KALAALLIT NUNAATA KUJATAA - IMMIKKOORTUMI KILLEQARFIMMI NALILIINEQ KALAALLIT NUNAATA KUJATAANUT ATUUTTOQ AATSITASSARSIORNERMUT SULIAQARNERMUT SAMMITITAQ

Ilisimatuussutsikkut nalunaarusiaq DCE-meersoq – Danish Centre for Environment and Energy

No. 482 2023

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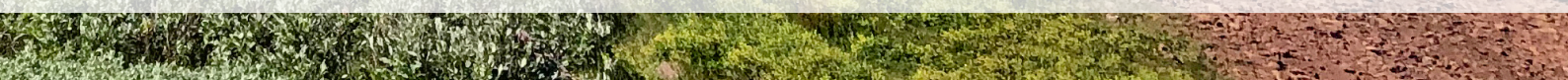

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Janne Fritt-Rasmussen[1]
Katrine Raundrup[2]
Anders Mosbech[1]

[1]Aarhus University, Department of Ecoscience
[2]Greenland Institute of Natural Resources

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Paasissutissat allattorsimaffiat

Saqqummiussat qulequtaa normualu.: Ilisimatuussutsikkut nalunaarusiaq DCE-meersoq – Danish Centre for Environment and Energy No. 482

Suussuseq: Ilisimatuussutsikkut siunnersuisuniit nalunaarut

Qulequtaq: Kalaallit nunaata kujataa - immikkoortumi killeqarfimmi naliliineq kalaallit nunaata kujataanut atuuttoq aatsitassarsiornermut suliaqarnermut sammititaq

Allaaserinnittut: Janne Fritt-Rasmussen[1], Katrine Raundrup[2], Anders Mosbech[1]

Ilassuteqarlutik allaqataasut: Peter Aastrup[1], David Boertmann[1], Drude Fritzbøger Christensen[1], Janne Fritt-Rasmussen[1], Kim Gustavson[1], Ida Bomholt Dyrholm Jacobsen[2], Kasper Lambert Johansen[1], Christian Junker Jørgensen[1], Debora Hansen Kleist[2], Christian Koch Madsen[3], Anders Mosbech[1], Josephine Nymand[2], Simun Dalsenni Olsen[4], Katrine Raundrup[2], Jens Søndergaard[1], Kristine Thrane[4] og Karl Zinglersen[2]

Ukunaneersut: [1]Aarhus University, Department of Ecoscience; [2]Greenland Institute of Natural Resources, [3]Nunatta Katersugaasivia Allagaateqarfialu/Greenland National Museum & Archived (NKA), [4]Geological Survey of Denmark and Greenland (GEUS)

Saqqummersitsisoq: Aarhus University, DCE – Danish Centre for Environment and Energy ©

URL: http://dce.au.dk/en

Saqqummersinneqarfia: Januar 2023

Katiterlugu piareerfia: Januar 2023

Innersuunneqarfiinut inissisimasut: Josephine Nymand[2] (Kapitali 1, 8 aamma 9), Kim Gustavson[1] (Kapitali 3), Aili Labansen[2] (Kapitali 4), Daniel Spelling Clausen[1] (Kapitali 5 and 7), Ida Bomholt Dyrholm Jacobsen[2] (Appendix 3), Peter Aastrup[1] (Appendix 4)[1]
Aarhus University, Department of Ecoscience; [2]Greenland Institute of Natural Resources

Pitsaassutsimik qulakkeerinnittoq, DCE: Kirsten Bang

Oqaatsitigut QA: Alleqa Hammond

Avataaniit ilassuteqartut: Kalaallit Nunaanni aatsitassarsiorneq pillugu allattoqarfik. Allagarisimasat uani takuneqarsinnaapput: http://dce2.au.dk/pub/komm/SR482_komm1.pdf

Aningaasatigut tapiiffigineqarneq: Suliaq Aatsitassarsiorneq pillugu allattoqarfimmiit aningaasalersorneqarpoq

Aamma inassutigineqartut: Fritt-Rasmussen, J., Raundrup, K. & Mosbech, A. (Eds). 2022. Kalaallit Nunaata Kujataani - Immikkoortumi killeqarfimmi nakkutiginninneq Kalaallit Nunaata Kujataanut atuuttoq aatsitassarsiornermut suliaqarnermut sammititaq. Aarhus University, DCE – Danish Centre for Environment and Energy, 210 pp. Scientific Report No. 482grl, https://dce2.au.dk/pub/SR482grl.pdf

Suliarisassatut siunniussaq: Immikkoortumi killeqarfimmi naliliineq Kalaallit Nunaata kujataanut atuuttoq aatsitassarsiornermut suliaqarnermut sammititaq suliamit Kalaallit Nunaanni Aatsitassaqarnermut Allattoqarfiup (EAMRA), Pinngortitaleriffiup (GINR) aamma DCE (AU) suleqatigiinneratigut isumassarsarsiamit pinngorpoq. Suliap siunertaraa aatsitassarsiornermi avatangiisitigut pilersaarusiorsinnaaneq naliliisinnaanerlu nunami immikkoortumi paasissutissat pioreersut aammalu paasissutissat misissuisimanermit nutaat piusut tunngavigalugit naliliinissaq aammalu paasiuminartunngorlugit tamanillu pissarsiarineqarsinnaanngorlugit suliarissallugit.

Pingaarnertut oqaaseqarnerit: Immikkoortumi killeqarfimmi nakkutiginninneq Kalaallit Nunaata Kujataanut atuuttoq, Aatsitassarsiorneq, Avatangiisitigut nakkutiginninneq

Isikkua: Graphic Group, AU Ecoscience

Saqqaata assitaa: Qassiarsummiit savaateqarfimmut Tasiusamut aqqut, Kalaallit Nunaata kujataa, Katrine Raundrup

ISBN: 978-87-7156-659-8

ISSN (electronic): 2244-9981

Number of pages: 210

Internet version: The report is available in electronic format (pdf) at http://dce2.au.dk/pub/SR482.pdf

Internettikkut allanneqarsimaffia: Nalunaarusiaq qarasaasiakkut (pdf) uani aaneqarsinnaavoq https://dce2.au.dk/pub/SR482grl.pdf

Ilassutigalugu allagaqaatit: Januaari 2023-meersoq. Siullermik allanneqaqqaarnermi isikkut: januar 2022. Nalunaarusiaq Naalakkersuisunit tusarniarneqarsimavoq kinguneraalu erseqqissaassutinik amerlanngitsunik immikkoortuni 5.5, assiliartami 4.11-mi nutarsaanermik, imm. 4.1, imm. 7.1 imm. 7.2 aamma imm. 7.3

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Aallarniut

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Suliaq EAMRA-mit aningaasalerneqarpoq.

Sammenfatning

Formålet med en regional baggrundsundersøgelse (RBU) er at tilvejebringe oplysninger til støtte for miljømæssig forsvarlig planlægning og regulering af mineaktiviteter. Det gøres ved at sammenfatte eksisterende regionale baggrundsoplysninger suppleret med nye undersøgelser og gøre disse resultater operationelle og let tilgængelige. RBU'en for Sydgrønland samler eksisterende rumlige baggrundsoplysninger om geologi, miljøkemi, biodiversitet, menneskelig brug og kulturarvsværdier i Sydgrønland. De eksisterende oplysninger er suppleret med en vegetationskortlægnings-undersøgelse samt yderligere indsamling og kemiske analyser af miljøprøver. Baseret på de nuværende oplysninger er der udarbejdet en integreret rumlig overlay-analyse, der fremhæver zoner med flere interessenter herunder mulige fremtidige minedriftsaktiviteter og områder med relevans af biologisk, menneskelig og kulturarvsmæssig karakter.

De tilgængelige oplysninger præsenteres og beskrives på et overordnet niveau i rapporten og understøttes af oversigtskort. Alle data findes på NatureMap.gl og i en integreret projektspecifik webGIS (rba.eamra.gl). Den videnskabelige rapport "South Greenland – Regional Environmental Baseline Assessment for mining activities" består af 9 kapitler og 4 bilag.

Kapitel 1 Indledning – Regionale baggrundsundersøgelse (RBU) af mineaktiviteter i Sydgrønland

Minedrift (efterforskning, udnyttelse og transport) må nødvendigvis forventes at have en vis indvirkning på natur og miljø. I Grønland, som i andre lande, er det ofte nødvendigt at oprette midlertidige industrizoner i forbindelse med minedrift. Minedrift har en negativ indvirkning på naturen, de oprindelige miljøforhold og lejlighedsvis kulturarven, og kan begrænse andre former for menneskelig brug i området. Miljøbestemmelser og naturplanlægning har til formål at sikre, at den eksisterende natur og det eksisterende miljø ikke ødelægges til skade for nuværende såvel som kommende generationer samtidig med, at der skabes mulighed for at udvikle aktiviteter i forbindelse med minedrift. Tilstrækkelig baggrundsviden om procesteknologi, geokemi, økotoksikologi, biodiversitet og økologiske sammenhænge kan hjælpe med at forudsige konsekvenser af nye mineprojekter. Gennem planlægning, afbødning og regulering kan eventuelle indvirkninger, der rækker ud over det faktiske udnyttelsesområde i vid udstrækning begrænses.

I udvalgte områder af særlig interesse i forhold til landbaserede mineaktiviteter vil RBU tilvejebringe:

- tilgængelig viden om sårbare og biologisk vigtige områders placering gennem undersøgelser af plante- og dyrearters udbredelse samt lokalkendskab til områderne.
- opdateret viden om naturlige baggrundsniveauer for udvalgte grundstoffer.
- forbedret offentlig adgang til opdateret miljørelevant viden og data via bl.a. NatureMap (naturemap.eamra.gl).

Kapitel 2 De geologiske rammer for Sydgrønland set fra et mineperspektiv

Dette kapitel giver et kort overblik over de geologiske rammer i Sydgrønland med fokus på beskrivelser af lokaliteter af økonomisk interesse, herunder specifikationer for berigede grundstoffer. Flere detaljer findes i Bilag 1 "Report on the geological setting of South Greenland" (kun på engelsk). Disse oplysninger giver en vigtig forståelse af de geologiske baseline-niveauer i interesseområdet ("Area of Interest", AOI). I Sydgrønland er der flere forekomster af økonomisk interesse. Baseret på miljøgeokemien er nogle af de grundstoffer, der potentielt kan have en indvirkning på miljøet og skal forvaltes, blevet identificeret. En oversigt over disse forekomster findes i tabel 2.1.

Kapitel 3 Sydgrønlands miljømæssige baggrundskemi

Dette kapitel giver et overblik over de tilgængelige miljøkemiske data om Sydgrønland. Dataene stammer fra forskellige projekter og præsenteres her som median-, minimums- og maksimumsværdier. Data kan findes i miljøkemidatabasen "AMDA", der vedligeholdes af DCE/GINR Environmental Datacenter.

Sydgrønlands baggrundsmiljøkemi er blevet undersøgt i løbet af de sidste ca. 40 år, hovedsageligt i forhold til mulighederne for mineraludnyttelse, der er nævnt i kapitel 2, og efterforsknings- og udnyttelsesaktiviteter (figur 3.1). Samlet set består de vigtigste typer miljøprøver af blåmuslinger (*Mytilus edulis*), sne-kruslav (*Flavocetraria nivalis*), sediment, ferskvand (filtreret og ufiltreret), korthornet ulk (*Myoxocephalus scorpius*) og tang (*Fucus vesiculosus* og *Ascophyllum nodosum*). Analyser af andre prøvetyper er også tilgængelige og findes i AMDA-databasen.

Baseret på alle tilgængelige baggrundsdata (prøver, der repræsenterer ikke-forurenede forhold) i AMDA-databasen er der beregnet "grønlandske median" koncentrationsværdier for ca. 70 forskellige grundstoffer i otte forskellige prøvetyper. Baggrunds-medianværdier er også blevet beregnet for otte adskilte større regioner i Grønland. Her er den "sydgrønlandske median" af primær relevans for det område, der er af interesse for denne vurderingsrapport. Den fuldstændige liste over regionale mediankoncentrationsværdier for de forskellige grundstoffer i de forskellige prøvetyper findes i Bilag 2.

Kapitel 4 Biodiversitet og biologisk vigtige og beskyttede områder

Dette kapitel giver et overblik over det biologiske miljø. Dette inkluderer en præsentation af den almindeligt forekommende fauna samt populationernes betydning på tre forskellige niveauer: på AOI-skala, på grønlandsk skala og på globalt plan. Trusselsstatus i henhold til rødlisten (opsummeret på baggrund af IUCN-trusselskategorierne: LC, mindst bekymring; NT, nær truet; VU, sårbar; EN, truet; og CR, kritisk truet) på både nationalt og globalt plan fremgår af tabel 4.1 (fauna) og tabel 4.2 (flora).

Da offshoreområderne ikke er inkluderet, er det kun havpattedyr og fisk, der forekommer i kystmiljøet, der er omfattet. Af havpattedyrene er den spættede sæl (*Phoca vitulina*) af særlig betydning, da størstedelen af den grønlandske bestand findes i AOI. Der er et enkelt område, hvor denne art stadig opholder sig – ved øgruppen Qeqertat øst for Narsaq Kujalleq

(Narsarmijit). De fleste hvaler, der forekommer i Sydvestgrønland, opholder sig i offshore farvande, men vågehval (*Balaenoptera acutorostrata*) og i mindre grad pukkelhval (*Megaptera novaeangliae*) forekommer langs kysten og i de ydre dele af fjordene om sommeren.

En stor del af kapitlet er dedikeret til land- og ferskvandsfugle samt havfugle. Af rovfuglene har især havørnen relativt høje tætheder af yngleområder, og en betydelig del af den grønlandske bestand findes i AOI. Den vestlige AOI er meget vigtig for den grønlandske bestand af strømand (*Histrionicus histrionicus*). Flere fugle, der er forbundet med havmiljøet, yngler og overvintrer i AOI, hvor den vigtigste havfuglegruppe er alkefugle. AOI er især værdifuld for lomvie (*Uria aalgae*) og polarlomvie (*Uria lomvia*). Om vinteren fungerer kysten og farvandet ud for Sydvestgrønland, herunder AOI, som meget vigtige vinterhabitater for havfugle og fugle, der yngler i ferskvand.

Mere end 370 plantearter vides at forekomme i Sydgrønland, og af disse findes 56 inden for AOI og er rødlistede (sårbare og nær truede). Ti af disse arter er unikke for Sydgrønland. Der blev lavet et opdateret vegetationskort (skala 10x10 m) over Sydgrønland med fem vegetationstyper (krat, dværgbuskhede, lavholdig dværgbuskhede, græsland og kær). Detaljeret information om de metoder, der er anvendt til at lave vegetationskortet, findes i Bilag 3.

Inden for AOI er tre steder "Naturbeskyttelsesområder": Uunartoq og de to dale Qinngua og Klosterdalen, der er beskyttet efter Naturbeskyttelsesloven. Tre steder er beskyttet af "Fuglebekendtgørelsen"(med hjemmel i Jagtloven): Kitsissut Avalliit (også AOI'ets eneste Ramsar-område, nr. 388), Indre Kitsissut og øerne Qeqertat øst for Narsaq Kujalleq (Narsarmijit). Desuden blev I 2017 et område kaldet "Kujataa – et subarktisk landbrugslandskab i Grønland" optaget på UNESCO's verdensarvsliste. Det UNESCO-beskyttede område består af flere landområder omgivet af en bufferzone og er beskyttet af en forvaltningsplan med hjemmel i flere love.

På grund af manglende specifik viden om distribution og diversitet er svampe, mosser, laver samt og hvirvelløse dyr ikke inkluderet i denne rapport. Desuden er nogle af de resultater, der præsenteres i dette kapitel, baseret på relativt gamle data. Det gælder især fordelingen af plantearter, og flere af fuglekolonierne er ikke blevet undersøgt i de seneste år.

Kapitel 5 Menneskelig brug

Dette kapitel giver et overblik over menneskelig brug, dvs. landbrug/dyrehold (får og rensdyr samt udsættelse af moskusokser), anvendelse af marine ressourcer, plantager samt turisme og større tekniske infrastrukturer. Menneskets udnyttelse af ressourcerne i Sydgrønland er kendetegnet ved tilstedeværelsen af landbrug og dyrehold. Det er den eneste region i Grønland, hvor dette foregår i stor skala. Sydgrønland har ca. 6.500 indbyggere – ca. 5.600 indbyggere i byerne Qaqortoq, Narsaq og Nanortalik og ca. 900 i bygderne inklusive fårefarme.

Landbrug blev først introduceret i området af nordmændene ca. 985 e.Kr. I århundreder holdt nordmændene bl.a. får og kvæg, men fra ca. 1450 e.Kr. og i den følgende 4-500 års periode var der ikke landbrug og dyrehold i

Grønland. Fårehold blev genetableret i 1915, og i dag er der knap 40 aktive farme med ca. 18.000 får og ca. 350 køer i Sydgrønland.

Rensdyrhold foregår to steder – i Isortoq (siden 1973) og i Tuttutooq (siden 1992). De to bestandes samlede udbredelse dækker ca. 1700 km^2 og omfatter ca. 1.200 (Isortoq) og 350 (Tuttutooq) dyr. 18 moskusokser blev udsat i Ippatit-dalen på den nordlige kyst af Nanortalik-halvøen i 2014. I dag er der knap 50 moskusokser i området.

Langs store dele af kysten udnyttes fiskeressourcer til både privat såvel som kommerciel brug. Generelt er erhvervsfiskeriet i Sydgrønland begrænset i forhold til andre grønlandske farvande. I rapporten præsenteres de vigtige områder for fiskeri af fjeldørred (*Salvelinus alpinus*), atlanterhavstorsk (*Gadus morhua*), hellefisk (*Reinhardtius hippoglossoides*), stenbider (*Cyclopterus lumpus*), dybvandsrejer (*Pandalus borealis*) og snekrabbe (*Chionoecetes opilio*).

En væsentlig del af udarbejdelsen af en RBU er at inkludere lokal viden om de biologiske ressourcer i AOI. Da der blev lagt planer for feltarbejdet i 2020, var dette et integreret element, men på grund af Covid-19-restriktioner blev feltarbejdet beskåret til kun at omfatte vegetationsanalyser og indsamling af miljøprøver til kemiske analyser (se kapitel 3). Da møder med lokalbefolkningen, kommunale repræsentanter samt andre interessenter var forbudt, er inddragelse af opdateret lokal viden ikke en del af dette kapitel.

Kapitel 6 Grønlands kulturhistorie – en introduktion

Dette kapitel giver et overblik over kulturhistorien. Kulturarvszonerne i Sydgrønland fremgår af figur 6.2 og 6.3. Figur 6.4 viser endvidere tætheden af registreret kulturarv i Sydgrønland. Tætheden af steder med kulturarv viser først og fremmest omfanget af arkæologiske undersøgelser, men også til en vis grad det faktiske omfang af tidligere bosættelser.

Steder med kulturarv findes næsten overalt i Grønland, men i visse landskabstyper og ved visse landskabstræk er det mere sandsynligt finde at nye, uregistrerede steder - især større lejre eller bosættelser. De landskabstræk, der normalt får øget opmærksomhed under arkæologiske undersøgelser – og bør få det samme under efterforsknings- og udviklingsaktiviteter pga. den øgede sandsynlighed for at frembringe kulturarvssteder/landskabstræk – kan ses i tabel 6.1.

Kapitel 7 Integreret rumlig analyse af overlappende interesser

I kapitel 4-6 præsenteres en række kort, der fremhæver kendte udbredelsesområder for vigtig flora og fauna, menneskelig brug af regionen og områder med kulturarv. Alle disse træk kan betragtes som landskabs-mæssige aktiver eller interesser, der bør tages i betragtning ved planlægning af efterforskning efter mineralressourcer eller udvindingsaktiviteter.

I dette kapitel gives en sammenfattende analyse af, hvor mange af disse landskabsmæssige aktiver der overlapper med hinanden i forskellige dele af interesseområdet (AOI). I alt indgik 51 kortlag i analysen (tabel 7.1). Der blev gennemført tre forskellige analyser – en, der omfattede alle 51 kortlag, der afspejler både flora og fauna, menneskelig brug og kulturarv (figur 7.1 og 7.2), en med 34 kortlag med hovedsagelig biologisk relevante oplysninger

(figur 7.3) og en baseret på 29 kortlag med oplysninger, der primært afspejler menneskelig brug og kulturarvsinteresser (figur 7.4).

Når man anvender kortene, skal man huske på, at et stort antal overlap i et område ikke nødvendigvis betyder, at aktiviteter omkring udnyttelse af mineralske ressourcer vil have en stor miljøpåvirkning her. De understreger dog, at der med den nuværende viden er behov for at tilgodese flere forskellige interesser i forbindelse med mineraludvinding.

Kapitel 8 Minedrift og miljøpåvirkninger

I dette kapitel gives en oversigt over de typiske miljøpåvirkninger, der kan forventes fra moderne miner, der drives i henhold til høje internationale miljøstandarder. Eksempler på den geografiske udstrækning og varighed af de virkninger, der kan forventes ved typisk moderne minedrift, gives for forskellige aktiviteter. Man skal dog huske på, at mineralprojekter er forskellige, og det samme gælder de potentielle miljøpåvirkninger.

Det sidste afsnit i dette kapitel beskriver potentielle miljøpåvirkninger fra ulykker.

Kapitel 9 Fremtidsperspektiver og datahuller

Dette kapitel giver et overblik over de fremtidige klimaforandringer, der forventes at ske i Sydgrønland. Det giver endvidere eksempler på huller i data og dermed viden, der er identificeret i rapporten.

Summary

The purpose of a Regional Baseline Assessment (RBA) is to provide information to support environmentally sound planning and regulation of mining activities by summarising existing regional background information supplemented with new studies and making these results operational and easily accessible. The RBA for South Greenland compiles existing spatial baseline information on geology, environmental chemistry, biodiversity, human use, and heritage values of South Greenland. The existing information has been supplemented with a vegetation mapping study and additional sampling and chemical analysis of environmental samples. Based on the current information, an integrated spatial overlay analysis was compiled, which highlights areas with potential conflict zones between possible future mining activities and areas of biological, human and heritage values interest.

The available information is presented and described on a general level in the report and supported by overview maps. The full data are given in NatureMap.gl and an integrated project-specific webGIS (rba.eamra.gl). The scientific report "South Greenland – Regional Environmental Baseline Assessment for mining activities" is comprised of 9 chapters and 4 appendices.

Chapter 1 Introduction – Regional baseline assessments (RBA) of mining activities in South Greenland

Mining activities (exploration, exploitation and transport) are bound to have a certain impact on nature and environment. In Greenland, as in other countries, it is often necessary to set up temporary industrial zones in connection with mining. Mining has a negative impact on nature, the original environmental conditions and occasionally cultural heritage, and it may limit other types of human use in the area. Environmental regulations and nature planning aim to ensure that the existing nature and environment are not destroyed to the detriment of current as well as future generations, while still creating the possibility of developing mining activities. Sufficient background knowledge about process technology, geochemistry, ecotoxicology, biodiversity, and ecological contexts can help predict the impacts of new mining projects and often by planning, mitigation and regulation largely limit any effects beyond the actual area of exploitation.

Regional Baseline Assessments (RBA) of mining activities will, for selected areas of mining interest, provide:

available knowledge of the location of vulnerable and important areas through studies of the distribution of plant and animal species as well as local knowledge of the areas.

updated knowledge of natural background levels for selected elements.

improved public access to updated environmentally relevant knowledge and data via, e.g., NatureMap (naturemap.eamra.gl).

Chapter 2 Geological setting of South Greenland from a mining perspective

This chapter gives a short overview of the geological setting of South Greenland with focus on descriptions of localities of economic interest, including specifications of enriched elements. More details can be found in Appendix 1 "Geology in South Greenland". This information provides an important understanding of the geological baseline levels in the Area of Interest (AOI). In South Greenland, there are several occurrences of economic interest. Based on the environmental geochemistry, some of the elements that may potentially have an impact on the environment and need to be managed have been identified. An overview of these occurrences is given in Table 2.1.

Chapter 3 The environmental baseline chemistry of South Greenland

This chapter gives an overview of the available environmental chemistry data on South Greenland. The data are derived from different projects and presented here as median, minimum, and maximum values. Data can be found in the environmental chemistry database "AMDA", maintained by the DCE/GINR Environmental Datacenter.

The baseline environmental chemistry of South Greenland has been investigated during the past approx. 40 years, mostly in relation to the mineral prospects mentioned in Chapter 2 and exploration and exploitation activities (Takussutissiaq 3.1). Overall, the major types of environmental samples available are of blue mussels (Mytilus edulis), crinkled snow lichens (Flavocetraria nivalis), sediments, fresh water (filtered and unfiltered), shorthorn sculpin (Myoxocephalus scorpius) and seaweed (Fucus vesiculosus and Ascophyllum nodosum). Analyses of other matrices are also available and found in the AMDA database.

Based on all available baseline data (samples representing unpolluted conditions) in the AMDA database, "Greenland median" concentration values of approx. 70 different elements in eight different sample types have been calculated. Baseline median values have also been calculated for eight separate larger regions of Greenland. Here, the "South Greenland median" is of primary relevance to the area of interest for this assessment report. The full list of regional median concentration values of the different elements in the different sample types are given in Appendix 2.

Chapter 4 Biodiversity and biologically important and protected areas

This chapter gives an overview of the biological environment. This includes presenting the regular occurring fauna as well as the significance of the populations at three different levels: at AOI scale, at Greenland scale and at global scale. The threat status according to the red list (summarised based on the IUCN threat categories: LC, least concern; NT, near threatened; VU, vulnerable; EN, endangered; and CR, critically endangered) both at national and global level is presented in Table 4.1 (fauna) and Table 4.2 (flora).

As the offshore areas are not included, only marine mammals and fish occurring in the coastal environment are included. Of the marine mammals the harbour seal (Phoca vitulina) is of particular importance as the major part of the Greenland population is found in the AOI. There is a single area where this species still haul-out – at the archipelago Qeqertat east of Narsaq

Kujalleq (Narsarmijit). Most of the whales occurring in Southwest Greenland stay in offshore waters however, minke whale (Balaenoptera acutorostrata) and to a lesser degree humpback whale (Megaptera novaeangliae) occur along the coast and in the outer parts of the fjords in the summertime.

A large section of the chapter is dedicated to terrestrial and freshwater birds as well as seabirds. Of the birds of prey especially white-tailed eagle has relative high densities of nesting territories, and a significant part of the Greenland population is found in the AOI. The western AOI is very important for the Greenland harlequin duck population (Histrionicus histrionicus). Several birds associated with the marine environment breed and winter in the AOI, with the most important seabird group being the alcids. The AOI is especially valuable for common murre (Uria aalgae) and thick-billed murre (Uria lomvia). In winter, the coast and the waters off Southwest Greenland, including the AOI, act as very important winter habitats for seabirds and birds breeding at freshwaters.

More than 370 species of plants are known to occur in South Greenland and of these, 56 are found within the AOI and are red listed (vulnerable and near threatened). Ten of these species are unique to South Greenland. An updated vegetation map (scale 10x10 m) of South Greenland with 5 vegetation types (copse, dwarf shrub heath, lichen-rich shrub heath, grassland, and fen) was made. Thorough information on the methods used for making the vegetation map can be found in Appendix 3.

There are four types of protected areas in the South Greenland AOI. The areas fall within the legislation related to "Nature protection areas", "The bird protection act", "Ramsar sites" and "The UNESCO's World Heritage List". Within the AOI three sites are "Nature protection areas": Uunartoq, and the two valleys Qinngua and Klosterdalen. There are three sites in the "Bird protection act": Kitsissut Avalliit (also the AOI's only Ramsar site, no. 388), Indre Kitsissut and the islands of Qeqertat east of Narsaq Kujalleq (Narsarmijit). In 2017 an area called "Kujataa – a subarctic farming landscape in Greenland" was included in the UNESCO World Heritage List. The UNESCO protected area is composed of several land areas surrounded by a buffer zone.

Due to lack of specific knowledge of distribution and diversity, fungi, bryophytes, and invertebrates are not included in this report. Furthermore, some of the results presented in this chapter is based on relatively old data. This holds particularly true for the distribution of plant species, and several of the bird colonies have not been surveyed in recent years.

Chapter 5 Human use

This chapter gives an overview of the human use i.e., agriculture/farming (sheep and reindeer as well as muskox introductions), use of marine resources, plantations as well as tourism and larger technical infrastructures. Human use of the resources in South Greenland is characterised by the presence of land-based agriculture and farming. It is the only region in Greenland where this takes place at a large scale. South Greenland is home to approximately 6,500 inhabitants – ca. 5,600 people in the towns of Qaqortoq, Narsaq and Nanortalik, and ca. 900 in the settlements including sheep farms.

Agriculture was first introduced in the area by the Norse ca. 985 AD. For centuries the Norse farmed e.g., sheep and cattle, but from ca. 1450 AD and the following 4-500 year period agriculture and farming was absent from Greenland. Sheep farming was re-introduced in 1915 and today there are 37 active farms with ca. 18000 ewes and ca. 350 heads of cattle in South Greenland.

Reindeer herding takes place at two locations – at Isortoq (since 1973) and at Tuttutooq (since 1992). The combined ranges of the two herds amounts to ca. 1700 km2 and holds ca. 1200 (Isortoq) and 350 (Tuttutooq) animals. 18 muskoxen were introduced to the Ippatit valley on the northern coast of the Nanortalik peninsula in 2014. Today there are little less than 50 muskoxen in the area.

Long stretches of the coastline has fishing resources for both private as well as commercial use. In general, the commercial fishing in South Greenland is limited compared to other Greenland waters. In the report, the important areas for fishing Arctic char (Salvelinus alpinus), Atlantic cod (Gadus morhua), Greenland halibut (Reinhardtius hippoglossoides), lumpsucker (Cyclopterus lumpus), northern shrimp (Pandalus borealis) and snow crab (Chionoecetes opilio) are presented.

An essential part of making an RBA is to include local knowledge of the biological resources in the AOI. When plans were made for the field work in 2020, this part was an integral element, but due to Covid-19 restrictions the field work was trimmed to only include vegetation analyses, and collection of environmental samples for chemical analyses (see chapter 3). As meetings with locals, municipality representatives as well as other stakeholders were prohibited, the inclusion of updated local knowledge is not part of this chapter.

Chapter 6 Greenland's cultural history – an introduction

This chapter gives an overview of the cultural history. The heritage zones in South Greenland are presented in Takussutissiaqs 6.2 and 6.2. Furthermore Takussutissiaq 6.3 shows the density of registered heritage sites within a 5 km hexagon grid in South Greenland. The heritage site density mostly reveals archaeological survey intensity but also to some extent actual past settlement intensity.

While heritage sites in Greenland may be found almost everywhere, particular landscape types and features are predictively more likely than others to produce new, unregistered sites – especially larger camps or settlements. Land-scape features that normally receive heightened attention during archaeological surveys and should do so also during exploration and development activities because of their increased probability for producing heritage sites/features, can be found in Table 6.1.

Chapter 7 Integrated spatial analysis of overlapping interests

In chapters 4-6, a number of maps are presented, highlighting known distribution areas of important flora and fauna, human use of the region and concentrations of cultural heritage sites. All these features may be regarded as landscape assets or interests that should be taken into account when planning mineral resource exploration or extraction activities.

In this chapter, a summary analysis of how many of these landscape assets overlap in different parts of the area of interest (AOI) is provided. In total, 51 map layers were included in the analysis (Table 7.1). Three different analyses were conducted – one including all 51 map layers, reflecting both flora and fauna, human use and cultural heritage (Takussutissiaq 7.1 and 7.2), one including 34 map layers with mainly biologically relevant information (Takussutissiaq 7.3) and one based on 29 map layers with information primarily reflecting human use and cultural heritage interests (Takussutissiaq 7.4).

When using the maps, it should be remembered that a large number of overlaps in an area do not necessarily mean that mineral resource activities will have a high environmental impact here. They do, however, emphasise that, given the present knowledge, several different interests need to be addressed in relation to mineral extraction operations.

Chapter 8 Mining and environmental impacts

In this chapter, an overview of the typical environmental impacts that can be expected from modern mines operated according to high international environmental standards is given. Examples of the geographical extent and duration of the effects that can be expected from a typical modern mining operation is provided for different activities. It should, however, be kept in mind that mineral projects are diverse and so are the potential environmental impacts.

The last section in this chapter describes potential environmental impacts from accidents.

Chapter 9 Future perspectives and data gaps

This chapter gives an overview of the future climatic changes expected to occur in South Greenland. It further provides examples of the data gaps identified throughout the report.

Naalisagaq

Immikkoortumi Killeqarfiup iluani Naliliinermi (RBA) aatsitassarsiornermi avatangiisitigut pilersaarusiorsinnaaneq naliliisinnaanerlu nunami immikkoortumi paasissutissat pioreersut aammalu paasissutissat misissuisimanermit piusut nutaat tunngavigalugit naliliinissaq aammalu paasiuminartunngorlugit tamanillu pissarsiarineqarsinnaasunik suliaqarnissaq suliami siunertarineqarpoq.

RBA Kalaallit Nunaata kujataanut atuuttup suliarisimasap ujarassiornikkut, avatangiisitigut akuutissaqarnikkut, uumasoqatigiit assigiinngisitaarneratigut, inuit nunamik atuineratigut aammalu Kalaallit Nunaata kujataani eriagisassaqarfitsigut inissisimaffik tamakkiinerusumik takussutissaqartippaa. Paasissutissat pioreersut nunap naggorinnerinut tunngasutigut takussutissatigut ilassuteqartinneqarsimapput aammalu avatangiisinit akuutissat misiliutaasimasutut katersat misissorneqarnerannik ilassuteqartinneqarlutik. Paasissutissat maannamut pigineqartut aallaavigalugit tamakkiisumik misissueqqissaarneq ingerlanneqarsimavoq taassumalu misissuisimanerup takutippaa sumiiffiit assigiinngitsut siunissami aatsitassarsiorfigineqassappata soqutigisassat qaleriiffeqassasut uanimi uumasoqatigiit, inuit aammalu kingornussassat isiginiartillugit soqutigisat sumiiffinni qaleriiaaramik.

Paasissutissat pigineqartut saqqummiunneqarput aammalu nalunaarummiittut nalinginnaasumik nassuiaatigineqarlutik tamannalu aamma ataatsimut quppersakkatigut takuneqarsinnaapput. Paasissutissat tamakkiisut NatureMap.gl aqqutigalugu tunniunneqarput aamma immikkut suliaq WebGIS (rba.eamra.gl) erseqqissaassutaalluni. Ilisimatuussutsikkut nalunaarusiaq "Kalaallit Nunaata kujataani - Immikkoortumi killeqarfimmi naliliineq Kalaallit Nunaata kujataanut atuuttoq aatsitassarsiornermut suliaqarnermut sammititaq" suliaavoq eqikkagaq 9-nik kapitalilik ilassuteqartorlu 4-nik.

Kapitali 1 Aallarniut – Immikkoortup killeqarfiata iluani naliliineq Kalaallit Nunaata kujataanut atuuttoq (RBA) aatsitassarsiornermut suliaqarnermut sammititaq

Aatsitassarsiornermik ingerlatsinerit (misissueqqaarnerit, piiaanerit assartuinerillu) avatangiisimut nunamullu arlaatigut sunniuteqartarput. Kalaallit Nunaanni, soorlu nunani allanitulli pisariaqartartutulli, atuukkallartussanik suliffissuaqarnermut killeqarfiliinissaq atuukkallarpoq, taamaaliornissarlu pinngitsoorneqarsinnaanngilaq. Aatsitassarsiorneq nunamut pitsaanngitsumik kinguneqartarpoq, nunap siornatigut iluserisimasaa aammalu ilaatigut eriagisassaqarfiit kulturikkut pingaaruteqartut minnerunngitsumillu inuit atuisimanerat sumiiffimmi ersiuteqartarlunilu ersittarpoq. Avatangiisit pillugit malittarisassat aammalu nunamik atuinermi pilersaarutit qulakkeerinnittussaapput aatsitassarsiornerup periarfissiissutaasa peqqutigisaannik nunap avatangiiserisallu ingerlatsinermit aserorneqanngitsumik maannamut kinguaariinnut siunissamilu kinguaariit atuisinnaanissaannut mattussaanissaat pinngitsoortinniagassaagami. Paasissutissat ilisimasallu naammattut pingaaruteqarput, ingammik teknologimut, ujarassiornikkut akuutissanut, nunami akuutissanut, uumassusillit assigiinngisitaarnerinut

aammalu uumasoqatigiit imminnut ataqatigiinnerinut tunngasut pigineqartariaqarput aatsitassarsiornermi ingerlatsiniarnermi aammalu pilersaarusiorniarnermi, nakkutiginninniarnermi malittarisassiornermilu annertuumik piiaanermi sumiiffimmut sunniutigisinnaasai sillimaffigineqarniassammata.

Killeqarfimmi sumiiffiup iluaniittumi naliliineq (RBA) aatsitassarsiornermik ingerlatsiniarnermi soqutigineqartussat makkuupput:

Paasissutissat pigineqartut sumiiffimmut attuumassuteqartut aarlerinartumiittullu ilisimatusarnikkut paasisaqarfigineqarnissaat, aammattaaq naasut uumasullu assigiinngitsut sumiiffimmiittut katersorlugit nalunaarsorneqarnissaat.

Avatangiisinut immikkut aaliangiiffigineqarsimasunut tunngatillugu avatangiisit pillugit paasissutissat ullutsinnut malinnaasut pigilissallugit.

Avatangiisit assigisaallu pillugit paasissutissat ilisimasallu innuttaasunit aaneqarsinnaasut ullutsinnut tulluartuunissaat qulakkiissaallugit soorlu NatureMap (naturemap.eamra.gl) aqqutigalugu.

Kapitali 2 Kalaallit Nunaata kujataa aatsitassarsiornerup tungaanit isigalugu

Kapitalimi uani Kujataani ujarassiornikkut sumiiffiit aningaasarsiornikkut soqutiginaateqartut aatsitassallu akoqannginnerit ilanngullugit naatsumik sammineqassapput. Paasissutissat itisiliinerusut Ilanngussaq 1-imi "Kalaallit Nunaani ujarassiorneq"-mi takuneqarsinnaapput. Paasissutissat aatsitassat killeqarfimmi sumiiffiup iluaniittut inissisimaneri Sumiiffimmi Soqutigisaqarfimmi (AOI) paasissutissiisuupput. Kujataani aningaasarsiornikkut soqutiginaateqarfiit arlariiupput. Avatangiisini ujaqqat akuutissatigut katitigaanerat aallaavigissagaanni, avatangiisinut sunniuteqaateqarsinnaasut aammalu aqulluarneqartariaqartut suussusersineqarput. Taakku tamakkiisumik Takussutissiaq 2.1-mi atuarneqarsinnaapput.

Kapitali 3 Immikkoortumi killeqarfimmi Kalaallit Nunaata kujataani akuutissatigut kemi-p isikkua

Kapitalimi uani avatangiisini akuutissat pillugit paasissutissat Kujataanut attuumassutillit sammineqassapput. Paasissutissat suliniutinit assigiinngitsunik ingerlataqartunit saqqummiunneqassapput immikkut taallugit 'Akunnattumik naleqarlutik naatsorsukkat', 'Naatsorsukkat minnerpaamiitinneri' aammalu naatsorsukkat nalingi annertunerpaamiittut. Avatangiisini akuutissat pillugit paasissutissat "AMDA"-mit, DCE/Pinngortitaleriffimmillu avatangiisit pillugit paasissutissaasivimmit isumagineqarput.

Kujataani killeqarfiup iluani avatangiisit akorisaannik misissuineq ukiuni 4o-it missaanniittuni ingerlanneqartuarsimavoq, amerlanertigut aatsitassarsiorsinnaanissamut attuumassuteqartut periarfissat Kapitali 2-mi taaneqartut aamma misissueqqissaarnissat aatsitassarsiorsinnaanissamullu suliniutit pineqartillugit (Takussutissiaq 3.1). Ataatsimut isigalugu, avatangiisini misissugassat katersorneqarsimasut amerlanersai tassaapput uillut (Mytilus edulis), orsuatsiaat (Flavocetraria nivalis), qaleriissaarnerit,

imeq tarajoqanngitsoq (salinnikoq salinneqanngitsorlu), kanajoq (Myoxocephalus scorpius) aamma qeqqussat (Fucus vesiculosus and Ascophyllum nodosum). Kisitsisit allat tunngavigalugit misissueqqissaarnerit allat aamma AMDA-p paasissutissartaanni takuneqarsinnaapput.

Killeqarfimmi paasissutissat pigineqareersut tunngavigalugit (avatangiisinit mingutserneqarsimanngitsunit misissugassat tiguneqarsimasut) AMDA-mi paasissutissartaanniittut, assigiinngitsut 70-it assigiinngitsunut arfineq-pingasuusunut agguarneqarsinnaasut naatsorsorneqarsimapput "Kalaallit Nunaani uuttuinermi akunnattumik inerneqartutut". Killeqarfiup sumiiffiata iluani naliliinermi uuttuinermi akunnatsumik nalinga sumiiffinni annertuuni amma Kalaallit Nunaani sumiiffinni allani arfineq pingasuusuni naatsorsorneqarsimavoq. Uani "Kalaallit Nunaanni uuttuinermi akunnatsumik inernilik" nalunaarusiami uani sumiiffimmut soqutigisamut annerpaajusumik tulluartinneqarpoq. Sumiiffinni uuttuinermi akunnattumik inerniliussat allattorsimaffiat tamakkiisoq naleqassutsinut assigiinngitsunut misissuinermit takussutissartalik Ilanngussaq 2-mi takuuk.

Kapitali 4 Pinngortitamii assigiingisitaarneq aamma uumassuseqatigiissutsit pingaarutillit sumiiffiilu

Kapitalimi avatangiisinii uumassuseqatigiit tamakkiisumik takussutissaqartinneqarput. Uumasoqassuseq assigiinngitsunut pingasunut aggulullugu saqqummiunneqassaaq: AOI-mut uuttuutigalugu, Kalaallit Nunaani uuttuutit atorlugit aammalu nunarsuarmioqatigiit uuttuutigisaat atorlugu. Aarlerinartorsiortitaasut tamarmik allattorsimaffimmi aappaluttumi nalunaarsorneqarsimasut (naalisarneqartoq IUCN aarlerinartorsiornermut uuttuutigisai atorlugit; LC mianernanngitsumiittoq; NT, aarlerinartumiilernissaminut qanittumiittoq; VU, ernumanartumiittoq; EN, nungutaanissamut aarlerinartorsiortoq; aammalu CT, nungutaalluinnarnissamut ulorianartorsiortoq nunat tamarmiusut tamarmik aammalu nunarsuaq tamakkerlugu uuttuutit atorlugit inissisimaffik saqqummiunneqassaaq Takussutissiaq 4.1 (uumasut) aamma Takussutissaq 4.2 (naasut).

Sinerissap avataa ilanngunneqanngimmat, miluumasut imarmiut aalisakkallu sinerissap qanittuani avatangiisiniittut kisimik ilanngunneqarput. Miluumasunit imarmiunit aataaq (Phoca vitulina) immikkut pingaaruteqarpoq tassami Kalaallit Nunaanni aataaqassutsip annerpaartaa AOI-miimmat. Sumiiffiik ataaseq uninngaarfigineqartartoq - Qeqertani Narsaq Kujalliup (Narsarmijit) kangianiittoq. Arferit amerlanerpaat Kujataata kujammut kippasissuaniittarput sinerissallu avataaniittarlutik, taamaattoq tikaagullik (Balaenoptera acutorostrata) aammalu annikitsumik qipoqqaq (Megaptera novaeangliae) sinerissami takussaasarput pingaartumik aasaanerani kangerluit silarpasissuini.

Kapitalimi annertungaatsiartumik timmissat nunamiittut aammalu imartaniittut timmiarussallu eqqartorneqangaatsiassapput. Timmissanit qaasuttunit nattorallit sumiiffinni amerlasuuni manniliortarput Kalaallit Nunaannilu peqassuseq eqqarsaatigissagaanni amerlanerpaat AOI-mi takussaapput. AOI-p kitaa toornaviarsoqassuseq (Histrionicus histrionicus) eqqarsaatigalugu Kalaallit Nunaanut tamanut sanilliullugu pingaaruteqarluinnartumik inissisimavoq. Timmissat imartani avatangiiseqartut arlalissuit AOI-mi ukiisarput, taakkunanit

pingaarnerpaajullutik timmiaaqqat. AOI appa sigguttooq pingaaruteqarluinnarpoq (Uria aalgae) aamma appa (Uria lomvia)-nut pingaaruteqarluinnarpoq. Ukiuunerani, sineriak Kujataatalu imartaa, AOI ilanngullugu, timmiarussanut timmissallu tatsinut qaniittunut manniliortunut ukiivittut pingaaruteqaqaaq.

Kujataani naasut assigiinngitsut ilisimaneqartut 370-it sinneqartut Kujataani naasuupput taakkunanillu 56-it AOI-p iluaniipput allattorsimaffimmilu aappalaartumi nalunaarsorneqarsimapput (navianartorsiortutut aammalu aarlerinartorsiortitaanissamut qanittumiittutut). Taakkunanit naasunit qulit Kujataanut immikkuullarissuupput. Naasut pillugit nalunaarsuut takussutissaq (scale 10x10 m) Kujataani naasut assigiinngitsut 5-it immikkoortitat tassaapput (orpikkat, musaasat, orsuatsiaat, ivikkat aamma uiffaat. Naasut pillugit nalunaarsuutit suliarinerini periuseq pillugu Ilanngussaq 3-mi takuneqarsinnaavoq.

Kujataani AOI-mi sumiiffiit sisamat illersorneqartut sisamat assigiinngitsuupput. Sumiiffiit illersorneqarneri "Nunaminertat illersorneqartut", "Timmissat illersorneqarnerat pillugu inatsit", "Samsar sites" aamma "UNESCO-p nunarsuarmioqatigiinnut kingornussarsiaqarfiata allattorsimaffia" inatsisinut attuumassuteqarput. AOI-p iluani sumiiffiit pingaasut tassaapput "Nunaminertat illersorneqartut" iluani: Uunartoq aammalu Qinnguani qooroq Klosterdalenimilu qooroq. "Timmissat illersorneqarnerat pillugu inatsit" iluaniittut pingasuupput: Kitsissut Avalliit (aamma AOI-mi Ramsar site nr. 388), Kitsissuit ilua aammalu Qeqertat Narsaq Kujalliup (Narsarmijit) kangia. "Kujataa - Kalaallit Nunaanni issittumi nunalerineq" 2017-mi UNESCO-p nunarsuarmioqatigiit kingornussassaqartut allattorsimaffimmut ilanngunneqarpoq. UNESCO-mi kingornussarsiaqarfik sumiiffiup iluani arlariinnik nunatanik katitigaavoq.

Paasissutissat immikkuullarissut pigineqannginneri peqqutaalluni pupiit, bryophytes aamma inevertebrates pillugit uani nalunaarusiami ilanngunneqanngillat. Ilassutigalugu, inerniliussat ilai uani kapitalimi ilanngunneqartut paasissutissanit qangarnitsaneersuupput. Uani immikkut naasut suussusaalu pillugit aammalu timmiaqarfiit ukiuni kingullertigut misissuiffigineqarsimannginneri pissutaallutik.

Kapitali 5 Inuit atuinerat

Kapitalimi uani inuit atuinerat nalinginnaasumik eqqartorneqassaaq, soorlu nunalerinermi/uumasuuteqarnermi (savat, tuttut aamma umimmaliinerit), imartat pisuussutaannik atuineq, orpeqarfiit, takornariaqarneq aammalu attaveqaatit teknikkimut sammisut . Kujataani avatangiisimik atuineq annerpaamik nunalerinermit uumasuuteqarnermillu tunngaveqarpoq. Kalaallit Nunaanni taamatut ingerlatsineq Kujataani kisimi pivoq. Kujataa 6,500-it missaanik inoqarpoq - 5,600 missingi illoqarfinni Qaqortoq, narsaq aamma Nanortalimmiillutik, 900-it missingi nunaqarfinni savaateqarfinnilu.

