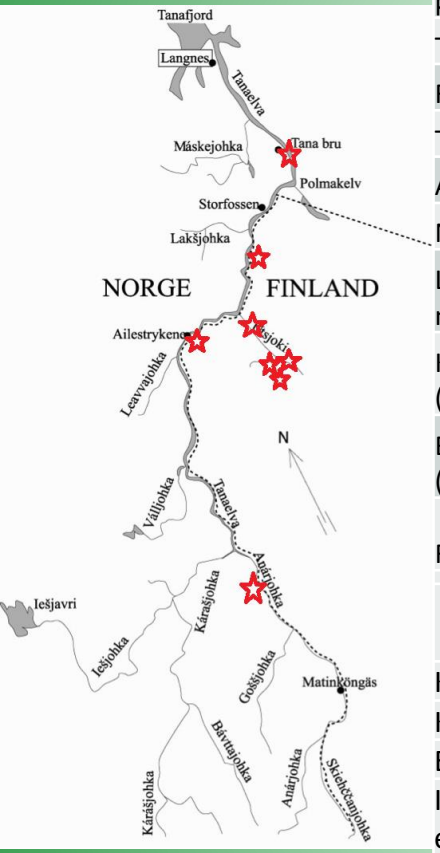

	Anarjohka	Kevojoki	Kevojärvi surface	Kevojärvi bottom	Upper Kevojärvi	Utsjohka	Tana 1	Tana 2	Tana 3
pH	7,2	7,4	7,1	7,4	7,4	7	7,2	7,3	7,6
Total fosfat µg/l	7	6,6	7,2	3,3	7,5	6,2	5,1	6,3	8,6
Fosfat PO4-P g/l	2,2	2,4	<2,0	2,1	2,1	5,2	<2,0	<2,0	2,2
Total Nitrogen µg/l	140	86	120	120	140	150	130	130	120
Ammonium (NH4-N) µg/l	140	<100	<100	<100	<100	<100	<100	<100	<100
Nitrat (NO3-N) µg/l	<5,0	8,2	8,2	9	8,5	6,1	13	<5	<5
Løst organisk karbon (DOC) mg/l	26	21	13	3,9	13	3,3	5,2	11	12
Kjemisk oksygenforbruk (KOFCr) µg/l	80	70	41	7	39	9,6	12	30	34
Biokjemisk oksygenforbruk (BOF) µg/l	53	52	27	<3	24	<3	<3	16	19
Fritt Ammoniakk (NH3) µg/l	0,4	0	0	0	0	0	0	0	0

	Anarjohka	Kevojoki	Kevojärvi surface	Kevojärvi bottom	Upper Kevojärvi	Utsjohka	Tana 1	Tana 2	Tana 3
Kimtall	**19**	**17**	**19**	**45**	**32**	**54**	**7**	**5**	**31**
Koliforme	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**
E. Coli	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Intestinale entrokokker	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Clostridium perfingens	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3**