Nunalerineq aatsaat qallunaatsiaanit 985-mi eqqunneqarpoq. Ukiuni untritilikkaani qallunaatsiaat savaateqarneq nersutaateqarnerlu ingerlassimavaat, kisianni ukioq 1450-ip kingorna ukiuni 4-500-ni Kalaallit Nunaani nunalerinermik ingerlatsisoqarsimanngilaq. Kujataani savaateqarneq ukioq 1915-mi eqquteqqinneqarpoq ullumikkullu savaateqarfiit 37-iupput savat piaqqiortut 18000-iupput nersutillu 350-it uumasuutigineqarlutik.

Tuttuuteqarneq sumiiffinni marlunni ingerlanneqarpoq - Isortumi (1973-miilli) aamma Tuttutuumi (1992-miilli). Tuttuuteqarfiit ataatsimut nunami isorartussutsimi 1700 km2 inissisimapput aammalu 1200 -it missaani (Isortoq) aamma 350-it missaani (Tuttutooq) uumasuuteqarput. Ippatit qoorua Nanortallup nuua 2004-mi 18-nik umimmalerneqarpoq. Ullumikkut 50-it ataallugit sumiiffik taanna umimmaqarpoq.

Sinerissat annertunerpaava aalisagarpassuaqarpoq inuinnarnit aammalu inuussutissarsiutigalugu aalisartunit aalisarfigineqartumik. Kalaallit Nunaata sinneranut sanilliullugu Kujataani aalisarneq annikinneruvoq. Nalunaarusiami eqaluit (Salvelinus alpinus), saarullik (Gadus morhua), qaleralik (Reinhardtius hippoglossoides), nipisak (Cyclopterus lumpus), raaja (Pandalus borealis) saattuat (Chionoecetes opilio) saqqummiunneqarput.

RBA-p suliarinerani pingaartut ilagaat nunaqavissut pisuussutit AOI-mi uumassusillit pillugit innuttaasut ilisimasaat ilanngutissallugit. Sumiiffimmi sulinissami pilersaarusiorneq 2020-mi ingerlanneqarlernerani pingaartinneqarluinnarpoq, kisiannili nualluussuup Covid-19 peqqutigalugu killilersuutit atuunnerini tamanna pinngilaq taamaallaallu naasut pillugit misissuinerit, avatangiisinit misissugassanik akuutissanik tigusinerit ingerlanneqarput (Kapitali 3). Nunaqavissut ataatsimeeqatiginissaat, kommunimi sinniisut ataatsimeeqatiginissaat aammalu aaliangiisartut allat ataatsimeeqatigisinnaaneri inerteqqutigineqarmat nunaqavissut isumaat uani kapitalimi ilanngunneqanngillat.

Kapitali 6 Kalaallit Nunaanni kulturikkut oqaluttuassartaq – aallarniut

Kapitalimi kulturikkut oqaluttuassartaq ataatsisimut isiginerusoq saqqummiunneqassaaq. Kujataani eriagisassaqarfiit sumiinneri Takussutissiaq 6.2-mi aamma 6.3-mi takuneqarsinnaapput. Ilanngullugulu Takussutissiaq 6.3-mi Kujataani nukissiuteqarfinnit 5 km iluini eriagisassaqarfiit akulikissusaat ersersinneqassapput. Eriagisassaqarfiit sumiinneri amerlanertigut itsarnisarsiornikkut misissuisimanerit sumiissusersineqartarput kisiannili ilaatigut nunaqarfiit imminnut qanissusai aamma peqqutaasarput taamaattoqarneranut.

Kalaallit Nunaanni eriagisassaqarfiit sumi tamaani nassaassaagaluartut, nunap ilusaasigut isikkuisigullu takuneqarsinnaasarpoq tamanna nassaassaqarfiusoq suli nalunaarsorsimanngitsumik - pingaartumik inoqarfiit imaluunniit nunaqarfiit angisuujusimatillugit. Nunap isikkuatigut qattunersaqarlutik tinunertaqartutut isikkullik itsarnisarsiornikkut misissuinikkut suussusersineqartariaqarput arlaannaatigulluunniit misissueqqissaarniartoqartillugu aammalu ingerlatsisoqarniartillugu sumiiffiit eriagisassaanersut paasineqarnissaat qulakkeerniarlugu, tamakkuusinnaasut Takussutissami 6.1-imi takuneqarsinnaapput.

Kapitali 7 Soqutigisat qaleriiffianni tamakkiisumik isiginnilluni itisiliineq

Kapitalini 4-6-ni nunap assingi arlariit saqqummiunneqarput, erseqqissaavigalugu sumiiffiit naasunut aamma uumasunut inuillu kulturikkut eriagisassaqarfinni atuinerinut pingaaruteqartut sumiiffiit. Takussutissat taakku imaassinnaavoq nuna nalinginnaasutut isigineqartut

kisiannili ilisimagineqassaaq aatsitassarsiorluni misissueqqaarniarnermi piiaaniarnermilu pilersaarusiornermi pingaaruteqartuuneri.

Kapitalimi nunat tamakku soqutiginaateqartut assigiinngitsutigut soqutiginaateqarneri AOI-p iluani qaleriiffeqarsinnaammata. Katillugu, nunap assingi qaleriiffeqartut 51-it misissueqqissaarsimanernik ilallit (Takussutissaq 7.1) ilanngunneqarput. Misissueqqissaarnerit pingasut ingerlanneqarsimapput - ataaseq nunap assingi qaleriiffeqartut 51-sut naasut uumasullu, inuit atuinerat aammalu kulturikkut eriagisassaqarfiit (Takussutissiaq 7.1 aamma 7.2), nunap assingani ataatsimi qaleriiffillit 29-put inuit atuinerat pillugu paasissutissartaqarlutik aammalu kulturikkut eriagisassanut soqutiginaateqartunut attuumassuteqarlutik (Takussutissiaq 7.4).

Nunap assingi atorneqartillugit eqqaamaneqassaaq qaleriiffillit amerlasuut sumiiffimmi ataatsimiippata isumaqartoqassanngimmat aatsitassarsiornermi ingerlatsinermi avatangiisinut annertoorujussuarmik tassanerpiaq sunniuteqassasut. Taamaattoq, maannamut ilisimasanik soqutigisanut arlariinnut aatsitassarsiorniarnermut ingerlatsiniarnermi soqutiginaateqarsinnaammata.

Kapitali 8 Aatsitassarsiorneq aamma avatangiisinut sunniutit

Kapitalimi uani avatangiisinut sunniutit nalinginnaasut ullutsinni aatsitassarsiornermi nutaaliaanerusumi nunarsuarmioqatigiinni piumasaqaataasut naapertorlugit sunniutaasinnaasut sammineqassapput. Nunamut sunniutit aammalu sunniutit qanoq sivisutigisumik piusinnaaneri aammalu aatsitassarsioriaatsit assigiinngisitaartut pineqartillugit avatangiisinut suut sunniutigisinnaaneraat assersuutigineqassapput.

Kapitalimi uani immikkoortoq kingullermi ajutoortoqartillugu avatangiisinut sunniutaasinnaasut pillugit nassuiaateqartoqassaaq.

Kapitali 9 siunissami periarfissat paasissutissanillu amigaateqarnerit

Kapitamili uani siunissami silap allanngoriartornerata Kujataanut sunniutigiumaagassaat qanoq ittut ilimagineqarsinnaanersut sammineqassaaq. Nalunaarusiamittaaq tamarmi assersuutitut paasissutissaasinnaasut suut amigaatigineqarnersut saqqummiunneqartussaapput.

1 Aallarniut – Immikkoortumi killeqarfimmi naliliineq Kalaallit Nunaata Kujataanut atuuttoq aatsitassarsiornermut suliamut sammittitaq

Allaaserinnittoq Anders Mosbech[1], Katrine Raundrup[2] and Janne Fritt-Rasmussen[1]

[1]Department of Ecoscience, Aarhus Universitet, [2]Greenland Institute of Natural Ressources

Aatsitassarsiornerit (misissueqqaarneq, piiaaneq aamma assartuineq) tamarmik avatangiisitigut arlaatigut sunniuteqartarput. Kalaallit Nunaat, nunat allat assingalugit, aatsitassarsiortoqarniartillugu nunaminertamik suliffissuaqarfittut atugassanik killeqarfiliisarpoq. Aatsitassarsiorneq avatangiisimut ajortumik kinguneqartarpoq, nuna attorneqarsimanngitsoq aammalu kulturikkut eriagisassat kiisalu ilaatigut inuit nunamik atuisinnaanerat killeqalersarami. Avatangiisit pillugit malittarisassat aammalu nuna pillugit pilersaarutit avatangiisit aserorluinnanngnissaannut siunissamilu kinguaariit aamma aatsitassarsiornerup periarfissiissutaanik iluaquteqarniarnissaat qulakkeerniarneqartussaagamik. Teknologi, ujarassiornermi akuutissat, avatangiisit tamarmik uumassuseqarnikkut ataqatigiinnerannik ilisimatusarneq, uumassusillillu assigiinngisitaartuunerisa ilisimasaqarfiginerisigut aatsitassarsiornerup sunniutai pilersaarusiorluarnikkut, nakkutiginnilluarnikkut, naatsorsuilluarnikkullu aatsitassarsiorfiusup piiaaffiusup sunniutigisinnaasaanik annikillisarneqarsinnaapput.

Mianersortumik pilersaaruteqarneq aammalu teknologitigut atugassiissutigineqartut pissarsiarineqarsinnaasut pitsaanerpaat (BAT) aamma avatangiisit pillugit periutsit pitsaanerpaat (BEP) ataavartumillu sunniutaasinnaasut pillugit nakkutiginnikkut aatsitassarsiornerup annertuumik avatangiisinut sunniutigisinnaasai pakkersimaarneqarsinnaapput. Aatsitassarsiornerit amerlasuutigut ukiuni qulikkaani ingerlanneqarsinnaapput taamaammat pingaaruteqarpoq aallaqqaaterpaaniilli qanoq isiornikkut nunap allanngutsaalineqarsinnaanera aammalu aatsitassarsiortuerunnerani nuna siornatigutut isikkoqalersinneqaqqissinnaanera eqqarsaatigilluassallugu pingaaruteqarpoq. Piffissaq ungasinnerusoq pilersaarusiorfigineqartillugu uumassusillillu allanngutsaalisimatillugit aatsitassarsiorfik matugaluaruniluunniit uumassusillit pilersaarusiorfigilluarneqarsimagunik siornatigut pissutsinut assingusumik pilersitsisoqarsinnaavoq.

Aatsitassarsiornermi avatangiisinut sunniutigisinnaasai siusissumi pilersaarusiornermili eqqummaariffigalugit samminissai pingaaruteqarpoq. Suliniut piviusunngortinneqassasoq aaliangertoqarpat avatangiisinullu sunniutaasinnaasut akuersaarneqarpata - nunaqavissunit aammalu nunagisami minnerunngitsumillu nunarsuaq tamakkerlugu eqqarsaatigalugu - taava tamat oqartussaaqataaneranit aammalu politikkikkut aaliangiineq pissaaq. Maannamut Kalaallit Nunaanni

aatsitassarsiornermi malittarisassat eqaatsumik aaqqissugaapput. Imatut paasillugu, suliniutit tamarmik misissorneqartillugit ilisimasat pigineqartut annertuumik nalorninaateqarsinnaasut atorneqartaramik. Pingaartinneqartuarpoq akuersissuteqartoqartillugu avatangiisinut sunniutai appasinnerpaaffissamiitissinnaaneri ingerlanneqartussaagaangata.

Aatsitassarsiornermi piianermi ingerlatsisoqartarpoq nalinginnaasumik avatangiisinut nunamullu killilimmik ajoqusiisumik ingerlatsisoqarsinnaatillugu. Nalinginnaasuusarpoq piiaasoqartillugu avatangiisinut ulorianaateqarsinnaasut sapinngisamik ajoqusiisinnaannginnerumut katersortarlugit soorlu aarlerinannginnerusunut inissillugit, mitit inigisaaniit ingalassimatillugit imaluunniit sajuppallatsitsilluni misissuinerit aputeqarnerani ingerlanneqartarlutik.

Misissueqqaarnerit piianeerillu ingerlanneqartillugit tamarmik sumiiffimmut aaliangersimasumut piffissamullu aaliangersimasumut ilaatigut (ukiuni qulikkaartuni) pisarput. Allatut oqaatigalugu, eqaatsumik suleriuseqartoqarneq ajorpoq qaqugu qanorlu suliaqarnissaq eqqarsaatigalugu. Selskabit tamarmik pisussaaffeqarput avatangiisinut sunniutigineqarsinnaasut pillugit nalillisuarnissaminnut (EIA) tamannalu aallartitsinnani pereersimasussaavoq erseqqissaassutigalugu qanoq isiornikkut avatangiisinut sunniutigisinnaasai annikinnerpaaffianiitinniarnerlugit. Taamaattumik selskabimut pisariaqarluinnartarpoq paasissutissat piginissaat aammalu naliliiniarnerminni ilisimasat naammattut pigisariaqartittarlugit, EIA-p nalunaarusiaa erseqqissoq uniuutinngitsorlu suliarineqassappat. Selskabit paasissutissanik ilisimasanillu naammattunik peqanngikkunik piumasaqaataasarpoq taakku suliaqartitsissasut ilisimatuussutsikkut suliatigut paasissutissaat amigaatigineqartut matussuserniarlugit.

Kalaallit Nunaata naalakkersuisui uuliamik misissueqqaarnissamut aammalu piiaasoqassatillugu avatangiisit pillugit sunniutigisinnaasanut naliliineq Jameson Landimut Nuussuarmullu suliaqarsimavoq (sumiiffinni avatangiisinut sunniutaasinnaasunut naliliineq immikkut taakkununnga sammititaq - SEIA).

Periuseq taanna naapertorlugu, killeqarfik sumiiffimmi naliliineq (RBA) aatsitassarsiortoqassatillugu suliarisimasassat tikkuagassat makkuupput:

- Sumiiffimmi aarlerinaateqarsinnaasut paasisimasaqarfigissallugit naasut uumasullu sumiiffinniittut ilisimatusarfigisimassallugit nunaqavissullu sumiiffimmut ilisimasaat paasisimassallugu.
- Susassaqarfinnut avatangiisimi aaliangersimasunut tunuliaqutaqarluartumik ilisimasat ullutsinnut naleqquttut pigissallugit.
- Innuttaasunit tamanit pitsaasumik paasissutissiisarneq aallersinnaanerlu soorlu una aqqutigalugu NatureMap (www.naturemap.eamra.gl).

Kujataani aatsitassarsiorluni ingerlatsiniarnermi RBA una suliaavoq EAMRA, GINR and DCE (Aarhus University) suleqatigiillutik. Suliap siunertaraa avatangiisit pillugit pilersaarusiornermi nakkutilliinermilu tunngavissamik suliaqassallutik anguniarlugulu sumiiffimmi paasissutissat mianerinarsinnaasullu itisilerlugit suliarissallugit tamanit atuarneqarsinnaasunngorlugit paasiuminartunngorlugillu saqqummiutissallugit. Siunertaq pingasoqiusaavoq:

- Aatsitassarsiortoqarniartillugu avatangiisinut nunamullu tunngasunut suliaqarnermi aaliangersaaniarnermi pisortanut ajornannginnerulersitsiniarneq.
- Nunaqavissut aammalu allat soqutigisaqartut paasissutissanut aatsitassarsiornerullu sumiiffimmut sunniutigisinnaasai pillugit suliaqarneq.
- Avatangiisit pillugit sunniutaasinnaasut pillugit suliaqarneq selskabinut siunnersortaannullu akikinnerusumik aammalu ajornannginnerusumik nalilersuuteqarsinnaanermut atugassanik. RBA aatsitassarsiortunut selskabinut allanullu suliniutinut minnernut akuersissuteqartunut piareersaateqarnermilu nalunaarusiornermi iluaqutaassaqaaq ("Siunnersuinerit Kalaallit Nunaanni aatsitassarsiorniarnermi atuuttussat nalunaarusiorniarnermi sinaakkutissatut EIA-mit [Avatangiisit pillugit naliliineq]-mi atugassaq 2015-meersoq").

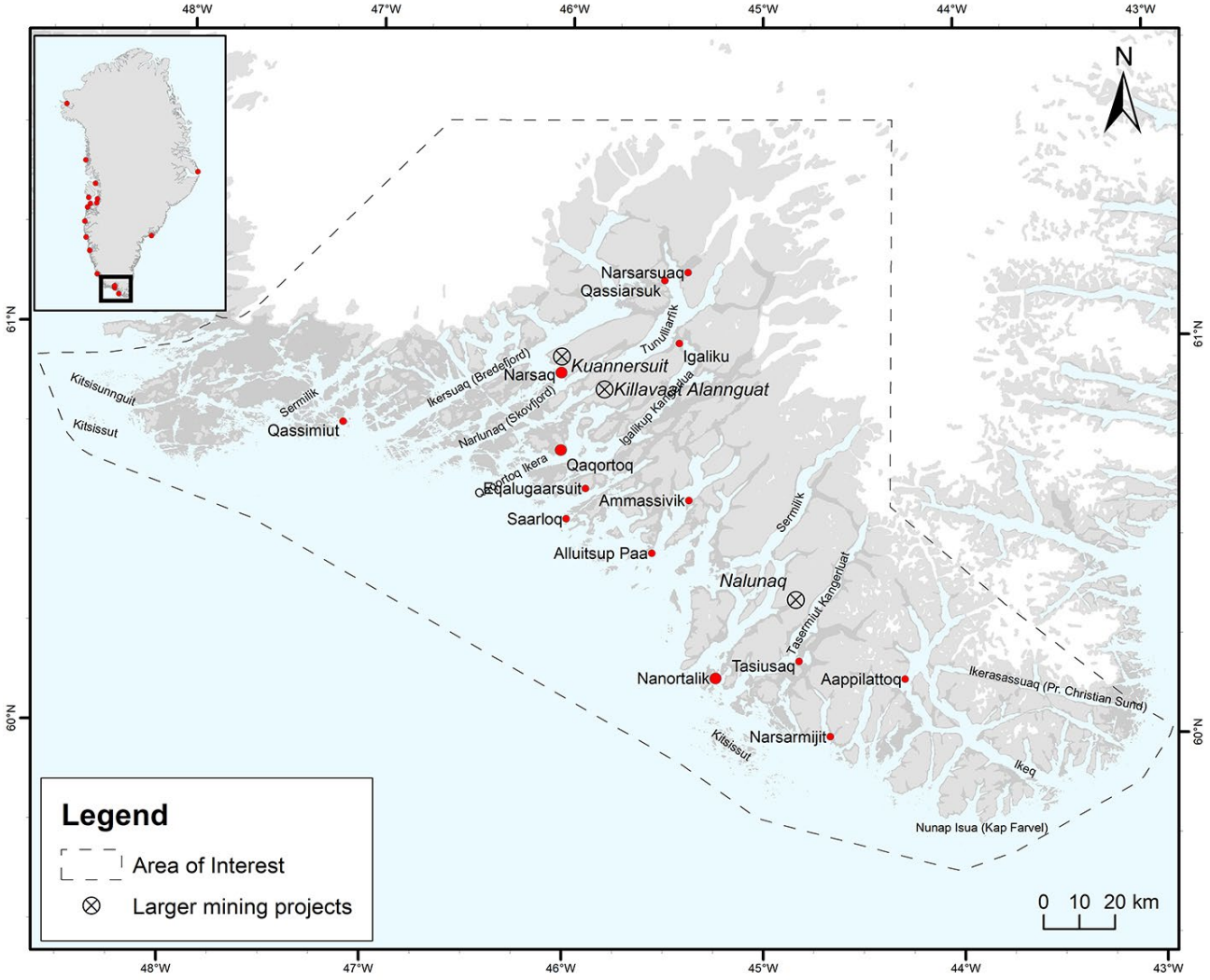
Kujataanut RBA maannamut suliaasoq paasissutissat pioreersut aallaavialugit katitigaavoq (Kapitali 2 aamma Ilanngussaq 1, GEUS-mit ilassutitalik), Uumassusillit assigiinngisitaartuunerat (Kapitali 4), Inuit atuinerat (Kapitali 5), sumiiffimmut tunngasut Kulturikkut oqaluttuassartaq aamma itsarnisarsiorneq (Kapitali 6, Kalaallit Nunaata Katersugaasivia Allagaateqarfianit ilassutitalik).

Nalunaarusiaq una paasissutissat, ilisimasaqarfinneersut aamma nunaqavissut ilisimasaat naasut pillugit ilisimatusarnerit (Ilanngussaq 3) aamma avatangiisini akuutissat pillugit misissugassatut katersorsimasat pillugit paasissutissat misissuisinermanerniillu (Kapitali 3 aamma Ilanngussaq 2) imaqarput taakkuuppullu paasissutissat tamarmik pioreersut. Killeqarfik soqutiginartoq (AOI) Takussutissiaq 1.1-mi takutinneqarpoq. Sumiiffimmi paasissutissat naapertorlugit, qulaaniit isigisumik nunap assinganik suliaqarsimavugut soqutigineqartoq ersersillugu (Kapitali 7). Ilisimasat avatangiisini pissutsit pillugit ilisimasaqarneq, qulaaniit isigisumik nunap assiliorsimavugut soqutigisaqatigiit qaleriiffigisai ersersillugit (Kapitali 8), uanilu aatsitassarsiorniarnermi pilersaartoqartillugu qaleriiffeqarneranut tunngatillugu itisiliisumik suliaqarnissaq pingaaruteqarpoq.

RBA suliarinerani nunaqavissut uumassusillit pissarititaasut pillugit ilisimasaat AOI-mi ilaatissallugit pingaaruteqarluinnarpoq. Pilersaarutit nunami misissueqqissaarnissat 2020-mi ingerlanneqalermata taakkua peqataatinneqartussaagaluarput, kisiannili nualluussuup Covid-19 peqqutigalugu killilersuisoqarmat ajoraluartumik peqataatinneqanngillat ingerlatsinermilu naasut pillugit misissueqqissaarnerit, qeqqussat (Fucus vesiculosus), uillut (Mytilus edulis), issoq aamma orsuatsiaat (Flavocetraria nivalis) akuutissaqarneranik misissoqqissaarneqarput (see chapter 3). Nualluussuup Covid-19-ip killilersuutai peqqutaallutik nunaqavissut oqartussallu allat ilisimasaat katersorneqanngillat taamaammat uani nalunaarusiami aamma peqataatinneqanngillat. Taamaattoq, nalunaarusiap uuma ingerlanerani tusarniaavigineqarnissaat periarfissaavoq.

Nalunaarusiami kapitalit maannamut ilisimasat pigineqartut aallaavigalugit ataatsimut isigisumik saqqummiussinissaq siunertaavoq kisianni aamma paasissutissat amigaatigineqartut ilanngunneqarput (Kapitali 9). Ilanngussaq 4-mi DCE/GINR-mit innersuussat naalisarneri nunami misissueqqaarnermi malittarisassat pillugit takuneqarsinnaapput.

Nalunaarusiat imarisamigut avatangiisinut sunniutaasinnaasut uuttuutit (EIA) imaluunniit inunnut sunniutaasinnaasut pillugit uuttuutit aatsitassarsiornermut sammitillugit imarisamikkut tamakkiisuunngillat.



Takussutissiaq 1.1. Kujataani sumiiffimmi soqutiginaatilimmi killeqarfimmi naliliineq.

2 Nunaata kujataa aatsitassarsiornerup tungaanit isigalugu

Allaaserinnittoq Kristine Thrane[1]
[1]*Geological Survey of Denmark and Greeland*

Kapitalimi uani naatsukullammik Kujataani ujarassiornikkut inissisimaffik sammineqassaaq immikkut sumiiffinni aningaasatigut soqutiginaatillinni peqassutsillu minguissusaat ilanngullugit nassuiaatigineqartussaapput. Itisiliissutit Ilanngussaq 1-mi "Kujataani ujarassiorneq"-mi takuneqarsinnaapput. Paasissutissat killeqarfimmi sumiiffimmi ujarassiornikkut soqutiginaateqartut paasisimassallugit pingaarutillit saqqummiunneqassapput.

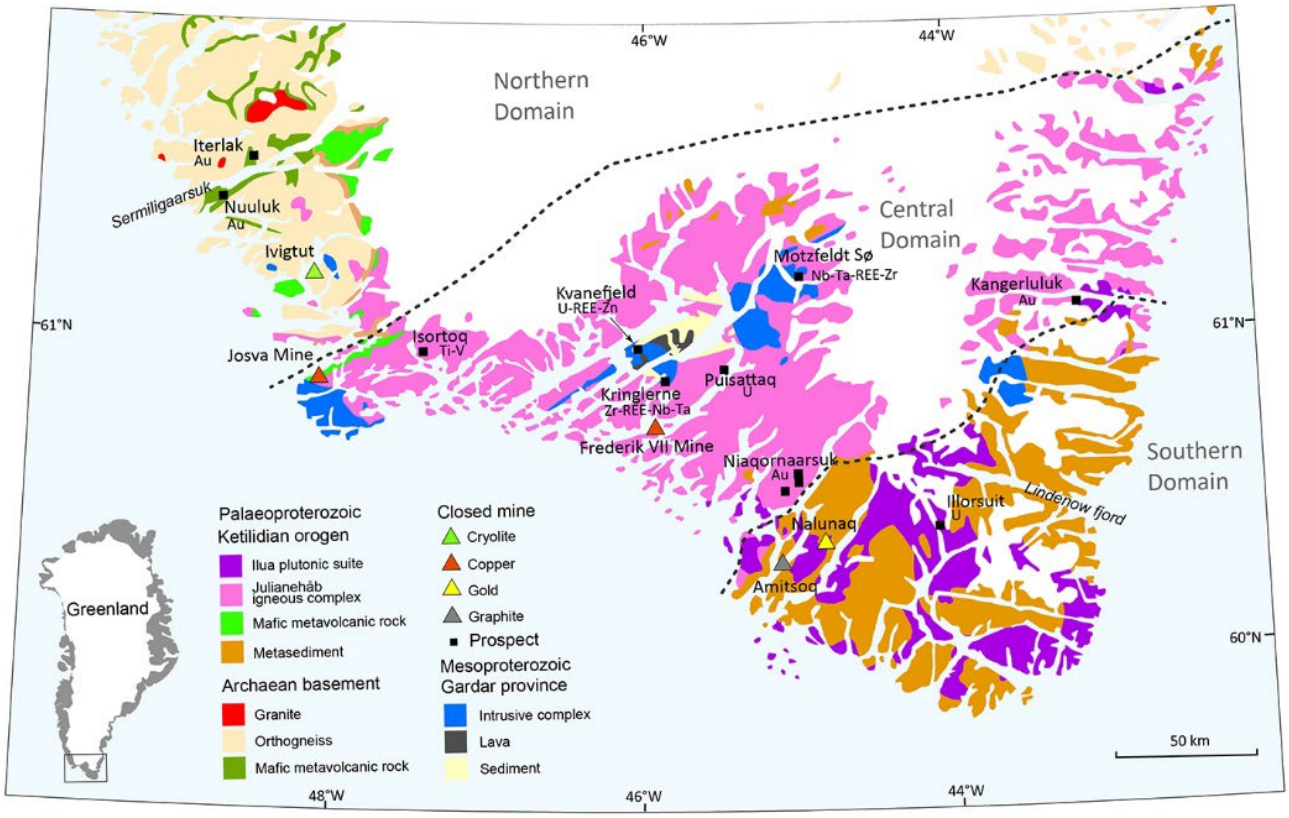
Kujataa piffissami Archaean aamma Palaeoproterozoic rocks-ip nalaani (Archaean = ukiut 4,000 -miit 2,500 million-nit tunngaanni) pinngorpoq, piffissallu Mesoproterozoi-ip nalaani c (ukiut 1,600 -miit 1,000 million-it matuma siorna), tunngavik temactonic pilerpoq aamma qaatungaa qalipanissimasoq siaarneqarpoq tamassumalu ujarassiornermi siaangasoqarfittut taasarpaat. Qaleriiaatut qaqqaq isikkoqartarpoq nunap siaangasutut ilusaanut ersilerluni. Piffissaq taanna qalerpersimaffimmut lava nunap qaatigut kuuppoq lavaqarfiit pilersillugit qattunerusumiittullu poorlugillusooq ilillugit. Sumiffiit ilaanni, lava nunap qaanut pivoq taamaasillunilu lava kuunnerisut isikkoqalersillugu nunap qaa.

Kujataa ujarassiornikkut sisamanut agguarneqaqqavoq (takuuk Assililartaq 2.1). Avannarpasissoq, eqqa aamma kujalliit, Archaean aamma Palaeoproterozoic rocks ataatsimoortut ujarassiornikkullu immikkuullarissuseqarlutik kisianni Gardarip nalaani Mesoproterozoic ujaqqat assigi sumi tamaani toraagassaapput taakkulu ujaqqat pisoqaanerit qaallerneqarsimasut takussaasarput. Sumiiffik soqutiginaateqartoq Kujataani killeqarfik naliligaq (RBA) aatsitassarsiornissamut soqutiginaatilik (Takussutissiaq 1.1. Aallarniut) allatut isikkoqarpoq ujarassiornikkut nassuiaatigineqarsimasunit allanit; taamaammat Avannarpasissoq Gardarillu nalaa kangiatalu sineriaa RBA-mi ilanngunneqanngillat.

Kujataani aningaasarsiorfiusinnaasutut soqutiginaateqartut arlariiupput. Avatangiisitigut akuutissat katitigaanerat tunngavigalugu akorisat ilai avatangiisinut sunniuteqarnissamut inissisimapput taakkulu suussusersineqartariaqarput. Sumiiffiit taakku tulliuttutut nassuiaatigineqassapput, aamma ataatsimut isigisumik takussutissaq Takussutissiaq 2.1-mi takuneqarsinnaapput.

Avannarpasinnermi, gulteqarfiit(Au) marluk nassaarineqarlutillu misissorneqarsimapput.

Qeqqani kobber (Cu) nassaassaavoq, ilanngullugu qanga kobberimik piiaaviusimasut ilanngullugit Josva mine (1851-54; 1905-14) aamma Frederik VII mine (1852, 1905, 1912) ilanngullugulu gulteqarfiit peqarfiillu annertunngitsut uranimik (U) akoqartut minguitsut nassaarineqarput.



Takussutissiaq 2.1. Kujataata ujarassiornikkut agguataarsimanera. Steenfelt et al. (2016)-mit.

Tabel 2.1. Aatsitassat aningaasatigut soqutiginaatillit takussutissarineqarnerat matumani Kujataanut attuumassuteqartut. Suussusiisa naalisarneqarnerisa suuneri paasiniaraanni allassimasuni atuarneqarsinnaapput. Ag: Sølvi, La: Lanthanum.

Sumiiffik	**Ateq**	**Pingaarnertut pineqarput**
Sumiiffiup avannarpasittuani	Nuuluk + Iterlak	Au, As
Sumiiffiup qeqqani	Niaqornaarsuk/Vagar	Au, Ag, As, (F)
	Josva Mine – Ilordleq Group	Cu, Ag, Au
	Nunatak – Nordre Sermilik	U, Th
	Puisattaq + Vatnahverfi	U, Th, F
Sumiiffiup Kujasinneru-sortaani	Illorsuit	U, Th
	Amitsoq + Sissarissoq	Graphite
	Nalunaq + Lake 410 + Ippatit	Au, As
	S-type granites	U, Th
Qallunaatsiaqarfinni	Kuannersuyit	REE, U, Th, Zn, F
	Killavaat	Zr, Nb, Ta, REE, F
	Igaliko - Motzfeltip tasia	Nb, Ta, U, Th, Zr, Ce, La, F
	Ivigtut	Cryolite, F, Zn, P
	Grønnedal-Ika	REE, Zn, Fe
	Isortoq	Fe, Ti, V

Kujallerniittut aamma aatsitassarsiorfeqarput matusimasunik Nalunami gultisiorfik (2003-2013) aamma Amitsoq graphite mine (1915-1924). Aamma arlariinnik peqarpoq gultitalinnik, grafit aamma uran. Ujaqqat akuutissanik akoqassusaannik misissuinerit takutippaat Kujataa tamarmi arsenicimik

akoqanngingajattumik (As) aamma antimony (Sb), Cesium (Ce) aamma zink (Zn) akoqarpallaanngitsunik peqartoq.

Qallunaatsiaqarfiusimasup Gardarip qanittua nunamik innerup anitsineranit ujaralik ilisimaneqarpoq taannalu ujaqqat akuutissatigut akorisai immikkuullarissuupput. Ujaqqat taakku aatsitassartaqarput qaqutigoortunik arlariinnik soorlu tamanna oqaluttuarisaanermi piiaaffiusimasoq tusaamasaq orsugiassiorfikoq cryolite mine (Ivigtut, 1854-1987). Maannakkut Kuannersuit aamma Killavaat Alannguat tassaapput sumiiffimmi suliniuteqarfigineqartut inerisaasoqarluni immikkut misissuiffigineqarlutik aatsitassanik qaqutigoortunik (REE) peqartutut. Ilanngullugu, Gardarip qanittuani ataatsimut isigalugu makkuninnga nassaassaqarpoq zirconium (Zr), niobium (Nb), uranium, zinc, thorium (Th), fluorine (F), beryllium (Be), lithium (Li), phosphorus (P), yttrium (Y), gallium (Ga) aamma tantalum (Ta). Aammalu Gardarip qanittuani pisuussuteqarpoq uumaatsunik annertuumik dolerithe dykes Isortumi saviminissaq (Fe), titanium (Ti) aamma Vanadium (V).

Paasissutissat amerlanerusut Ilanngussaq 1 "Kalaallit Nunaanni ujarassiorneq"-mi atuarneqarsinnaapput.

Aallerfissat

Steenfelt, A., Kolb, J. & Thrane, K. 2016. Metallogeny of South Greenland: A review of geological evolution, mineral occurrences and geochemical exploration data.

3 Kujataani avatangiisit tunngaviusumik akuutissartaat

Allaaserinnittoq Janne Fritt-Rasmussen[1], Drude Fritzbøger Christensen[1,2], Kasper Lambert Johansen[1], Jens Søndergaard[1] and Peter Aastrup[1]

[1]Department of Ecoscence, Aarhus University, [2]Current address: Department of Geosciences and Natural Resource Management, University of Copenhagen

Kapitalimi uani avatangiisini akuutissat katitigaanerat pillugu Kujataanut immikkut sammititat ataatsimut isigisumik saqqummiunneqassapput. Paasissutissat suliniutinit assigiinngitsunit ingerlanneqartarsimasunit suliaasimasut saqqummiutissapput uani akuutissat pillugit uuttuutit akulleq, minnerpaaq aamma annerpaamik nalingi pineqarput. Paasissutissat tamarmik avatangiisini akuutissat katitigaanerat pillugu paasissutissat katersorsimaffiani "AMDA"-mi DCE/GINR Avatangiisit Pillugit Paasissutissanik Katersivimmi pissarsiarineqarsinnaapput.

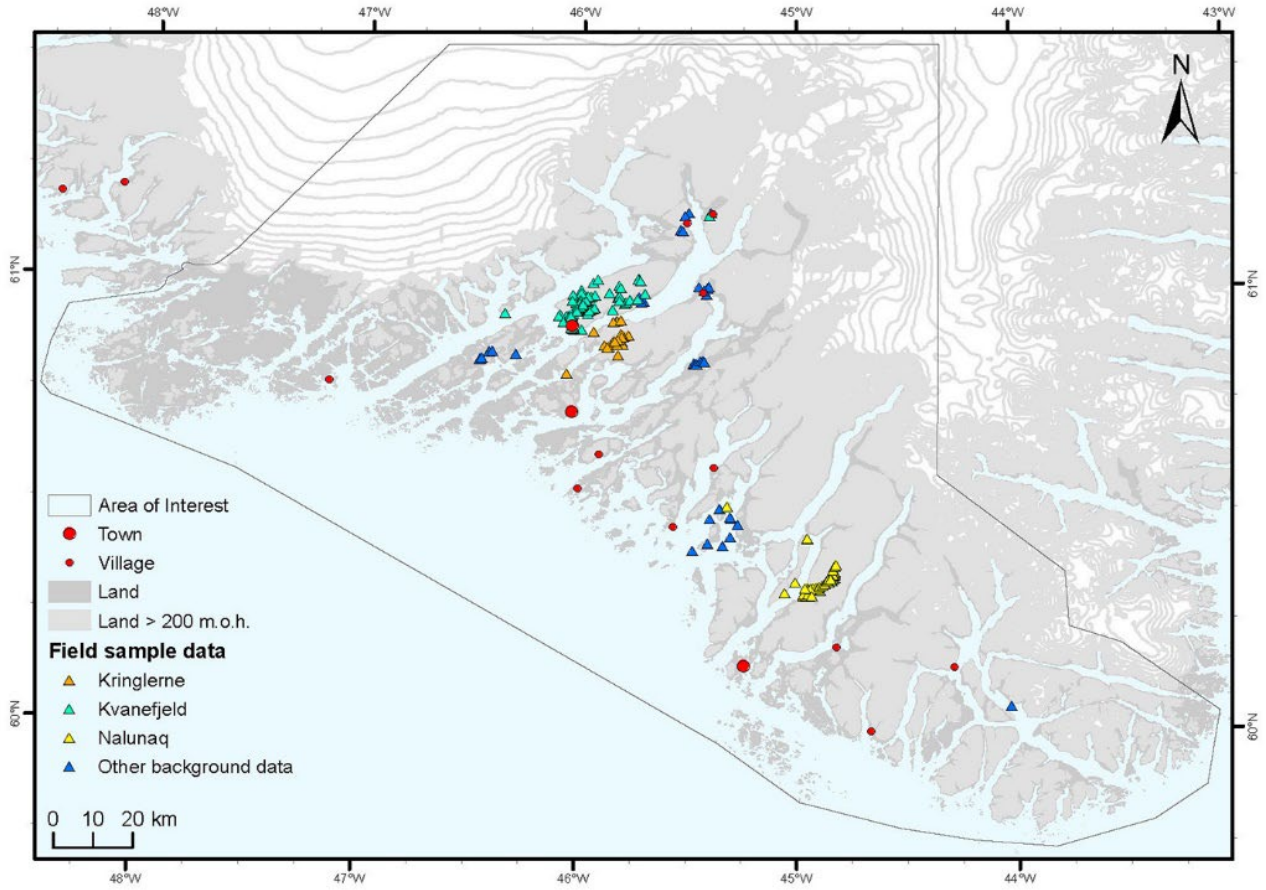
3.1 Kalaallit Nunaata kujataani katersat avatangiisineersut misissoqqissaarneqarfii

Kujataani ujarassiornikkut nassuiaaneq sukumiinerusoq Kapitali 2-mi takuneqarsinnaavoq. Ataatsimut isigalugu, sumiiffiit pingaarutilinnut sisamanut aggugaavoq (Avannaa, Qeqqa, Kujalleq aamma Gardar qanittua) ujaqqatigut aaliangersimasutigut ilisarnaateqarlutik sumiiffinnilu misissueqqaarnissamut aamma piiaanissamullu periarfissaqarluni.

Killeqarfimmi sumiiffimmi naliliiffiusumi ujaqqat akuutissatigut katitigaanerat Kujataani ukiuni 40-it missaanni misissuisoqartarsimavoq pingaartumik aatsitassarsiorsinnaaneq eqqarsaatigalugu soorlu tamanna Kapitali 2-mi eqqaaneqartoq, aamma misissueqqaarnerit piiaanerillu ingerlanneqartarsimasut (Takussutissiaq 3.1). Avatangiisini akuutissat katitigaaneri misissorneqarsimapput soorlu immami, nunap qaleriissaarnerini, orsuatsiaani, uilluni, qeqqussani aammalu aalisakkani misissugassanik katersisimanermit. Suliaqarnermi killeqarfimmi misissugassanik katersisoqarpoq aatsitassarsiorfiusunit suli ammasunit aammalu nakkutigisassatut katersanik. Ilanngullugu, killeqarfimmi misissuineq aammalu akoqanngitsunik Kujataaniit misissuisimaneq naammassipput.

2020-mi misissugassat RBA-p kangimut kitaata tungaaneersunit akuutissat minguinnerusutut nalilikkat katersorneqarsimasut ilanngunneqarput taamaasilluni killeqarfimmit paasissutissat RBA Kujataanut atugassat pitsaanerulersillugit ("Killeqarfimmi avatangiisini akuutissat katitigaanerat" takukkit itinerusumiittut). Sumiiffiit ataatsimut isigalugit, misiliutit assigiinngitsut aammalu katersat misissorneqarneri Takussutissiaq 3.1-mi aamma Tabel 3.1-mi takuneqarsinnaapput. Maannamut misissuiffigeriikkat uani kapitalimi takuneqarsinnaareersut avataatigut AMDA-p paasissutissaataani, DCE, Århus Universitetimi pigineqarput katersat misissukkat qeritinneqarsimasut panertissimasullu inissisimatinneqarput, amerlanerit killeqarfimmiit misissugassatut katersaasut aammalu aatsitassarsiorfinniit allaneersut sanillersuutaasinnaasut ilanngullugit.

Misissugassanut katersaasivik misissukkat 20,000-it sinnillit soqutiginaateqartut pigineqarput.



Takussutissiaq 3.1. Sumiiffiit avatangiisini Kujataani ujaqqat akuutissaasa katitigaanerat pillugit misissugassanik katersaqarfit taakkualu-p paasissutissaasivianni nassaarineqarsinnaapput. Immikkoortoq "paasissutissat allat tunuliaqutaat" killeqarfimmi paasissutissat pigineqartut katiterneraat ('AMAP'-mi suliaq, 'Akuutissat arrortissinnaanngitsut' aamma 'Kujataani RBA').

Avatangiisini akuutissat katitigaanerat pillugu paasissutissat 1982-rnisaapput kingornalu pissarsiaallutik, misissugassasut katersat aammalu misissoqqissaarinerit misissugassallu assigiinngisitaarnerni ukiut ingerlanerini assigiinngitsuusarput. Paasissutissat misissuataarnerini tamanna eqqaamaneqartariaqarpoq.

Akuutissat katitigaanerisa misissoqqissaarneqarneranni AAS ilanngunneqarpoq (Atomic Absorption Spectroscopy) aammalu kingullertigut ICP-MS misissuinerit ilanngunneqarlutik (Inductively Coupled Plasma Mass Spectrometry). Ataatsimut isigalugu paasissutissat allat makku aallaavigalugit uillut (Mytilus edulis), orsuatsiaat (Flavocetraria nivalis), nunamit qaleriissaarnerit, imeq tarajoqanngitsoq (salinnikoq salinneqanngitsorlu), kanassut (Myoxocephalus scorpius) qeqqussat (Fucus vesiculosus misissoqqissaarneqarput aamma tamarmik AMDA-mi paasissutissaasivimmi nassaarineqarsinnaapput. Qeqqussat aamma uillut imartani avatangiisimik pitsaassusaa piffissap sivisuup iluani pisuni annertuumik malussarissuupput. Taamaakkaluartoq, qeqqussat nuuini ukiumiit ukiumut mingutsitsisoqarsimaneranit ersiuteqartarput (ukiumi naaffigisaanni ersertarlutik) aamma uillut ukiut 10-15-it iluini taamaattarput (Bach 2020). Kalaallit Nunaanni sumi tamaani uilluut nassaassaapput kisianni Kalaallit Nunaata kangiani nassaassaanngillat (Wenne et al. 2020). Nunarsuarmi tamani avatangiisit uumassusaat misissorniarnerini

uuttuutaapput ilisimaneqarluartut imartani angisuuni uumassusillit timitaatigut allannguutit nakkutiginiarnerini atorneqartarput (sulluusallit milluaasullillu akuutissanik arrortikkuminaatsunik tigooraasut aammalu aqerlussanik iioraasunik taaneqarsinnaasut) (Rigét et al. 1997; Søndergaard et al. 2011). Qeqqussat akorilersimasaasa nalilersorneqarsinnaanerat taamaallaat tarajulimmi pisarput (Rainbow 1995).

Tabel 3.1. Kujataani avatangiisini akuutissat katitigaanerat AMDA-p paasissutissaatai. Misissugassat suussusai, amerlassusai maannamullu misissorneqarsimasut. Immikkoortut "qeqqussat" assigiinngitsunik quajatinik marlunnik akoqarput. Misissugassat assingusut ukiut siuliini sumiiffimmi ataatsimi katersorneqarsimasut assigiinngitsunik inerneqarsinnaapput. Kinguneraalu akoqarpianngitsut nalunaarsorsimasut imaassinnaasut katersanut allanut sanilliullugit minnerusut assigiinngitsuusinnaasullu. Misissuinermi periuseq ICP-MS imaluunniit AAS atorneqarpoq. Suliniutaasimasut inissisimaffii Takussutissiaq 3.1-mi takuneqarsinnaapput. Suliniut 'AMA', 'Akuutissat arrortikkuminaatsut' aamma 'Kujataani RBA' tamarmik allattorsimaffimmi 'paasissutissat allat tunuliaqutaat'-ni Takussutissiaq 3.1-mi takuneqarsinnaapput.

Suliniutip aqqa	Misissukkat suuneri	Suussutsit	Panertitap sinnera % (d.m.%)	Ukioq katersiffik	Katersukkat amerlassusii
AMAP	Kanajoq (tingua)	Cd, Hg, Pb, Se	d.m.%	1994	45
	Nunami qaleriissaarnerit	As, Cd, Cu, Hg, Ni, Pb, Zn		1994	5
	Uiloq	Cd, Hg, Pb, Se	d.m.%	1994	29
Akuutissat arrortikkuminaatsut	Qaleriissaarnerit	Hg		1985	2
Killavaat Alanngua	Uiloq		d.m.%	1989	18
	Kanajoq	Cd, Hg, Se	d.m.%	1989	1
	Imeq salinneqanngitsoq	Ag, Al, As, Au, Ba, Be, Bi, Ca, Cd, Ce, Co, Cr, Cs, Cu, Fe, Ga, Hg, K, La, Li, Mg, Mn, Mo, Na, Nd, Ni, P, Pb, Pd, Pt, Rb, Rh, S, Sb, Sc, Se, Si, Sn, Sr, Ta, Te, Th, Ti, Tl, U, V, W, Y, Zn, Zr		2007, 2010	25
Kuannersuit	Uiloq	Ag, Al, As, Au, B, Ba, Be, Bi, Ca, Cd, Ce, Co, Cr, Cs, Cu, Dy, Er, Eu, Fe, Ga, Gd, Hf, Hg, Ho, K, La, Li, Lu, Mg, Mn, Mo, Na, Nb, Nd, Ni, P, Pb, Pb-210, Pd, Po-210, Pr, Pt, Ra-226, Ra-228, Rb, Re, Ru, Sb, Sc, Se, Sm, Sn, Sr, Ta, Tb, Te, Th, Ti, Tl, Tm, U, V, W, Y, Yb, Zn, Zr	d.m.%	2001, 2009, 2014, 2017	22
	Orsuatsiaat	Ag, Al, As, Au, B, Ba, Be, Bi, Ca, Cd, Ce, Co, Cr, Cs, Cu, Dy, Er, Eu, Fe, Ga, Gd, Hf, Hg, Ho, K, La, Li, Lu, Mg, Mn, Mo, Na, Nb, Nd, Ni, P, Pb, Pb-210, Pd, Po-210, Pr, Pt, Ra-226, Ra-228, Rb, Re, Ru, Sb, Sc, Se, Sm, Sn, Sr, Ta, Tb, Te, Th, Ti, Tl, Tm, U, V, W, Y, Yb, Zn, Zr		2009, 2014, 2017	32
	Qeqqussat	Ag, Al, As, Au, B, Ba, Be, Bi, Ca, Cd, Ce, Co, Cr, Cs, Cu, Dy, Er, Eu, Fe, Ga, Gd, Hf, Hg, Ho, K, La, Li, Lu, Mg, Mn, Mo, Na, Nb, Nd, Ni, P, Pb, Pb-210, Pd, Po-210, Pr, Pt, Ra-226, Ra-228, Rb, Re, Ru, Sb, Sc, Se, Sm, Sn, Sr, Ta, Tb, Te, Th, Ti, Tl, Tm, U, V, W, Y, Yb, Zn, Zr	d.m.%	2001, 2009, 2014, 2017	16

	Qaleriissaar-nerit	Ag, Al, As, Au, B, Ba, Be, Bi, Ca, Cd, Ce, Cl, Co, Cr, Cs, Cu, Dy, Er, Eu, F, Fe, Ga, Gd, Hf, Hg, Ho, K, La, Li, Lu, Mg, Mn, Mo, Na, Nb, Nd, Ni, P, Pb, Pb-210, Pd, Po-210, Pr, Pt, Ra-226, Ra-228, Rb, Re, Ru, S, Sb, Sc, Se, Si, Sm, Sn, Sr, Ta, Tb, Te, Th, Ti, Tl, Tm, U, V, W, Y, Yb, Zn, Zr		2009, 2013, 2014	4
	Kanajoq	Ag, As, B, Ba, Be, Bi, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Mo, Na, Ni, P, Pb, Pb-210, Po-210, Ra-226, Ra-228, Sb, Se, Sn, Sr, Th, Ti, Tl, U, V, Zn		2008, 2009, 2014	5
	Issoq	Ag, Al, As, B, Ba, Be, Bi, Ca, Cd, Co, Cr, Cu, Fe, Hg, K, Mg, Mn, Mo, Na, Ni, P, Pb, Ra, Sb, Se, Sn, Sr, Th, Ti, Tl, U, V, Zn		2009, 2014	3
	Imaq filterik-koortitaq	Ag, Al, As, Au, B, Ba, Be, Bi, Ca, Cd, Ce, Cl, Co, Cr, Cs, Cu, Dy, Er, Eu, F, Fe, Ga, Gd, Hf, Hg, Ho, K, La, Li, Lu, Mg, Mn, Mo, Na, Nb, Nd, Ni, P, Pb, Pd, Pr, Pt, Rb, Re, Ru, S, Sb, Sc, Se, Si, Sm, Sn, Sr, Ta, Tb, Te, Th, Ti, Tl, Tm, U, V, W, Y, Yb, Zn, Zr		2011, 2013, 2014, 2017	107
Nalunaq	Uiloq	Ag, Al, As, Au, Ba, Be, Bi, Ca, Cd, Ce, Co, Cr, Cs, Cu, Fe, Ga, Hg, K, La, Li, Mg, Mn, Mo, Nd, Ni, P, Pb, Pd, Pt, Rb, Rh, Sb, Sc, Se, Si, Sn, Sr, Ta, Te, Th, Ti, Tl, U, V, Y, Zn, Zr	d.m.%	1998, 2000, 2001, 2004-2007, 2009, 2011, 2012, 2014, 2015, 2017	138
	Orsuatsiaat	Ag, Al, As, Au, Ba, Be, Bi, Ca, Cd, Ce, Co, Cr, Cs, Cu, Fe, Ga, Hg, K, La, Li, Mg, Mn, Mo, Nd, Ni, P, Pb, Pd, Pt, Rb, Rh, Sb, Sc, Se, Si, Sn, Sr, Ta, Te, Th, Ti, Tl, U, V, Y, Zn, Zr	d.m.%	1998, 2000, 2001, 2004-2007, 2009, 2011-2015, 2017	228
	Qeqquaq	Ag, Al, As, Au, Ba, Be, Bi, Ca, Cd, Ce, Co, Cr, Cs, Cu, Fe, Ga, Hg, K, La, Li, Mg, Mn, Mo, Nd, Ni, P, Pb, Pd, Pt, Rb, Rh, Sb, Sc, Se, Si, Sn, Sr, Ta, Te, Th, Ti, Tl, U, V, Y, Zn, Zr	d.m.%	1998, 2000, 2001, 2004-2007, 2009, 2011-2015, 2017	137
	Qaleriissaar-nerit	As, Au, Cd, Co, Cr, Cu, Fe, Hg, Ni, Pb, Se, Zn	d.m.%	2012	7
	Kanajoq	Ag, Al, As, Au, Ba, Be, Bi, Ca, Cd, Ce, Co, Cr, Cs, Cu, Fe, Ga, Hg, K, La, Li, Mg, Mn, Mo, Nd, Ni, P, Pb, Pd, Pt, Rb, Rh, Sb, Sc, Se, Si, Sn, Sr, Ta, Te, Th, Ti, Tl, U, V, Y, Zn, Zr		2000, 2004-2009, 2011-2013, 2017	188
	Imeq salinni-koq	Ag, Al, As, Au, B, Ba, Be, Bi, Ca, Cd, Ce, Co, Cr, Cs, Cu, Dy, Er, Eu, Fe, Ga, Gd, Ge, Hf, Hg, Ho, K, La, Li, Lu, Mg, Mn, Mo, Na, Nb, Nd, Ni, P, Pb, Pd, Pr, Pt, Rb, Re, Rh, Ru, S, Sb, Sc, Se, Si, Sm, Sn, Sr, Ta, Tb, Te, Th, Ti, T, Tm, U, V, W, Y, Yb, Zn, Zr		2012-2014, 2019	29
	Imeq salin-neqanngitsoq	Ag, Al, As, Au, Ba, Be, Bi, Ca, Cd, Ce, Co, Cr, Cs, Cu, Dy, Er, Eu, Fe, Ga, Gd, Hf, Hg, Ho, K, La, Li, Lu, Mg, Mn, Mo, Na, Nb, Nd, Ni, P, Pb, Pd, Pr, Pt, Rb, Re, Ru, Sc, Se, Sm, Sr, Ta, Tb, Te, Th, Ti, Tm, U, V, W, Y, Yb, Zn, Zr		2019	4
Kujataani RBA	Uiloq	Ag, Al, As, Au, Ba, Be, Bi, Ca, Cd, Ce, Co, Cr, Cs, Cu, Dy, Er, Eu, Fe, Ga, Gd, Hf, Hg, Ho, K, La, Li, Lu, Mg, Mn, Mo, Na, Nb, Nd, Ni, P, Pb, Pd, Pr, Pt, Rb, Re, Ru, Sb, Sc, Se, Sm, Sr, Ta, Tb, Te, Th, Ti, Tm, Tl, U, V, W, Y, Yb, Zn, Zr	d.m.%	2020	24

Crinkled snow lichen	Ag, Al, As, Au, Ba, Be, Bi, Ca, Cd, Ce, Co, Cr, Cs, Cu, Dy, Er, Eu, Fe, Ga, Gd, Hf, Hg, Ho, K, La, Li, Lu, Mg, Mn, Mo, Na, Nb, Nd, Ni, P, Pb, Pd, Pr, Pt, Rb, Re, Ru, Sb, Sc, Se, Sm, Sr, Ta, Tb, Te, Th, Ti, Tm, Tl, U, V, W, Y, Yb, Zn, Zr	2020	20
Orsuatsiaat	Ag, Al, As, Au, Ba, Be, Bi, Ca, Cd, Ce, Co, Cr, Cs, Cu, Dy, Er, Eu, Fe, Ga, Gd, Hf, Hg, Ho, K, La, Li, Lu, Mg, Mn, Mo, Na, Nb, Nd, Ni, P, Pb, Pd, Pr, Pt, Rb, Re, Ru, Sb, Sc, Se, Sm, Sr, Ta, Tb, Te, Th, Ti, Tl, Tm, U, V, W, Y, Yb, Zn, Zr	2020	11
Issoq	Ag, Al, As, Au, Ba, Be, Bi, Ca, Cd, Ce, Co, Cr, Cs, Cu, Dy, Er, Eu, Fe, Ga, Gd, Hf, Hg, Ho, K, La, Li, Lu, Mg, Mn, Mo, Na, Nb, Nd, Ni, P, Pb, Pd, Pr, Pt, Rb, Re, Ru, Sb, Sc, Se, Sm, Sr, Ta, Tb, Te, Th, Ti, Tl, Tm, U, V, W, Y, Yb, Zn, Zr	2020	21

Erngup salinnikup misissornerani akoqassusaa uani uuttorneqarnerani 0.45 µm issingeersut atorneqarpoq. Taamaattoq, imeq salinneqanngitsoq suli aamma akoqarpoq. Imeq misissugassaq uuttorneqartarpoq PH-a, kissassusaa, kallerup inneranik ingerlatsisinnaassusia aammalu redox-mik (Eh)/oxygen silaannarmik akoqarsinnaanera misissorneqartarpoq (Bach 2020).

Orsuatsiaat Issittumi annertuumik siaruarsimapput. Orsuatsiaat Flavocetraria nivalis, Kalaallit Nunaanni misissussallugit piuminarnerupput taakku sumi tamaani nassaassaagamik (Søndergaard et al. 2020). Orsuatsiaat pujoralaqassutsimut uuttuutigissallugit atorneqartarput, uani sumiiffik nunaminertaq annertooq misissorniartillugu aammalu sorlaqanngitsunik naasoqartillugu. Aatsitassarsiornermik ingerlatsiviit pujoralatsitsineri orsuatsiat atorlugit uuttuisoqartarnera misissuinerit arlallit takutippaat (Naeth and Wilkinson 2008; Søndergaard et al. 2011; Søndergaard et al. 2013; Søndergaard et al. 2020). Mingutsitsineq orsuatsiaani takuneqarsinnaavoq aamma piffissap sivisunerup iluani pisimatillugit. Taamaattumik, nakkutilliilluarneq angujumallugu orsuatsiaanik ikkussuisoqartarpoq taakkuusarpullu ukiumit ukiumut piffissap sivisunngitsup iluani pujoralaqassutsimik uuttuutaasartut.

Kanajoq (Myoxocephalus scorpius) tassaavoq aalisagaq Kalaallit Nunaani sumi tamaani immap naqqani (Muus 1990) aalaakkaalluartoq pisariuminartorlu. Aatsitassarsiorfimmut qanittumi immap mingutsinneqarneranut uumassusilinnut sammititamut nakkutilliinermi atorneqartartoq (Søndergaard et al. 2020).

Eqaluk nakkutilliinermi pilersaarummut aamma peqataatinneqartariaqarpoq kuuit aatsitassarsiorfiup qanittuaniittut mingutsinneqarnerinut nakkutiginninniarnermi. Killeqarfiup avatangiisii pillugit ilisimasat soorlu qaleriiaakkaangata, imermit, ujaqqanik misissugassanik tigusinermitulli pingaaruteqartigaat (Kapitali 2 Ujarassiorneq takuuk).

3.2 Siornatigut aatsitassarsiorfiusimasunit paasissutissat katersat

Ullumikkumut, Kujataani aatsitassarsiornermut ingerlatsinerit misissueqqaarneriillutik aammalu nunami campeqarluni

ingerlatsinermiipput. Aatsitassarsiorfik kisiartaalluni piffissami sivisunerusumi ingerlanneqartoq tassaavoq Nalunami gultisiorfik taannalu 2004-miit 2013-mut ammavoq (Boertmann et al. 2018). Aatsitassarsiornerit allat 1800-kkut naanerani aamma 1900-kkut aallartinnerini Josva kobber aatsitassarsiorfik Innatsiap qanittuani pivoq (2,252 tons piiarneqarlutik), Frederik VII kobber aatsitassarsiorfik Qaqortup eqqaani (18 tons katillugu piiarneqarput) aamma Amitsoq graphite aatsitassarsiorfik Nanortallup eqqaani (6,000 tons katillugu piiarneqarput) (Secher and Sørensen 2014). Kuannersuarni piiaasoqarsimavoq; ataani "Kuannersuit eqqaalu" takukkit.

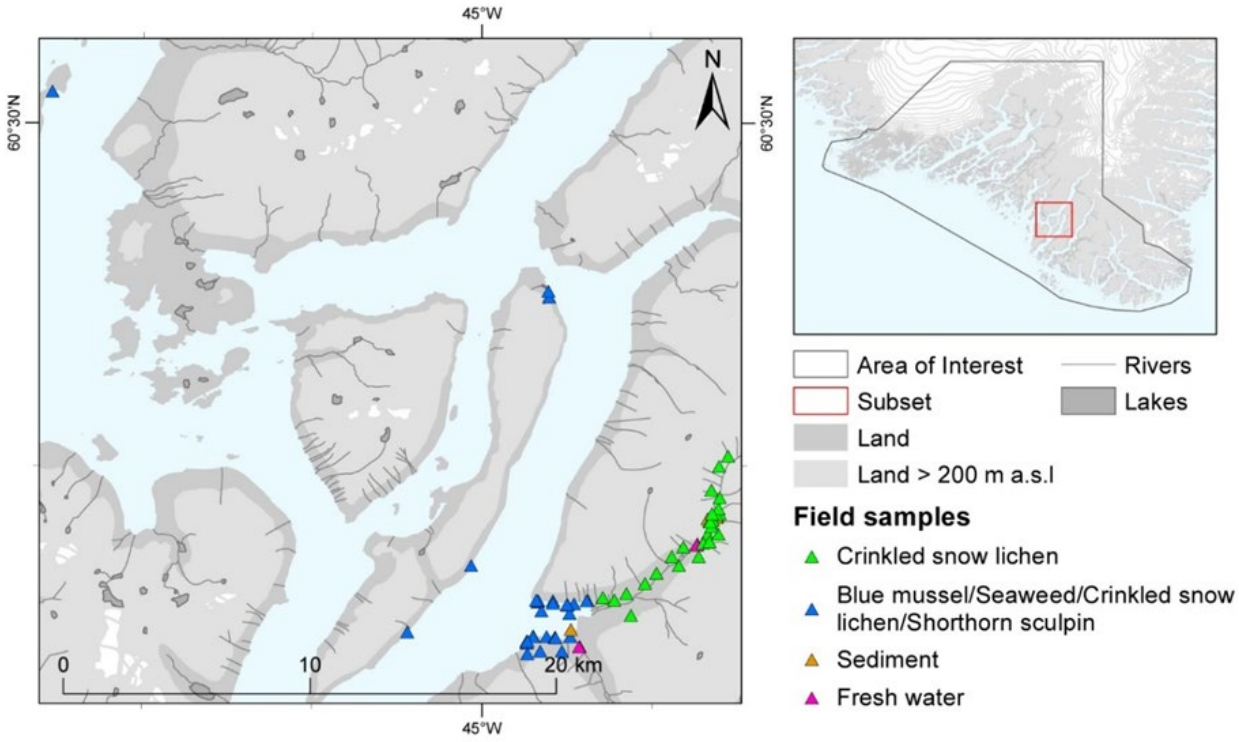
Nalunaq eqqaalu

Kapitalimi uani Nalunami ingerlatsineq pillugu nalunaarusiaq "Environmental monitoring at the Nalunaq gold mine, South Greenland, 2004-2019" (Bach 2020) tunngavigalugu imaqassaaq.

Nalunap inissisimaffia tassaavoq qaqqaq sermillip qooruani Saqqap Kangerluani Nanortalimmit 40 km-sut avannamut kangisissuaniittumi. Proterozoic amitsumik siammasissumik akoqarfeqarpoq, gulti minguitsoq (Bach 2020). Gulteqarnera 1992-mi paasineqarpoq (Secher et al. 2008) aammalu nassaarineqartut allat pillugit naatsorsuutigineqartarpoq tamanna annertuumik gulteqartoq (Bach 2020). Nalunaq Kalaallit Nunaanni gulteqarfittut siullerpaatut 2004-mi ammarpoq 2013 2014-milu matulluni. Nalunaq Kirkespirdalenimiippoq qooroq sermilik qaqqartalik inngigissunik 1,200-1,600 missaani meterisut qatsitsigisumi, kooqarpoq Kirkespirelven taannalu qooqqutigut kuuppoq (Bach 2020). Aqqusinniortoqarsimavoq 12 km-sut isorartutigisumik tamannalu aatsitassarsiorfimmiit kangerlummut katersivimmut suliaalluni. Talittarfiliortoqarsimavoq assartuisunut tulaffissiatut usilersortarfittut. Aatsitassarsiorfimmi ujaqqat piiarneqartut aserorterneqartarput sissiukkamilu assartorneqartigatik katersorneqartarput (Bach 2020). DCE-ip killeqarfimmi avatangiisit pillugit misissuinini 1998-2001-mi piareerpaa (Glahder et al. 2005), aammalu DCE/GINR-ip avatangiisit pillugit 2004-2019-mut misissuinini ingerlallugu, uani misissugassat katersat avatangiisinit katersorneqarsimapput (orsuatsiaat, eqaluit, uillut, qeqqussat, kanassut aammalu imeq salinneqanngitsoq). Misissuinerup akuutissat suussusersiniarlugit ingerlatsineruvoq (soorlu, As, Cd, Co, Cr, Cu, Hg aamma Pb) killeqarfimmilu misissugassanik katersat sanillersuunneqarput. Misissuisimanermit nassuiaatit tamakkiisut aammalu inerniliussat 2004-2013-meersut uani takuneqarsinnaapput Glahder and Asmund (2005, 2006, 2007); Glahder et al. (2008, 2009, 2010, 2011); Bach et al. (2012), Bach & Asmund (2013) and Bach et al. (2014).

Aatsitassarsiorfiup matuneranit avatangiisinut misissuineq ingerlaannarpoq 2014-mi, 2015-mi aamma 2017-mi tulluarsarneqartumik (Bach et al. 2015; Bach and Larsen 2016; Bach and Larsen 2018). Inaarutaasumik 2019-mi misissuisoqarpoq uanilu imeq kisiat misissoqqissaarneqarpoq aammalu uumassusilinnit misissugassat DCE-mi siunissami misissuinermut atugassaasutut toqqorsisoqarluni (Bach and Olsen 2020). Avatangiisit misissornerini Nalunap qanittuani As, Co, Cr aamma Cu nassaarineqarput. Takussutissaq 3.2-mi akuutissat nalingi killeqarfimmi avatangiisini takuneqarsinnaapput Nalunallu qanittuanit misissugassanik ukunannga katersisoqarpoq 1998-2019) uillut (Mytilus spp.), orsuatsiaat (Flavocetrari nivalis), issoq qaleriissaartoq, imeq tarajoqanngitsoq (salinnikoq aamma salinneqanngitsoq) aamma qeqqussat (Fucus vesiculosus and Ascophyllum nodosum) ukiuni arlariinni (Takussutissiaq 3.2 nunap assingatigut

misissugassanik katersiviit assigiinngitsut takuneqarsinnaapput. Misissugassatut katersat allat aamma pissarsiarineqarsinnaapput.



Takussutissiaq 3.2. Nalunap eqqaa misissugassanik assigiinngitsunik katersivik. Tungujortut pingasunik teqeqqullit tassaapput misissugassanik assigiinngitsunik katersiffiit; uillut aamma/imaluunniit qeqqussat aamma/imaluunniit orsuatsiaat aamma/imaluunniit kanassut..

Takussutissiaq 3.2-mi "Kalaallit Nunaanni uuttuinermi akunnaatsumik inerniliussap nalinga "aamma "Kujataani uuttuinermi akunnaatsumik inerniliussap nalinga" misissugassanit mingutsinneqarsimanngitsunit nassaartoqarpoq sanillersuunneqassappullu, ajornanngippat, nalinik sinaakkutaalluarsinnaasunik. "Killeqarfimmi avatangiisini akuutissat katitigaaneri pillugit ilisimasimatusarnerit" takukkit Kalaallit Nunaanni aammalu Kujataani misissuisimanermit uuttuinermut nalip qanoq naatsorsortarnera pillugu.

Tabel 3.2. Nalunami avatangiisimit misissugassani katersanit ukiuni arlariinni (1998-2019) uku aqqutigalugit uillut (Mytilus spp.), orsuatsiaat (Flavocetralis nivalis), nunap qaleriaarnera, imeq tarajoqanngitsoq (salinnikoq aamma salinneqanngitsoq) aamma qeqqussat (Fucus vesiculosus and Ascophyllum nodosum) As, Co, Cr aamma Cu akoqassusaannik misissuisoqarpoq. “Kalaallit Nunaanni uuttuinermi akunnaatsumik inernilik” aamma “Kujataani misissuinermi akunnaatsumik inernilik” nalingi pillugit killeqarfimmi misissugassanik katersisoqarpoq (mingutsinneqarsimanngitsumit) AMDA-milu paasissutissaasivimmiitinneqarput. Periarfissaqartillugu sinaakkutissat pigineqarput.

Akuutissaq	Misissukkat suussusaa		Akunnatsoq	Minnerpaaq	Annerpaaq	Misissukkat amerlassusai	No. of samples	Kalaallit Nunaanni uuttuinermi akunnaatsumik inernilik	Kalaallit Nunaanni uuttuinermi akunnaatsumik inernilik	Sinaakkusiussat aalllaavigusinnaasut
As	Uillut	mg/kg	11.57	0.01	20.84	154	138	12.66	12.5	
As	Orsuatsiaat	mg/kg	0.49	0	9.33	256	228	0.04	0.05	
As	Imeq salinnikoq	µg/l	6.3	0.6	306.11	25	25	0.05	0.11	4 µg/l[a]
As	Qeqqussat	mg/kg	52.03	11.83	89.54	165	138	40.59	38.92	

As	Nunap qaleriaarnerni	mg/kg	18.09	3.06	338.91	8	7	5.37	5.6	20-52 mg/kg[b]
As	Kanassut	mg/kg	2.3	0.78	22.25	216	188	7.08	2	
Co	Uillut	mg/kg	0.32	0.0003	0.77	154	138	0.58	0.53	
Co	Orsuatsiaat	mg/kg	0.21	0.00005	3.22	255	227	0.18	0.11	
Co	Imeq salinnikoq	µg/l	0.51	<DL	50.85	29	29	0.02	0.01	
Co	Qeqqussat	mg/kg	0.26	0.08	1.45	162	138	0.58	0.45	
Co	Nunap qaleriaarneri	mg/kg	7.88	2.19	37.02	8	7	9.11	1.4	
Co	Kanassut	mg/kg	0.02	<DL	0.15	216	188	0.05	0.01	
Co	Imeq salinneqanngit-soq	µg/l	0.13	0.007	7.35	4	4	0.08	0	
Cr	Uillut	mg/kg	0.64	0.0005	2.25	154	138	1.06	0.75	
Cr	Orsuatsiaat	mg/kg	0.6	0.0002	6.29	258	228	0.33	0.25	
Cr	Imeq salinnikoq	µg/l	0.07	0.02	0.17	29	29	0.08	<DL	3 µg/l[a]
Cr	Qeqqussat	mg/kg	0.1	<DL	2.36	166	138	0.29	0.18	
Cr	Nunap qaleriiaarneri	mg/kg	69.24	31.66	198.35	8	7	66.77	1.1	70-560 mg/kg[b]
Cr	Kanassut	mg/kg	0.01	<DL	0.57	215	188	0.01	<DL	
Cr	Imeq salinneqan ngit-soq	µg/l	0.09	0.08	0.12	4	4	0.11	0.02	
Cu	Uillut	mg/kg	6.99	0.006	12.23	154	138	7.37	7.12	6 mg/kg
Cu	Orsuatsiaat	mg/kg	1.05	0.0004	22.23	256	228	0.76	0.66	
Cu	Imeq salinnikoq	µg/l	1.22	0.04	28.49	29	29	0.61	0.19	2 µg/l[a]
Cu	Qeqqussat	mg/kg	1.42	0.05	19.35	165	138	1.97	2.12	
Cu	Qaleriissaarnerit nu-nameersut	mg/kg	17.24	5.44	285.38	8	7	20.44	13	35-51 mg/kg[b]
Cu	Kanssut	mg/kg	1.27	0	16.69	216	188	1.6	1.2	
Cu	Imeq salinneqanngit-soq	µg/l	0.27	0.09	1.15	4	4	0.68	0.08	

a) Kalaallit Nunaanni erngup minguissusissaanut piumassaqaatit (GWQC) (MRA 2015).

b) Bakke et al. (2010) – Norskit qaleriissaarnerit nunameersut pillugit minguissutsimut piumassaqaatit ; immikkoortoq "Pitsaavoq".

c) OSPAR (2014) - CEMP-mi uillut pillugit nakkutilliinermi paasissutissat pitsaassusissaannik piumasaqaatit atorneqarput.

3.3 Killeqarfinnit avatangiisit pillugit misissuisimanernit paasisat

Killeqarfimmi sumiiffiit soqutiginaateqarsinnaasut allat misissueqqissaarnissamut akuersissummut atatillugu akuersinissamullu suliniarneq aallartinneqarneranut atatillugu, kisianni aatsitassarsiorneq maannamut ingerlanngilaq. Sumiiffiit taakku tamarmik Kuannersuarnut Killavaallu Alannguanut attuumassuteqarput, tamarmik Gardarip qanittuaniittut aammalu tamakkiisumik ataani nassuiaatigineqarput.

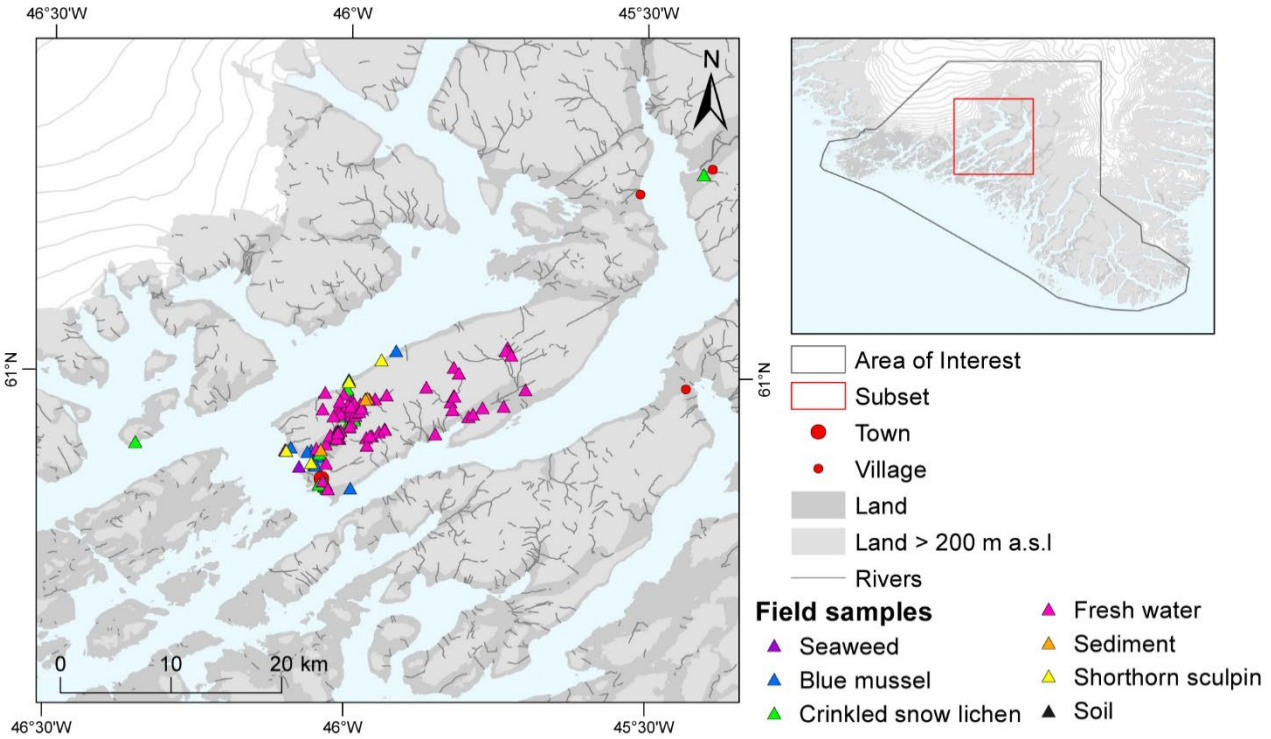
Kuannersuit eqqaa

Kuannersuit qaqqaa Narsamit avannamut kangiatungaanut 8 km-sut ungasitsigisumiippoq qaqqaavorlu 690 metersut portutigisoq. Kuannersuit uraniumitaqarpoq alkaline minnerpaaffiatut Ilimaussaq intrusionitut (Pilegaard 1990). Tamanna 1955-kkunnili misissorneqartarpoq aamma 1962-mi 180 tonsit piiarneqarput. Kuannersuarni suliniarfik uranimik suliaqartoq

1979 aallartippoq uanilu 1979-1980-mi 4,000 tonsit piiarneqarput (Pilegaard 1990) aamma piiaaqqittoqarluni 1982-mi aamma 1983-mi.

Piiaanerit ilai Kuannersuit naqqata tungaani ingerlanneqarput aammalu ilai siviganersani aatsitassarsiorfiup isaariaata eqqaani (10,000 tons missaat) (Asmund 2001). Piiaasimanermit avatangiisinut sunniutigisimasinnaasai pillugit misissuineq 2001-mi ingerlanneqarpoq (Asmund 2001). Avatangiisimit misissugassat katersat misissoqqissaarneqarnerini nassaarineqarput akuutissat amerlasuut, ilanngullugu aatsitassat qaqutigoortut (REE). Akuutissat allamit qaffassinnerusumik akullit makku nassaarineqarput REE, zirconium, niobium aamma thorium. Taamaakkaluartoq, Kuannersuarmi 1976-mi misiliilluni piiaasussaqalermat misissukkat maannalu misissukkat akumikkut qaffaseqatigiinnerat takusassaavoq (Asmund 2001). Ataatsimut isigalugu misissuisimanermit inerniliussaq tassaavoq piiaaffinnit aatsitassarsiorfiullu isaariaanit kuunnerit Narsap kuuanut/Narsap Iluanut sunniuteqanngillat.

Narsami kuup naqqa nunamut aamma itisoorsuarmut annguttarpoq (Pilegaard 1990). Erngup tarajoqanngitsup akua sumiiffinni arlariinni misissorneqartarsimavoq (Pilegaard 1990 innersuussaalu uani). Ataatsimut isigalugu, erngup minguissusaa qaqqanit allatuulli kuuttutut ippoq (Pilegaard 1990). Taamaattoq akuutissat ilai immikkut qaffasinnerusut nassaassaapput pingaartumik fluoride.



Takussutissiaq 3.3. Kuannersuit eqqaani assigiinngitsunik misissugassanik katersiviusimasoq.

Tabel 3.3. Kuannersuit eqqaani ukiuni arlaqartuni (2001-miit ullumimut) akuutissanik REE (tamarmut*), Zn, U, Pb aamma F akoqassuseq uillut (Mytilus spp.), orsuatsiaat (Flavocetralis nivalis), qaleriaarnerit nunami, imeq tarajoqanngitsoq (salinnikoq aamma salinneqanngitsoq) aamma qeqqussat (Fucus vesiculosus and Ascophyllum nodosum) aqqutigalugit misissuiffigineqartarpoq. "Kalaallit Nunaanni uuttuinermi akunnaatsumik inernilik" aamma "Kujataani uuttuinermi akunnaatsumik inernilik" nalingi killeqarfimmi misissugassanit katersanit aallaaveqarput (mingutsinneqarsimanngitsunit) AMDA-milu paasissutissaasivimmi pigineqarput. Periarfissaqartillugu, sinaakkutissat nalingi tunniunneqartarput. Annerusumik fluoride avatangiisini piunera, aatsitassat qaqutigoortut aamma nalinginnaasumik qingornerit pillugit paasisaqartoqarusuppat, ikinngutinnersumik Hansen et al. 2022 attaveqarfigineqarli.

Akuutissap suussusaa	Misissukkat		Akunnatsoq	Minerpaamik	Annerpaamik	Misissukkat amerlassusii	Misissukkat katillugit	Kalaallit Nunaani uuttuinerni akunnatsumik inernilik	Kujataani uuttuinermi akunnatsumik inernilik	Sinaakkutissat nalingi
F	Imeq salinnikoq	µg/l	1039	<DL	28302	91	91	1039	1039	1500[e]
F	Qaleriissaat nunami	mg/kg	3.12	3.12	3.12	2	2	3.12	3.12	
Pb	Uillut	mg/kg	3.74	0.16	11.14	27	22	0.69	1.01	1.3 mg/kg[c]
Pb	Orsuatsiaat	mg/kg	1.00	0.18	11.41	34	32	0.66	0.82	
Pb	Imeq salinnikoq	µg/l	0.06	<DL	7.06	116	107	0.03	0.06	1 µg/l[a]
Pb	Qeqqussat	mg/kg	0.23	<DL	0.85	25	16	0.12	0.23	
Pb	Qaleriissaat nunami	mg/kg	39	<DL	110	4	4	14.13	18.14	30-83 mg/kg[b]
Pb	Kanassut	mg/kg	<DL	<DL	<DL	5	5	0.007	0.007	
Pb	Issoq	mg/kg	70	14	87	3	3	12.55	13.28	
U	Uillut	mg/kg	0.21	<DL	0.87	38	22	0.26	0.25	
U	Orsuatsiaat	mg/kg	0.07	<DL	1.6	37	32	0.01	0.06	
U	Imeq salinnikoq	µg/l	0.08	0.004	2.82	116	107	0.06	0.08	15 µg/l[f]
U	Qeqqussat	mg/kg	0.76	0.15	1.56	31	16	0.64	0.85	
U	Qaleriissaat nunami	mg/kg	30	0.0003	61	6	4	1.95	30	
U	Kanassut	mg/kg	<DL	<DL	0.02	10	5	0.002	<DL	
U	Issoq	mg/kg	30	22	74	6	3	3.45	3.47	
Zn	Uillut	mg/kg	74	16	245	27	22	75.70	74.23	63 mg/kg[c]
Zn	Orsuatsiaat	mg/kg	21	8	90	34	32	19.25	22.18	
Zn	Imeq salinnikoq	µg/l	1.42	0.133	14.17	116	107	0.99	1.41	10 µg/l[a]
Zn	Qeqqussat	mg/kg	35.30	<DL	129.62	25	16	13.98	19.61	
Zn	Qaleriissaat nunami	mg/kg	215	0.002	730	4	4	69.11	92.62	150-360 mg/kg[b]
Zn	Kanassut	mg/kg	10	8	61	5	5	33.71	10	
Zn	Issoq	mg/kg	300	40	380	3	3	64.85	68.54	
∑REE*	Uillut	mg/kg	46					7.21	11.42	
∑REE*	Orsuatsiaat	mg/kg	9					7.06	10.12	
∑REE*	Imeq salinnikoq	µg/l	0.35					0.34	0.35	2 µg/l[d]
∑REE*	Qeqqussat	mg/kg	3.96					1.66	3.75	
∑REE*	Qaleriissaat nunami	mg/kg	0.0002					109.87	0.0002	

*Akunnatsut minguissusaat ataasiakkaat 17-usut katinnerat 17 REEs Pm pinnagu.

a) MRA (2015) Kalaallit Nunaanni erngup pitsaassutsikkut qaffasissusissaannut piumasaqaatit (GWQC).

b) Bakke et al. (2010) – Norgemi qaaleriiaat nunami misissuinermi pitsaassusissamut piumasaqaatit; Inissisimaffik “Pitsaasoq”.

c) OSPAR (2014) - Uillut misissukkat nalilereqarnerini CEMP paasissutissat atorneqarput.

d) de Boer et al. (1996), Imeq inunnit imerneqartartoq Hollandimi pillugu isumannaatsuunissamut piumasaqaatitigut killissaliussaq ∑REE - qaassutsimut nalingitinneqartup inissisimaffia 32 µg/L-ssagaluarpoq.

e) Anon (2008) Kalaallit Nunaanni imaq, imeq salinneqanngitsoq aammalu imeq pillugu pitsaassutsimut killissaliussaq.

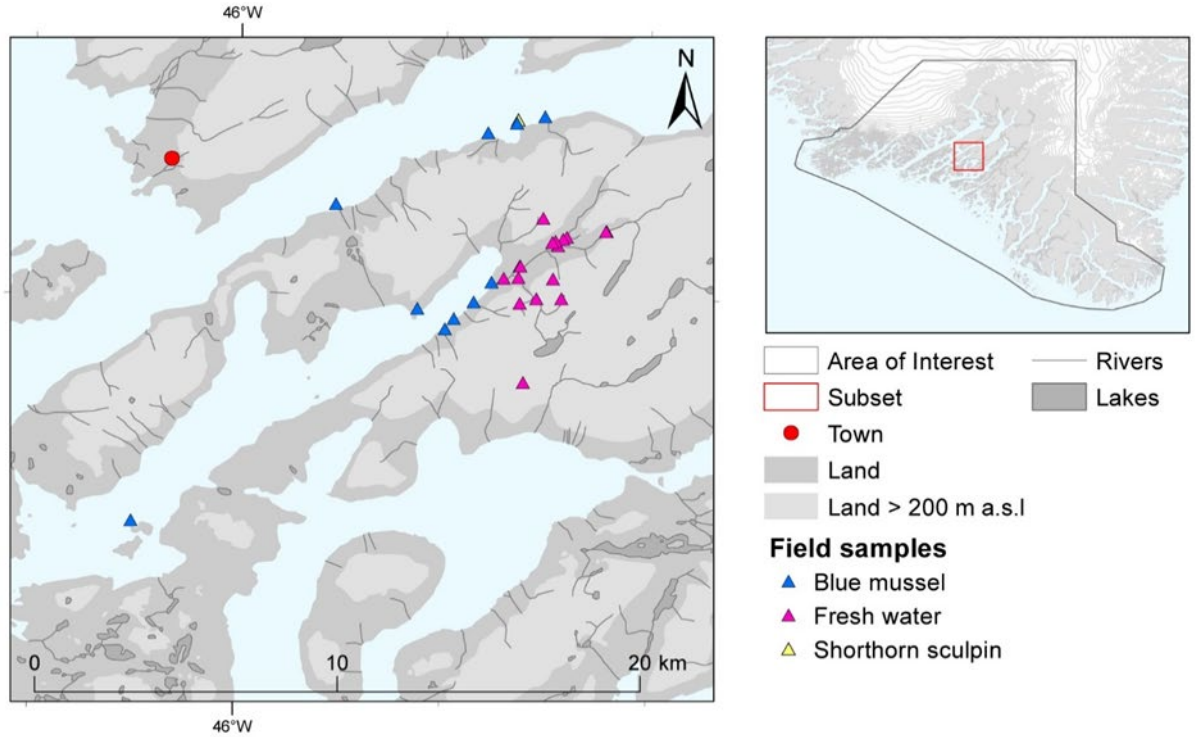
f) CWQG (2011) Canadami erngup pitsaassutissaanut piumasaqaatit sinaakkutaasut.

Akuutissat nalinginnaasumik qaffasinnerusut Kuannersuarni takussaapput. Misissuisimanerit inerisa takutippaat REE (tamarmiusoq), Zn, U, Pb aamma F avatangiisini soorlu aamma uilluni (Mytilus spp.), orsuatsiaani (Flavocetraria nivalis), qaleriissaat nunami, imeq tarajoqanngitsoq (salinnikoq aamma salinnneqanngitsoq) aamma qeqqussani (Fucus vesiculosus and Ascophyllum nodosum) ukiut ingerlanerini (2001-ullumikkumut aatsitassarsiortut siunnersortaannit aamma DCE-mit ingerlanneqartarsimasut)qaffasinnerusumik akorineqartoq toraartarsimagaat tamannalu Tabel 3.3.-mi takuneqarsinnaavoq. Akuutissat allat misissorneqarsimasut pigineqarput. Takussutissiaq 3.3-mi nunap assingatigut misissugassanit assigiinngitsunit aallerfiusarsimasut takuneqarsinnaapput.

Killavaat Alannguata eqqaa

Killavaat Alannguat imaluunniit Kringlerne sananeqaatimigut ujaqqat qaleriissaartutut isikkoqartuuvoq Kangerluarsuup kangerluani Narsap Qaqortullu akornani ippoq. Qaqqap ilusaani aatsitassaq eudialyte nassaassaavoq uanilu aatsitassaq qaqutigoortoq akoqanngiusartoq nassaassaavoq aamma REE.

1988, 1989, 2007, 2008 aamma 2010-mi avatangiisinit misissugassat misissueqqissaarnermut atatillugu katersorneqarput. Misissugassat tamakku misissugassaasivimmiitinneqarput siuinissami EIA-mit misissuinermi piiaanissamut akuersissummik qinnuteqarnermi atorneqartussatut siunniunneqartut. Taamaattoq, ullumikkut akuutissat katitigaanerat pillugit annikitsuinnarmik suliaqartoqarsimavoq. Takussutissiaq 3.4 takuuk sumi misissugassanik katersisoqarsimanera pillugu aamma Tabel 3.5 takuuk misissugassanit suut misissorneqarsimanersut.



Takussutissiaq 3.4. Killavaat Alannguata eqqaa misissugassanik assigiinngitsunik katersiviusimasoq.

Takussutissaq 3.4. Killavaat Alannguini eqqaanilu avatangiisimi misissugassanik katersinermit (1989 aamma 2007, 2010) kanassuni (Myoxocephalus scorpius) aamma imermi tarajuunngitsumi (salinnikoq) REE (tamarmi*), Zn, U, Pb aamma F akoqassuseq uuttorneqarsimapput, "Kalaallit Nunaanni uuttuinermi akunnaatsumik inernilik" nalinga aamma "Kujataani uuttuinermi akunnaatsumik inernilik" nalinga killeqarfimmi katersanit (mingutsinneqanngitsumiittut) aallaavigalugu kisinneqarsimapput AMDA-llu paasissutissaatigut piullutik. Pissarsiarineqarsinnaatillugu, najoqqutassat nalingi tunniunneqarsinnaapput.

Akuutissaq	Misissugassap suunera		Akunnatsoq	Minnerpaamik	Annerpaamik	Misissorneqarsimasut amerlassusai	Misissukkat amerlassusai	Kalaallit Nunaanni uuttuinermit akunnatsumik inernilik	Kujataami uuttuinermi akunnatsumik inernilik	Najoqqutassat nalingi
Cd	Kanassut	mg/kg	2.85	2.85	2.85	1	1	1.00	0.46	0.026 mg/kg[b]
Cd	Imeq salinneqanngitsoq	µg/l	0.01	<DL	0.09	30	25	0.01	0.01	0.1 µg/l[a]
Hg	Kanassut	mg/kg	0.04	0.04	0.04	1	1	0.05	0.01	0.035 mg/kg[b]
Hg	Imeq salinneqanngitsoq	µg/l	<DL	<DL	0.13	30	25	<DL	<DL	0.05 µg/l[a]
Pb	Imeq salinneqanngitsoq	µg/l	0.06	0.001	0.49	30	25	0.10	0.06	1 µg/l[a]
Se	Kanassut	mg/kg	0.25	0.25	0.25	1	1	0.86	0.88	
Se	Imeq salinneqanngitsoq	µg/l	0.20	<DL	0.43	30	25	0.07	0.20	
U	Imeq salinneqanngitsoq	µg/l	0.05	0.01	0.69	30	25	0.12	0.05	15 µg/l[c]
Zn	Imeq salinneqanngitsoq	µg/l	2.27	<DL	16.29	30	25	2.56	2.27	10 µg/l[a]

a) Kalaallit Nunaani erngup saligaatsuunissaanut piumasaqaatinut killissaliussat (GWQC) (MRA 2015).

b) OSPAR (2014) - CEMP-mi aalisakkat pillugit nakkutilliinermi naliliiniarnermi killissaliussat.

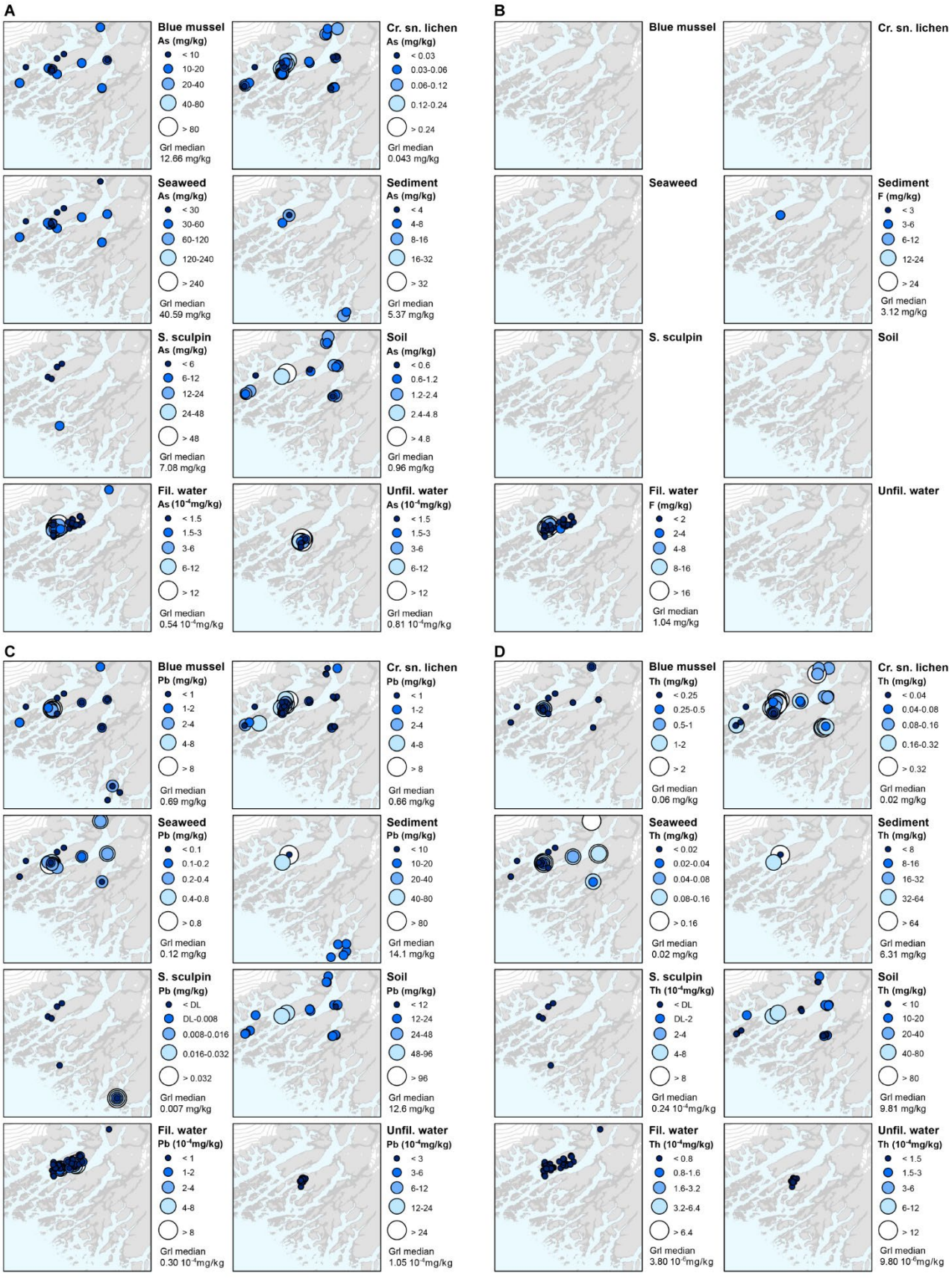
c) CWQG (2011) Canadami erngup saligaatsuunissaanut piumasaqaatinut killissaliussat.