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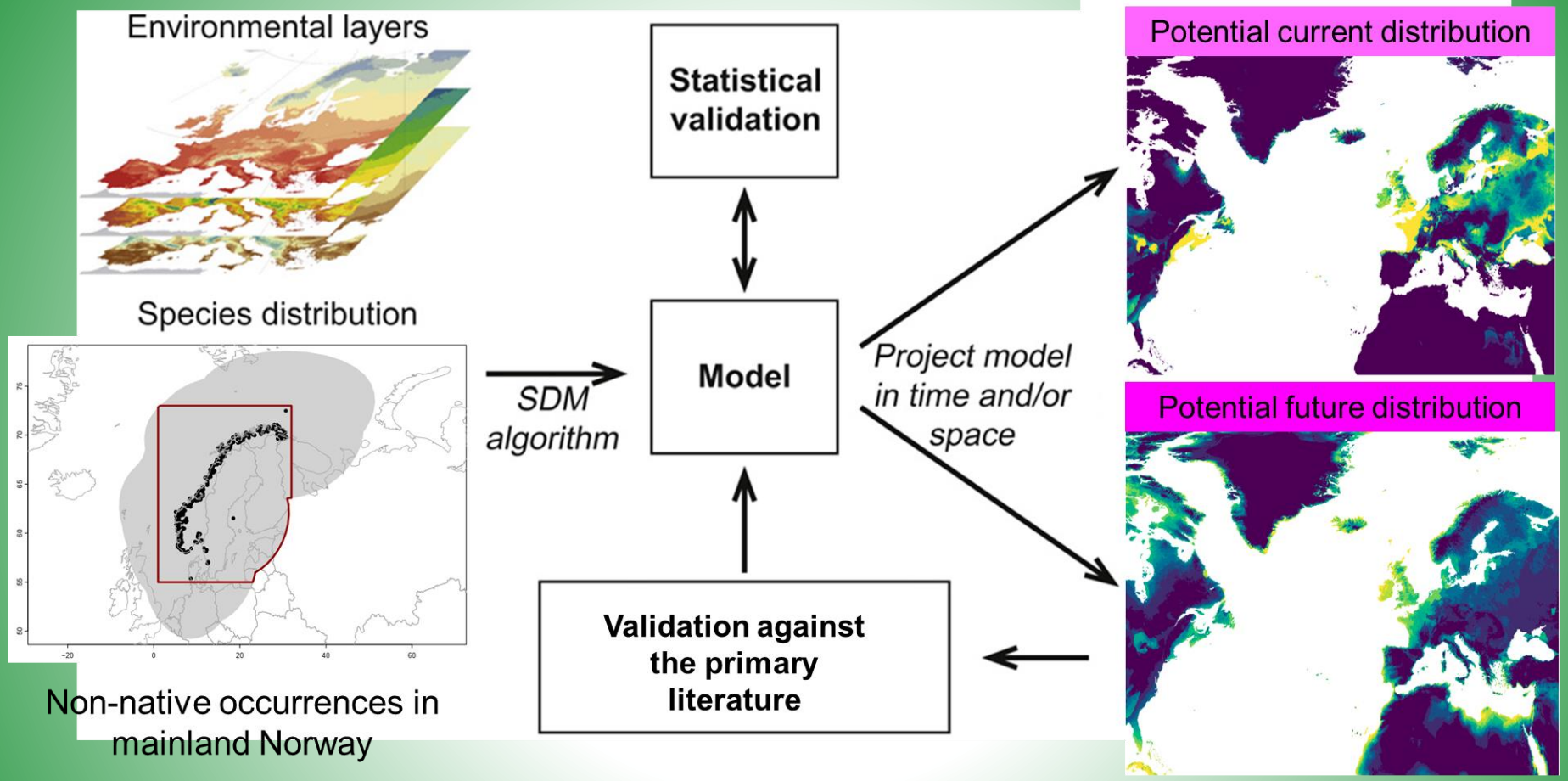
Foto: Juho Matti Vuolteenaho



SDM algorithms: Used two regression-based (i-ii) and two machine-learning approaches (iii-iv): (i) Generalized Linear Models (GLM), (ii) Generalized Additive Models (GAM), (iii) Boosted Regression Trees (BRT), and (iv) Maximum Entropy (MaxEnt).

Maduna et al 2024 Ecological niche modelling and population genomics provide insights into the geographic and demographic 'explosion' of a non-indigenous salmonid. Diversity and distribution 30(3).