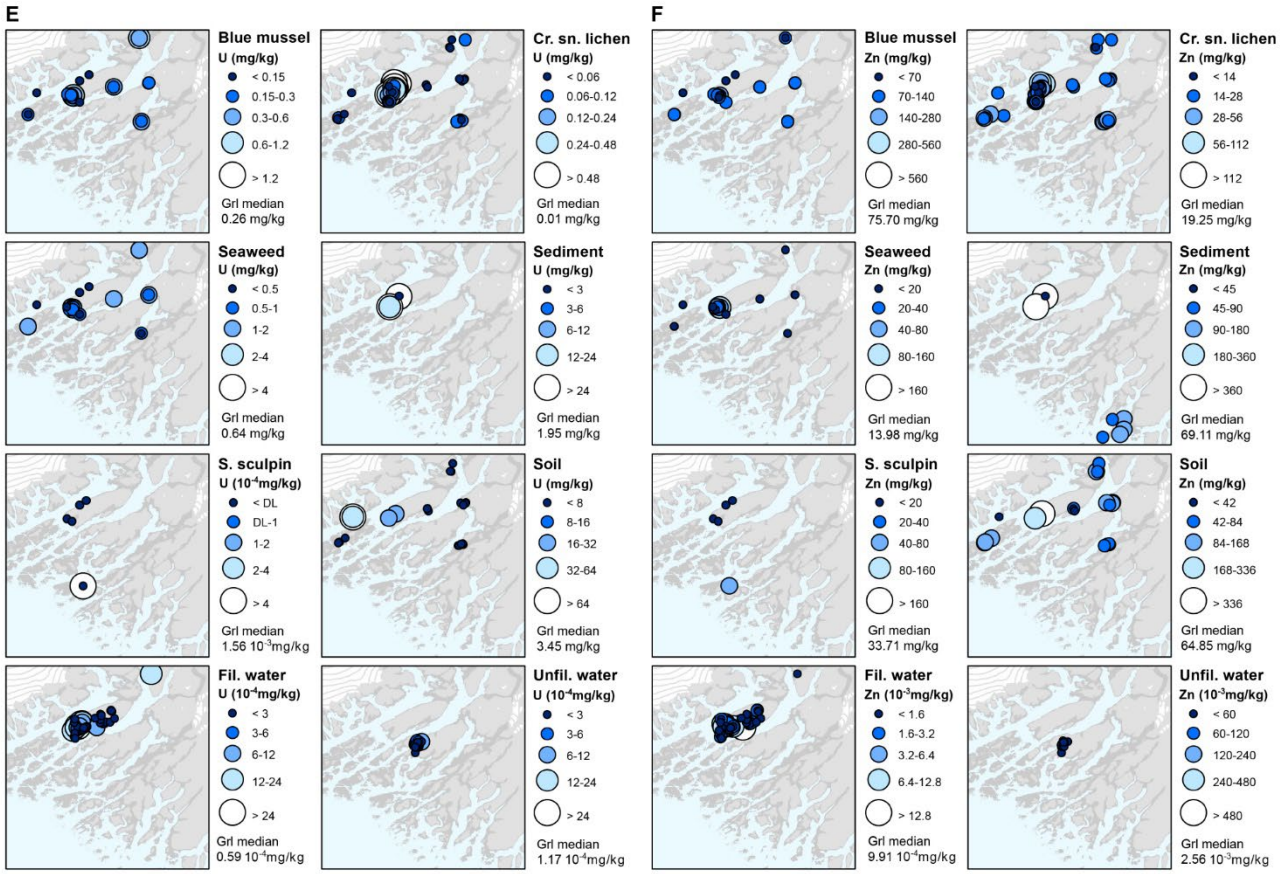
Ujarassiornikkut aamma avatangiisitigut akuutissat katitigaanerat

Takussutissiaq 3.5-mi (A - F) takuneqarsinnaavoq akuutissat immikkut toqqarsimasat (As, F, Pb, Th, U aamma Zn) misissugassanit assigiinngitsunit soqutigisaqarfiup iluaneersunit katersat. Killeqarfimmi misissugassatut tigusat uani ilanngunneqarput soorlu aatsitassarsiorfinnit pioreersunit imaluunniit allanit mingutsitsiviusimasunit misissugassanik katersanik ilanngussaqartoqanngilaq.

Killeqarfimmi paasissutissat pissarsiarineqarsinnaasut tamarmik tunngavigalugit (misissugassatut katersat mingutsinneqarsimanngitsumik katersat) AMDA-p paasissutissaasiviani, "Kalaallit Nunaanni uuttuinermi akunnatsumik inernilik" minguitsup nalingata misissugassanit assigiinngitsunnit arfineq pingasuneersunit naatsorsorneqarsimavoq. "Kalaallit Nunaanni uuttuinermi akunnatsumik inernilik" nalinga misissugassanit 2115-usunit Kalaallit Nunaani sumiiffinnit tamaneersumit naatsorsorneqarpoq (qeqqussat: 71; orsuatsiaat: 194; uillut: 364; kanassut4; qalerissaat nunamit: 123; issoq: 43; imeq salinnikoq: 288, aammalu imeq salinneqanngitsoq: 178). "Kalaallit Nunaanni uuttuinermi akunnatsumik inernilik" nalinga Takussutissiaq 3.5-mi inissisimaffiit pillugit allassimasuni ilanngunneqarput aammalu Ilanngussaq 2-mi "Kalaallit Nunaani uuttuinermi akunnatsumik inernilik" nalingi takuneqarsinnaapput.

Maluginiarneqassaaq suussutsit ilai aammalu misissugassat aaliangersimasut ilai pillugit annikitsuinnarmik paassissutissanik peqarmat. Aamma maluginiaqqunarpoq "Kalaallit Nunaanni uuttuinermi akunnatsumik inernilik" nalingi imaanngilaq nunakkut/silaannakkut oqimaaqatigiissarneqarsimasut kisiannili oqimaaqatigiissaarsimanngitsut akunnattut killeqarfimmi misissukkatut katersat ersipput taakkuusarpullu sumiiffinni amerlasuujusartut aammalu aatsitassarsiorniarnermi taakkuupput soqutiginaateqartut, kisianni aamma avatangiisinit misissugassanik allanik katersanik ilaqartinneqarput.


A
Blue mussel
As (mg/kg)
< 10
10-20
20-40
40-80
> 80
Grl median
12.66 mg/kg
Cr. sn. lichen
As (mg/kg)
< 0.03
0.03-0.06
0.06-0.12
0.12-0.24
> 0.24
Grl median
0.043 mg/kg
Seaweed
As (mg/kg)
< 30
30-60
60-120
120-240
> 240
Grl median
40.59 mg/kg
Sediment
As (mg/kg)
< 4
4-8
8-16
16-32
> 32
Grl median
5.37 mg/kg
S. sculpin
As (mg/kg)
< 6
6-12
12-24
24-48
> 48
Grl median
7.08 mg/kg
Soil
As (mg/kg)
< 0.6
0.6-1.2
1.2-2.4
2.4-4.8
> 4.8
Grl median
0.96 mg/kg
Fil. water
As (10-4mg/kg)
< 1.5
1.5-3
3-6
6-12
> 12
Grl median
0.54 10-4mg/kg
Unfil. water
As (10-4mg/kg)
< 1.5
1.5-3
3-6
6-12
> 12
Grl median
0.81 10-4mg/kg
B
Blue mussel
Cr. sn. lichen
Seaweed
Sediment
F (mg/kg)
< 3
3-6
6-12
12-24
> 24
Grl median
3.12 mg/kg
S. sculpin
Soil
Fil. water
F (mg/kg)
< 2
2-4
4-8
8-16
> 16
Grl median
1.04 mg/kg
Unfil. water
C
Blue mussel
Pb (mg/kg)
< 1
1-2
2-4
4-8
> 8
Grl median
0.69 mg/kg
Cr. sn. lichen
Pb (mg/kg)
< 1
1-2
2-4
4-8
> 8
Grl median
0.66 mg/kg
Seaweed
Pb (mg/kg)
< 0.1
0.1-0.2
0.2-0.4
0.4-0.8
> 0.8
Grl median
0.12 mg/kg
Sediment
Pb (mg/kg)
< 10
10-20
20-40
40-80
> 80
Grl median
14.1 mg/kg
S. sculpin
Pb (mg/kg)
< DL
DL-0.008
0.008-0.016
0.016-0.032
> 0.032
Grl median
0.007 mg/kg
Soil
Pb (mg/kg)
< 12
12-24
24-48
48-96
> 96
Grl median
12.6 mg/kg
Fil. water
Pb (10-4mg/kg)
< 1
1-2
2-4
4-8
> 8
Grl median
0.30 10-4mg/kg
Unfil. water
Pb (10-4mg/kg)
< 3
3-6
6-12
12-24
> 24
Grl median
1.05 10-4mg/kg
D
Blue mussel
Th (mg/kg)
< 0.25
0.25-0.5
0.5-1
1-2
> 2
Grl median
0.06 mg/kg
Cr. sn. lichen
Th (mg/kg)
< 0.04
0.04-0.08
0.08-0.16
0.16-0.32
> 0.32
Grl median
0.02 mg/kg
Seaweed
Th (mg/kg)
< 0.02
0.02-0.04
0.04-0.08
0.08-0.16
> 0.16
Grl median
0.02 mg/kg
Sediment
Th (mg/kg)
< 8
8-16
16-32
32-64
> 64
Grl median
6.31 mg/kg
S. sculpin
Th (10-4mg/kg)
< DL
DL-2
2-4
4-8
> 8
Grl median
0.24 10-4mg/kg
Soil
Th (mg/kg)
< 10
10-20
20-40
40-80
> 80
Grl median
9.81 mg/kg
Fil. water
Th (10-4mg/kg)
< 0.8
0.8-1.6
1.6-3.2
3.2-6.4
> 6.4
Grl median
3.80 10-4mg/kg
Unfil. water
Th (10-4mg/kg)
< 1.5
1.5-3
3-6
6-12
> 12
Grl median
9.80 10-4mg/kg



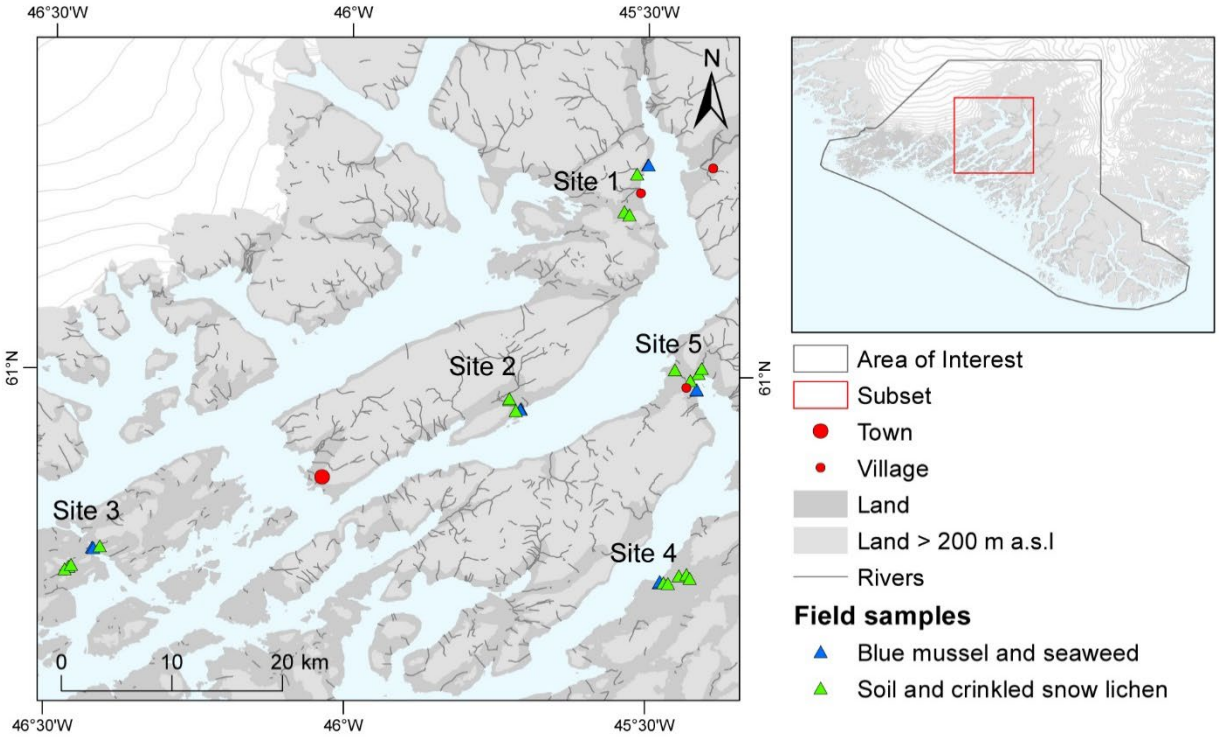
Takussutissiaq 3.5. Killeqarfimmi akuutissat misissugassani katersaniittut makku annertuumik akullit arsenic, As (a), fluor, F (b), lead, Pb (c), thorium, Th (d), uranium, U (e) aamma zinc, Zn (f) (mingutserneqarsimanngitsumit tigusat) AMDA-p paasis-sutaasivianut soqutigisaqarfiusumut tunngasunut katersorneqarput. "Kalaallit Nunaani uuttuinermi akunnattumik inernilik" nalinga katersanit killeqarfimmeersumit tamanit naatsorsorneqarpoq AMDA-llu paasissutissaasiviani ilaavoq. Nunap assingini takussutissani nalinganik allassimasoqanngitsoq isumaqarpoq "paasissutissaqanngilaq".

Killeqarfimmi akunnattumik inernilimmi nalinga sumiiffinni arfineq pingasunik Kalaallit Nunaanni sumi tamaanit tunngaveqartumik naatsorsornikuuvoq. "Kujataani uuttuinermi akunnattumik inernilik" tassaavoq naliliiniarnermi uani soqutigineqarluni pingaarneq. Sumiiffinni assigiinngitsunit akunnattumik inerniliiniarneq akoqassutsimut nali sumiiffinnut allanut sanilliullugu allaanerungaatsiarsinnaavoq assigiinngitsuusinnaallunilu tamannalu Ilassut 2-mi takuneqarsinnaavoq, ilanngullugu nunap assiliaq Kalaallit Nunaanni sumiiffinni misissugassanik katersat qanoq assigiinngitsigisuniinnerannik takussutissiaavoq.

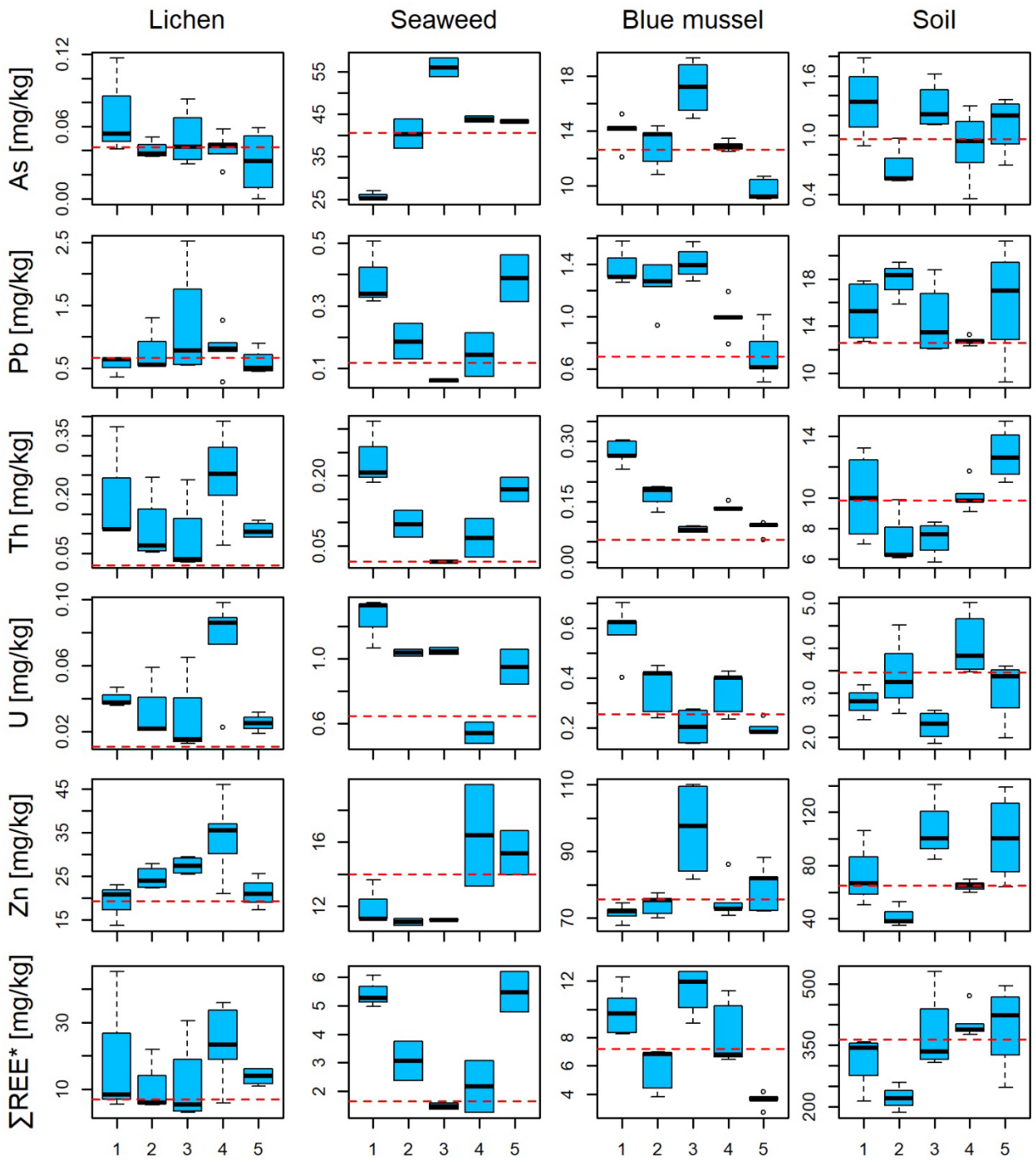
Kujataani killeqarfimmi paasissutissat - nunami 2020-mi misissuisimanermit

Avatangiisimit katersat misissugassat (orsuatsiaat, issoq, uillut aamma qeqqussat) killeqarfimmi inissisimaffik erseqqissarniarlugu katersorneqarsimapput Kujataata qeqqani RBA -mi soqutiginaateqartumi. Misissugassanik katersiviit tallimaasut (Site 1-5) Takussutissiaq 3.6-mi takuneqarsinnaapput. Naliliiffissat allat pillugit katersuisoqarsimavoq sumiiffinni As, Zn, Pb, U, Th aamma REE qanoq inissisimatiginersut paasiumallugu taakkulu Takussutissiaq 3.7-mi takuneqarsinnaapput misissugassatut katersat suuneri pillugit (orsuatsiaat, issoq, qeqqussat aamma uillut). Assiliartami "Kalaallit Nunaanni uuttuinermi akunnatsumik inernilik" nalinga aamma sanillersuutitut ilanngunneqarpoq. Inerniliussamiit sumiiffinniit tallimaasuniit oqaatigineqarsinnaanngilaq

ilumut Kalaallit Nunaata sinneranit appasinnerusumik imaluunniit qaffasinnerusumik akunnattumik inerniliussat naleqarnersut. Taamaattoq, misissugassatut katersaasimasut erseqqissumik akuutissat sumiiffimmiittut akuutissanut allaanerusunut killeqarfimmiittunut attuumassuteqarnersut oqaatigiuminaappoq. Inernerit taakku takutippaat immikkut killeqarfigisami aatsitassarsiortoqassatillugu avatangiisit eqqarsaatigalugit pilersaarusiorluarsimanissaq ilisimasanillu katersilluarnissaq qanoq pingaaruteqartiginersoq.



Takussutissiaq 3.6. 2020-ip aasaanerani nunami suliaqarnermi avatangiisiniit misissugassanik katersiviit.

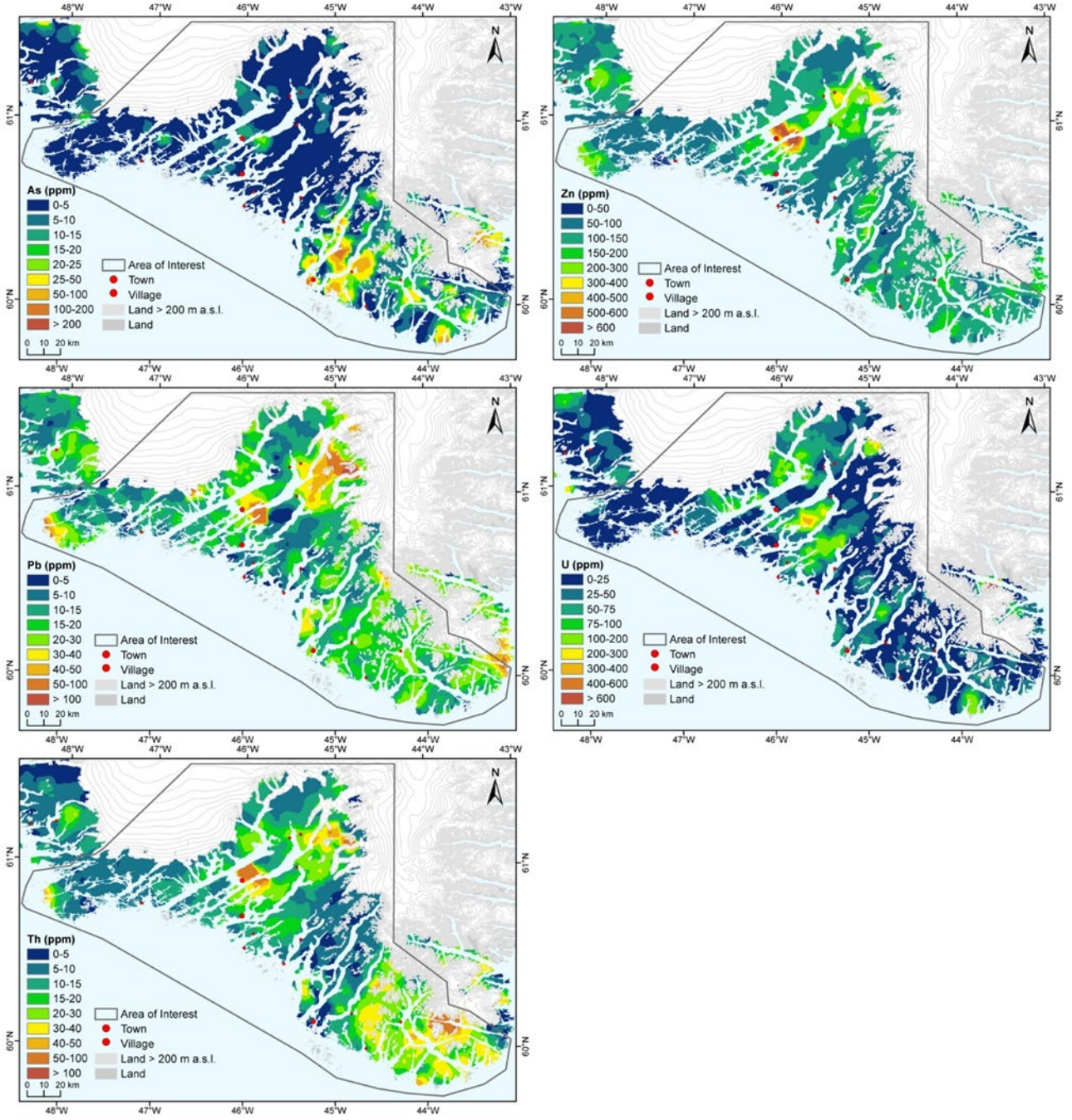


Takussutissiaq 3.7. Kipparissut allattorsimasut misissukkanit katersiviit As, Zn, Pb, U, Th aamma REE -mik akoqartut (orsuatsiaat, issoq, qeqqussat aamma uillut) ersipput tamannalu ingerlanneqarpoq 2020-ip aasaagaa nunami sulinermi (Kujataani killeqarfik RBA misissukkat). Normut x-tallit sumi katersiveqarsimanerinik ersersitsipput soorlu Takussutissiaq 3.6-mi. Aappalaartumik nalunaarsornilik: "Kalaallit Nunaani uuttuinermi akunnattumik inernilik"-ip nalinga.
*17 REEs Pm -lu pinnagu ataasiakkaat akunnatsumik ataasiakkaarlutik nalingi.

3.4 Ujarassiornikkut aamma avatangiisitigut akuutissat katitigaanerat

Nalunaarummi uani GEUS naalisakkamik nassuiaasiorpoq Kujataani ujarassiorneq pillugu (Takuuk Kapitali 2 aamma Ilanngussaq 1), aammalu paasissutissat sukumiinerusut pillugit takuuk Steenfeldt et al. (2000 and 2016).

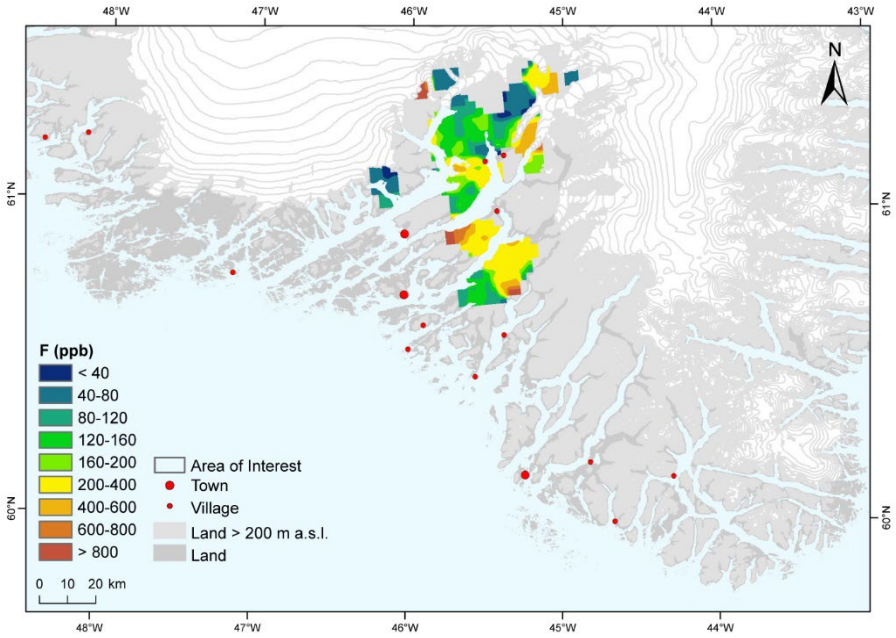
Naalisakkap ilaatut GIS-mit paassissutissat pissarsiarineqarsinnaapput, akuutissat ujarassiornikkut qanoq ittuuneri pillugit qaleriissaattutut misissueqqissaarsimaneq GEUS-ip paasissutissaateqarfianit aamma katersuinerup nalaani katersorneqarput. Katersat seqersiffigalugit misissoqqissaarneqarsimasut Zn, Pb, U, Th aamma As (GIS paasissutissaatai) akoqarasoralugit. Misissugassatut katersat sapinngisaq tamaat Kujataa tamakkerlugu katersiviupput aammalu aappassaanik imaluunniit pingajussaanik seqersiffigalugit misissorneqartut tamarmik 10 km2 iluanit katersaapput (Thrane and Olsen 2020, Ilanngussaq 1). Misissukkat immameersut aamma ujaqqaneersut fluoridemik akoqarneri misissorneqarput. Ujaqqanit paasissutissat paasissutissanik marlunnik immikkoortunik ilaqarput kisianni paasissutissanik katersaasivimmiittunut sanillersuussinnaallutik (GEOROC aamma GEUS paasissutissaasivia); taamaattoq, paasissutissat taakku saqqummiunneqarput sanillersuunneqarlutillu (GIS-mit paasissutissanut). Paasissutissat annertunerusut Ilanngussaq 1-mi takuneqarsinnaapput.



Takussutissiaq 3.8. Ujarassiornikkut akuutissat katitigaanerat pillugu nunap assingani qalipaasersuutitigut arsenic, As, zink, Zn, lead, Pb, uranium, U, aamma thorium, Th-nik akoqassuseq takuneqarsinnaapput. Paaissutissat GEUS-ip paasissutissaasivianit pissarsiaapput (GIS paasissutissat)

Ujarassiornikkut akuutissat katitigaaneri seqersillugit qaleriissaaneri misissugassatut katersat ima paasineqassapput, taakkuummata sumiiffimmi pissutsit qanoq inissisimanerinut sakkussutissatsialaat tigussaasut paasissutissanik katersiniarnermi atorneqarsinnaasut. Paasissutissat isorartussutsimit uuttuummit 2,500 m -mit illuatungeriisillugit atorneqarput. Paasissutissanik katersinermi ungaluugaasaq katersivilerlugu atorneqarpoq. Silaannarmiissinnaasoq atorneqarpoq uuttuutillu (klumpeq, ungasissuseq aamma illaagutaasalik) tamarmik immikkut qaleriissaarneri aallaavigalugit suussusersineqarsinnaallutik. Takussutissiaq 3.8-mi (a, b, c, d, e) takuneqarsinnaapput nunami assitami. Fluorine katersat misissugassat Takussutissiaq 3.9-mi nunap assingatigut takuneqarsinnaavoq.

Seqersitsinikkut erserpoq qaleriissaakkatut inissisimasut Kalaallit Nunaata sinneranut sanilliullugit akuutissat eqqarsaatigalugit Kujataa immikkuullarissumik inissisimasuusoq, pingaartumik uran aamma arsenice akoqannginnerusumik nassaassaagamik. Kalaallit Nunaanni tamarmiusumi misissuinermi gulti tamaani akoqannginnerpaatut taaneqarpoq (Steenfelt 1990; Steenfelt 1996).



Takussutissiaq 3.9. Ujaqqani akuutissat katitigaanerat nunami misissuiffiusimasumit nunap assingatigut qalipaaserlugu takussutissiaavoq, uani fluoride (F) qanoq akoqassusaa imermi misissueqqaarnermi atorneqarpoq. Paasissutissat GEUS-p paasissutissaasivianeersuupput (GIS-p paasissutissaatai)

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4 Uumassusillit assigiinngiiaassusiat uumasoqatigiiaanut pingaarutillit sumiiffiillu eqqissisimatitat

Allattut Katrine Raundrup[1], Karl Zinglersen[1] and David Boertmann[2]

[1]Greenland Institute of Natural Resources, [2]Department of Ecoscience, Aarhus University

4.1 Aallarniut

Kalaallit Nunaata Kujataani sila isseqannginnerpaajuvoq, nunallu ilaminerujussua soqutigisamiippoq (AOI) ujaqqat akoqassusaasa katitigaanerat Issittup kissarnerusortaatut taaneqartarpoq pissutigalugu juulimi silap kissassusia agguaqatigiisillugu 10 °C.-nik kissarnerusarmat. Tamassuma kinguneraa nunap naanera oqquartani portusuunngorsinnaasarluni nunalerinissarlu periarfissaalertarluni. Uumassusillit assigiinngisitaarnerat orpikkatigut annertoqaaq kisiannili timmissatigut miluumassutigullu annikinnerusumik inissisimavoq.

Kapitalimi uani avatangiisimi uumassusillit AOI-p iluaniittut ataatsimut nassuiarneqassapput. Uumasut takkutikulasut nalinginnaasullu aammalu peqassuseq uuttorneqassaaq assigiinngitsutigut pingasunut immikkoortiterlugu; AOI-mut sanilliullugu, Kalaallit Nunaanni tamarmut sanilliullugu aammalu nunarsuaq tamakkerlugu uuttuutinut sanilliullugu. Ilanngullugulu, aarlerinartorsiortinneqarnerat qanoq inissisimanersoq erseqqissaavigineqassalluni allattorsimaffik aappalaartumut nalunaarsorsimaneri aallaavigalugit (naalisaanerit IUCN-ip aarlerinartorsiortutut allattorsimaffianiittut naapertorlugit: LC, mianernanngitsumiittoq; NT aarlerinartorsiornissaminut qanittumiittoq; VU, navianartumiittoq; EN, nungutaanissamut ulorianartorsiortoq; CR, nungutaalluinnarnissamut ulorianartorsiortoq) tamarmik nuna tamakkerlugu uuttuutit aamma nunarsuarmioqatigiit akornanni uuttuutit atuuttut atorneqarput. Tabel 4.1 naalisagaq paasissutissat uumasunut tunngasut takuneqarsinnaapput aamma Tabel 4.2 naasunut tunngasoq.

Imartat avataa ilanngunneqanngilaq, taamaallaat miluumasut imarmiut aammalu aalisakkat sinerissami qanittumiittut ilanngunneqarput. Paasisssutissat sumiiffinnut eqqissisimatitanut tunngasut, nunap naaneranut itisiliisumik nassuiaatinullu tunngasut nunap assiliorneri aammalu uumassusillit pingaarutillit sumiiffii pingaarutillit ilanngullugit ersersinneqarput. Paasissutissat aaliangersimasut amigaatigineqarneri peqqutigalugit pupiit, bryophytes aamma sullullit pillugit nalunaarusiami uani ilaatinneqanngillat.

Kalaallit Nunaata kujataa nunaleriffiusartoq ilisimaneqarluarpoq. Qulequttamut tassunga attuumassuteqartut Kapitali 5-mi Inuit Atuinerisa ataani saqqummiunneqassapput.

Tabel 4.1. Timmissat aammalu miluumasut AOI-miittut (F, tatsini; M, imartani, T, Nunami) aammalu nunami tamarmi nunarsuarlu tamakkerlugu allattorsimaffik aappalaartumut nalunaarsorsimasut (IUCN arlerinartorsiortut pillugit allattorsimaffiat: LC mianernanngitsumiittut; NT, aarlerinartorsiornissamut qanittumiittut; VU, navianartumiittut; EN, nungutaanissamut aarlerinaatilimmiittut; CR, nungutaalluinnarnissamut aarlerinartorsiortut, DD paasissutissat naammanngitsut; NE, nalilersorneqarsimanngitsut). AOI-miittut ilanngullugit (B, manniliortut; W Ukiisartut; S, aasaanerani takkusimaartartut) AOI-mut pingaaruteqartuupput aasaaneranimut aamma ukiuuneranimut (L, appasippoq; M, akunnappoq; H, qaffasippoq; O, saqqumineq ajorput; ? ilisimaneqanngilaq), aamma AOI-mi nunarsuarmioqatigiillu uuttuutaat naapertorlugu inissisimaneri. * Nunap namminerisamik uumasui. Paasissutissat uannga pissarsiaapput Boertmann & Bay (2018). Maannamut IUC-p ataani allattorsimaffik
aappalaartumi nalunaarsorsimasut uani takuneqarsinnaapput www.iucn.redlist.org.

			Peqassuseq pillugu allattorsimaffimmi aappalaartumi nalunaarsorsimasut			AOI summiiffimmi peqarneranut pingaaruteqarnerat		AOI nunarsuarmi peqarneranut pingaaruteqarnera
Suussuseq	**Ilisimatuussutsikkut taaguut**	**Sumiiffiit**	**Nunami nammineq**	**Nunarsuarmioqatigiinni**	**Peqassuseq**	**Aasakkut**	**Ukiukkut**	
Timmissat								
Alleq	*Clangula hyemalis*	F, M	LC	VU	B, W	L	H	M
Miteq sioraki	*Somateria spectabilis*	M	LC	LC	W	0	L	L
Miteq siorartooq	*Somateria mollissima*	M	LC	NT	B, W	L	H	M
Nujalik	*Mergus serrator*	F, M	LC	LC	B, W	L	M	L
Toornaviarsuk	*Histrionicus histrionicus*	F, M	LC	LC	B, S, W	M	M	M
Qeerlutooq	*Anas plathyrhynchos*	F, M	LC	LC	B, W	L	H	H*
Aqisseq	*Lagopus mutus*	T	LC	LC	B, W	L	L	L
Qarsaaq	*Gavia stellata*	F, M	LC	LC	B	L	0	L
Tuullik	*Gavia immer*	F, M	NT	LC	B	M	0	M
Timmiakuluk	*Fulmarus glacialis*	M	LC	LC	B, W	L	L	L
Qaqullunnaq	*Ardenna gravis*	M	LC	LC	S	L	0	L
Oqaatsoq	*Phalacrocorax carbo*	M	LC	LC	W	0	L	L
Tuujuk	*Charadrius hiaticula*	T	LC	LC	S	L	0	L
Saarfaarsuk	*Calidris maritima*	T	LC	LC	B, W	L	L	L
Naluumasortoq	*Phalaropus lobatus*	F, M	LC	LC	B	L	0	L
Qilanngaq	*Fratercula arctica*	M	VU	VU	B	L	L	L
Serfaq	*Cepphus grylle*	M	LC	LC	B, W	M	M	L
Apparluk	*Alca torda*	M	LC	NT	B	H	0	L
Appaliarsuk	*Alle alle*	M	LC	LC	W	0	M	L
Appa	*Uria lomvia*	M	VU	LC	B, W	H	H	M
Appa sigguttooq	*Uria aalge*	M	EN	LC	B, W	H	H	L
Isunngaq	*Stercorarius parasiticus*	M	LC	LC	B	L	0	L
Taateraaq	*Rissa tridactyla*	M	VU	VU	B, W	L	L	L

Nasalik	*Chroicocephalus ridibundus*	F, M	VU	LC	B	H	0	L
Naajarluk	*Larus fuscus*	M	LC	LC	B	M	0	L
Naajaannaq	*Larus glaucoides*	M	LC	LC	B, W	L	M	M*
Naajarujussuaq	*Larus hyperboreus*	M	LC	LC	B, W	L	M	L
Naajarluk	*Larus marinus*	M	LC	LC	B, W	L	M	L
Imeqqutaalaq	*Sterna paradisaea*	M	NT	LC	B	L	0	L
Nattoralik	*Haliaeetus albicilla*	T, M	VU	LC	B, W	H	H	M
Kissaviarsuk	*Falco rusticolus*	T	NT	LC	B, W	L	L	L
Kiinaaleeraq	*Falco peregrinus*	T	LC	LC	B	M	0	L
Kussak	*Oenanthe oenanthe*	T	LC	LC	B	L	0	L
Kussattarsuaq	*Turdus iliacus*	T	DD	LC	B	H	?	L
Tulugaq	*Corvus corax*	T	LC	LC	B, W	L	L	L
Orpimmiutaq	*Acanthis flammea*	T	LC	LC	B	L	0	L
Orpimmiutaq qaqortaq	*Acanthis hornemanni*	T	LC	NE	W	0	L	L
Narsarmiutaq	*Calcarius lapponicus*	T	LC	LC	B	L	0	L
Qupaloraarsuk	*Plectrophenax nivalis*	T	LC	LC	B	L	0	L
Miluumasut								
Natseq	*Phoca hispida*	M	LC	LC	S, W	L	L	L
Qasigiaq	*Phoca velutina*	M	CR	LC	S, W	H	H	L
Aataaq	*Pagophilus groenlandicus*	M	LC	LC	S, W	L	L	L
Pagophilus groenlandicus	*Cystophora cristata*	M	VU	VU	S	M	L	M
Ussuk	*Erignathus barbatus*	M	LC	LC	W	L	L	L
Tikaagullik	*Balaenoptera acutorostrata*	M	LC	LC	S	L	L	L
Qipoqqaq	*Megaptera novaeanglia*	M	LC	LC	S	L	L	L
Niisa	*Phocoena phocoena*	M	LC	LC	S	L	L	L
Aarluarsuk	*Lagenorhynchus albirostratus*	M	LC	LC	S	L	L	L
Aarluarsuk	*Lagenorhynchus acutus*	M	DD	LC	S	L	L	L
Niisarnaq	*Globicephala melas*	M	LC	LC	S	L	L	L
Nanoq	*Ursus maritimus*	M/T	VU	VU	S, W	L	L	L
Terianniaq	*Vulpes lagopus*	T	LC	LC	B, W	L	L	L
Ukaleq	*Lepus arcticus*	T	LC	LC	B, W	L	L	L

4.2 Miluumasut

Miluumasut nunamiut

Kalaallit Nunaanni miluumasut nunamiut nalinginnaasut arfineq marluupput taakkunanillu marluk Kujataani uumasuupput: Terianniaq (*Vulpes lagopus*), aamma Ukaleq (*Lepus arcticus*).

Sumiiffimmi tamaani terianniaq ukalerlu takussaapput kisiannili qanoq amerlassusii ilisimaneqanngillat. Ukaleq piniagarissallugu nuannarineqarpoq kisiannili terianniaq annerpaartaatigut perlerortuusinnaanera pillugu pisarineqartarpoq (takuuk Kapitali 5, "Inuit atuinerat") killeqanngitsumik piniagaapput septemberip qeqqaniit maajip qeqqanut (terianniaq) aamma augustimiit aprilimut (ukaleq). Marluutillugit pigiinnarumaneqarput nalunaarsorsimaffimmiippullu "aarlerinanngitsutut" (LC) Kalaallit Nunaanni allattorsimaffimmi aappalaartumi nalunaarsukkatut (Boertmann and Bay 2018).

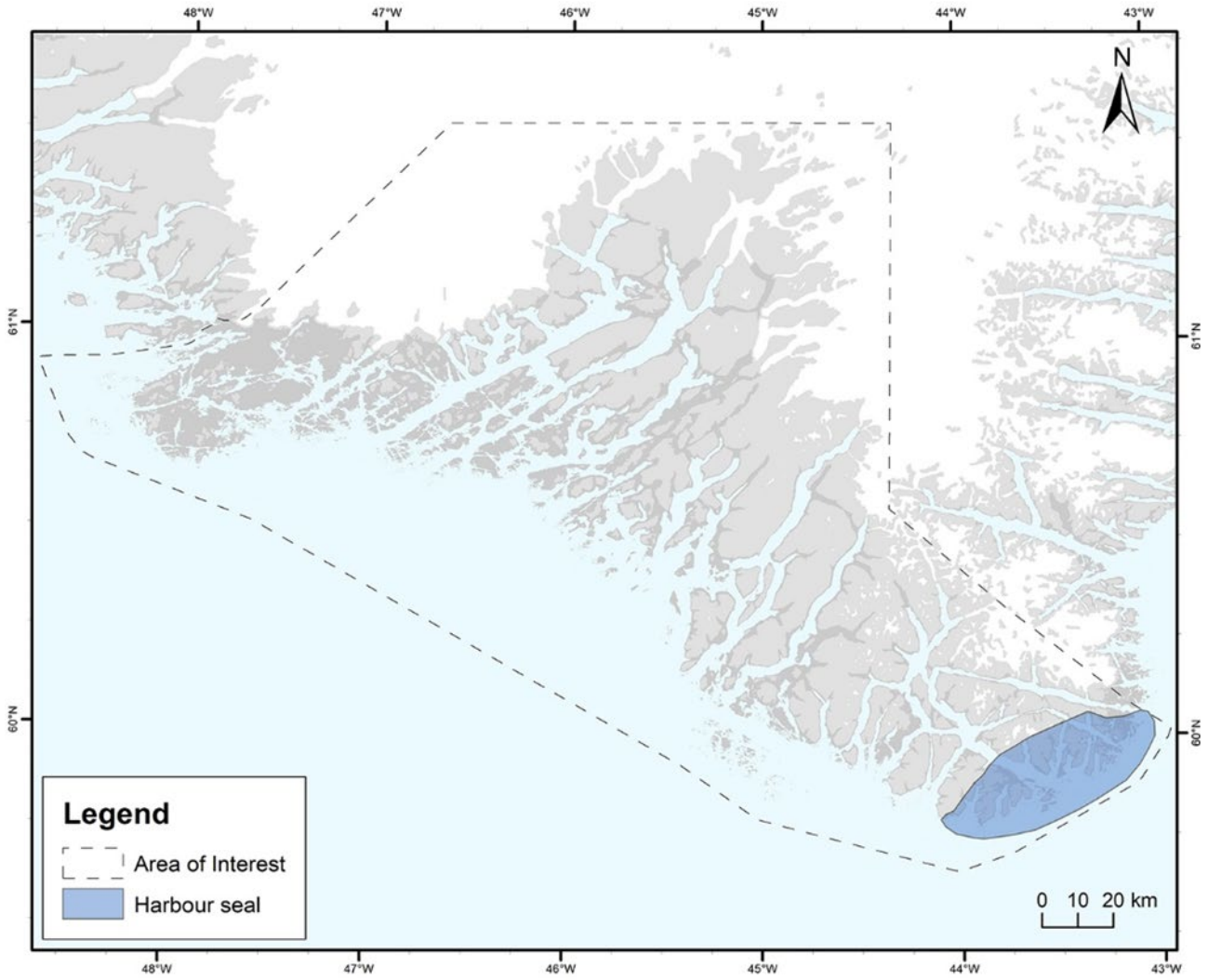
Umimmak (*Ovibos moschatus*) Ippatinut Nanortallip kangerliumaneranut 2014-mi umimmaliisoqarpoq (Takussutissiaq 5.2) siornatigut tamaani umimmaqarnissaa nalinginnaasuunngilaq. Kingullertigut kisitsisoqarmat (2020-mi) eqqoriarneqarpoq umimmaat 46-usut, sulili piniagarineqarnissaat ammaanneqarnikuunngilaq.

Tuttuutit (*Rangifer tarandus tarandus*) 1973-mi Isortoq aamma Tuttutooq 1992-mi (Takuuk Kapitali 5.2.3 aamma Takussutissiaq 5.2) tuttulerneqarput, sumiiffinnilu taakkunani marluusuni suli tuttuuteqartoqarpoq (Cuyler 1999). Sumiiffinni taakkunani marluusuni ukiumut ataasiarlutik tuttut katersorneqartarput toqoraanerlu ingerlanneqartarluni (takuuk Kapitali 5 "Inuit atuinerat").

Miluumasut imarmiut

Kujataani miluumasut imarmiut arlariit nalinginnaasumik uumasuupput. Puisinit qasigiaq (*Phoca vitulina*) Kalaallit Nunaanut tamanut pingaaruteqarpoq qasigissallu AOI-mi (Takussutissiaq 4.1) amerlanersai nassaassaapput. Qasigiaq Issittumi imartani nillerpallaanngitsuni nassaassaasarpoq. Kalaallit Nunaanni ullumikkut qasigiaq qaqutigoortuuvoq nungutaalluinnarnissamullu aarlerinartorsiortutut nalilerneqarluni (Boertmann and Bay 2018) maannakkut piaqqiorfii mamaarfiilu ikitsuinnanngorsimallutik (Rosing-Asvid 2010). AOI-p iluani qaqisigissat suli katerisimaarfeqarput - Qeqertani Narsaq Kujallermit (Narsarmiji) kangimut) (Takussutissiaq 4.1). Sumiiffik tamanna piaqqiornerup nalaani najorneqartarpoq (maajip naaneranit juulip aallartisimalerneranut) aamma mamaarnerup nalaani (augustip qeqqaniit septemberip qeqqanut), taamaattoqq piaqqiorfiit mamaarfiillu marluk taakku piffissap taassuma avataani pisinnaapput (Rosing-Asvid 2010). Kalaallit Nunaanni peqassuseq appariartortuummat maannakkullu 100-innaasutut eqqoriarneqarmat, taakkunanilu affai AOI-miillutik, "nungutaalluinnarnissamut ulorianartorsiortutut" Kalaallit Nunaanni allattorsimaffik aappalaartumi nalunaarsorsimapput (Takussutissaq 4.1 and Boertmann and Bay 2018). Qasigiaq 2010-miilli (Anon. 2010), eqqissisimatitaavoq aamma aatsitassarsiortoqassappat qasigissap katerisimaffii siunissami pilersaarutini ilaatinneqartariaqarput (takuuk Ilanngussaq 3).

Puiseqatigiit allat sisamat AOI-miipput (Frederiksen et al. 2012), tamarmillu Kalaallit Nunaata imartaani nalinginnaasuupput. Natseq (*Phoca hispida*) nalinginnaasuuvoq sumilu tamaani imartani ilulialinni ukioq kaajallallugu takussaalluni (kangerluit iigartartullit). Aataaq (*Pagophilus groenlandica*) amerlasuujulluni piuvoq aasaaneranilu sineriammiuusarpoq kisianni ukiukkut aamma takkusimaartarluni; Qaqortup avataani sikuni piaqqiortoq aamma qanittumi nalunaarsorneqarsimavoq (Rosing-Asvid 2008). Natsersuaq (*Cystophora cristata*) avataani takussaaneruvoq, aamma nunarsuaq tamakkerlugu peqassuseq appariartorpoq. "Aarlerinartumiittutut" (VU) Kalaallit Nunaanni aamma nunarsuarmioqatigiit allattorsimaffianni aappalaartumi nalunaarsorsimavoq (Boertmann and Bay 2018) pissutigalugu peqassuseq tamarmi appariartormat. Puiseqatigiit sisamaat ussuk (*Erignathus barbatus*), sikup takkusimaanerani ikittukkaarlutik takussaasartut.



Takussutissiaq 4.1. Qasigissat AOI-mi sumiiffii. Piaqqiornermi mamaarnermilu sumiiffiit nalunaaqutsersimasuni ataaseq imaluunniit arlariit najugaqarfigisarpaat (Rosing-Asvid et al. 2020).

Arferit amerlanerit Kujataani takussaassarput avataaniittarmatalu uani nalunaarusiami ilanngunneqanngillat. Taamaakkaluartoq, arferit soqqallit, tikaagullik (*Balaenoptera acutorostrata*) aammalu annikinnerusumik qipoqqaq (*Megaptera novaeangliae*) ilaatigut sinerissap qanittuanut kangerlunnut aasaanerani pulasimaarsinnaapput. Arfeqatigiit taakku marluk Kalaallit Nunaata imartaani nalinginnaasuupput. Arferit kigutillit soorlu niisa

(*Lagenorhynchus albirostris*), aarluarsuk (*Lagenorhynchus acutus*) aamma niisarnaq (*Globicephala melas*) aammalu nannut (*Ursus maritimus*) ilaatigut AOI-mi sinerissap qanittuaniittarput Tunumiit sikorsuartigut takkuttarlutik.

4.3 Timmissat

Timmissat tasermiut aammalu sinerissap qanittuaniittut

AOI-mi timmissat avatangiisimi nalinginnaanerpaat timmiaaraapput: qupaloraarsuit (*Plectrophenax nivalis*), narsarmiutat (*Calcarius lapponicus*), kussaat (*Oenanthe oenanthe*), orpimmiutat (*Carduelis flammea*) aamma tulukkat (*Corvus corax*). Tamarmik Kalaallit Nunaanni sumi tamaani timmiaapput peqarluarporlu. Eqqissisimatitsinermit isigalugit peqassutsimut killeqarfik pingaarnerpaajunngilaq. Ukiuni kingullerni kussattarsuaq (*Turdus iliacus*) sumiiffimmiittalerpoq orpigaqarfinnilu takussaasalerluni. Qanoq amerlatigineri ilisimaneqanngilaq kisianni Narsarsuarmi takussaavoq. Timmiaaqqat amerlanersai, tulugaq qupaloraarsuillu ikitsuinnaat pinnagit, tamarmik ukiuunerani Kalaallit Nunaat qimattarpaat.

Timmiaaraq ataaseq - orpimmiutaq (*Acanthis hornemanni*) - AOI-p iluani manniliorneq ajorpoq kisiannili ukiuunerani Kalaallit Nunaata avannaaniit tikissimaartarpoq.

Aqisseq (*Lagopus mutus*) AOI-mi nunami takussaasarpoq, amerlavallaaratik kisianni ukiut ilaanni nalinginnaasumit amerlanerusarput. Aqissit ukioq kaajallallugu Kujataaniittarput ukiuuneranilu Kalaallit Nunaata avannarpasissuaniit ilaneqartarput. Aqisseq piniagarissallugu nuannarineqarpoq (takuuk Kapitali 5 "Inuit atuinerat") killeqanngitsumik augustimiit aprilimut piniagaasarlutik.

Timmissat sissarmiut marluk AOI-mi manniliortarput: saarfaarsuk (*Calidris maritima*) aamma tuujuk (*Charadrius hiaticula*). Arlaannaalluunnit Kujataanut immikkuullarissuunngillat Kalaallit Nunaanni sumi tamaani siaruarsimammata aamma eqqissisimatitsinermit isigalugu Kalaallit Nunaanni timmiaqassutsimut sanilliullugu AOI immikkut pingaaruteqanngilaq.

Timmissat qaasuttut pingasut periutsimikkut tamarmik imminnit assigiinngilluinnartut AOI-mi manniliortarput: Kiinaaleeraq (*Falco peregrinus*), nattoralik (*Haliaeetus albicilla*) aamma kissaviarsuk (*Falco rusticolus*). Sumiiffimmi kiinaaleeraq nalinginnaaneruvoq aammalu Kalaallit Nunaanni tamarmi siaruarsimavoq. Amerlassusaat ikiliartorput eriagineqarnissaallu pingaartinneqarput. Kiinaaleeqqat nikittartuupput ukiuuneranilu Kalaallit Nunaat qimattarpaat. Kiinaaleeqqat manniliortut ukiut tamaasa innaq manniliorfigisartagartik uteqqiaffigisarpaat ajoqusersuutinullu malussarissuupput (Christensen et al. 2016).

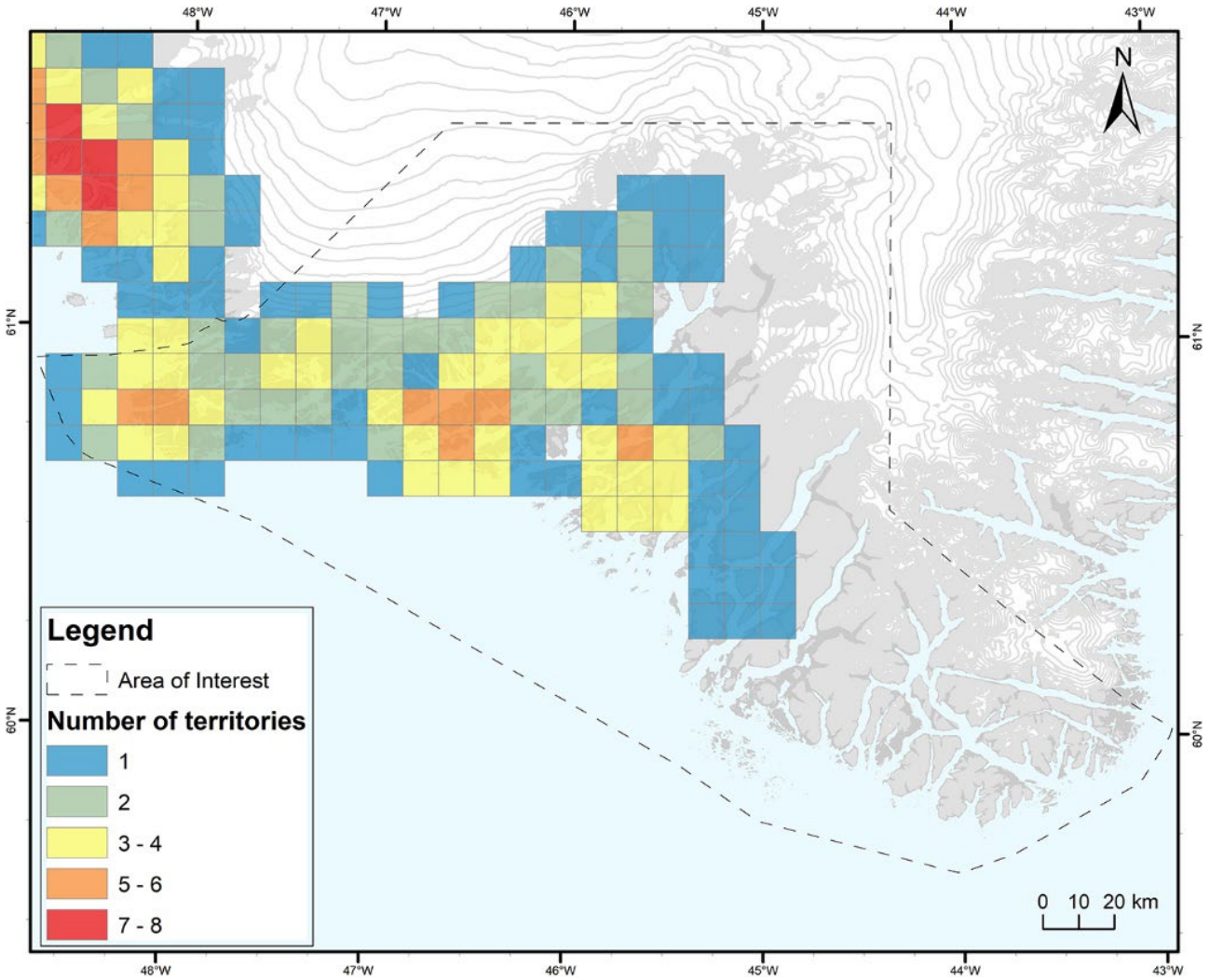
Kissaviarsuk AOI-mi amerlasoorsuunatik manniliortarput. Kissaviarsuit sumiiffimmi aalajaatsuupput aamma ukiuunerani avannaaniit Canadamiillu ukiiartortunit ilaqalersarput. Kalaallit Nunaanni peqassuseq "ulorianartorsiortinneqarnissaminnut qanittumiittutut" (NT) Kalaallit Nunaata allattorsimaffimmi aappalaartumi nalunaarsorsimapput amerlannginneri pequtaallutik (Christensen et al. 2016). Eqqissisimatitsiniarnermit isigalugu AOI immikkut peqassutsimut

pingaaruteqanngilaq. Kissaviarsuit manniliortut amerlasuutigut ukiut tamaasa innaq manniliorfigisartik utikaffigisarpaat aammalu ajoqusersorneqarnerminnut malussarissuupput.

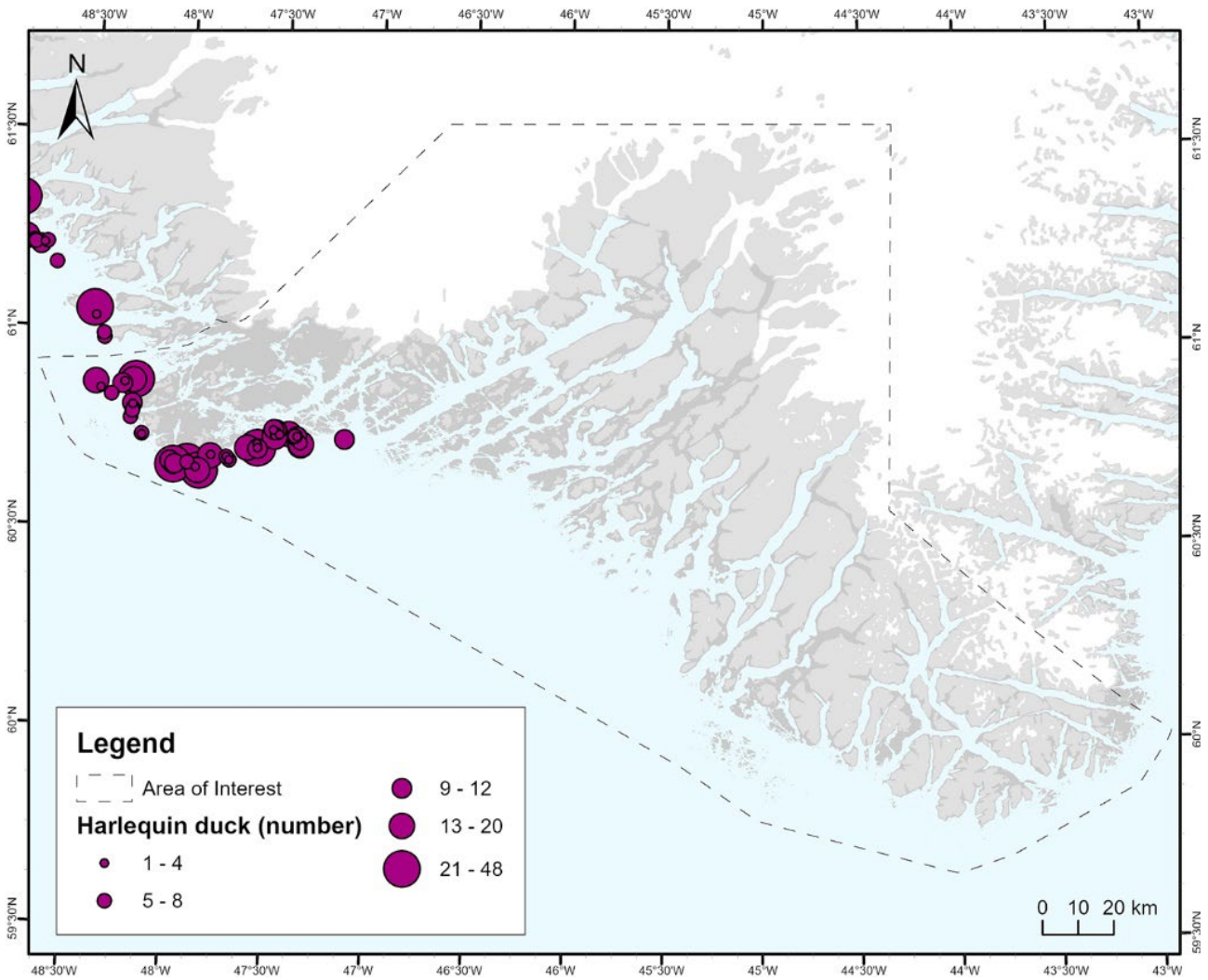
Nattoralik (*Haliaeetus albicilla*) nunami aammalu avataani takussaasarpoq. AOI-p sineriaata qanittuani takussaasarpoq. Sumiiffimmi manniliortut arlariissuupput katillugu 10 km2-mi -mi arfinillit (Takussutissiaq 4.2), sumiiffiit ilaanniusarput Kalaallit Nunaannilu peqassuseq naapertorlugu amerlanersaat maaniipput. Taamaammat AOI pingaaruteqartorujussuuvoq ukiuunerani aasaaneranilu. Nattorallit ""navianartumiittutut" (VU) Kalaallit Nunaanni allattorsimaffimmi aappalaartumik nalunaarsorsimapput peqassutsip appasinnera peqqutaalluni (Boertmann and Bay 2018). Nattorallit manniliortut sumiiffimmut aalaakkaasuusarput kisiannili utoqqaanngitsut manniliortut sumiiffinnut allanut Kalaallit Nunaanni nuussinnaasarput (Lyngs 2003). Nattorallit manniliorfitik allanngorsinnaasarpaat sumiffimmi ataatsimi ukiumit ukiumut nikissinnaallutik ajoqusersorneqarnermullu malussarissuupput, pingaartumik nerukkaanerisa aammalu piaraasa sapaatip akunnerisa marlunngornerisa nalaanni.

Timmissat arlariit tatsip timmiaatut manniliornerup nalaani isigineqartarput. Tuullik (common loon, *Gavia immer*) tatsini angisuuni nassaassaavoq, peqassuserlu appasimmat Kalaallit Nunaanni allattorsimaffimmi aappalaartumi nalunaarsorsimavoq "aarlerinartorsiortinneqarnissaminnut qanittumiittutut" (NT). Qarsaaq (*Gavia stallata*) tatsini minnerni manniliortarput sinerissat qanittuaniunerusoq nalinginnaasuuvorlu. Tuulleqatigiit tamarmik taakku marluk ukiukkut Kalaallit Nunaat qimattarpaat.

Qeerlutuut (*Anas plathyrhynchos*), allerit (*Clangula hyemalis*), toornaviarsuit (*Histrionicus histrionicus*) aamma naluumasortut (*Phalaropus lobatus*) tamarmik AOI-mi manniliortarput - toornaviarsuit kuunni supisuni ilaali tatsini taseqqanilu. Naluumasortut ukiuunerani Kalaallit Nunaat qimattarpaat ilaali timmiaqatigiit pingasut ukiuunerani AOI-p sineriaata qanittuaniittarput. Qeerlutuut siaruarsimaqaat takussaallutillu; allerit maani manniliortarput aasaanerani ikitsuinnaariarlutik ukiuunerani amerlasoorsuakkaartarlutik. Toornaviarsuit ikitsuinnaat AOI-mi manniliortarput kisiannili ukiuunerani angutivissat amerlasuut Kalaallit Nunaannit Candamiillu takkusimaartarput sinerissap qanittuani mamaarlutik (Takussutissiaaq 4.3) aammalu ukiuunerani tamaaniikkiartorlutik (Boertmann and Mosbech 2002). AOI qeerlutuunut pingaaruteqarnerpaanngikkaluarluni kisianni allernut, naluumasortunut AOI-p kitaatungaa assorsuaq Kalaallit Nunaata peqassusaanut pingaaruteqarput (Takussutissiaq 4.3). Allerit "aarlerinartumiittutut" nunarsuaq tamakkerlugu allattorsimaffimmi aappalaartumi nalunaarsorsimavoq (BirdLife International 2018b).



Takussutissiaq 4.2. AOI-p qeqqani aammalu avannarpasissuani nattorallit sumiiffii. Kujasinnerusumi aamma manniliortarput kisiannili amerlassusai ilisimaneqanngillat. Annertussuseq 10x10 km-sut naatsorsuussaavoq "paasissutissartaqanngilamik" allassimallutik. Paasissutissat 2020 sioqqullugu pigineqarput.



Takussutissiaq 4.3. Toornaviarsuit mamaartut 1999-ip aasaanerani misissuinermit.

Timmissat imarmiut

Timmissat imarmiutut taasakkat AOI-mi manniliortarlutillu ukiisarput.

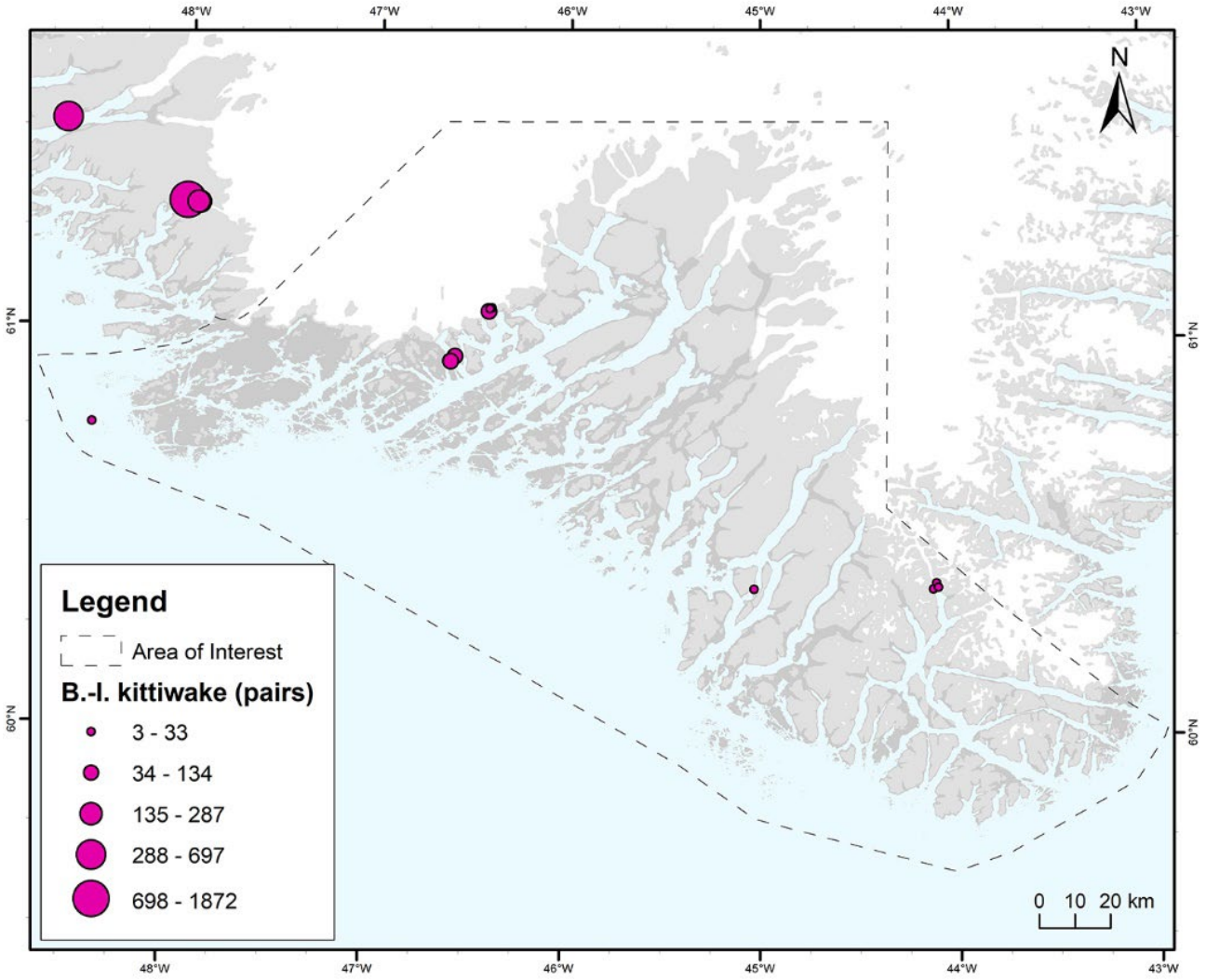
Timmiarussat amerlanerpaartai timmissat inaanni innani manniliortarput, ilai ataasiakkaajullutik ilaalli tusindilikkaajullutik. AOI-mi timmiaqarfiit 2003-mi misissorneqarsimapput (Boertmann 2004), Kitsissuit Avalliini timmiaqarfiit akutsunngitsumik nakkutigineqarlutillu ilisimatusarfigineqartarput (Linnebjerg et al. 2013).

Timmiaqarfinnit misissuisimanermit paasissutissat aamma qangaaniilli paasissutissat tamarmik DCE-mit aamma GINR-mit toqqortaatigineqarput (Boertmann et al. 2010), aamma paasissutissat assiliartaniittut kapitalimut ilanngussaasut tassannga tigusaapput. Timmiaqarfiit ajoqusersorneqarnermut malussarissuupput misissueqqissaarnermilu taakkua ajoqusersorneqarnissaat annikinnerpaaffianiitikkumallugu malittarisassaqartariaqarpoq.

Timmiaqarfinni nalinginnaanerpaat naajaapput. Naajat assigiinngitsut pingasut AOI-miittut amerlanerpaasut tassaapput: naajarujussuaq (*Larus hyperboreus*), naajaannaq (*Larus glaucoides*), naajarluk (*Larus marinus*) aammalu nasalik (*Larus fuscus*). Timmiaqarfinni amerlanerpaat ilaat sisamaapput: taateraat (*Rissa tridactyla*) manniliorfimminni Kitsissut

Avalliini takussallutik, ilaalu sermip iigartartumut qanittumiittarlutik (Takussutissiaq 4.4). Nasalik (*Chroicocephalus ridibundus*) timmiaqarfinni ikinnerusunik manniliorfinniinnerusarput ilaalu kangerluit qinnguini tatsiniittarlutik. Taateraat aammalu nasallit allattorsimaffimmi aappalaartumi nalunaarsorsimapput " aarlerinaateqartutut" (VU) - taateraat peqassutsikkut appariartormata aamma nasallit ikimmata.

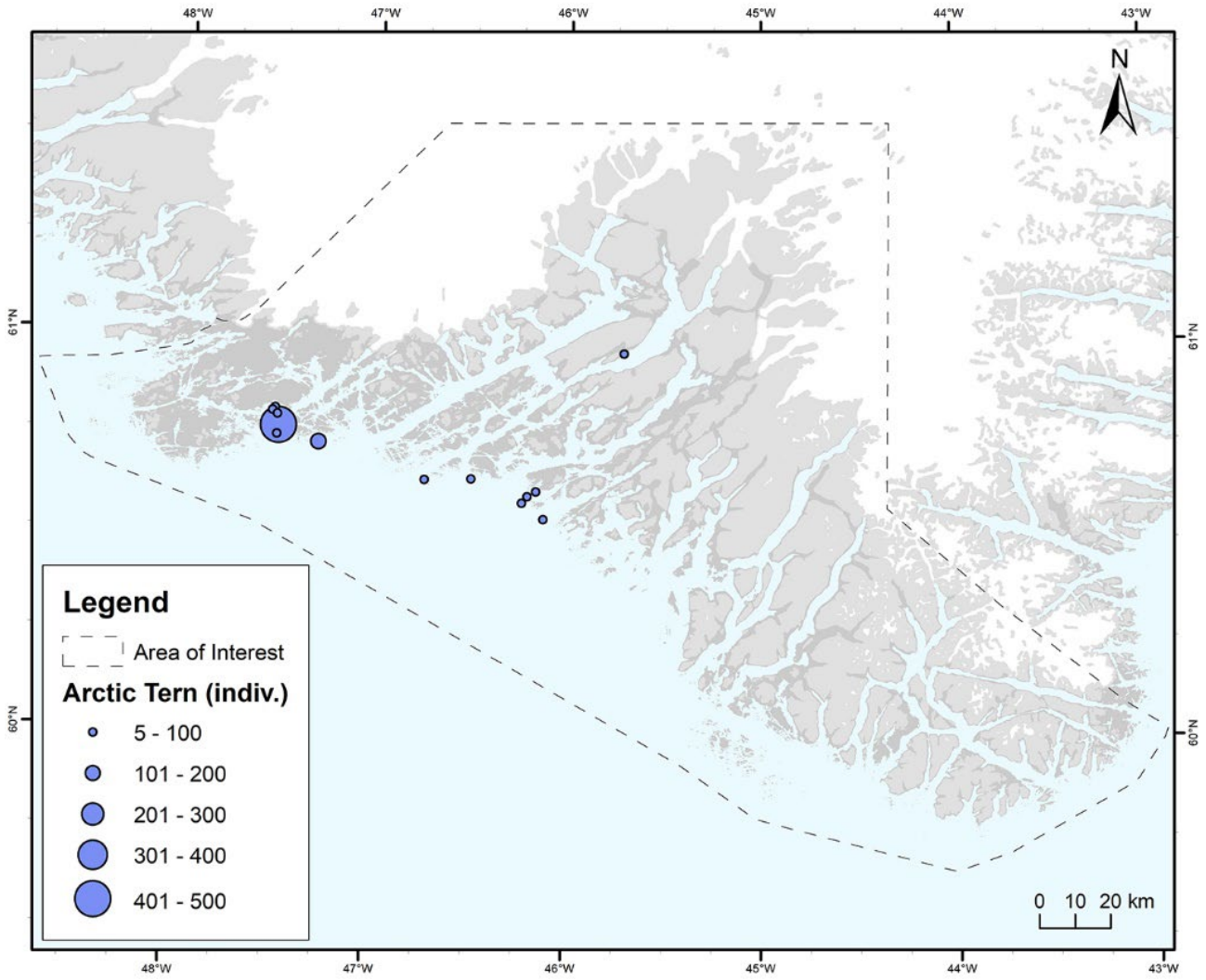
Naajarluk aamma nasalik ukiuunerani Kalaallit Nunaat qimattarpaat. Taateraat avammukartarput ukiuuneranilu sinerissap qanittuani takussaanngiusartarput. Naajat sinneri AOI-p sinerissap qanittuani ukiuunerani amerlasoorsuanngorlutik takussaasarput, soorlu sissanut qanittuni neriniarlutik. AOI naajanut ukiuunerani najorneqartarmat ilisimanarpoq pingaaruteqartorujussuusoq.



Takussutissiaq 4.4. Taateraat ineqarfiata annertussusaa, manniliortarpullu aappaariikkaajullutik. Paasissutissat Kalaallit Nunaanni timmissat imarmiut pillugit allattorsimaffimmeersuupput.

Imeqqutaallat (Sterna paradisaea) ineqarfii ikittuinnaat AOI-mi nassaarineqarnikuupput, amerlanertigut avataani (Takussutissiaq 4.5). Imeqqutaallat avannaani amerlasoorsuusarput aamma AOI-mi imeqqutaalaqassuseq annikitsuinnartut taaneqarpoq. Timmissat taakku "aarlerinartorsiornissaminnut qanittumiittutut" (NT), Kalaallit Nunaanni allattorsimaffimmi aappalaartumi nalunaarsorsimasutut nalilerneqarput

(Tabel 4.1), Boertmann and Bay 2008) Kalaallit Nunaata kitaani ikiliartornerat peqqutigalugu.

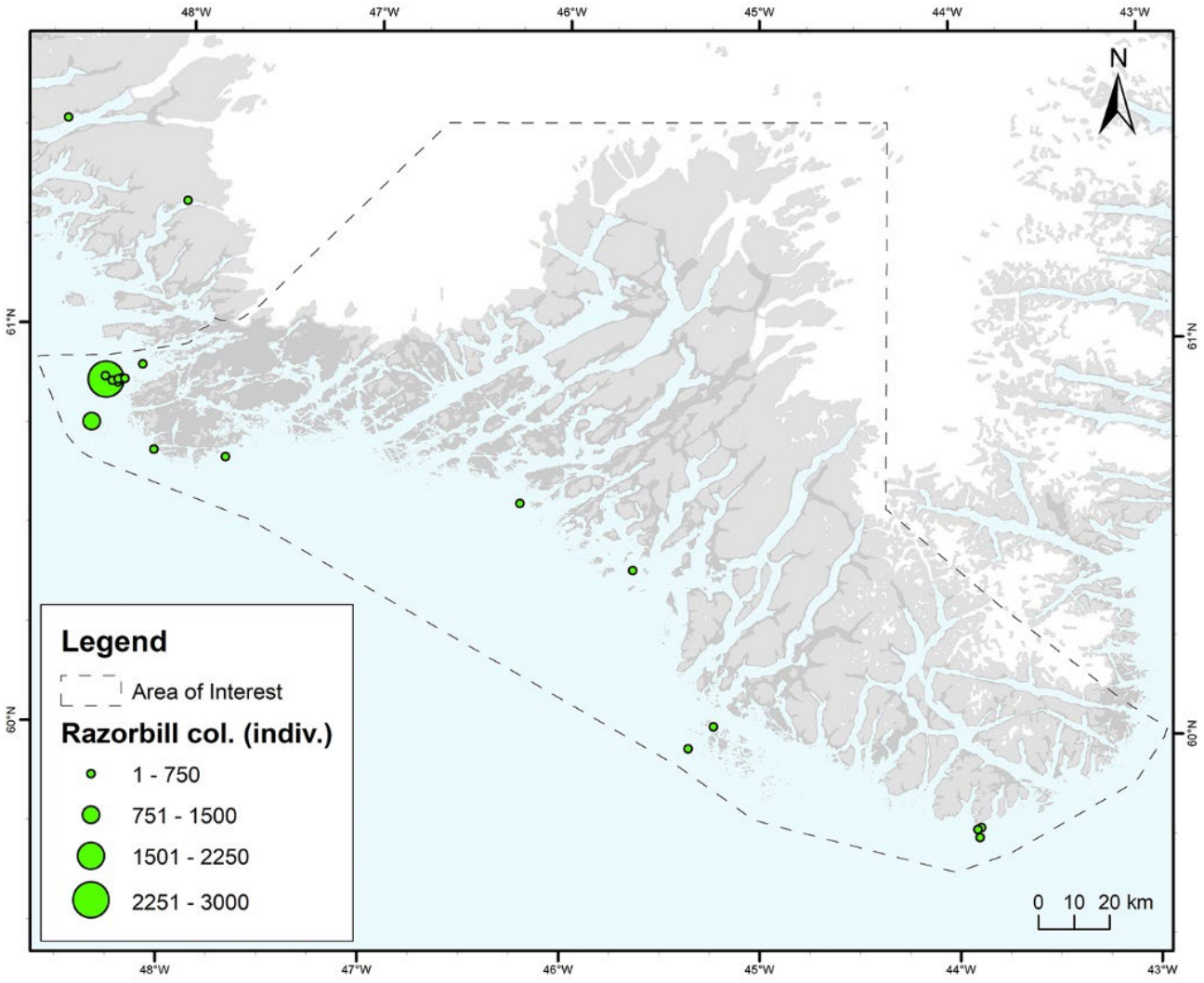


Takussutissiaq 4.5. Imeqqutaallat sumiiffigisartagaasa annertussusaat amerlassusaallu. Paasissutissat Kalaallit Nunaanni timmissat imarmiut ineqarfii pillugit allattorsimaffimmeersuupput.

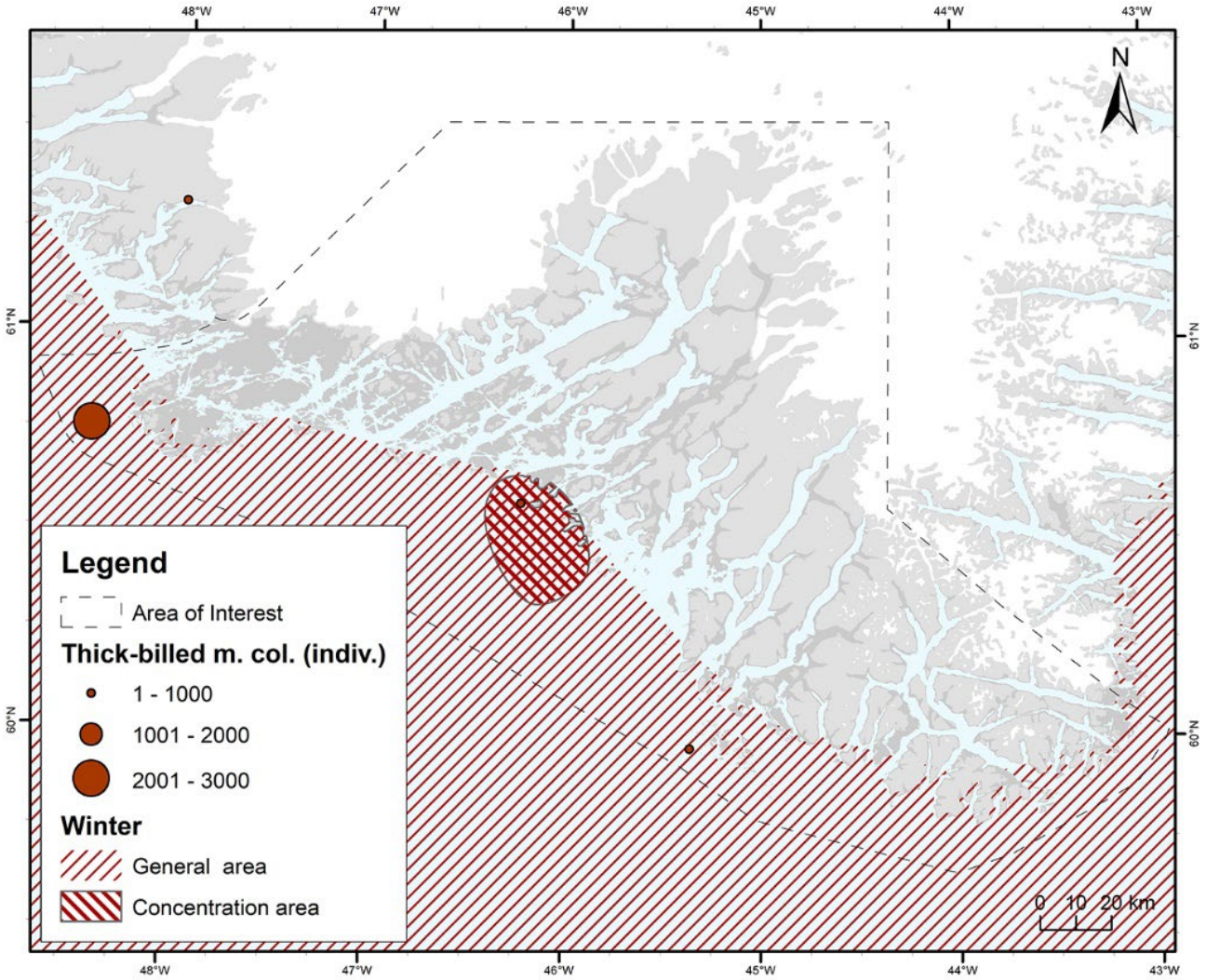
Isunngaq (*Stercorarius parasiticus*) ikitsunnguakkaarlutik ineqartarput AOI-milu ataasiakkaanik peqarpoq, amerlanertigut kisimiittut takussaasarlutik. Ukiuunerani aallartarput.

AOI-mi timmissat imarmiut appaqatigiit ilagaat. AOI tamakkerlugu Kalaallit Nunaannilu tamarmi serfaq (*Cepphus grylle*) timmiaqarfinni ikitsunnguakkaartuusarput ineqarfeqarlutik amerlanertigut sinerisaap qanittuata avatinnguani. Apparluk (*Alca torda*) Kitsissut Avallerni qeqertaaqqani sinerissallu qanittuani innalinni ikitsunnguakkaartut takussaasarput, soorlu Nunap Isuani (Kap Farvel) aamma Kitsissut iluani (Takussutissiaq 4.6). Apparluk nunarsuaq tamakkerlugu "ulorianartorsiorninneqarnissamut qanittumiittutut" (NT) nunarsuarmi allattorsimaffimmi aappalaartumi nalunaarsoqqavoq (BirdLife International 2018a). Appa (*Uria lomvia*) appaqatigiinni Issittumi nalinginnaanersaavoq nunarsuarmilu appaqassuseq eqqarsaatigissaganni taakku 5-7%-at Kalaallit Nunaanni manniliortarput. AOI-mi ineqarfik ataasiinnaq ilisimaneqarpoq (Kitsissut Avalliani), kisianni ataasiakkaat timmiaqarfiit Nanortallup eqqaani aasakkut takussaasarput (Takussutissiaq 4.7-mi toorneq). Kalaallit

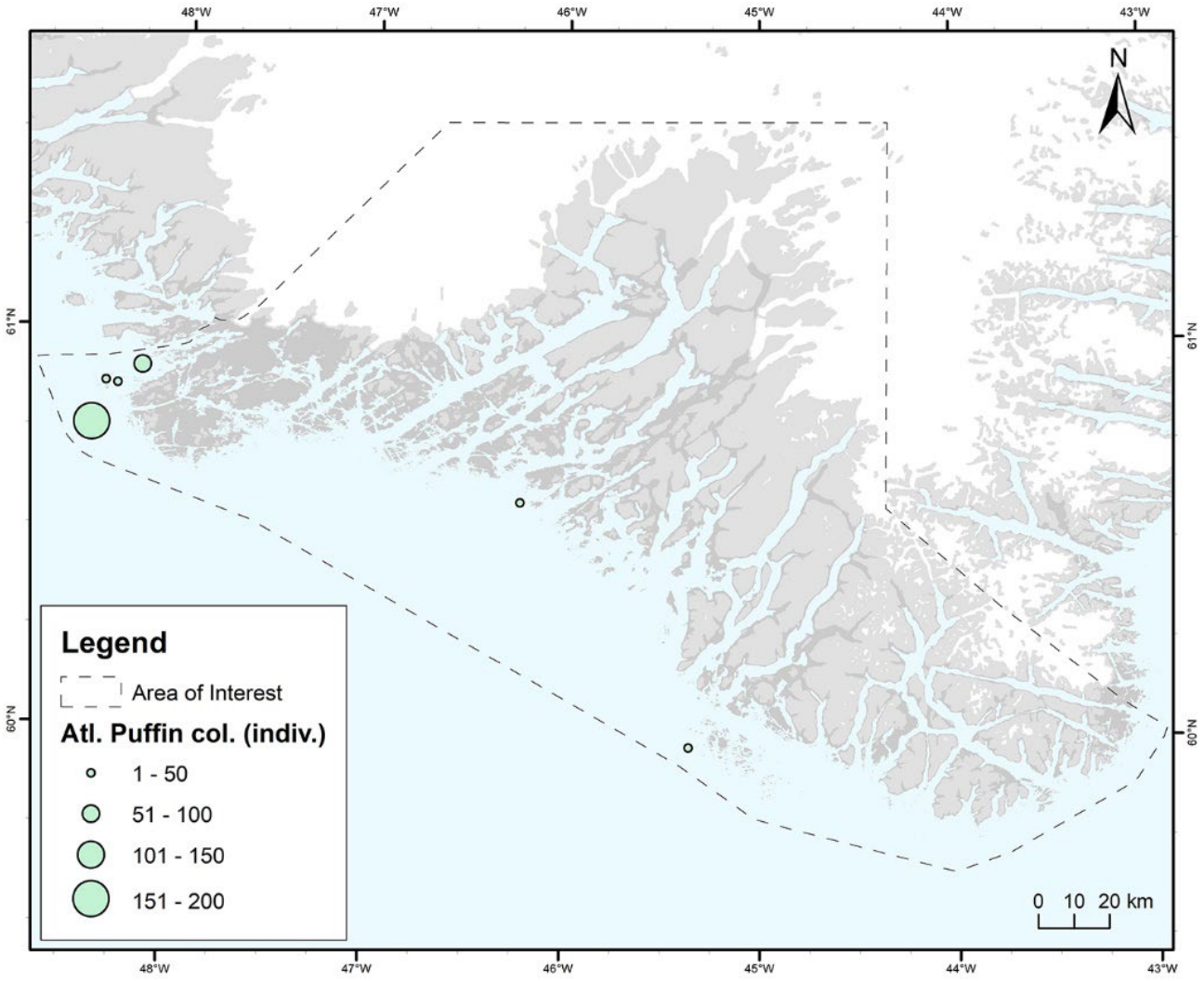
Nunaanni appaqatigiinni Kitsissut Avalliit appat manniliorfigisartagaannit kujasinnersaapput timmiaqarfiit tullii Arsuup kangerluaniipput taakku qaninnersaallutik AOI-mit avannarpasilaaginnartumiilluni. (Takussutissiaq 4.7). Appaqatigiit appa sigguttuunut (Uria aalge) qaninnerpaat Kitsissut Avallerniittut tassaapput appat. Appaqatigiit taakku marluk tamarmik "nungutaanissaminut aarlerinartorsiortutut" (EN) Kalaallit Nunaanni allattorsimaffimmi aappalaartumi nalunaarsorsimapput, appa "nungutaanissaminut aarlerinartorsiortutut" (EN) allattorsimalluni aammalu appa sigguttooq "aarlerinartumiittutut" (VU) Kalaallit Nunaanni allattorsimaffimmi aappalaartumi nalunaarsorsimalluni. AOI appaqatigiinnut Kalaallit Nunaannut annertuumik pingaaruteqarpoq. Kingullerlu, qilanngaq (*Fratercula arctica*) timmiaqarfinni ikitsuinnarniipput (Takussutissiaq 4.8). Timmissat taakku avannaani nassaassaaneruppput, kisiannili eqqissisimatitsiniarnermit isigalugu ernumanartumiipput massa ukiuni kingullerni peqassuseq ikiliartormat Kalaallit Nunaannilu tamakkerlugu allattorsimaffik aappalaartumi "aarlerinartorsiortutut" (VU) nalunaarsorsimavoq. AOI-p avataani qaqulluit (*Fulmarus glacialis*) amerlagaluartut, taamaattoq Kitsissut Avallerni qeqertani aammalu Nunap Isuata qanittuani (Kap Farvel) qaqulluit kisimi manniliorfeqarput (Takussutissiaq 4.9).



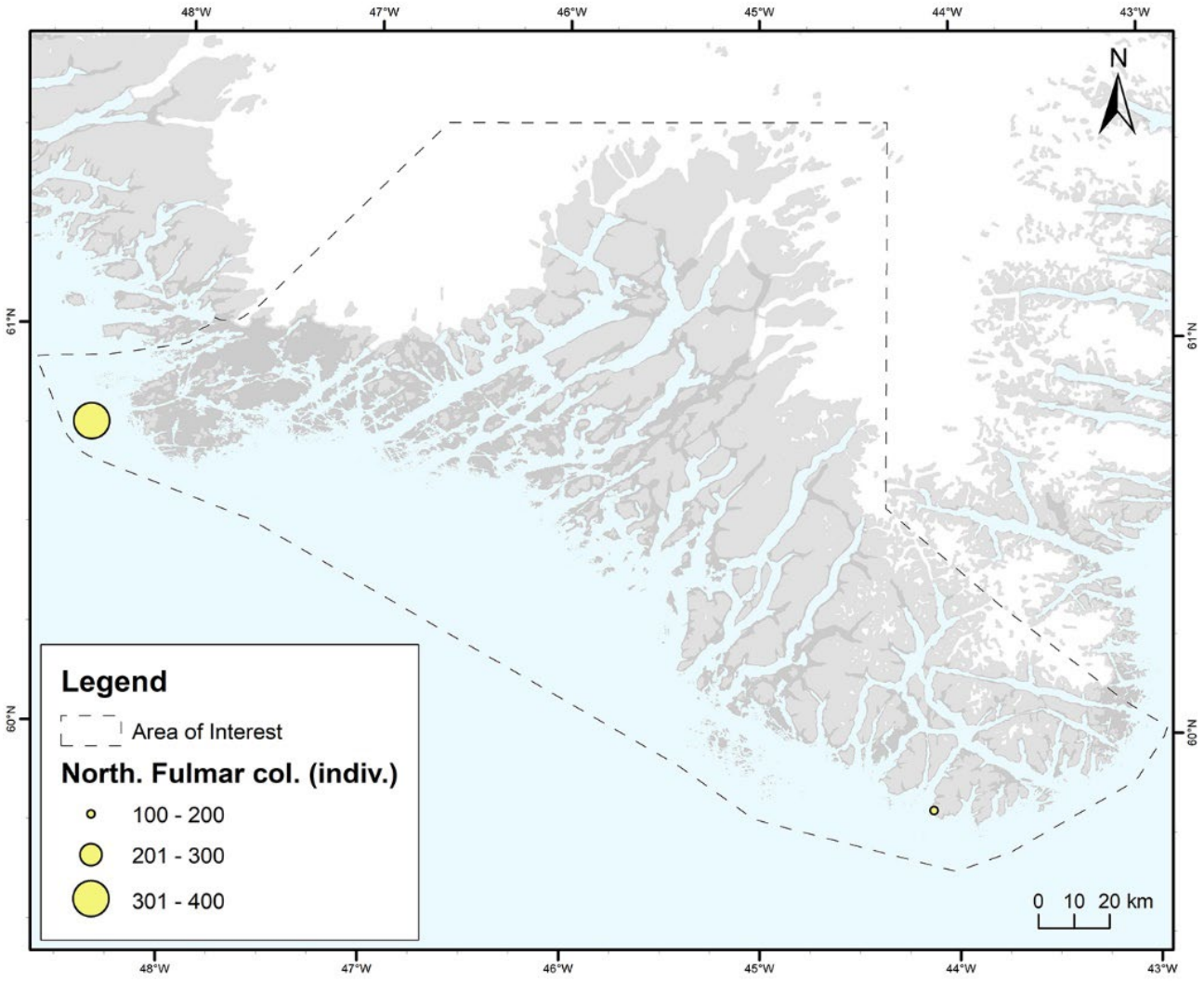
Takussutissiaq 4.6. Apparluit ineqarfii amerlassutsimikkut aammalu ataasiakkaatut. Paasissutissat Kalaallit Nunaanni timmissat imarmiut ineqarfii pillugit nalunaarsuiffimmit.



Takussutissiaq 4.7. Appat ineqarfii aamma eqqaani peqassuseq aasaanerani (titarneq amitsoq) ukiuuneranilu katersuussimaartarfiat (titarneq issuneq). Paasissutissat Kalaallit Nunaanni timmissat imarmiut ineqarfiisa allattorsimaffiat.