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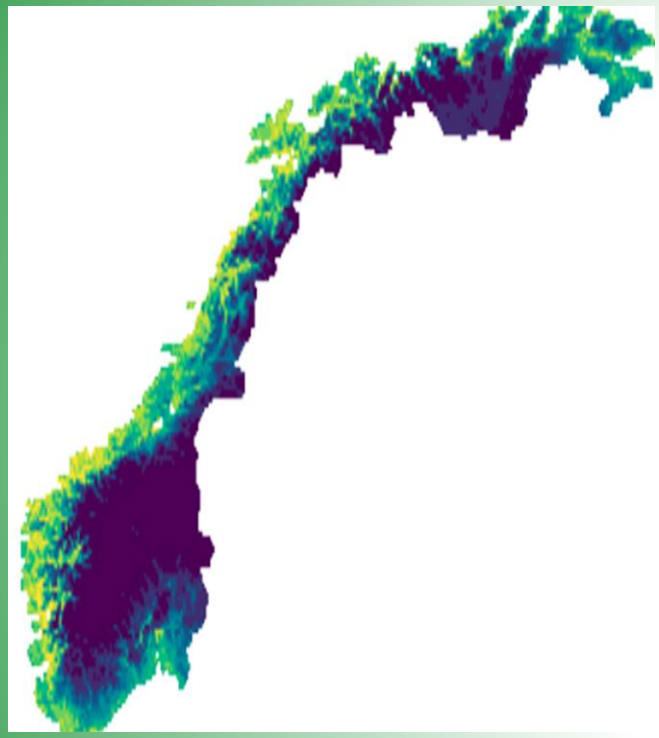
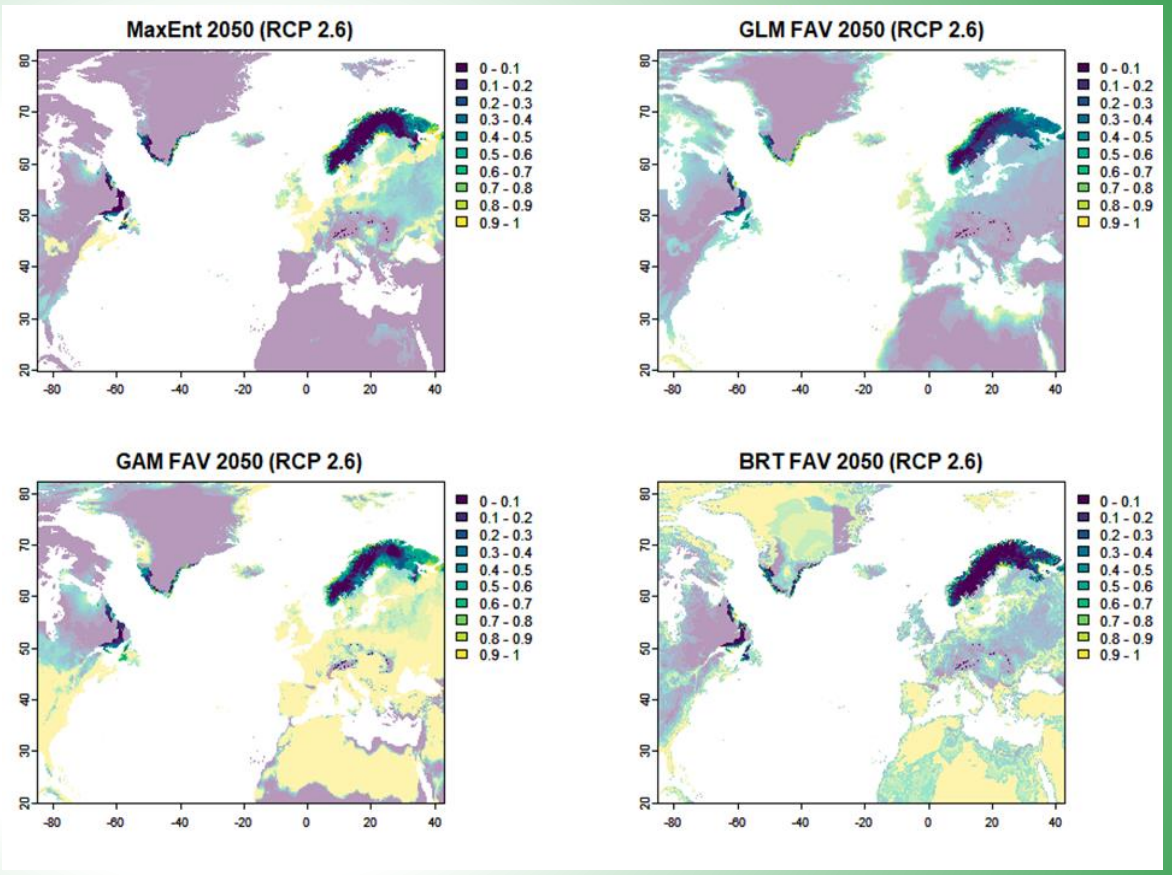


Ensemble predictive model:
AUC−weighted prediction mean



Time projections of habitat suitability for top performing species distribution models

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