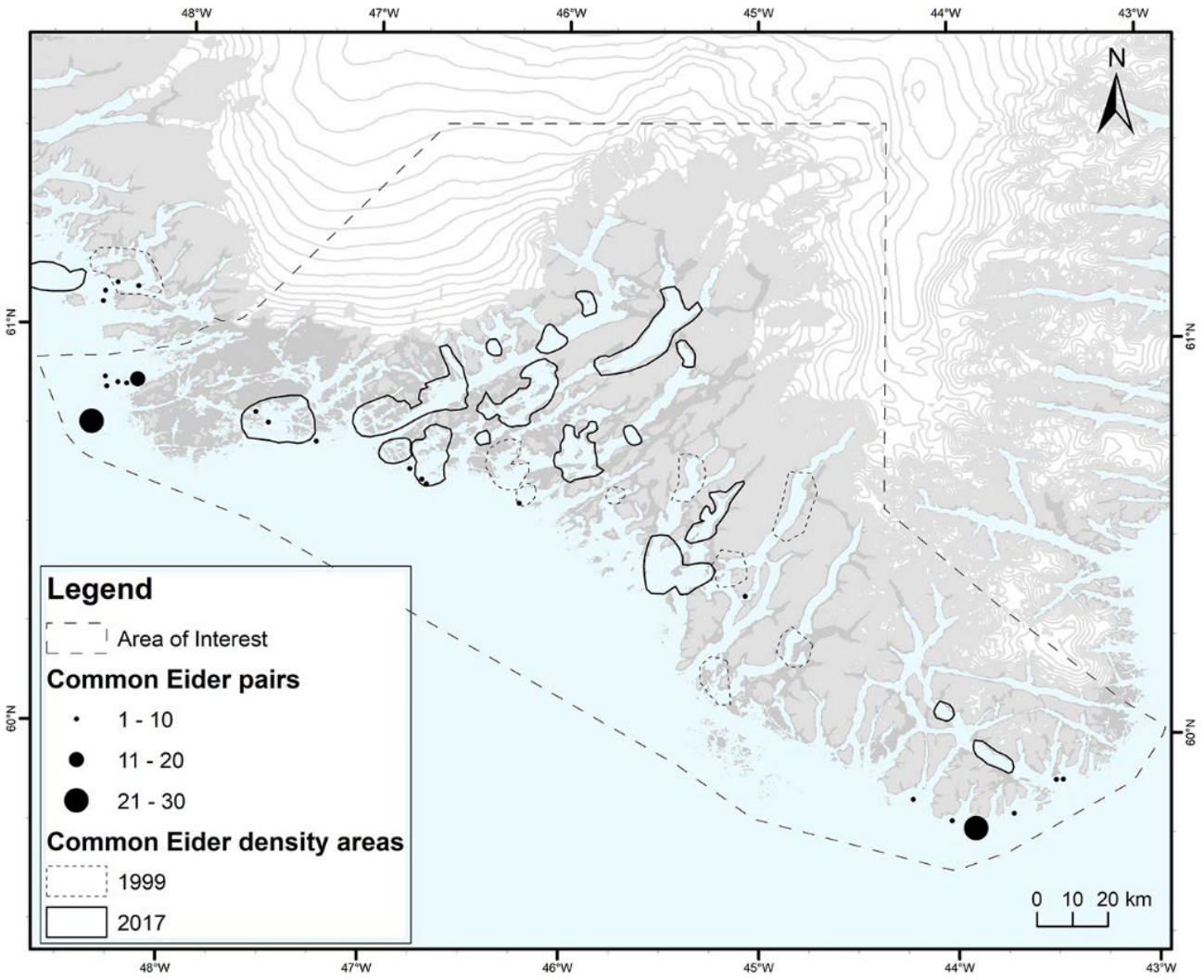
Takussutissiaq 4.8. Qilanngat ineqarfii amerlassusaalu. Paasissutissat Kalaallit Nunaanni timmissat imarmiut ineqarfiisa allattorsimaffiat.



Takussutissiaq 4.9. Qaqulluit ineqarfii aamma amerlassusii. Paasissutissat Kalaallit Nunaanni timmissat imarmiut ineqarfiisa allattorsimaffiat.

Qeerlutuut akornanni miteq (*Somateria mollissima*) kisiartaalluni imaani uumasuuvoq ikitsunnguakkaarlutik ineqartartut qeqertani minnerni avataani (Takussutissiaq 4.10). Nujalik (*Mergus serrator*) ataasiakkaarlutik manniliortarput tatsini avataanilu arnavissallu manniliunngitsut kangerliumanerni kangerlunnilu mamaartarput.

Ukiuunerani Kalaallit Nunaata imartaa AOI ilanngullugu timmiarpassuarnut imarmiunut aammalu timmiarpassuarnut tatsini manniliortartunut pingaaruteqaqaaq (Boertmann et al. 2006; Merkel et al. 2019). Timmiarpassuit millionilikkaajullutik Canadamit, allaat Alaskamiit, Kalaallit Nunaanniit, Svaldbardimiit, Norgemiit aamma Ruslandimiit ukiakkut tikerartarput ukiuunerani tassani sinerissami avataanilu katersuussimaariartorlutik. Takussutissiat 4.10 aamma 4.7 takutippai mitit aamma appat katersuussimatillutik amerlanerpaaffigisartagaat 2017-mi misissuinermit paasineqarput. Timmiaqatigiit taakku marluk piniagarineqarluartarput ukiullu tamaasa tusindilikkaat AOI-kkoortarput (www.stat.gl).



Takussutissiaq 4.10. Miteqarfiit ukiuunerani 1999-mi misissuinermit nalunaarsorneqarsimasut (toortarnillit) aamma 2017-mi (titarnerit) Paasissutissat Merkel et al. (2019). Toorneeqqat amerlanersaasa takutippaat manniliorfiit ilisimaneqanngilarli timmissat qanoq amerlatiginersut.

Ukiuunerani timmissat amerlalluinnarlutik takkusimaartartut tassaapput taateraat, qaqulluit, appaliarsuit (*Alle alle*) – amerlanerit avataani, aamma naajat amerlanerit (qulaa takuuk) aammalu oqaatsut (*Phalacrocorax carbo*). Ukiukkut timmissat imarmiut aammalu timmissat tasermiuusartut ukiuunerani AOI-miittarput, saarfaarsuit, qeerlutuut, miteq sioraki aammalu allerit allaat. 2017-mi qeerlutuut aamma allerit maani AOI-mi amerlasoorsuit toraarneqarput (Merkel et al. 2019).

4.4 Aalisakkat qaleruallillu

Kalaallit Nunaata imartaa aalisagaqarluarlunilu qalerualeqarluarpoq, taamaattoq Kujataata imartaa nunap sinneranut sanilliullugu aalisagakinneruvoq. AOI-ip iluani aalisakkat arlariit inuussutissarsiornermut soqutiginaateqartut tassaapput: Saarulliit (*Gadus morhua*), qalerallit (*Reinhardtius hippoglossoides*), nipisaat (*Cyclopterus lumpus*), raajat (*Pandalus borealis*) saattuallu (*Chionoecetes opilio*). Ilanngullugu aamma eqaluit (*Salvelinus alpinus*) inuussutissaqarniarnermut nuannaarniutigalugulu (timersuutit ilaattut) eqalunniarnermut pingaaruteqarput. Kapitali 5-mi "Inuit atuinerat"-ta ataani takuneqarsinnaavoq soqassutsimut pisaqartarnermullu takussutissaq.

4.5 Nunap naanera

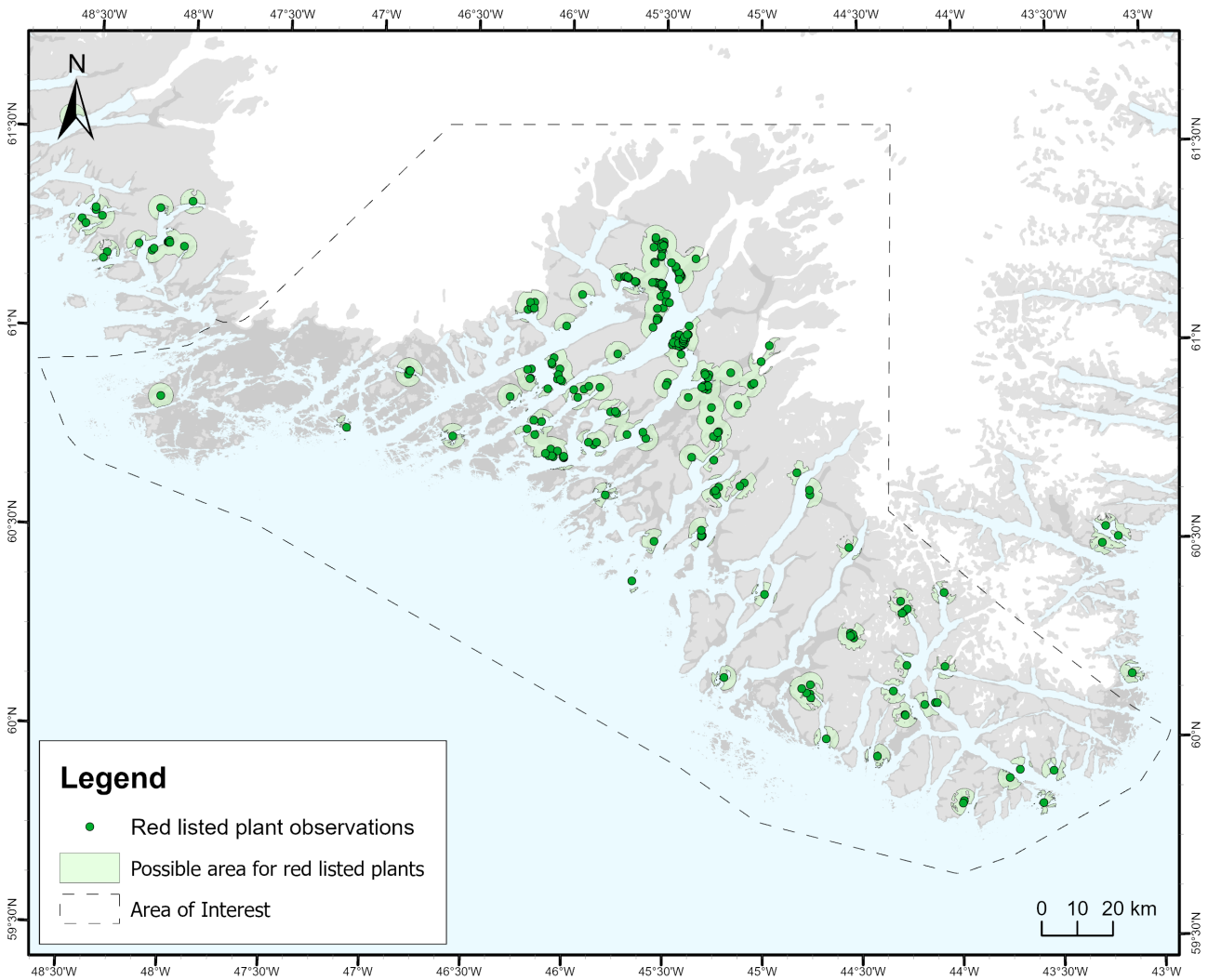
Naasut allattorsimaffimmi aappalaartumi nalunaarsorsimasut suuneri

Kujataani naasut 370-it assigiinngitsut naasuusut ilisimaneqarpoq (Feilberg 1984).Taakkunanit 56-it AOI-p iluani naasuupput aammalu Kalaallit Nunaani allattorsimaffimmi aappalaartumi "aarlerinartumiittutut" (VU) aammalu "aarlerinartorsiornissaminnut arlerinartumiittutut" (NT) 2018-mi nalunaarsorsimapput (Takussutissiaq 4.2, Boertmann and Bay 2018). Taakkunanit qulit Kujataanut immikkuullarissuupput.

Oqaluttuarisaanermit qanga naasut pillugit allattorsimaffiup aappalaartup nalunaarsorsimasut pillugit saqqummiunneqarnera Takussutissiaq 4.11-mi takutinneqarput. Assiliartatigut nunap assinganik qarasaasiakkut nuussinikkut pivoq aammalu naasut nerineqarsinnaasut misissuiffigeqqissaarneranneerpoq (Feiberg 1984) amerlanerpaallu 1962-mi aamma 1996-mi Kalaallit Nunaanni naasorsiuut misissuinerinit paasissutissat katersorneqarsimapput saqqummersinneqareersimasunillu ilassuserneqarput (Bay 1993). Toornerit marluk tamarmik (nakkutilliisimaneq) aammalu sumiiffik aaliangersimasumik killilimmi misissuisoqarnermi nunap assingatigut sumi ingerlatsisoqarsimaneranik takutitsivoq ataanilu takuneqarsinnaavoq.

Takussutissiaq 4.11-mi naasut ilisimaneqartut allattorsimaffimmut aappalaartumut nalunaarsorneqartariaqartut sumiiffigisinnaasaat. (Takussutissiaq 4.11-mi aamma toornertut takutinneqarpoq), sumiiffiit naasoqarfiusimasutut aappaluttumi nalunaarneqarsimasut illersorniarlugit sumiiffik 3,5 kilometerinik annertussuseqartoq qulakkeerinniffissatut toqqarneqartarpoq aamma 800 meterinik qatsitsigisoq ilanngullugu immamit imaluunniit iigartartumit qallerneqarsimagaluarpalluunniit. Sumiiffimmi nunaminertap 3.5 km.-sut annertussuseqartup toqqarneqarneranut patsisaavoq naasut qanga nalunaarsorneqarsimasut pillugit nalunartut pillugit eqqoqqissaanngitsunik nalunaarsuisoqarsimanissaanik qulakkeerinninniarnermik siunertaqarpoq, imaanngitsoq paasissutissaqanngimmat kisiannili paasissutissat pigineqartut qulakkeerniarlugit. Taamaattoq, toorneqanngippat isumaqanngilaq allattorsimaffimmi aappalaartumi nalunaarsuisoqarsimanngitsoq kisianni ilimanarnerulluni aappalaartumi allattorsimasut toornermiit illusinnerulaartumi inissisimanissaat. Tatsini 800m-sut qatsitsigisumiittuni sermillu qanittuaniittut sumiiffimmi misissuiffissatut killilersimasumi nungutinneqarnikuupput nuna naanertaqanngitsut ilaatinniarnagit. Sumiiffiit toornillit aammalu 'sumiiffiit ilimagisat naasoqassasut aappalaartumi allattorsimafimmi nalunaarsorneqarsinnaasut' uani ersersinneqanngillat ilimagisatullu ersersinneqaratik kisiannili periarfissaannartut isigineqarlutik. Sumiiffiit naasunik allattorsimaffimmi aappalaartumi nalunaarsorsimasussatut ilimagineqartut tassaapput sumiiffiit siunertamut aaliangersimasumik siunertaqarluni misissuiffissat arlaatigut suliffissuartigut aallartittoqartinnagu misissuiffigineqartariaqartut. Missingersuutit suliarinerini eqqaamaneqassaaq nunap naanera naasullu assigiinngitsut eqqarsaatigineqarmata.

Nunap naaneranut takussutissaq sumiiffinni ersersinneqartoq isumaqanngilaq naasut allattorsimaffimmi aappalaartumi nalunaarsorsimasut takutinniarneri taamatullu atorneqartussaanani.



Takussutissiaq 4.11. Naasut misissorneqarsimasut allattorsimaffimmi aappalaartumi nalunaarsorsimasut (aarlerinartumiittutut aamma aarlerinartorsiornissaminnut qanittumiittut) AOI-mi takussaasut. Nunap assingatigut eqqoqqissaartumik nalunaarsorsimanerisa pitsaassusaa appasilaarpoq kisianni misissuiffissatut killissaliussap iluani (3,5 km radius isorartutigisumi, sinerissap qanittuanut ilaatinnagu aammalu qatsissuseq 800 m-sut qatsisigisumut killissalerlugu) misissuinerit takussutissami ersersinneqarput (naasut ilisimaneqartut allattorsimaffimmi aappalaartumi nalunaarsorsimasut).

Tabel 4.2. Aarlerinartorsiortut (aappalaartumi allattorsimasut; aarlerinartorsiornissaminnut qanittumiittut aamma aarlerinartumiittut) AOI-mi naasut sulluusallit. IUCN-ip aarlerinartorsiortut allattorsimaffianni uuttuutit: LC (mianernanngitsumiittut), NT (aarlerinartorsiornissaminnut qanittumiittut) aamma VU (aarlerinartorsiortut), aammalu nunap naanera naasullu piuneri ilisimaneqartut (Boertmann and Bay 2018).

Suuneri	Allaaserinnittoq	Allattorsimaffimmi aappalaartumi inissisimaneri	Naasut suuneri
*Agrostis gigantea**	Roth	VU	Orpikkat
Agrostis stolonifera	L.	NT	Tasinnguaq
Alchemilla vestita	(Bus.) Raunk.	NT	-
Alchemilla wichúrae	(Bus.) Stefanss.	NT	Sivinganeq nerineqarsinnaasunik naasulik
Amerorchis rotundifolia	(Banks ex Pursh) Hult.	VU	Orpikkat
Andromeda polifolia	L.	VU	Tasinnguaq
*Athyrium filix-femina**	(L.) Roth.	VU	Sivinganeq nerineqarsinnaasunik naasulik
Atriplex longipes ssp. praecox	Drej.	VU	-

Botrychium multifidum	(Gmel.) Rupr.	VU	Sivinganeq nerineqarsin-naasunik naasulik
Botrychium simplex	Hitchc.	VU	Ivigaqarfik
Botrychium tenebrosum	A.A. Eaton	VU	Ivigaqarfik
Cakile edentula ssp. edentula	(Bigelow) Hook.	VU	-
Calamagrostis hyperborea	Lge.	NT	Orpikkat
Calamagrostis poluninii	T. Sør.	NT	Qaarsuunerusoq
Carex abdita	Wbg.	VU	Narsarsuaq ivigalik
*Carex buxbaumii**	Wbg.	VU	Taseq
Carex chordorrhiza	L.	VU	Tasinnguaq
Carex disperma	Dew.	VU	Orpikkat
Carex lyngbyei	Horn.	VU	Narsaq sissalik
Carex mackenziei	Krecz.	VU	Narsaq sissalik
Carex magellanica ssp. irrigua	Lam.	NT	Tasinnguaq
Carex panicea	L.	NT	Tasinnguaq
Carex salina	Wbg.	VU	Narsaq sissalik
Carex trisperma	Dew.	VU	Tasinnguaq
*Carex viridula**	Michx.	VU	Tasinnguaq
Catabrosa aquatica	(L.) Beauv.	VU	Sarfaq
Cornus canadensis	L.	NT	Orpigaqarfik
Cystopteris montana	(Lam.) Desv.	VU	Orpikkat
*Danthonia spicata**	(L.) Beauv.	VU	Orpikkat
Drosera rotundifolia	L.	NT	Tasinnguaq
Dryopteris abbreviata	(DC.) Newman	NT	Orpikkat
*Eleocharis palustris**	(L.) Roemer & Schultes	VU	Tasinnguaq
Eleocharis quinqueflora	(F. Hartmann) O. Schwartz	NT	Taseq tarajulik, tasinnguaq
*Eleocharis uniglumis**	(Link) Schultes	VU	Tasinnguaq
*Galium boreale**	L.	VU	Orpikkat
Gentiana amarella	(L.) Boerner	VU	-
Gentianella detonsa	(Rottb.) Don	NT	Taseq tarajulik
Geum rivale	L.	VU	Puilasut assigiimmik kissassusillit
*Hierochloë odorata**	(L.) Beauv.	VU	Tasinnguaq
*Isoëtes lacustris ssp. lacustris**	L.	VU	Taseq
*Juncus gerardii**	Lois.	VU	Taseq tarajulik
Juncus ranarius	Perr. & Song.	NT	-
Myriophyllum spicatum ssp. exalbescens	L.	NT	Taseq
Parnassia kotzebuei	Cham & Schlechht.	NT	Kuup kuuffia
Polypodium virginianum	L.	VU	Ujarak
*Potamogeton natans**	L.	VU	Taseq
Potentilla anserina (*)	L.	NT	Narsaq sissalik
Primula egaliksensis	Wormsk.	NT	Puilasoq assigiimmik kissassuseqartoq
Rorippa islandica	(Oed.) Borb.	VU	Taseq
Rubus chamaemorus	L.	NT	Orpigaaqqat

Rubus saxatilis	L.	VU	Sivinganeq nerineqarsinnaasunik naasulik
Sagina nodosa *	(L.) Fenzl	NT	-
*Selaginella rupestris**	(L.) Spring	VU	Ujarak
*Trientalis europaea**	L.	VU	Orpigaaqqat
Utricularia intermedia	Hayne	NT	Taseq
Vaccinium myrtillus	L.	VU	Orpigaaqqat

* AOI kisiat aallaavigalugu Kalaallit Nunaani ilisimaneqartut.

Naasut nunallu naanerata nunap assiliarinera

2020-mi nunami nalunaarsuinermi sulinerup annersaa nunami naanernik katersineruvoq uppernarsarniarlugu qaammataasiakkut nunamik misissuisimanerup ullumikkumut tulluarsarsimanera (Takussutissiaq 4.12). Periuserineqartoq tunuliaqusiisoq nalunaarusiaq tamakkiisoq teknikkikkullu periuseq itisiliissutitaqartoq Ilanngussaq 3-mi nanineqarsinnaavoq.

Nunap naanera aamma naasut nalunaarsorniarlugit innersuussaqaraanni pingaaruteqarpoq eqqaamassallugu nunamik assilioriaaseq/periuseq isumaqanngimmat naasut allattorsimaffimmi aappalaartumi nalunaarsorsimasut ersersinniarnissai imaluunniit naasut aaliangersimasuinnaat takutinniarnissai. Naasut arlalissuit allattorsimaffimmi aappalaartumi nalunaarsorsimasut suussusersisimanngitsut periuserineqartoq peqqutaalluni, nunallu assiliornermi angissusiineq isoqartussuserlu toqqarneqarsimasoq (10 m x 10 m), soorlu "aputeqarfik" imaluunniit "sivinganeq naasunik nerineqarsinnaasunik naaffiulluartoq" uani ilanngunneqanngillat.

Tamakku siaruarterniarneri killeqarsinnaasarput nunallu assiliornerani taakkua immikkoortinneqarnikuunngillat.

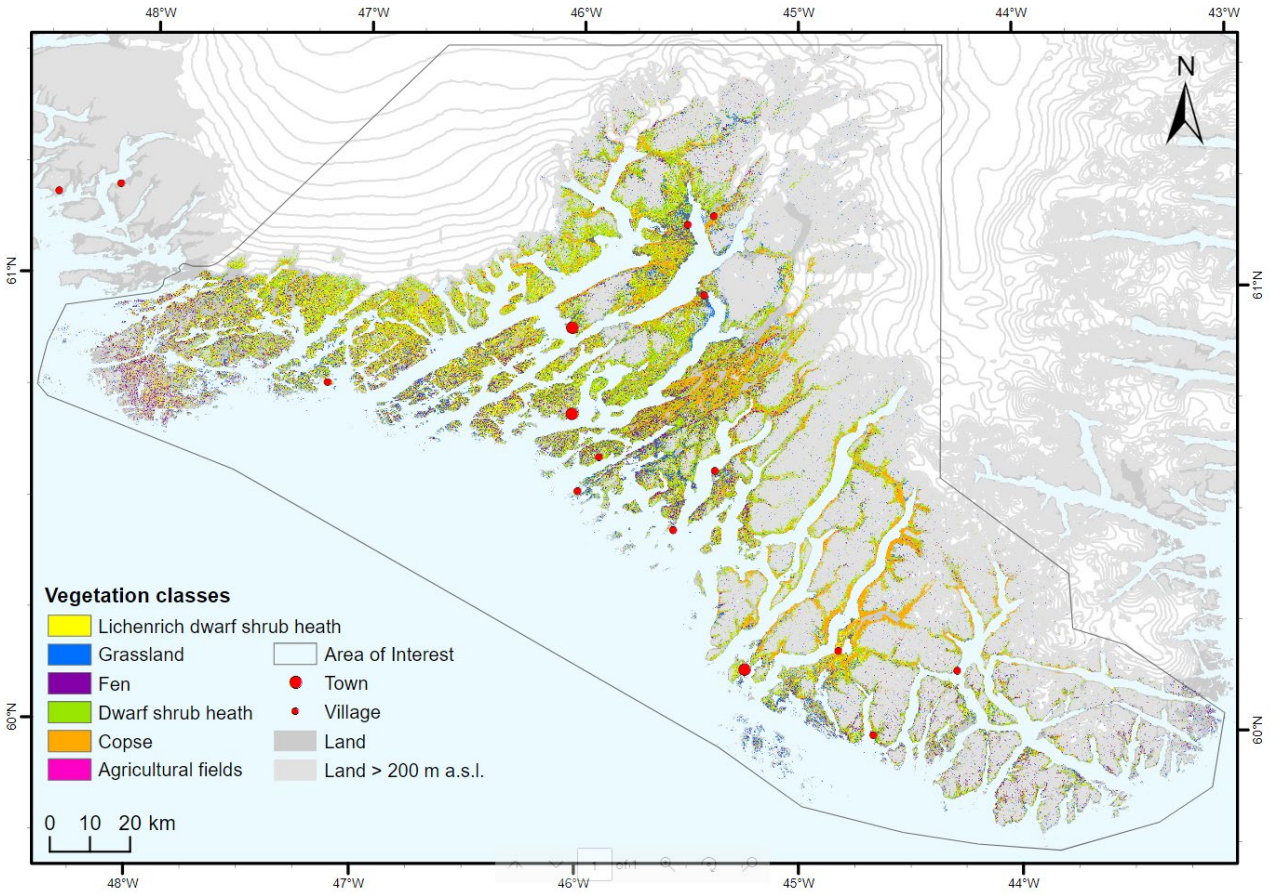
Nunap naanera aammalu naasut misissoqqissaarnerini naasoqatigiit suussusersineqartarput. Suuneri aallaavigalugit immikkoortinneqartarput kisiannili immikkoortiterinermi paasissutissat ilanngunneqartarlutik soorlu portussusai, sivinganermiinnersut aammalu issup isugutassusaa. Naasoqutigiit tallimat assigiinngitsut ukuupput: paarnaqutit, orsuatsiaat, uiffaat, ivikkat, aamma orpikkat (Tabel 4.3).

Tabel 4.3. Nunami misissuinermi naasut nalinginnaanerpaat Kujataani nalunaarsorneqartut

Naasup suussusaa	Nalinginnaanerpaat
Paarnaqutit	*Salix glauca*, *Salix arctophila*, *Vaccinium ulignosum*, *Betula glandulosa*, *Deschampsia flexuosa*
Orsuatsiaat	*Salix glauca*, *Salix arctophila*, *Vaccinium ulignosum*, *Betula glandulosa*
Uiffaat	*Carex bigelowii*, *Carex rostrata*, *Carex rariflora*, *Carex microglochin*, *Scirpus caespitosus*
Ivikkat	*Deschampsia flexuosa, Carex bigelowii*, *Poa pratensis*, *Agrostis* sp., *Agrostis hyperborea*, *Kobresia myosuroides*, *Calamagrostis langsdorfii*
Orpikkat	*Salix glauca*, *Betula pubescens*

Nunap naaneranut takussutissaq (Takussutissiaq 4.12) nalinginnaasumik isikkoq ersersinneqarluni naasoqarfiit nunallu naanerata sumi assigiinngisitaartuuneri ersersinneqarput. Paarnaqutit aammalu orpikkat nalinginnaanerpaapput aammalu nunap naaneranit minnerpaamik 50%-ia taakkunannga naaneqarpoq. Appasinnerusumiittut siammarluarnerusimapput (qatsissuseq annerpaamik 200 m) nunap qinnguani/kangerluit qinnguini. Allani avammut sinerissap qanittuaniinnerusut orsuatsiaat annerusumik naapput. Uiffannit Kujataa tamarmi tatsinit 30-40 m-sut ungasissumiittuniit tamarmi naaffigineqarpoq. Ivigaqarfiit annikinnerpaapput naasunit, tassa naasoqartillugu ivikkat 12%-iinnarmik nalunaarsorneqarput kisiannili sumiiffimmi tamani naallutik. Igalikup Qassiarsuullu eqqaa ivigaqarnerpaavoq aammalu Kangerluarsorujuup aammalu Nuugaarsuup eqqaa aamma ivigaqarnersaalluni. Nunami ivikkanik naatitsineq nunaminertamik annikitsuinnarmik atuivoq (ca. 1,200 ha, Takuuk Kapitali 5 "Inuit atuinerat"), Qassiarsummi Igalikumi eqqaanilu annertunerpaalluni.

Nunap naanera nunap assiliarinerani, orpigaqarfiit Kujataani aamma ersersinneqarput. Siammasissusaa killeqarpoq taamaammat uani nunap naaneranut misissueqqissaarnermi ilanngunneqanngillat. Melby et. al (2019) naapertorlugu orpeqarfiit anginerit arlariiupput, orpiliassaanerullutik taakkulu Kujataani kangerluit iluini nassaassaapput (Takussutissiaq 5.1). Orpigaqarfiit saniasigut orpigarsuit portusuut orpittulli portutigisut 3 meterit qaangerlugit portutigisut AOI-mi nassaassaapput. Sumiiffiit tamakkua orpigaqarluarnissaanut periarfissagissaarput nunap naqqa atugassaqarluartitsimmat orsuatsiaat anginerit aammalu pupiit naalluarnissaannik atugassarissaartitsimmat (Christensen et al. 2016). Siunissami sumiiffiit orpigaqarfiusinnaasut annertusiartussasut silap allanngoriartornerata kingunerisaanik ilimagineqassaaq. Kisianni namminerisamik annertusiartornissaat sukkavallaassanngitsoq ilimanarpoq killeqartitsineq peqqutaalluni (Normand et al. 2013).



Takussutissiaq 4.12. Kujataani nunap naanera. Sumiiffik annertussuserlu nunalerinermut atortoq, paasissutissat uannga Agency for Data and Efficiency (SDFE 2017).

4.6 Nunaminertat illersugaasut allattorsimaffiat

Kujataani AOI-mi (Takussutissiaq 4.13) nunaminertat arlariit assigiinngitsut eqqissisimatitaapput. Nunaminertat taakku inatsisinut attuumassuteqarput:

- Nunamik eqqissisimatitsiviit
- Timmissanik eqqissisimatitsinermut
- Ramsar sites
- UNESCO-p nunarsuarmioqatigiinnut kingornussaqarfiani allattorsimaffik.

Nunaminertanik eqqissisimatitsiffiit (Nunamik allanngutsaaliinermi inatsit) Uunartoq ilannguppaa (Anon. 2005a). Uunartoq tassaavoq AOI-mi kissartumik puilasoqarfik aamma kissartumik puilasoqarfiit allat Qeqertarsuarmiipput Kalaallit Nunaata kitaani imaluunniit Ittoqqortoormiit eqqaani Tunumi. Uunartup imartaata kissassusaa 42 °C-uvoq (Hjartarson and Armannsson 2010) nunaqavissunit takornarissanillu ornigarluarneqartartoq.

Qinnguata qoorui (Anon. 2005b) aamma Klosterdalen (Landsrådsvedtægt af 30. juni 1970) Tasermiut kangerlua nunaminertaapput nunap naasimaneratigut immikkuullarissuunerat peqqutigalugu eqqissisimatitaasut. Orpigarpassuaqarpoq birketræjunerusunik (Betula pubescens) aammalu piletræ (Salix glauca) (Feilberg 1984).

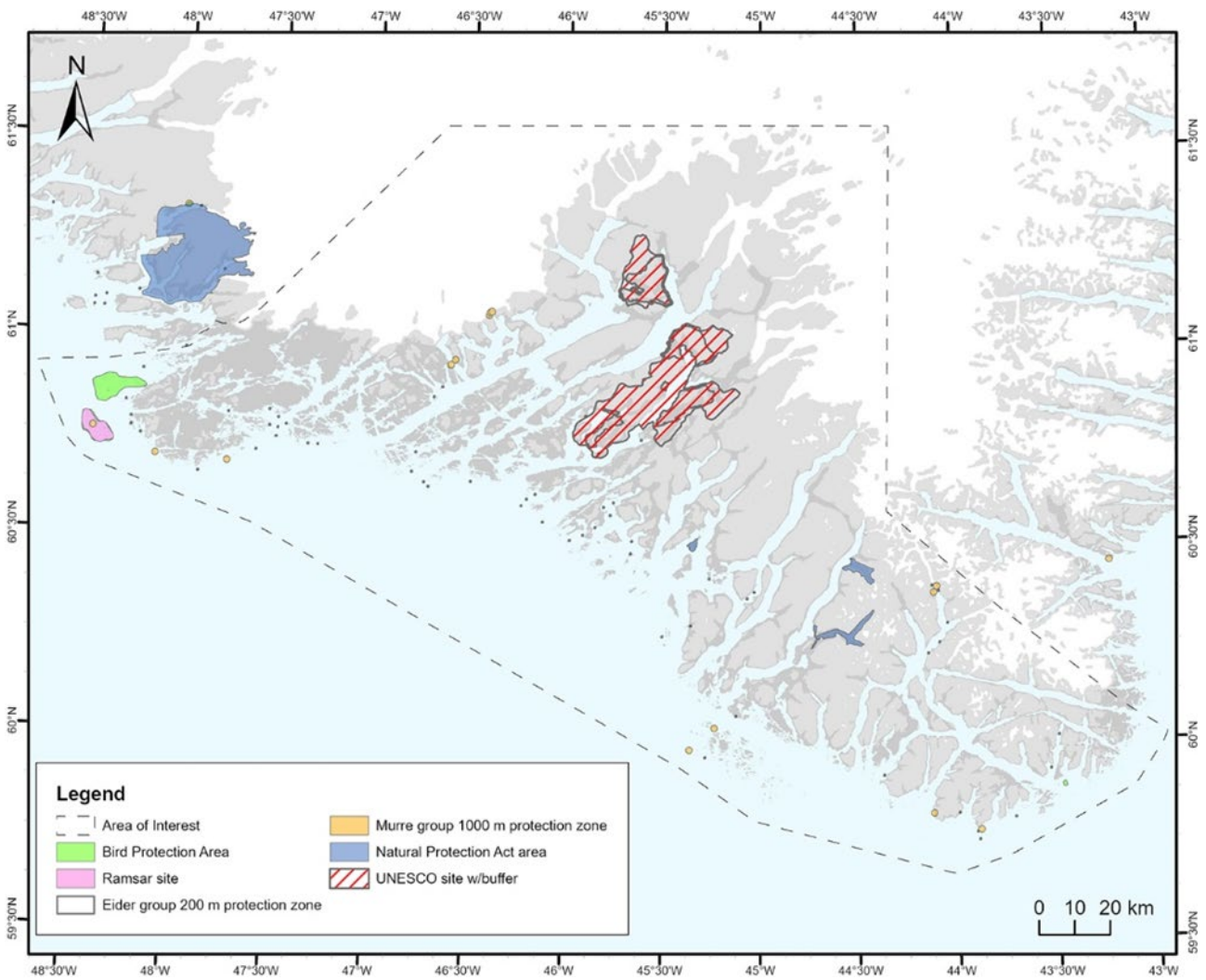
Timmissanik eqqissisimatitsinermut inatsisip (Anon. 2019) erseqqissarpaa "timmissanik sumiiffiit eqqissisimatitsisut". AOI-mi taamaattut pingasuupput tamarmik qeqertaaraallutik timmiarpassuarnit manniliorfigineqartartut: Kitsissut Avalliit, Kitsissut ilua aamma Qeqertat Narsaq Kujalleq (Narsarmijit) kangiata tungaaniittut (Takussutissiaq 4.13). Eqqissisimatitsineq timmissanut manniliornerullu nalaanut tunngasutigut angallannermut ajoqusersuinermullu taakkua sammitinneqarnerupput.

Timmissanik eqqissisimatitsinermut Inatsip (Anon. 2019) aamma nalinginnaasumik timmissat manniliorfiusut angallannikkut ajoqusersuinissamillu pinngitsoortitsiniarnermut illersuutigaa. AOI-mi timmissat ineqarfii Takussutissiaq 4.13-mi toornertut mikisutut qorsuttut aammalu sungaartutut takuneqarsinnaapput.

Kalaallti Nunaanni Timmissat eqqissisimatinneqarnissaannut Inatsisip saniatigut, Kalaallit Nunaata Ramsar-mi Nalunaarut masarsummiunut tunngasoq atuuttussanngortinnikuuaa (https://www.ramsar.org/). AOI-mi ataatsimik Ramsar siteqarpoq taannaavorlu Kitsissut Avallerni qeqertaaqqat (https://rsis.ramsar.org/ris/388; Takussutissiaq 4.13). Ramsar Sites tassaapput nalunaarummi masarsummiut timmissat pillugit aaliangersagaq taannalu Kalaallit Nunaanni inatsimmut ilanngunneqarpoq (Anon. 2016a).

Aatsitassanik misissueqqaarnerni "avatangiiseq uumasoqatigiinnut pingaarutillit" sumiissusersineqarput (Anon. 2000). Sumiiffinni tamaani aatsitassatigut misissueqqaarnerit aaliangersagaapput sapinngisamik uumasoqatigiinnut ajoqusersuineq annikinnerpaaffianiitinniarlugu. AOI-mi timmissat aammalu timmiaqarfiit pineqarput. Paasissutissanut annertunerusumik ujaasiffik alakkaruk NatureMap NunaGis-mi (iserfigalugu: “Timmissanut eqqissisimatittiffiit”). Takuuk Kapitali 8, aatsitassarsiornermi sumiiffiit eqqissisimatitat.

Sumiiffinni taakkunani marluusuni aatsitassarsiornikkut misissueqqissaarnermi suliniarneq aaliangersaaffigineqarpoq qulakkeerniarlugu uumasoqatigiinnut ajoqusersuisoqannginnissaa. AOI-mi timmiaqarfiit aammalu timmissat qeqertat najortagaannut atuuppoq.



Takussutissiaq 4.13. Nunaminertanik eqqissisimatitsiviit Kalaallit Nunaanni nunamik eqqissisimatitsinermut inatsit, Ramsar sites, Sumiiffiit timmissanik eqqissisimatitsiviusut, UNESCO-p nunarsuarmioqatigiinnut kingornussassaqarfiani allattorsimaffik aammalu mitinut appanullu pingaaruteqartut sumiiffiinut takussutissaq (uani ammalortuliatut takuneqarsinnaapput, maluginiaruk WebGIS aqqutigalugu erseqqinnerusumik sumiinneri takuneqarsinnaammata).

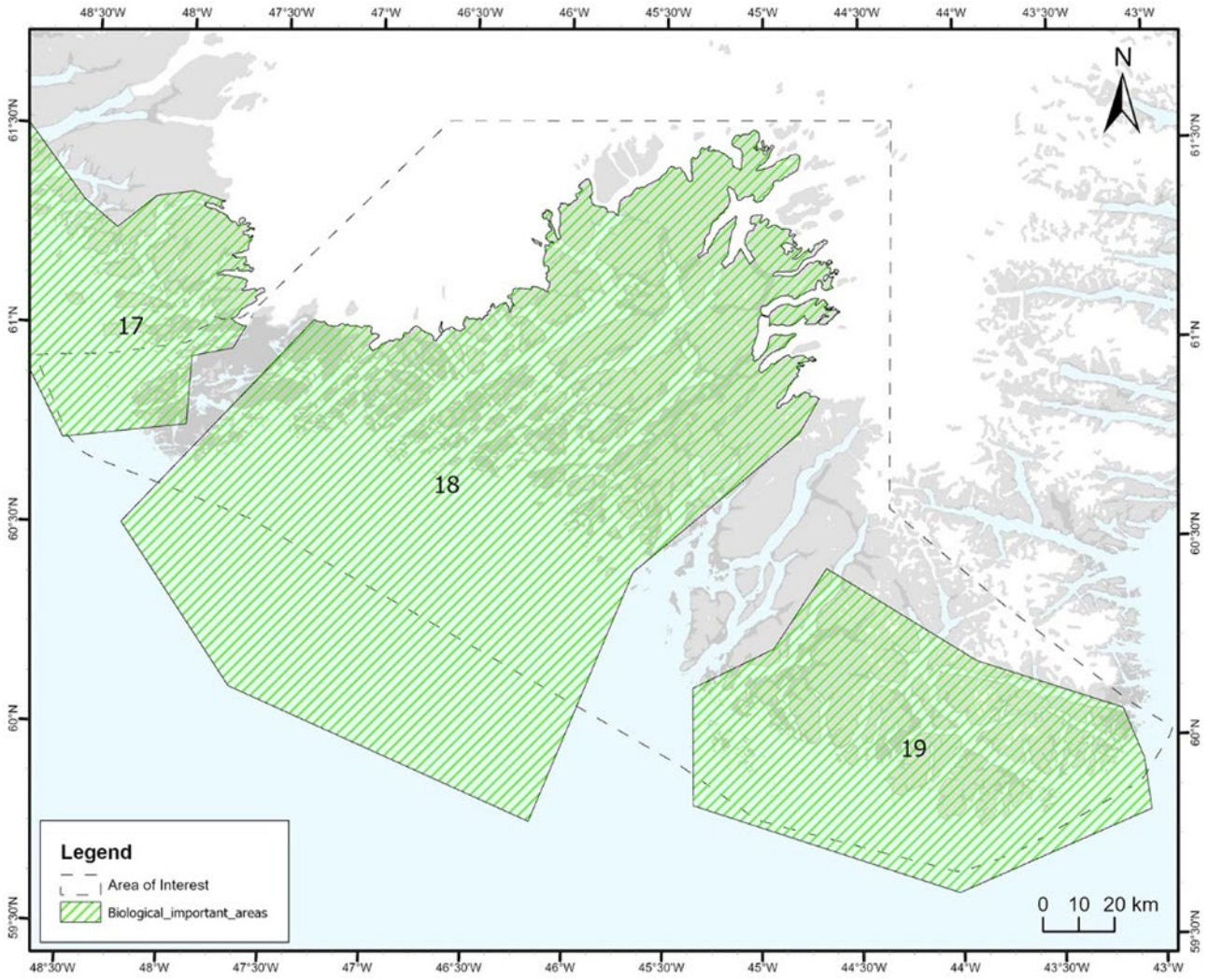
Naggasiullugu, "Kujataa – Issittumi nunaateqarneq" 2017-mi UNESCO-p nunarsuarmioqatigiinnut kingornussarsiassanut allattorsimaffimmi ilaalerpoq. Tamanna kulturikkut eriagisassaqarpoq kisianni uumassuseqassutsikkut immikkut illersugaanani (Anon. 2016). Eqqissisimatitat sumiinneri killeqarfimmiittut aaku: (https://naalakkersuisut.gl/da/Naalakkersuisut/Moeder-for-Naalakkersuisut/M%C3%B8dereferater/2018/11/22_11_18) (Takussutissiaq 4.13). Nunat eqqissisimatitaasut immikkualuttuupput ataatsimut isigisassat. UNESCO-p nunarsuarmioqatigiinnut kingornussarsiaqarfiani allattorsimaffimmi Kalaallit Nunaanni pingajoraat nunalerinermut oqaluttuassartaq qallunaatsiaat takkunneraneersumit aallartittoq tunngavigalugu (Vésteinsson et al. 2016).

4.7 Uumassusillit pillugit sumiiffiit pingaarutillit

2016-mi nalunaarusiaq uumassusillit ataqatigiinnerat aammalu uumasoqatigiit sumiiffimmi pingaaruteqassusiat Kitaanut Tunumullu saqqummersinneqarpoq (Christensen et al. 2016). Nalunaarusiami uumaasusillit ataqatigiinnerat aammalu uumasut assigiinngitsut sammineqarput sumiiffiillu pingasut pingaaruteqarluinnartutut taaneqarput:

- *Sumiiffiit uumasunik aaliangersimaqqissaartullit*. Uumasoqatigiinnut aaliangersimasunut immikkut pingaaruteqarluinnartuupput sumiiffiit. Imaassinnaavoq sumiiffiit uumasunut pineqartunut amerlasoorsuanngorlutik uninngaffigisartagaat, ingerlaarnerminni najugarisartagaat imaluunniit allatut sumiiffik pingaartinneqarluni.
- *Najugaqarfiit pingaarutillit, nunap immikkuullarissusaa imaluunniit uumassusillit ataqatigiinneratigut allatut katitigaasimasut.* Uani sumiiffiit uumassuseqarluartut pineqarput, sumiiffiit uumasoqatigiitsigut immikkuullarissuseqartut aamma/imaluunniit annertuumik assigiinngisitaarfiusumik uumasoqarfiusut il.il.
- *Uumassusillit ataqatigiinnerat aamma uumassusillit pillugit naleqartinneqartut.* Tamakkuupput sumiiffiit uumasunut aaliangersimalluinnartunut inigineqartunullu pingaaruteqarluinnartut, nunamik sananeqaataatigut imaluunniit uumassusillit ataqatigiinneranni aaliangersimasut immikkut ataqatigiilluarneri peqqutaallutik.

Nalunaarummi *Uumassusillit ataqatigiinnerat aamma uumassusillit pillugit naleqartinneqartut* pingasut sumiissusersineqarput tamakkiisumik imaluunniit ilaannakortumik AOI-p iluaniittut. Christensen et al. (2016) nalunaarutaani taakku sumiissusersiffiit pingasuusut tamarmik "Sumiiffik 17, 18 aamma 19"-tut nalunaarsorsimapput (Takussutissiaq 4.14).



Takussutissiaq 4.14. Uumassusillit ataqatigiinnerat aammalu uumassusillit pillugit sumiiffiit pingaarutillit AOI-p iluaniittut ersersinneqarput 17, 18 aamma 19-tut Christensen et al. (2016) nalunaarutaani. Sumiiffiit aqqi pillugit taaneqartut, takuuk Takussutissiaq 1.1. aamma suut erseqqissumik pineqarnersut pillugit takussutissiat kapitalimi takukkit. .

Uumasoqatigiit ataqatigiinnerat aamma uumassusillit naleqartinneqartut 23-it pillugit tamarmik attuumassuteqartuusut nalunaarusiami inerniisumik naliliiffigineqarput ima paasillugu arlaatigut aarlerinartoqarsinnaatillugu uumasut sumiiffii aammalu uumassuseqartut ataqatigiinnerat Kitaani Kujataanilu illersorneqarsinnaanissaat. Taamaattoq nalunaarusiami inassuteqaatigineqarpoq taakku sumiiffiit 23-it pillugit immikkut sammisumik nunaminertanik eriaginnittoqarnissaa pisariaqartinneqassasoq sumiiffiit uumasunik aaliangersimaqqissaartunik uumasoqartut taakkualu 23-it avatangiisaat immikkut isigineqartariaqartut. Sumiiffiit aqqi pillugit taaneqartut, takuuk Takussutissiaq 1.1. aamma uumasut suussusai pineqartut kapitalimi uani assiliartani takukkit.

Sumiiffik 17-ip kujataa kisiat AOI-mi ilanngunneqarpoq. Sumiiffik tamanna timmiaqassutsimut pingaaruteqaqaaq taannaavorlu Kitsissut Avalliit aamma Kitsissut iluani qeqertat, timmiarpassuaqarfiugami (Kalaalit Nunaannut peqassutsimut sanilliullugu), timmiarpassuit assigiinngisitaartut appat, appat sigguttuut, apparluit, qilanngat aamma nattorallit tamaaniikkamik.

Timmissat taakku ilai arlallit Kalaallit Nunaanni aarlerinartorsiortutut nalunaarsorsimapput aamma/imaluunniit nunarsuaq tamakkerlugu (Takussutissaq 4.1, Boertmann and Bay 2018). Sineriammi toornaviarsuppassuaqarpoq (Takussutissiaq 4.3) ukialernerani mamaartunik aamma sinerissap avataaniittut ukiumilu timmiarpassuarnik najugaqarfigineqartut ilisimaneqarput, uani ilanngullugit appat aamma mitit (Assiliartat 4.7 aamma 4.10). Sinerissap avataa aamma arfernut soqqalinnut pingaaruteqaqaaq.

Sumiiffiup 18-ip eqqaa tamarmi (Takussutissiaq 4.14) Kujataa tamakkigajappaa. Tamanna orpeqarluarpoq (*Betula* sp.) aamma (*Alnus crispa*) orpikkat, sumiiffillu tamanna naasunik sullilinnik peqarluarpoq, ilanngullugu naasut takussaanngisut aammalu Kalaallit Nunaanni arlerinartorsiortinneqartutut taasariallit (Takussutissiaq 4.11, Takussutissaq 4.2). Sineriaqarpoq aamma qaqqartuunngitsunik pukkitsunik kooqarlunilu eqaloqarluartunik (Takussutissiaq 5.4) aamma nattoralik tamaani takussaalluarpoq (Takussutissiaq 4.2). Sumiiffik 18 Kalaallit Nunaanni nunalerinermut pingaaruteqarluarpoq, savaateqarneq ilanngullugu minnerunngitsumillu naatsiianik naatitsinermut pingaaruteqarluni (takuuk Kapitali 5 "Inuit atuinerat").

Kulturikkut eriagisassat amerlapput qallunaatsiaqarfiit amerlaqisut ilanngullugit (takuuk Kapitali 6 itsarnisarsiornikkut nassuiaatit). Sinerissap avataa timmissanut ukiisunut pingaaruteqarluarpoq (soorlu mitik, appat) aamma aasaanerani arferit soqqallit tamaaniittarput.

Sumiiffik 19-mi Issittup kujasittortaaniittartut kitaata tungaaniittarput uanilu orpiit birketræer amerlasoorsuanngorlutik maani takussaapput (takuuk imm. 4.7).

Nattorallit maani takussaalluarput aamma Nunap Isuatalu kangiani takussaallutik, maani timmiaqarfeqarluarpoq mitit apparluillu

timmiaallutik. Qeqertani qasigiaqarfiit ullumikkut ikitsuinnaat ilagilernikuuaat (Takussutissiaq 4.1). Tamanna aamma timmissanut eqqissisimatitsiviuvoq. Timmissanut ingerlaartunut avataa ukiuunerani ukiiffigineqartarpoq (soorlu mitit appallu), natsersuit (*Cystophoa cristata*) upernaakkut takkusimaartarlutik aammalu nannut (*Ursus maritimus*) sikorsuit takkusimaleraangata takussaasarput.

Soorlu qulaani taaneqareersoq, sumiiffiit 17, 18 aamma 19-ip avataani uumasoqatigiit ataqatigiissut aammalu uumassusillit sumiiffiit pingasut piupput. Tassaniipput Ammalortup qeqertaata kangiani timmiaqarfiit innat marluk taateraat naajallu allat manniliorfigisaat aammalu Kangersunermi Qinngorlermi (takuuk Takussutissiaq 4.4.) sumiiffik 18-ip aamma sumiiffik 19-ip sineriaata avataani ippoq mitinut ukiuunerani najugaqarfigineqassallugu pingaaruteqarluinnartoq.

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5 Inuit atuinerat

Allaaserinnittoq Katrine Raundrup[1], Josephine Nymand[1], Peter Aastrup[2] and Karl Zinglersen[1]
[1]Greenland Institute of Natural Resources, [2]Department of Ecoscience, Aarhus University

5.1 Allarniut

Kujataa 6.500 missaani amerlatigisunik innuttaqarpoq – 5.600 missai illoqarfinni Qaqortumi, Narsami aamma Nanortalimmi, aammalu 900-it missingi nunaqarfinniipput savaateqarfimmiillutillu (januarip 1 2021 naapertorlugu, www.stat.gl). Soqutigisaqarfik AOI tassaavoq (Takussutissiaq 5.1) nalunaarusiami uani sammineqartoq Kommuni Kujalleq, Kalaallit Nunaani kommuneqarfiit kujallersaat.

Kapitalimi uani inuit AOI-mi najugaallit atuinerat sammineqarpoq.

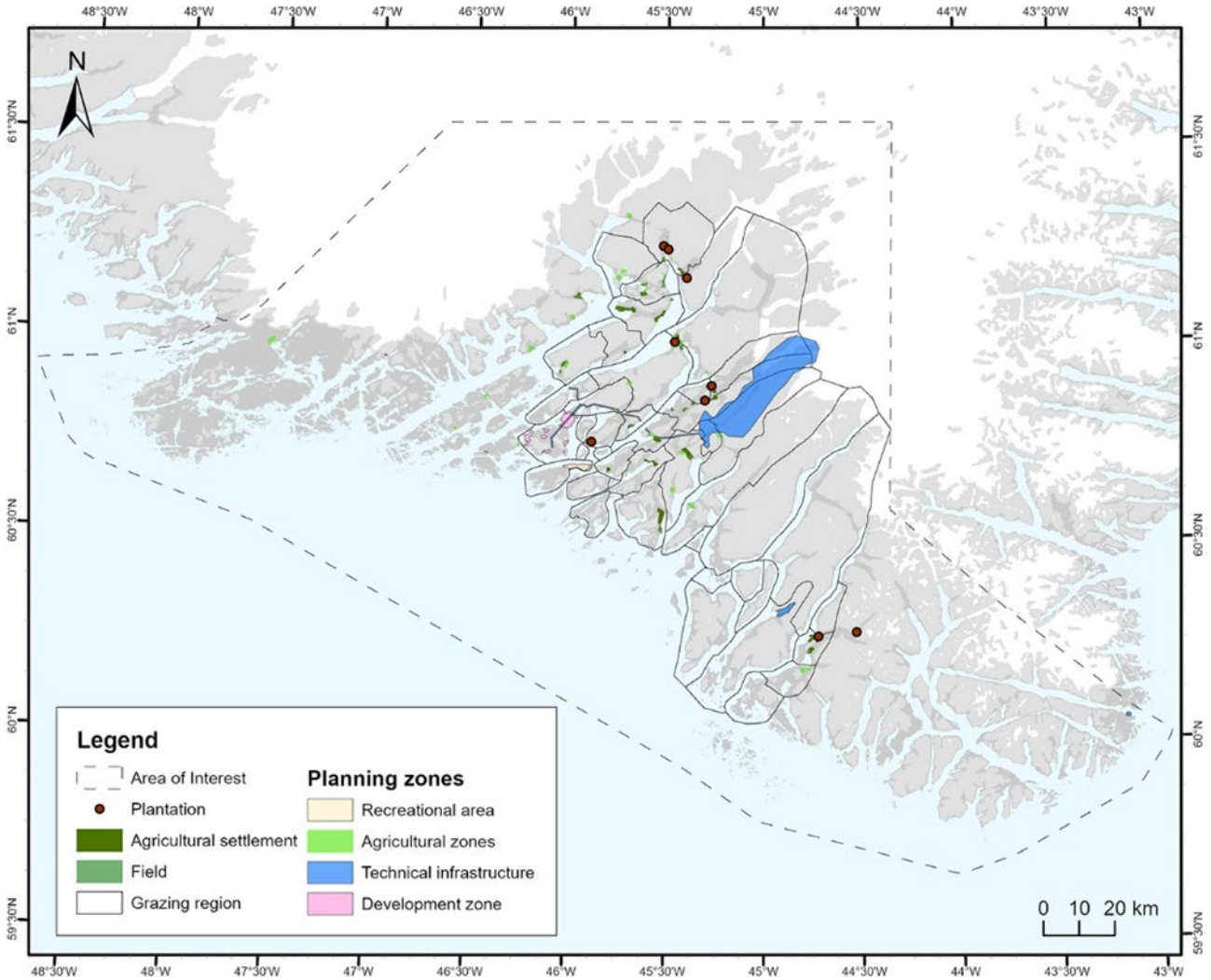
Kommunimi pilersaarut tamakkiisoq uani nassaarineqarsinnaavoq www.kujalleq.cowiplan.dk/dk (danskisut aamma kalaallisut). Tassaniipput nunap assingi, nunaminertat sukisaarsaarfittut naatsorsuussat, ulluliorfissat, nunalerinermut atugassat aammalu sanaartornermi atugassat, tamakkulu tamarmik naalisarnera Takussutissiaq 5.1-mi takuneqarsinnaavoq. Kommunimi pilersaarusiorneq Pilersaarusiortarnermut Inatsimmik nunamik atuinissamut aammalu nunamik illersuinissamik, akuersissuteqarnissamut inuit nunalu ineriartornermi imminut ataqatigiinnerinik tunngaveqartumik suliaavoq innuttaasunillu akuutitsinerulluni.

Kommuni pisussaaffeqarpoq illoqarfik pillugu pilersaarusiussalluni aammalu nunamik atuineq naliliiffigissallugu sumiiffimmi ineriartornikkut, inuussutissarsiuteqarnikkut atugassaqarnissaq siunertaralugu innuttaasunut tamanut iluaqutaasumik. Pilersaarut piffissami aaliangersimasumi atuuttussaavoq nunap sinneranut ineriartornermut malinnaassalluni, inuiaqatigiit soqutigisaannik ingerlatsissalluni aammalu angallannikkut nukissiuuteqarnikkullu inerisaassalluni minnerunngitsumik nunaminertat illersugaanissaanik aamma siunertalimmik suliaqarnissaminnut. Oqartussaasut kattuffiillu nuna tamakkerlugu ingerlatsiviusut kommunimut pisussaaffeqarput soqutisamik saqqummiunnissaannut kommunimullu tulluartunngorlugit tusarniuteqarnissaminnut. Kommuni pilersaaruteqarnermini kattuffiit innuttaasullu kissaataat illuliortiternissamut soqutigisaat tusarniassallugit pisussaaffigaa, uanilu nunaminertanik atuineq aammalu nuna illuliorfiunngitsoq ilanngullugu (Anon. 2010).

Nunamik atuineq aammalu aatsitassarsiorniarluni suliniutit Aatsitassat pillugit Inatsit tunngavigalugu suliarineqartarput uanilu akuersissutit aammalu nakkutiginninnerit Aatsitassanik allagartalerinermik sillimaniarnermillu oqartussaasut isumaginnittuusarput tamannalu susassaqartut nakkutilliisullu tamarmik tusarniarneqartarput (Mineral Resources Act, §3, govmin.gl). Inuit Kujataani pisuussutinik atuinerat nunami nunalerinermik savaateqarnermillu aallaaveqartorujussuupput. Tamanna nunalerinermik taama annertutigisumik kisiartaalluni

ingerlatsiviuvoq. Soorunami, immami sineriammilu aamma inuussutissarsiortoqarpoq. Kapitalimi uani nunalerineq/uumasuuteqarneq, immami inuussutissarsiorneq, orpeqarfeqarneq, takornariaqarneq aammalu angallannikkut teknikkikkullu tunngasut sammineqassapput.

Kujataa nunalerinermi qallunaatsiaanit ukioq 985-miilli ingerlatsiffiusimavoq. Qallunaatsiaat uumasut arlariit nassarlugit nunamut tikissimapput, soorlu savat, nersutit, savaasat, puulukit, hestit aammalu kukkukuut (Madsen 2015). Qallunaat Kalaallit Nunaanniipput ukioq 1450 tikillugu taamanilu sumiiffimmi illut nunaateqarfiit amerlassutsimikkut 200-it angusimavaat. Sooq nuna qimassimaneraat suli ilisimaneqanngilaq, kisianni inuuniarnermik nunamik atuineq (Arneborg et al. 2012) aammalu silap allanngornera (Grove 2001) peqqutit ilagisimassagaat ilimagineqarpoq.



Takussutissiaq 5.1. Kommuni Kujalliup illoqarfimmut pilersaarutaani sukisaarsaarnermut, nunalerinermut, ivigartorfinnut, uumasuuteqarnernut, orpigaqarfinnut aammalu teknikkikkut attaveqaatitigut tunngasut takuneqarsinnaapput. Innersuussaq: www.kujalleq.cowiplan.dk/dk.

Nunalerineq ukiuni tulliuttuni untritilikkaani Kalaallit Nunaanni piunngeriarluni savaateqarneq ukioq 1915-mi eqquteqqinneqarpoq (Nymand 2018). 1970-kkut tikillugu savat amerlanerpaartaatigut silamiissinnaapput ilaatigut taamaallaat uumasut inaaniitinneqartarlutik (Austrheim et al. 2008). 1966/1967-mi ukiorlulluni aperujussuarnerata kingunerisaanik uumasuutit savat piaqqiortut 50%-ii angullugit annaaneqartarput, kingornalu 1971/1972-mi aqutsineq

allanngortinneqarpoq ullumikkumut nutaaliaasumik aaqqissuussineq eqqunneqarluni ukiuunerani savat, savat inaaniitinneqartalerlutik (takuuk kapitalimut atasoq 5.2).

1960-kkunni aamma 1970-kkut aallartinnerini ukiorlussuit sioqqullugit, savat piaqqiortut 250-niit 1915-mi Islandimiit eqqunneqarmata 1966-mi 45.000-nngorsimapput. Toqorarujussuarnerisa kingorna savat piaqqiortut 20.000-nanngorsimapput.

5.2 Ullumikkut nunalerineq

Nunaateqarfiit 2005-mi 52-riarlutik 2019-mi 37-nanngorsimapput, appariaateqarlutik (www.stat.gl). Savaateqarfiit amerlanersai savaateqarput, ilaali nersutaateqarput, nunaleralutik naatsiianillu naatitsillutik.

Savaateqarneq

1982-mi savaateqarneq pillugu pilersaarusiaq saqqummiunneqarpoq, ukiumut qaammatini arfinilinni ivigartornermik nerukkaatissaqarnissaq siunertaalluni (maajip 1-nit - oktoberip 31-nut) kingornalu uumasut inaanni qaammatini arfinilinni nerukkaatissaqarneq tunngavigalugu ingerlanneqartarluni (1. novemberimiit apriilip 30-nut; Austrheim et al. 2008).

Nerukkaatissaqarniarneq ukiuunerani naammattusaarniarlugu nammineq nerukkaatissaqarniarneq (ivikkat naatitallu nammineq naatitat) tunngavigineqartarput aammalu avataaneersut nerukkaatissat. Taamaattoq, nunalerineq savaateqarfinni tamani ingerlanneqartarpoq siammasillunilu (Takussutissiaq 5.1). Sumiiffik tamarmi nunalerinermik ingerlatsiviuvoq 2005-mi 900 ha 2019-milu 1.200 ha missaaniittoq nunalerineqarpoq (www.stat.gl).

Piffissami tassanerpiaq savat piaqqiortut 2015-mi 21.000-ioriarlutik maanna 2019-mi 18,000-nngorsimapput (www.stat.gl). Ukiut tamaasa savaaqqat toqorarneqartartut amerlassusai aalaakkaasorujussuupput - 20,000 missiliorlugit. Savaaqqat toqoraaviliaanneqartarput, Neqi A/S (www.kni.gl/en/vores-virksomheder/om-neqi/k) Narsamut ukiaanerani toqoraanermi.

Qanittumi "Nunalerinermi periusissiaq 2021-2130" (APPN 2020) saqqummiunneqarpoq, siunissami anguniagaalluni savaaqqat ukiumut toqorarneqartartussat 28,000-it angussagaat. Ilanngullugulu, anguniagaavoq ukiuunerani nerukkaatissaqarniarneq imminerisamik 80% angullugu napatissinnaasunngorsimassasoq (maannakkut 50%-ia avataaniit tikisinnneqartarput). Anguniakkat anguniartillugit nunaminertat naggorissarneqarnissaat pisariaqartinneqarpoq (Westergaard-Nielsen et al. 2015), aammalu aqutsineq eqaannerusoq savallu piaqqiorsinnaasut amerlanerit pisariaqartinneqarput.

ivigartorfiit ilai Kujataaniittut maannamut malunniuteqarput ivigartorfigineqarpallaalernermik tamannalu ukiuni qulikkaani malunnarpoq, massa sumiiffiit ilai naaneerukkiartornerisa kingunerisaanik nuna sisuulersimasoq takussaalersimasoq (Fredskild 1992, Massa et al. 2012).

Ukiuni kingullerni savaateqarneq annikilliartortinneqarluni naatsiianik naatitanillu allanik soorlu ruuanik ingerlanneqaleriartorpoq. Qanittumi

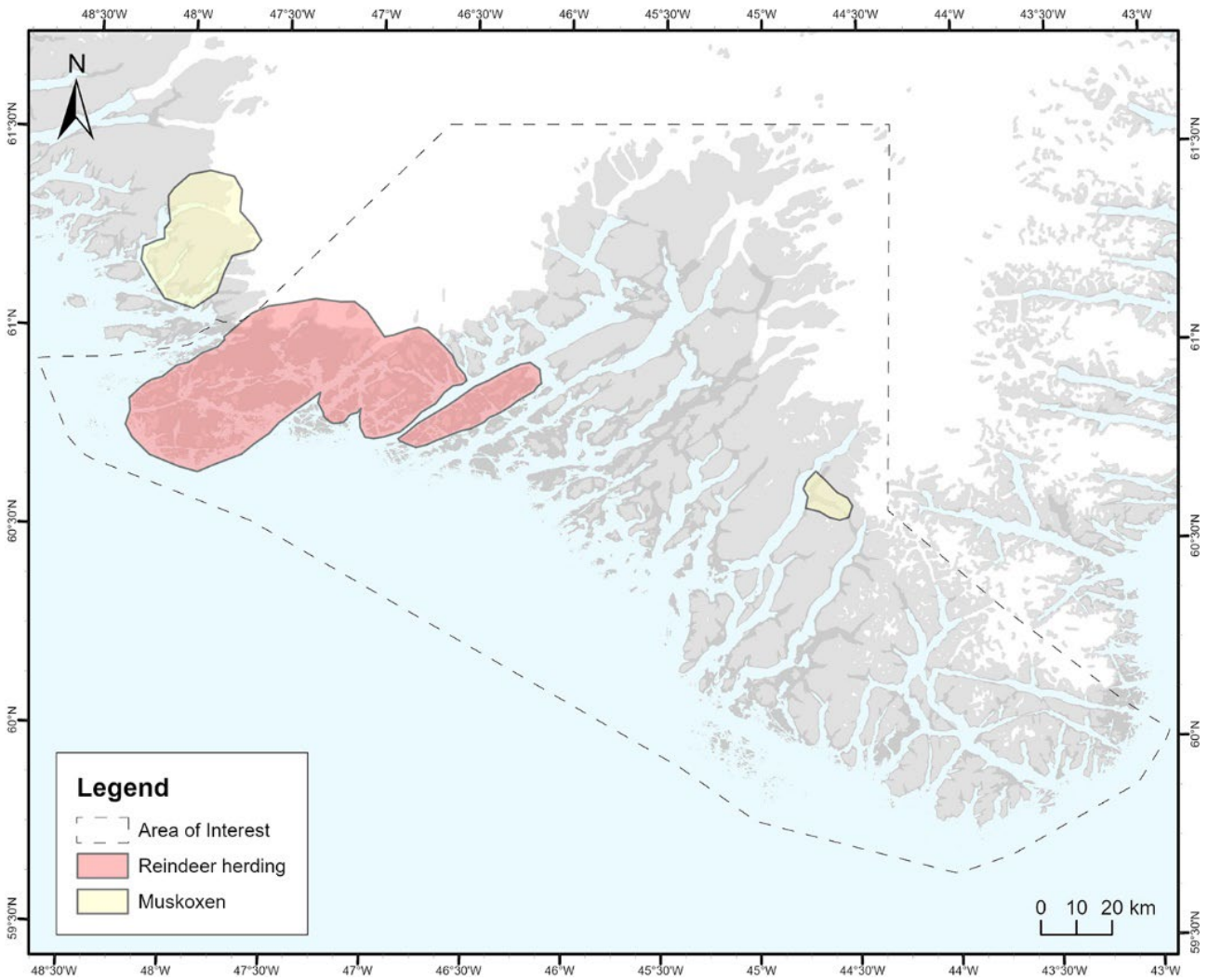
saqqummertumi "Nunalerinermi periusissiaq 2021-2030" allassimavoq naatitanik annerusumik pilersuinissaq anguniagaasoq (APNN 2020).

Nersutaateqarneq

Ukiuni kingullerni savaatillit ilai nersutaateqartalerput, ullumikkullu nersutit 300-it missaaniittut uumasuutigineqarput (www.stat.gl). Nersutaatit amelanersai neqissaqarniarneq aallaavigalugu pigineqarput amerlanngitsut tallimassuit akornaniittut immummik pilersuisussatut uumasuutigineqarput, namminerlu imminut pilersornermiilluni. Soorlu savat, nersutaatit qaqqani aasaanerani neriniartarput ivigartorlutik ukiuuneranilu uumasut inaaniitinneqartarput. Nersutit Neqimi Narsami toqorarneqartarput.

Tuttuuteqarneq

Nunap nammineq tuttua (*Rangifer tarandus groenlandicus*) sikoqanngitsumi Kitaani Kujataa pinnagu uumasuuvoq. 1952-mi tuttut nujuanngitsut (Rangifer tarandus tarandus) Norgemiit Itinneranut (Nuup Kangerluata qinnuguani 64°N, AOI-mit avannarpasinnerujussuarmi) nuunneqarput. Sumiiffimmut tuttut 260-it missingi tuttuliussaapput. 1990-kkut naanissaat tikillugu tamaani tuttuuteqarneq ingerlanneqarsimavoq (Cuyler 1999). Itinneranit tuttuutit 98-sut eqqunneqarmatali Isortumut eqqunneqarput (Takussutissiaq 5.2) tamannalu 1973-mi 1974-milu pivoq. Tuttuuteqarneq isorartussutsimi 1,500 km2 -missaaniittumi qaqqani ingerlanneqartarpoq tamannalu ukioq kaajallallugu pisarpoq. Ukiumut ataasiarlutik tuttunik katersisarput toqaanerlu ingerlanneqartarluni. Kisitsinermi kingullermi ilisimagineqarpoq tuttuutit 1,200-ssasut.



Takussutissiaq 5.2. Tuttuuteqarfiit (tunguusamik nalunaaqutsersimasut). Kippasinnerpaaq "Isortoq" aammalu kangerpasinnerpaaq "Tuttutooq". Umimmaat Nanortallup eqqaaniittut sungaartumik nalunaaqutsersimapput. AOI-ip avannamut kitaani Ivittuut umimmai piupput (sungaartumik nalunaaqutsersimasut).

Tuttutooq tuttuleqqineqarpoq 1992-mi (Takussutissiaq 5.2) (Cuyler 1999). Tuttuutit 220 km2-sut isorartutigisumiipput maannalu ilimagineqarput tuttuutit 35-ssasut.

5.3 Umimmaat pillugit aallarniut

Umimmak (*Ovibos moschatus*) nalinginnaasumik Kitaani uumasuunngilaq, kisianni piaqqat Tunumiit Kangerlussuarmut (ca. 66°N) 1960-kkut qiteqqukkaa nuunneqarput. Kangerlussuarmi amerliartupiloorput kingornalu Kitaani piffinnut arlariinnut nuussisoqarpoq, Ivittuut 1987-mi ilanngullugit (Boertmann et al. 1992).

2014-mi umimmaat 18-it (arnavissat 12-it angutivissallu 6-it) Ippatit qooruanut Nanortalimmiit avannamut kimmut (sungaartumik nalunaaqutserneqarput Takussutissiaq 5.2). Umimmaat Ivittuuniit nuussaapput (sungaartoq silinneq Assiliartami 5.2-mi AOI-mit avannamut kimmut). Umimmaat aallartitsinnagit nalunaarusiortoqarsimavoq umimmaat uumalluarsinnaanerinut aammalu naammattunik nerisassaqarnerannik erseqqissaasoqarluni, ilimagineqarporlu isorartussutsimi 150 km2 (Feilberg and Bürger 2013) tassani siaruarsimassasut.

2020-mi kisitsisoqarmat umimmaat 46-it missaaniipput (pers. comm. N.M. Lund, APNN). Umimmaqassuseq annikimmat suli piniarnermut ammaassisoqanngilaq.

5.4 Orpinnik naatitsiviit

Kalaallit Nunaanni orpiit namminerisamik nunamit pisut qaqutigoortorujussuupput taakkulu nassaassaasarput Kujataanni kangerluit qinnuigini (Böcher1979 aamma Kapitali 5).

Hans Egedep 1721-mi Kalaallit Nunaannut tikinneranit nunasiaateqarneq aallartippoq. Norskit danskillu tikinneranit niuertoqarfiit sineriammi pilersiortortinneqarput, qisunnik pisariaqartitsisoqarpoq soorlu ikummatissatut atugassatut (Meilby et al. 2019).

Orpik avaalaqiakulooq, nunap namminerisamik orpigarisai annertuumik nungukkasuarneqarput illuni kiassarnissamut atorneqarmata.

Kiassarnermut orpikkat atorsinnaasut nungummata, orpikkanik avataaneersunik 1840-kkunni ikkussuisoqartalerpoq. Orpigaqarfissat arlariit ikkussuiffigineqarput kisiannili sumiiffinni amerlasuuni ikkussugassat imaluunniit orpeeqqat toqusarsimapput. Orpeqarfiit naatinneqarsimasut suli orpiupput soorlu Norgemi orpiit (*Picea abies*), Skorskit orpiat (*Pinus sylvestris*), orpiliassaq qaamasoq (*Picea glauca*) aammalu Sibiriamiut orpiat (*Larix sibirica*) (Ødum 1979).

Takussutissiaq 5.3. Tunulliarfiup kangerluani Qanasarissat isuani orpeqarfik. Assiliisoq: K. Raundrup.

Ullumikkut, Kujataani orpeqarfeqarpoq arfineq pingasunik (Takussutissiaq 5.1 aamma Takussutissiaq 5.3). Narsarsuarmi annersaavoq Kalaallit Nunaata Orpigaateqarfia, 100 ha-tut isorartutigaaq orpikkat 100.000-it ikkussorneqarnikuupput orpiillu assigiinngisut 100-upput (Christensen et al. 2016; Ræbild et al. 2019). Orpinnik ikkussuineq kingulleq 2004-mi Itillimi Igalikup eqqaani pivoq. Orpiit 20.000 -inik sinneqartut Siberiamiut orpiat aamma orpiliassat ikkussorneqarput, ikkussuiffigineqartorlu 7 ha-tut isorartutigaaq. (Meilby et al. 2019).

5.5 Piniarneq

Kalaallit Nunaanni piniarnermut tunngasut Naalakkersuisunit oqartussaaffigineqarput. Piniartuuneq marloqiusamik aaqqissuussaavoq: saniatigooralugu pinialuttartut aamma inuussutissarsiutigalugu piniartut. Kujataani, piniagarineqartut nalingiinnaanerpaat pingasut tassaapput aqisseq (Lagopus mutus), ukaleq (Lepus arcticus), aamma terianniaq (Alopex lagopus) taakkulu piniagassat sumi tamaani uumasuullutillu peqarluarpoq.

Piniakkat amerlassusii ukiumiit ukiumut allannguuteqangaatsiarsinnaasarput. Pingaartumik aqissit amerlassutsimikkut 2006-miit 2019-mut appariarujussuarsimapput. Tamanna saniatigooralugu pinialuttartut inuussutissarsiutigalugulu piniartut Kujataani ikileriarujussuarsimanerinut peqqutit malunnaatilimmik ilagaat. 2006-mi saniatigooralugu imaluunniit inuussutissarsiutigalugu piniartutut (524 aamma 190) nalunaarsorneqarsimasut 714-pput kisiannili 2019-mi kisitsisit appariarujussuarsimapput 269-nngorsimallutik aammalu 127-nngorsimallutik, katillugu piniarnermik ingerlataqartut 369-nnanngorlutik (www.stat.gl).

Terianniat perleroortuusinnaasarput takuneqartillutillu amerlanerpaartaatigut toqunneqartarput pingaartumik savanut savaateqarfinnullu qaninngoortut takuneqarsimatillugit. Perlerorneq Kujataani terianniat akornanni ukiut 5-6-kkaarlugit takkuttarpoq (Raundrup et al. 2015), taamaattoqartillugulu terianniat toqorarneqarnerat annertusisarpoq.

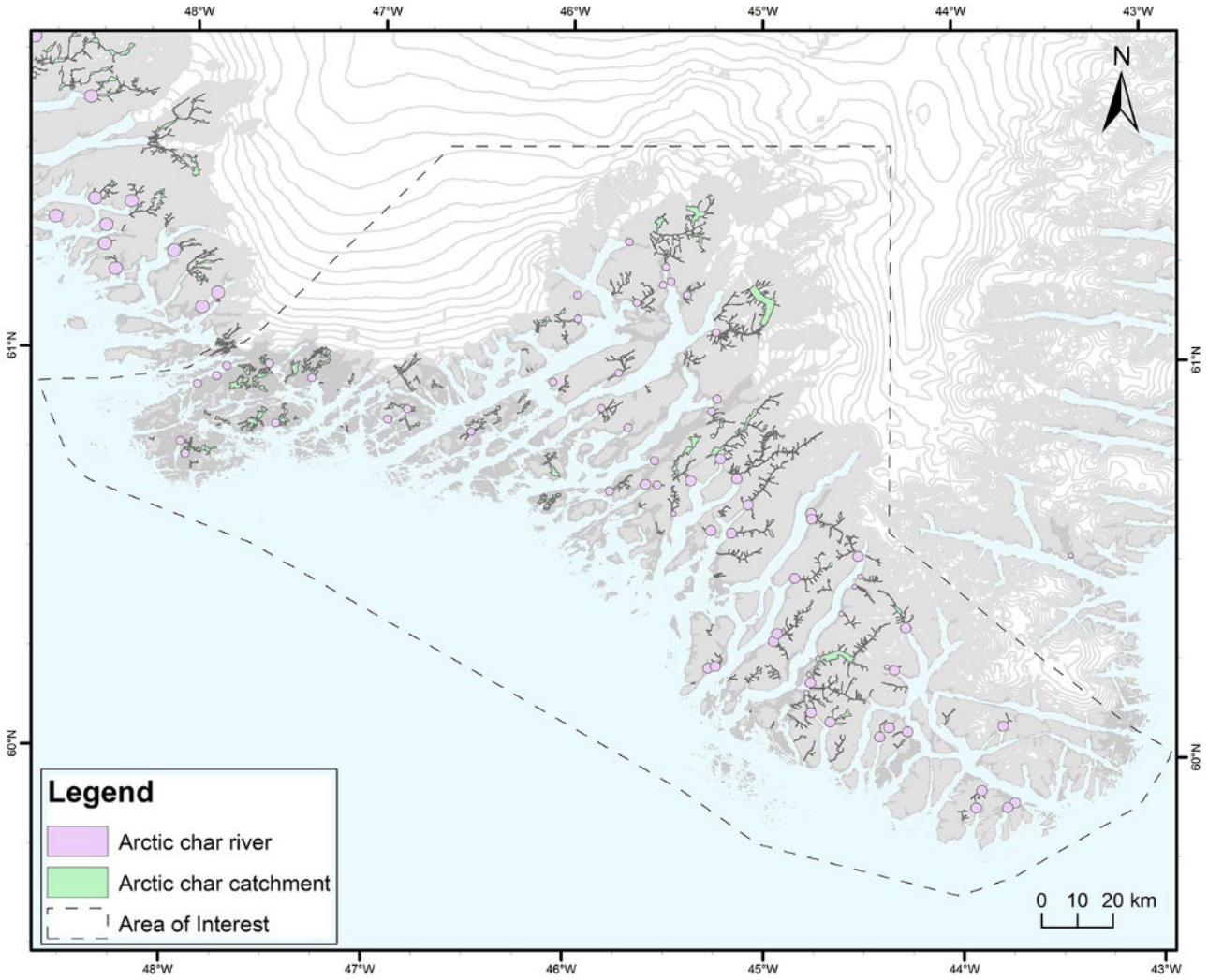
Sumiiffiit piniartunut immikkut pingaaruteqartinneqartut sumiissusersineqanngillat.

5.6 Sineriammi aalisarneq

Sineriassuarmi aalisarnikkut ingerlatsineq siammasippoq, imminut pilersorneq tunngavigalugu aalisartunut aammalu inuussutissarsiutigalugu aalisartunut. Ataatsimut isigalugu, Kujataani inuussutissarsiutigalugu aalisarneq killeqarpoq sinerissap sinneranut aalisarnermut sanilliussissagaanni. Tulliullugu eqalunniarnermut (*Salvelinus alpinus*), saarullinniarnermut (*Gadus morhua*), qaleralinniarnermut (Reinhardtius hippoglossoides), nipisanniarnermut (*Cyclopterus lumpus*), raajarniarnermut (*Pandalus borealis*) aamma saattuarniarnermut (*Chionoecetes opilio*) pingaaruteqartut saqqummiunneqassapput.

Eqaluit

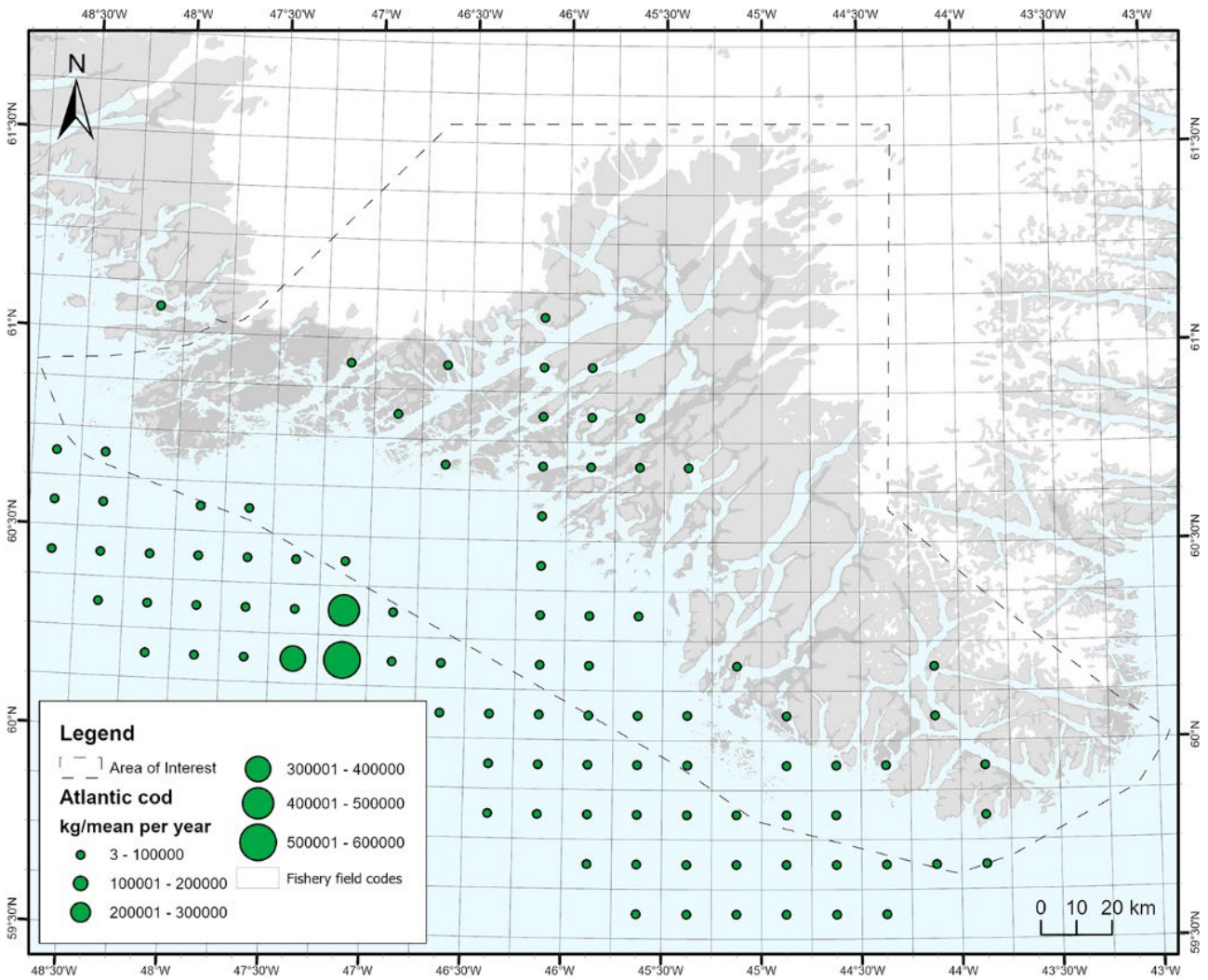
AOI-mi eqaluit nalinginnaasuupput kuuillu annerit eqalunnik suffiffiusarput. Eqaluit tatsini suffisarput aammalu eqalukkat ukiuni arlaqartuni immamut pinnginnerminni tatsiniittarput. Tatsit kuuillu ilai eqaloqartarput taratsumut ikaarneq ajortunik. Eqaluit tamarmik ukiuunerani tatsiniittarput piffissarlu taanna uumaannarnissaannut pingaaruteqartarpoq (Christensen et al. 2016). Eqaluit kuunni amerlasuuni takussaasarput (Takussutissiaq 5.4) aalisassallugillu nuannarineqartaqaat.



Takussutissiaq 5.4. Tatsit kuuillu eqaloqarfiusut.

Saarulliit

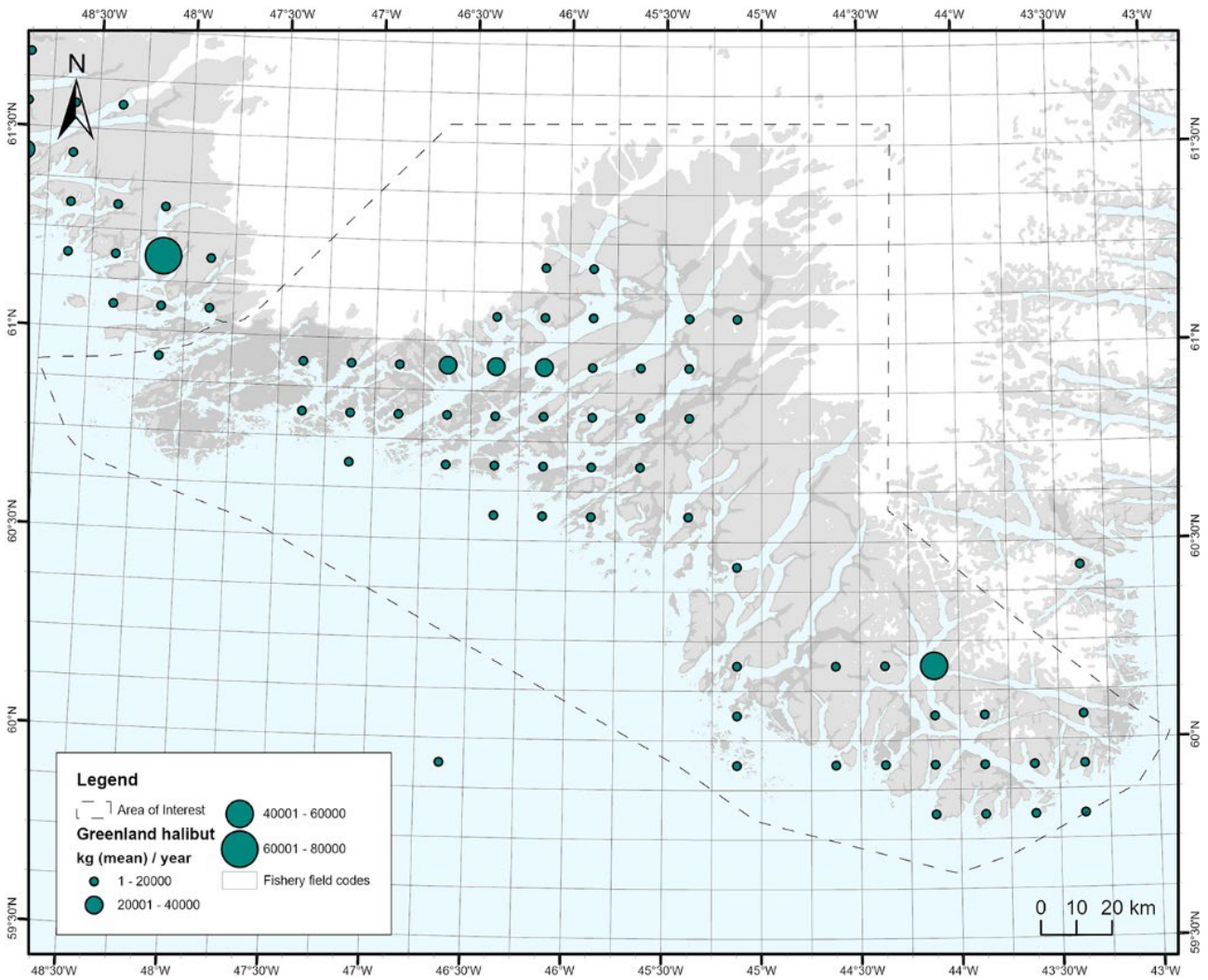
Kujataani, Kitaani aammalu Tunumi sinerissap avataani kangerlunnilu saarulleqarfeqarpoq saarulleqatigiinnik assigiinngitsunik. Saarullinniartoqaaluppoq AOI-lli avataani tamanna pineruvoq (Takussutissiaq 5.5). Saarullinniarneq kangerluit ilaanni taamaattoq ingerlanneqartarpoq (Christensen et al. 2016).



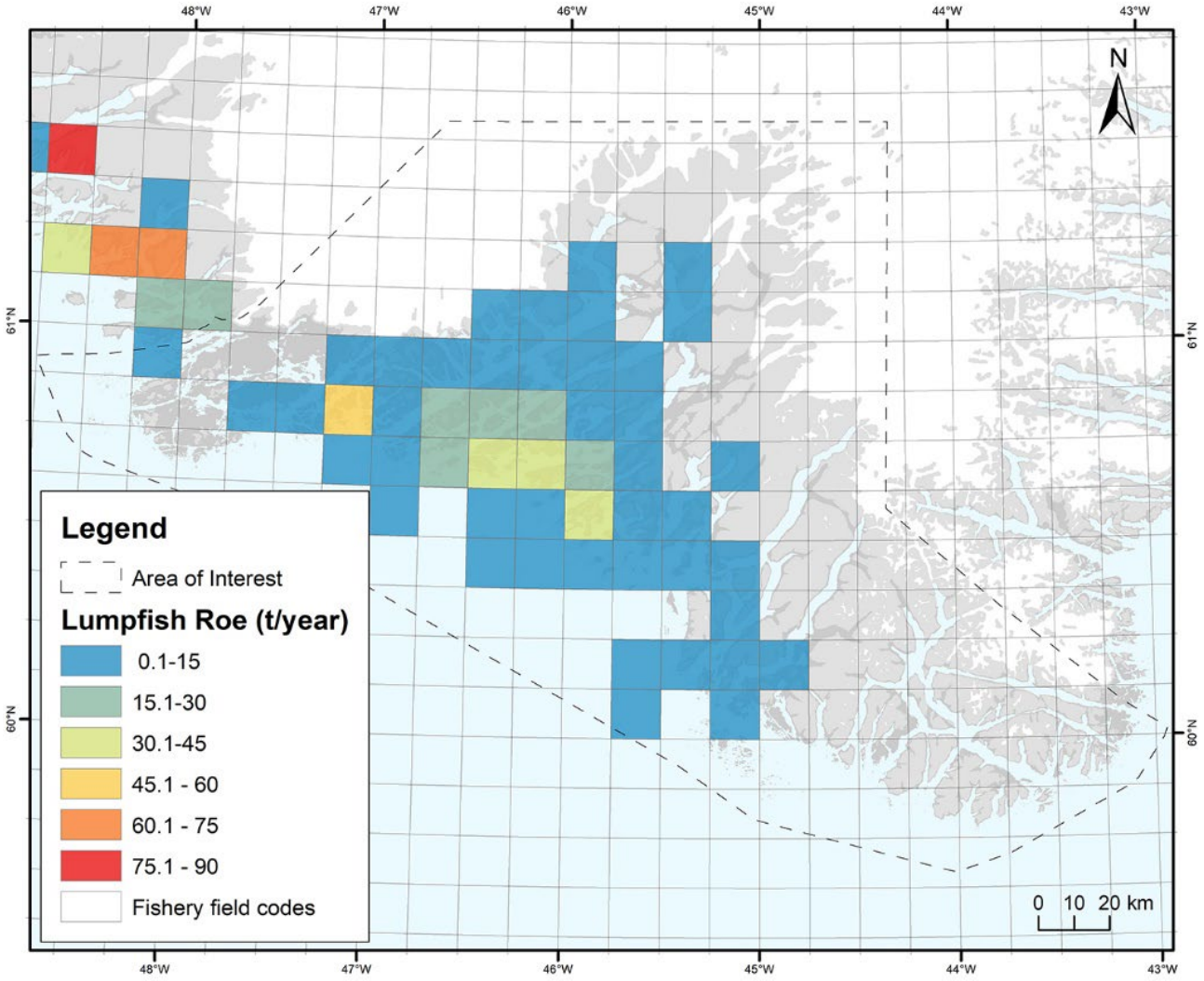
Takussutissiaq 5.5. Saarullittat agguaqatigiisillugit kiilunngorlugit (2014-2019). Kipparissut aalisarfiit takutippai (naatsorsueqqissaartarfimmit kisitsit kipparissuupput). Toornerit ataasiakkaat qeqqaniipput kipparissut iluanni taannalu isumaqarpoq sumiiffimmi aaliangersimasumi aalisarnermik nalunaarsuineq.

Qalerallit

AOI-mi qalerallit kangerlunni aalisarneqartarput (Takussutissiaq 5.6). Ukiumut aalisarneqartartut Kujataata kujammut kangisissuata kangerluisa qinnguini pisaqartarneq eqqaassanngikkaanni appasippoq. Kalaallit Nunaata kujasinnerpaavata kitaani qalerallit suffiffigisartagaat pingaarnerpaat ilagaat (Christensen et al. 2016).



Takussutissiaq 5.6. Ukiumut qaleralittarineqartartut kiilunngorlugit agguaqatigiisinneri (2014-2019). Kipparissut ataassiakkaat aalisarfigineqartartut (naatsorsueqqissaartarfimmit kisitsisit kipparissumi). Toornerit ataasiakkaat qeqqaniittut aalisarfimmili aaliangersimasumik pisarineqartarnerinit tikkuussinngilaq.



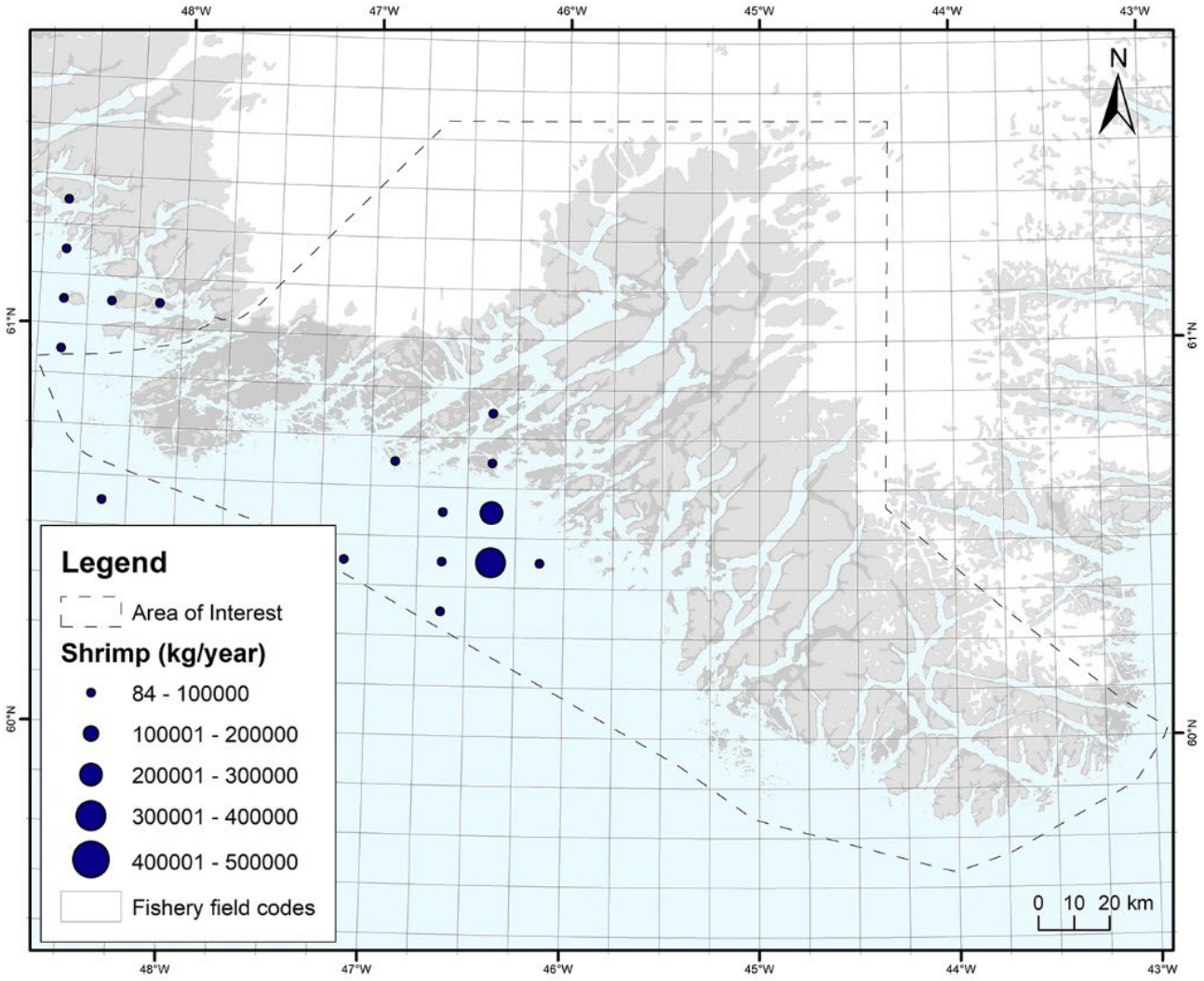
Takussutissiaq 5.7. Nipisaat suai pisarineqartartut ukiumut tonsinngorlugit agguaqatigiisinneri (2014-2018). Kipparissut ataasiakkaat pisaqarfigisarfiinik takutitsipput (naatsorsueqqissaartarfimmiit pisarineqartut nalunaarsorneri kipparissuni). Kipparissuni qalipaatillit agguaqatigiisillugu pisanik takutitsipput.

Nipisaat

AOI-p sineriaata annersaani nipisaat suffisarput, amerlanerpaanngikkaluarlutik. Upernaakkut suffisarput (martsimiit juunimut), aamma nipisanniarneq annertusiartorpoq. Nipisanniarneq annerpaamik arnarlunniarneruvoq suai avammut tunisaammata akigittut. Pisarineqartartunit annikitsuinnaat kalaalimineerniarfinni tunineqartarput (Takussutissiaq 5.7, Christensen et al. 2016).

Raajat

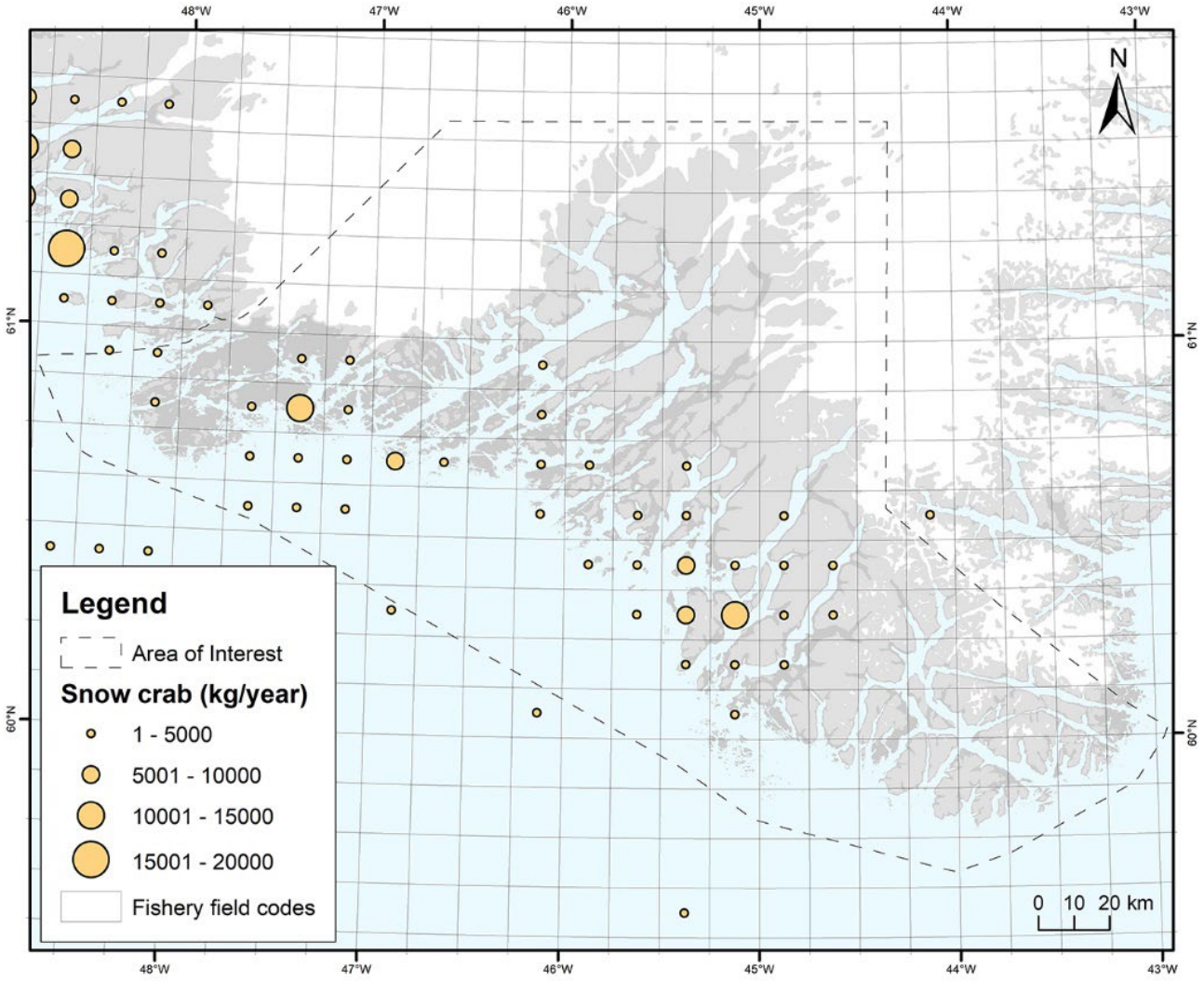
Issittup raajaa itisoormiuuvoq 600 m-lu tikillugu itittigisumi toraarneqartartoq. Imartani ikkannerusuni AOI-p qanittuani takussaanngilaq (Takussutissiaq 5.8). Raajarniarneq Kalaallit Nunaata kitaani tamarmi aalaakkaasooriarluni ukiuni kingullerni raajat AOI qimallugu avannarpariartorsimapput (Christensen et al. 2016).



Takussutissiaq 5.8. Ukiumut agguaqatigiisillugu kiilunngorlugit raajartat (2014-2018). Kipparissut ataasiakkaat aalisarfinnik takutitsipput (naatsorsueqqissaartarfimmi pisarineqartartut nalunaarsorsimasut kipparissuupput). Toornerit ataasiakkaat qeqqaniittut isumaqanngilaq pisarineqarsimasunut sumiiffinnut tikkuussisut.

Saattuat

Saattuat sinerissap qanittuani kangerlunnilu nassaassaapput. Saattuat amerlanerit martsimiit augustimut qalerussatik taarsertarpaat, piffissami tassani assut navianartumiittarlutik. Qalerussaminnik taarsiinerminni saattuatut aqitsutut taaneqartarput piffissamilu tassani inuussutissarsiutitut soqutineqarneq ajorput. AOI-mi ukiumut saattuartarineqartartut annertunngillat (Takussutissiaq 5.9, Christensen et al. 2016).



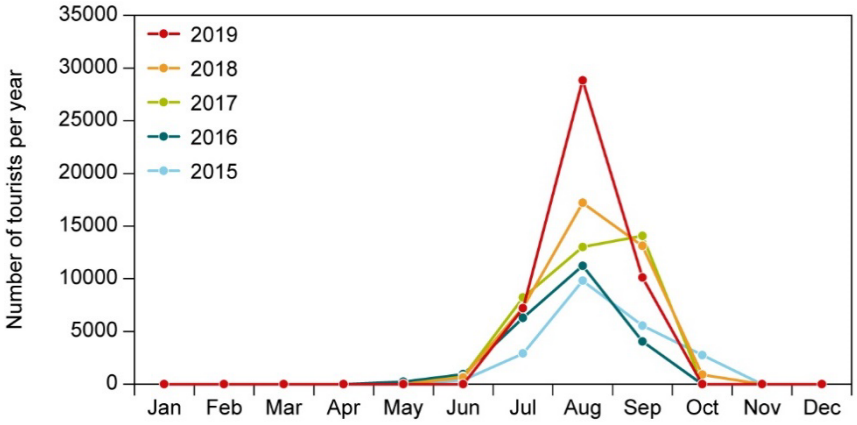
Takussutissiaq 5.9. Saattuartarineqartartut piffissami 2014-2019 ukiumut kiilunngorlugit. Kipparissut ataasiakkaat saattuarniarfigineqartartunit takutitsivoq (naatsorsueqqissaartarfimmit pisarineqartarfii kipparissut). Toornerit ataasiakkaat qeqqaniittut isumaqanngilaq sumi pisarineqarsimaranik tikkuussinerusoq.

5.7 Takornariaqarneq

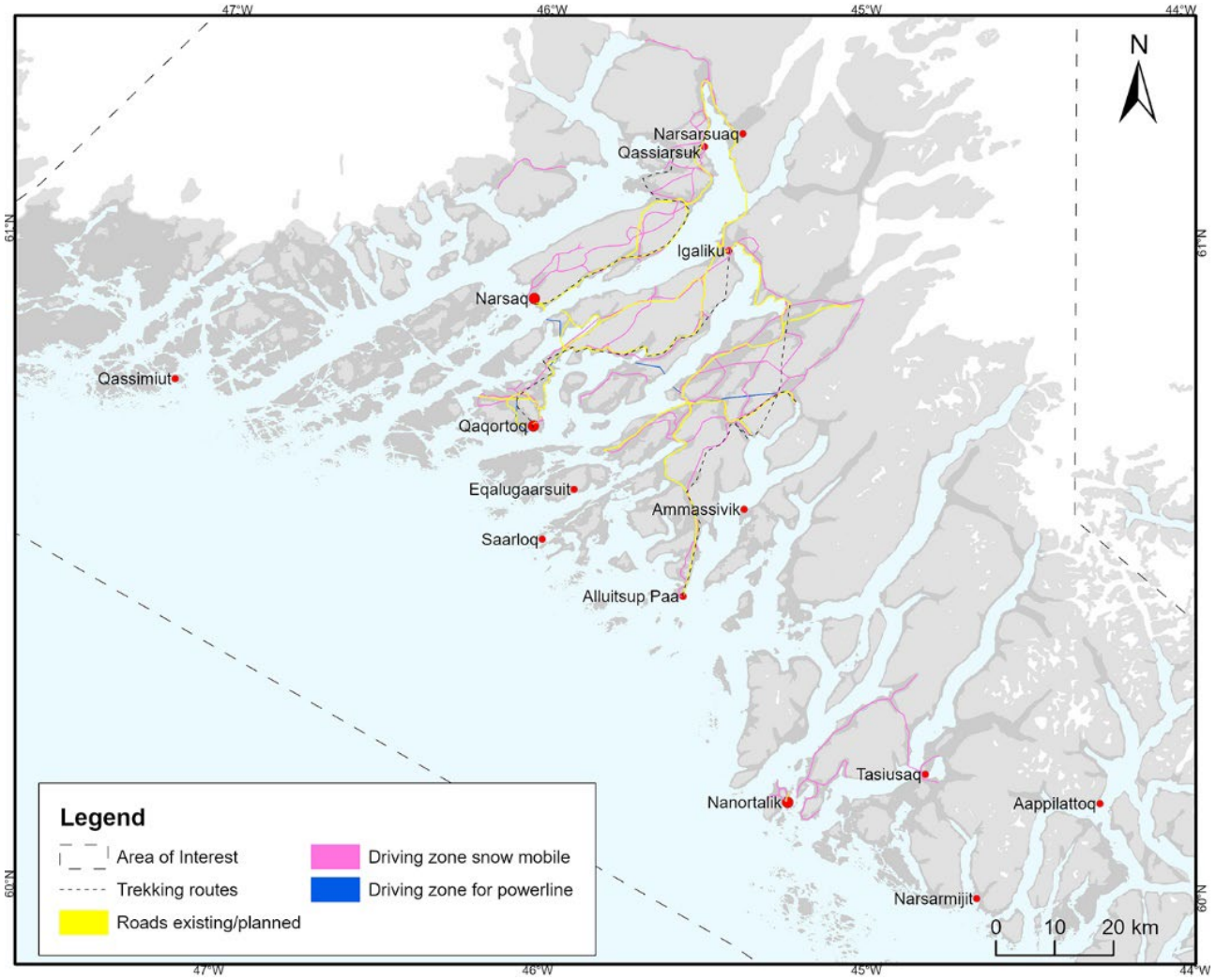
Issittoq tamakkerlugu takornariaqarneq annertusiartorpoq, aamma Kalaallit Nunaanni. Kujataani takornariaqarneq marloqiusaasumik ingerlavoq: takornariartaassuit aammalu pisuttuariat.

Takornariartaassuit amerlasuunik ilaasoqarlutik tikittarput piffissami 2015 aamma 2019-mi Kujataanut takornarianik 175.000-nik ilaasoqarsimapput (Takussutissiaq 5.10; www.stat.gl). 2019-mi takornariaqarnerup nalaani augustimi 29,000 takornarissat tikissimapput. Takornariartaassuarmik ilaasut amerlanertigut ungasissumut pisunneq ajorput illoqarfimmi qanittuanilu kilometerialuinnannguani ingerlaartaramik.

Takussutissiaq 5.10. Illoqarfinnut Nanortalimmut, Qaqortumut, Narsamut, Narsarsuarmut aamma Qassiarsuk takornariartaassuit tikittarput.



Takornariat tikittartut pisukkiat amerlassusai kisitsisaatigineqanngillat, kisianni amerliartorput. Kisitsisip uppernarsarpaa maanna savaateqarfiit amerliartuinnartut "unnuisarnernit ullaakkorsiornernillu" neqerooruteqartartut amerliartoramik, saniatigullu isertitatut pingaaruteqartutut inissisimalersimallutik. Pisuttuarfiit nalunaarsorneqarsimasut arlaliupput aqqutaappullu asfalterneqanngitsut (Takussutissiaq 5.11). Pisuttuarfigineqakkajuttut tassaapput Narsamiit Qassiarsummut aamma Qaqortumiit Igalikumut.



Takussutissiaq 5.11. Pisuttuarfiit aqqutit, maanna piusut aammalu pilersaarutaassut biilinik ingerlaffiusinnaasut soqutigisaqarfimmiittut. Paasissutissat kommunip pilersaarutaaneersuupput (www.kujalleq.cowiplan.dk/dk).

5.8 Teknikkikkut attaveqaatit

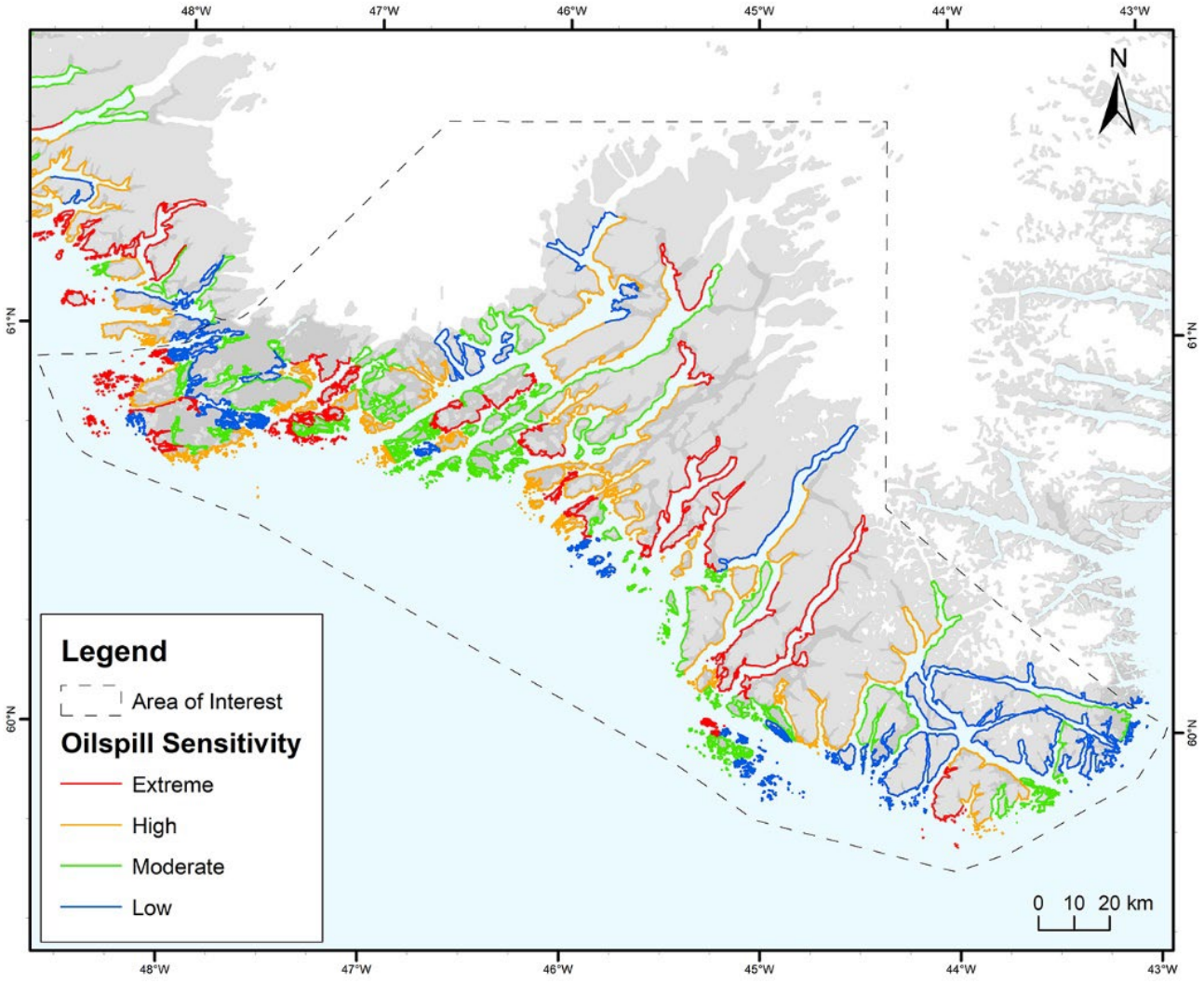
Kommunimi illoqarfimmut pilersaarummi soorlu Takussutissiaq 5.1-mi taaneqartoq, teknikkikkut attaveqaatit marluk taaneqarput. Annerpaaq tassaavoq Qorlortorsuarmi erngup nukiga atorlugu nukissiorfik uani tatsit sapusiallu ilanngullugit. Ernup nukissiorfik 2008-mi piareerpoq. Nukik 7.6 MW pilersittarpaa Narsaq Qaqortorlu pilersorlugit (www.nukissiorfiit.gl/da/Produkter/Vedvarende-energi/Vandkraft).

Sanaartorfik teknikkikkut suliaq alla Nalunami gultisiorfiusimasup nunataanut atasoq Nanortalimmiit avannamut kitaanut 35 km-sut ungasitsigisumi suliallu taakku 2013-mi aaliangerneqarput.

AOI-p iluani savaateqarfimmiit nunaqarfinnut aqqusineqarpoq atorsaalluartunik (Takussutissiaq 5.1). Assiliartami 5.11-mi nunap assingatigut takuneqarsinnaavoq pisukkiaq aqqutai soorlu Qassiarsummi, Narsami, Igalikumi aamma Qaqortumi aammalu Vatnahverfi eqqaanilu.

5.9 Uuliakoortoqartillugu mianerisassat

Uuliakoortoqartillugu mianerisassat pillugit najoqqutassiaq 2004 saqqummertoq (Mosbech et al. 2004) Takussutissiaq 5.12-mi takuneqarsinnaavoq. Mianerisassaq tassungalu uuttuutit atorneqartut uumassusillit pisuussutit sumiiffimmiittut inuillu pisuussutinik atuineranit aallaaveqartumik suliaavoq. Taanna naapertorlugu, sumiiffiit uuliakoornissamut ulorianartorsiortinneqarsinnaasut tassaapput sumiiffiit sinerisap qanittuaniittut, illukoqarfiit, uumasoqatigiit amerlasuut imaluunniit peqassuseq qaffasissumiittut aammalu sumiiffiit aalisarnermut piniarnermullu pingaaruteqartuusut. Uuliakoortoqartillugu mianerisassat pillugit najoqqutassiaq 2004-meersoq qulakkeerinnippoq kommunit tusarniarneqarnissaannut, paasissutissallu sumiiffimmi atuinermut attuumassuteqartut ilaatinneqarput.



Takussutissiaq 5.12. Kujataata sineriaani uuliakoornissamut mianerinartoq (from Mosbech et al. (2004)).

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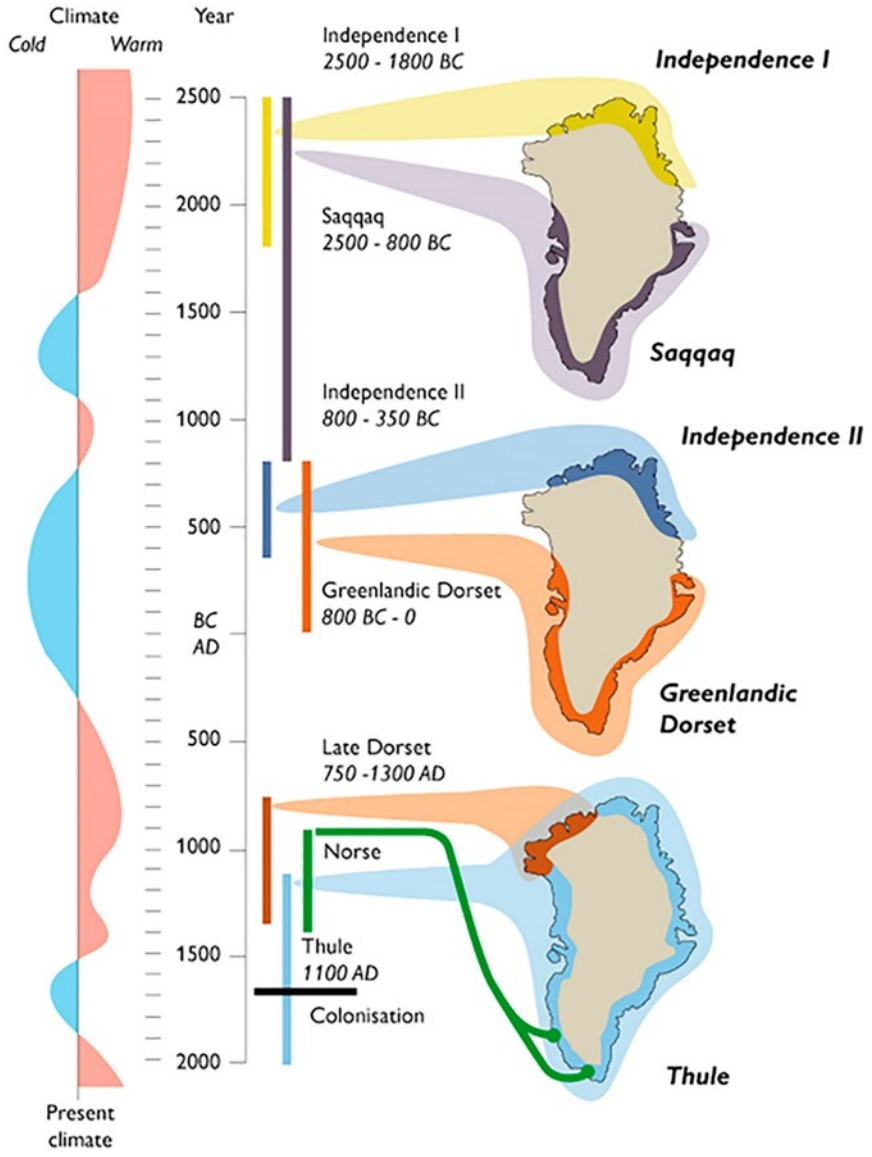
6 Kalaallit Nunaanni kulturikkut oqaluttuassartaq - aallarniut

Allaaserinnittoq Christian Koch Madsen[1]

[1]Nunatta Katersugaasivia Allagaateqarfialu/Greenland National Museum & Archives (NKA)

Kalaallit Nunaata qangaaniilli oqaluttuassartaa ukiuni 4.500 -ni pisoqaatigaaq (Takussutissiaq 6.1). Inuit siulliit Amerika Avannarliup Issittortaaniit ikaartut tassaapput Saqqaq aamma Independence kulturit. Ukioq 2.500-500 BCE missaanni, Kalaallit Nunaat tamakkiusallugu siaruarput. Sakkumikkut teknologi atugaat allannguallanneratigut paasinarsivoq ukioq 800 BCE nalaani kulturi nutaaq takkussimavoq, ilimanarluni inuit allat Amerikap Avannarliup Issittortaaneersut, Dorset kulturi Kalaallit Nunaannut anngussimasoq. Kulturi taanna ukioq 0 missaani tammarpoq taamaasilluni Kalaallit Nunaat ukiuni 800-it missaanni inoqarani. Dorset kulturillit kingulliit Kalaallit Nunaata avannamut kitaani inuupput, ukioq 800-1,300 akornanni CE aamma palæo-Inuit ikaarsimasut kingulliit. Inuit tamarmik taakku Amerikap Avannarliup Issittortaani najugaqartut assingalugit assingusorujussuarnik inooriaaseqarput. Angalatuujullutik ikitsunnguakkaarput, imartanut qanittut aammalu piniarnermik pilinermillu ingerlatallit "pisatarpassuaqaratik inoqarfeqartartut" aamma piniutimikkut annertuumik siuarsimasut, ujaraq pingaarnertut suliarisarlugu kapiutitut agguutitullu atukkaminnik. Palæo-Inuit allat assigiinngitsut taaneqartarput Issittumi mikisunik sakkulittut ileqqoqartutut (ATSt).

Ukioq 1.000 CE sioqqullugu ukiuni qulikkaani Islandimiit qallunaatsiaat ikitsukkaarlugit Kujataani nunnittarput. Katuullisut inuullutik najugaqarput nunaqarfigisaminnilu nunalerinermut, piniarnermik Europamullu niuernermik ukiuni 450-it missaanni inuusimapput. Taakku Kalaallit Nunaanni qallunaatsiaat inuusut annertusiartuinnartumik Thuile kulturimik Inunnik Canadamiit ukioq 1,200 CE missaani ikaarsimasunik ukiunilu untrilinni arlalialuinnannguani nuna tamakkerlugu siaruarsimasunik attaveqariartorsimapput. Maanna Kalaallit Nunaanni Inuit Thule kulturimit toqqaannartumik kingoqqisuupput. Thule kulturi piniarnikkut angallannikkullu atortumigut inerisaalluarsimapput aalaakkaanerusumik inooriaaseqarlutik niuersinnaallutillu. Taamaattoq, Thule kulturi niuernikkut annertusiartornermik ingerlatsinerminni avataaniit Europamiit arfanniat Kalaallit Nunaata imartaaniilersut 1700-kkunni pinngitsoorsinnaajartulersimavaat. Kitaani sumi tamaani arfanniaqarfiit inissitsitertut Europamiut akuulernerat danskit-norskit nunasiaateqarnermik 1721-miit kingornalu ingerlatsilerput. Nunasiaateqarnerup ingerlanneqarnerata kinguneraa nunaqariaaseq pisuussutinillu atueriaaseq allannguuteqarmat ullumikkullu sumiiffiit aammalu kulturikkut allannguutaasut suli Kalaallit Nunaanni inuiaqatigiinni atuupput.



Takussutissiaq 6.1. Kalaallit Nunaata oqaluttuarisaanerani kulturit takkuttarsimasut sumi piffissamilu sumi pisarsimanera pillugu takussutissiaq.

6.1 Kalaallit Nunaanni inuiattut eriagisassat sumiiffiillu

Nunatta Katersugaasivia Allagaateqarfialu/Greenland National Museum & Archives (NKA) allaffissornikkut qitiusuuvoq, pisortanit Naalakkersuisunit pigineqartoq, ullumikkumullu Ilinniartitaanermut, Kultureqarnermut, Timersornermut Ilageeqarnermullu Naalakkersuisoqarfimmit oqartussaaffigineqartoq (https://naalakkersuisut.gl/en/Naalakkersuisut/Departments/IKTIN). NKA inatsit Naalakkersuisunit piginnaatitsissuteqartoq toqqammavigalugu kisiartaavoq Kalaallit Nunaata kulturikkut eriagisassaatai pillugit aqutsisuullunilu oqartussaasoq. (ataa takuuk). NKA aatsitassaqarnermut misissueqqissaartoqarniartillugu imaluunniit piiaasoqarniartillugu eriagisassatigut avatangiisaasigullu tunngasunut tamarmut tusarniarneqartussaallunilu akuerseqataasussaavoq. Ilanngullugu, takorluukkanut tunngatillugu paasissutissat, ingerlatassat aammalu akisussaaffiit tamarmik katersugaasiviup nittartagaatigut atuarneqarsinnaapput : http://www.nka.gl.

Kalaallit Nunaanni eriagisassat pillugit inatsimmi (Anon. 2019a) allassimavoq kulturikkut erigisassaqarfiit pillugit: "Qangarnitsanik atortunik imaluunniit inuit najugaqarfigisimasaani, inuit timaanik tassungalu attuumassuteqartut

tamarmik inissisimaffiilu " (§2, imm. 2). Susassaqarfiup erseqqissarnera siammasissorujussuuvoq qulakkeerniarneqarporlu eriagisassaqarfiit annikitsuinnaagaluarpataluunniit inoqarferujussuugaluarpalluunniit tamarmik ataatsimut oqartussaaffigineqartut. Eriagisassaqarfiit kulturinit arlariinneersut Kalaallit Nunaanniittut sumi tamaani nassaassaapput sinerissami qeqertaaqqani sermersuullu sinaani tamani siaruaqqasuni. Minnerpaamik eriagisassaqarfiit 5.686-it maannakkut Kalaallit Nunaata Katersugaasiviata Allagaateqarfiatalu allattorsimasuutigai nittartakkakkullu imarisai qimerloorneqarsinnaapput: nunniffiit.natmus.gl.

Eriagisassaqarfiit pillugit allattorsimaffik ukiuni 200-nit ikinnerunngitsunik pisoqaatigaaq, tamassuma kingunerisaanik, sumiiffinni paasissutissat pitsaassusai annertuumik assigiinngeqaat. Eriagisassaqarfiit ilai sunannguaq tamaat ilanngullugu (eqqoqqissaassusut 20% ataallugu) nassuiaatitaqarput nunallu assingatigut nalunaarsorsimallutik allanili immaqa sumiiffiup aqqa kisimi allassimalluni. Aamma, eriagisasaqarfiit eqqoqqissaartuuneri pilllugit annertuumik assigiinngeqaat amerlanerpaartaalu nunap assiliarineqarsimapput atortorissaarutitigut GPS-kkut pitsaanngitsunik atortoqarallarnerulli nalaanit. Eriagisaqarfiit GPS-kkut nalunaarsuinnarsimasut nunniffit.natmus.gl -miittut nunap assingani erseqqissumik kisimik sumiissusersiorneqarnikuupput. Normulersueriaatsit atorneqarsimasut ukiut ingerlanerini allanngortarsimapput. Ullumikkut, eriagisassaqarfiit tamarmik 'NKAH' (Nunatta Katersugaasivia Allagaateqarfialu Heritage) pisortatigoortumik oqartussaaffigineqarlutik immikkut normulersorneqarput ID-qarlutik 0001-miit killeqanngitsumut normulersorneqarlutik.

Eriagisassaqarfiit nunniffiit.natmus.gl ataani allattorsimasut eriagisassaqarfiit ilaannai sumi tamaani nassaassaasut allattorsimasuutigai. Kalaallit Nunaata annertoortarujussua itsarnisarsiornikkut misissuiffigineqarsimavoq ilaanilu misissuiffigineqarsimanani. Taamaattoq, eriagisassat nalunaarsorsimasut 5.686-it maannakkut nalunaarsorsimappata nalunaarsorsimanngippataluunniit allagaataanngippataluunniit - tamarmik Kalaallit Nunaanni eriagisassat pillugit inatsisitigut illersugaapput.

6.2 Kalaallit Nunaanni eriagisassat pilluguit inatsit naalisarlugu

Kalaallit Nunaanni eriagisassat sumiiffiillu immikkuullarissuupput amerlanertigut pissutigalugu ersiinnartumiittaramik nunallu qaavinnaaniittarlutik, silap nillertup aammalu panertup uumassuseqartulluunniit paniinnartutut aanaveersarsinnaammagit, soorlu meqqut, ammit, qisuit, nutsat allaat inuit paniinnartunngorsinnaallugit aammalu uumasut taamatut paniinnarsinnaatittaraat. Innuttaasunit, itsarnisarsiuunit, ilisimatusartunit, takornarianit il. il. taamatut eriagisassat allanngutsaalisarneqartarneri iluarineqaraluarluni taamaattoq ajoqusersuutaasinnaasunut annertuumik ulorianartorsiortinneqarsinnaaneri aarlerinarpoq.

Kalaallit Nunaani eriagisassat pillugit inatsit (Anon. 2019a) peqqutigalugu avatangiisini aammalu tigussaasuni nassaassat tamarmik Kalaallit Nunaanni Katersugaasiveqarnermut inatsimmi (Anon. 2019b) oqartussaaffik inissisimavoq pinngitsooranilu illersorneqarnissaat (kulturlevn, Kalaallit Nunaanni katersugaasiveqarnermut inatsisip) qulakkeertussaavaa

eriagisassaqarfiit ajoqusersorneqaratillu nikisinneqassanngimmata (§ 28, stk. 2). Nassaartoqartillugu imaluunniit pasitsaassaqartoqartillgu NKA kalerrinneqassaaq imaluunniit katersugaasiveeraq qaninneq kalerrinneqassalluni. Eriagisassat nassaassat (naturelven, Kalaallit Nunaata katersugaasiveqarnermut inatsit) - ujaranngorsimasut imaluunniit ujaranngulersut naasut imaluunniit uumasunit sinnikut, nassaarfiusimasumilu nunataq qaleriiaarsimasoq, ullorissat anai - tamarmik Kalaallit Nunaanni Katersugaasiveqarnermut Inatsisip ataani illersugaapput (Inatsisartut peqqussutaat nr. 4 12. juni 2019-meersoq) aammalu Kalaallit Nunaanni Avatangiisinut Inatsit (Anon. 2003) ataani.

Eriagisassaqarfiit aaliangersimasut immikkuullarissut pillugit inatsit Kalaallit Nunaanni immikkut illersorneqartariaqartut pillugit atuuppoq. Nalinginnaasumik, eriagisassaqarfiit illersorneqartartut marluupput: eriagisassaqarfiit illersukkat aammalu eriagisassaqarfiit kingornussassiaqarfiit allat (fredning, aamma 'anden kulturarvsbeskyttelse', allassimaffeqartumi Kalaallit Nunaanni Eriagisassat Pilugit Inatsit). Kingornussassiaqarfiit illersugaasut tassaapput nakkutigineqarnerpaat aamma nalinginnaasumik allanit ingerlaannaq orninneqaqqusaanngillat. Sumiiffiit eriagisassaqarfiit illersorneqartuni suliaqarniarneq akuerineqarsinnaavoq inatsisikkut illersuutaasut pillugit aporaaffeqanngippat (Immikkut Suliakkiissutit, Anon. 2016, 2018).

Specified regulations for the National Park in Northeast Greenland are written directly into the National Greenlandic Heritage Act, while heritage regulations for other protected areas are defined in a series of executive orders (Anon. 1937, 1950, 1954, 1971, 1989, 2005, 2007, 2008, 2010, 2016, 2018). Several areas in Greenland are protected to safeguard combined natural and cultural heritage values. Specific regulations for such protected areas are laid down in individual executive orders.

The main protective regulations laid down in the National Greenlandic Heritage Act can be summarised as follows:

- Suut tamarmik qangarsuaaniit eriagisassat (fortidsminder, Kalaallit Nunaata Eriagisassat Pillugit Inatsit) - soorlu illukut, inoqarfikut, ilerrit, inussuit, pullatit, inoqarfikut il.il. - ukioq 1900 tikillugu toqqaannartumik illersugaapput atortuuppata uumassusiliuppataluunniit. Ilerrit tamarmik, apeqqutaatinnagu qanoq pisoqaatiginersut, illersugaapput. Nunami eqqissisimatitami Tunumi, inussuit tamarmik illersugaapput apeqqutaatinnagu qanoq pisoqaatiginersut aammalu suulluunniit inunnit attorneqarsimanngitsut tamarmik qanorluunniit pisoqatiginersut apeqqutaatinnagu ajoqusersorneqaqqusaanatillu illikaqqusaanngillat NKA-mit sioqqullugu akuersissummik pisoqarsimatinnagu. Tamanna aamma kalaallinit pigineqarsimasut 1945 sioqqullugu pisoqaatigisunut atuuppoq, nuna tamakkerlugu.
- Suulluunniit nassaassat eriagisassaasut marloqiusamik illersugaapput: nassaassamiit/pigisamiit 2 meter tikillugu qalleqqusaanngillat; 20 meter tikillugu nassaassamiit/pigisamiit inunnit paasissutissaqartoqartinneqarpat aatsaat qalleqqusaapput (allagartalersorsimappat, aqqusiorneqarsimappat il.il). Nunami eqqissisitami Tunumiittumi qalleqqusaannginneq 2 m aamma 100 m, atuuppoq.
- Misissueqqisssarnerit suulluunniit aammalu inerisaanernut ingerlatsinerit - pisortaneersuuppata imaluunniit

namminersortuneerpata - nunami ammaannartumi tamarmik sioqqullugu NKA-mit msissorneqaqqaarsimassaaq aammalu pisortatigoortumik tusarniaavigineqarsimaqqaassaaq. Apeqqutaalluni eriagisassat nalingat aammalu ineriartortitsinissamut pileraarutit, NKA piumasaqarsinnaavoq imaluunniit sanaartortussat aperineqarsinnaapput suliaq aallartitinnagu itsarnisarsiornikkut misissueqqaartoqassasoq (arkæologisk besigtiggelse, Kalaallit Nunaanni Katersugaasiveqarnermut Inatsit § 11) qulakkeerniarlugu eriagisassat naleqassusaa aammalu sumiiffimmi ernumartutut isigineqarsinnaasut qulakkeerniarlugit. NKA-p aamma ilanngullugu piumasarisinnaavaa sanaartortussat apeqquteqarfiginerisigut itsarnisarsiornikkut misissueqqarneq ingerlanneqassasoq (arkæologisk undersøgelse, Kalaallit Nunaanni Katersugaasiveqarneq Pillugu Inatsit § 12) eriagisassaqarfiit/assigisaalu sumiiffimmi sanaartorfissamiippata arlaatigut inerteqqutit allallu atorunnaarsinneqassanersut ilanngullugit qaqinneqarsinnaammat.

- Sumiiffinni tamani pilersaarutaasut suugaluarpataluunniit pingaartumik eriagisassat pillugit illersugassaqartillugu pingaaruteqarpoq sioqqullugulu NKA Immikkut Suliakkiussaat nr. 38 oktoberip 1-nit 2020-meersoq (Anon. 2020) salliutinneqartuartussaavoq. Apeqqutaatillugu NKA- naliliinera aammalu pilersaarutigineqartunut sunniutaasinnaaneri nalilersuutigineqareernerini suliassaqartoq suugaluarpalluunniit eriagisassaqarfik pillugu sunniutaasinnaasut pillugit naliliineq tamakkiisoq ingerlanneqassaaq (kulturarvsvurdering, Immikkut Suliakkiissut nr 38. oktoberip 1 2020). NKA-p aamma Kalaallit Nunaata Naalakkersuisuisa eriagisassaqarfiit pillugit misissueqqaarnerit nakkutilliinerillu sanaartortoqartinnagu ingerlanneqartut aningaasartuutigisai sanaartorniarluni qinnuteqartumit akilerneqassapput sioqqullugulu aningaasartuutigineqartussatut missigersuutaareersimassapput inatsit aamma Immikkut Suliakkiissutaasut naapertorlugit (Kalaallit Nunaanni Eriagisassat Pillugit Inatsit § 14).

Misilittakkat naapertorlugit pisortanit aammalu namminersortunit sanaartortoqarniartillugu siusissumik aammalu toqqaannartumik oqaloqatigiinnerit NKA peqatigalugu ingerlanneqartarput sanaartornermiippata misissueqqaarnermiippataluunniit aammalu eriagisassaqarfiit pillugit aningaasartuutaasinnaasullu pillugit aporfeqanngininissaq anguniarlugu.

6.3 Eriagisassaqarfiit

Immikkoortumi uani nunap assingi atorlugit eriagisassaqarfiit aammalu naleqassusai erseqqissarneqassapput sumiissutsit aammalu sumiiffimmi peqassuseq Kujataanut nunap assinngorlugu takutinneqassalluni. Nunap assingisa qulakkeerniassavaat allaffissornikkut sakkussat naliliiniarnermi eriagisassanut naleqartitanut aqutsiniarnermi ernummatigineqarsinnaasut pinngitsoortinniarlugit aammalu akuersissutit suliassaqarfiillu pineqartillugit nalornisoqaqqunagu. Periuseq nalorninarsinnaasullu piusut eriagisassaqarfiit pillugit paasissutissatigut (takuuk qulaa) maannakkut pigineqartut annertuumik unamminartunik nassataqartitsisarmata nunami sumiiffissiornerit erseqqissut aammalu sumiiffiit eriagisassaqarfiit inissisimaffii nalornissutigeqqunagit suliaapput. Sumiiffissiornerit aammalu takorlooruminarsaanerit eriagisassaqarfinnut naleqartitat pillugit suliaq ilutsimigut imaappoq:

Ataatsimut: isigalugu erigaisassaqarfiit nalunaarsorsimaffeqarput uani http://nunniffiit.natmus.gl.

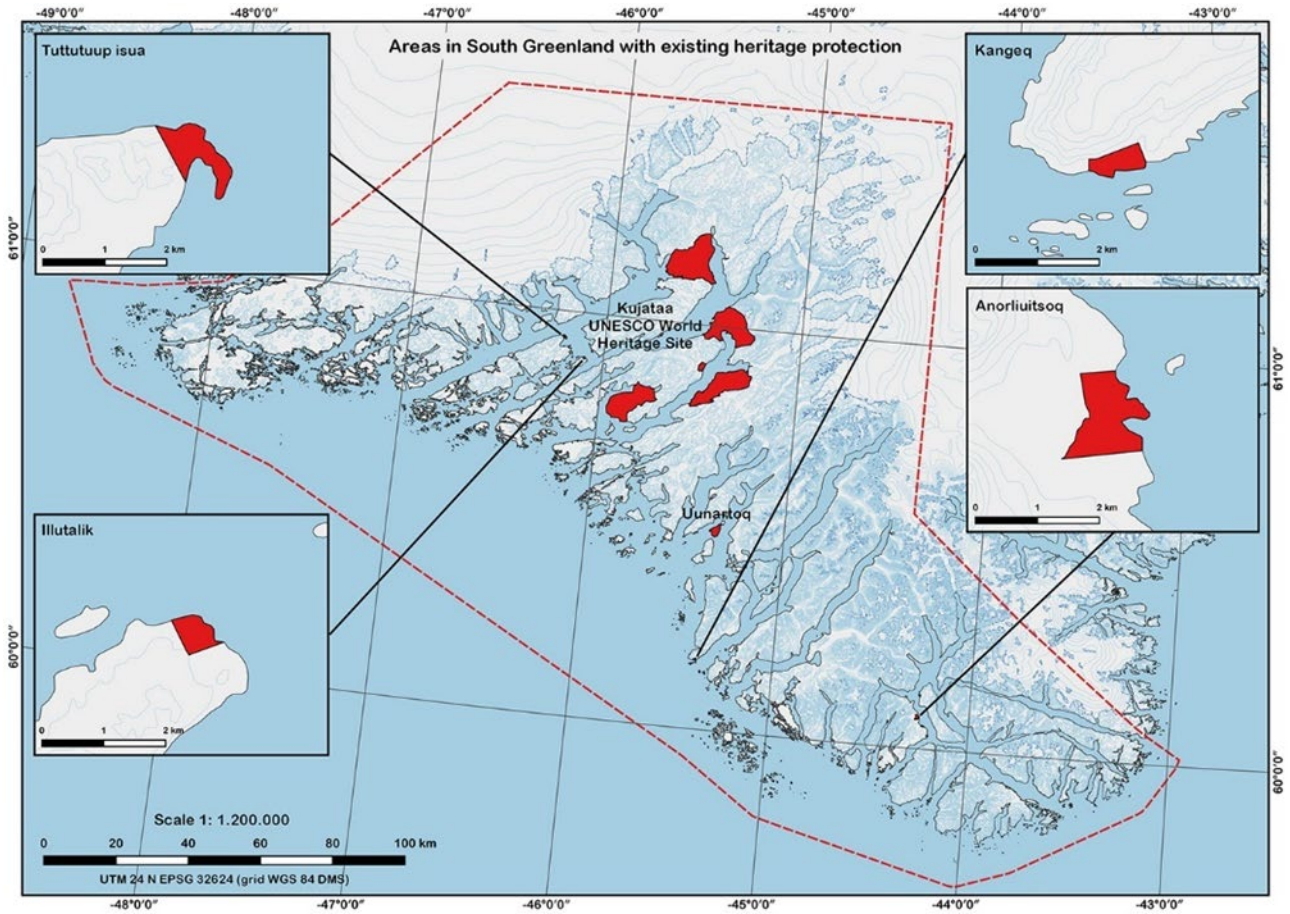
Atuuffii: takussutissat tamarmik ima aaqqissugaappata NKA peqatigalugu suliarineqarsimallutik ineriartortitsiniartullu misissueqqaarneq sumiiffinni eriagisassaqarfinni sulinerit inatsit atuuttup ataani ingerlanneqarpata.

Piviusunngorteqqinneqarsinnaappat: Sivitsorneqarsinnaavoq susassaqartut Kalaallit Nunaanni paassissutissanut pitsaassutsimut qanorluunniit ikkaluartumut ingerlatsinermut ernumanarsinnaasut eriagisassanut sammisut qulakkeerniarlugit.

Sumiiffik 1: Sumiiffiit eriagisassaqarfiit eqqissisimatitat

Suussusersinera: *Nunami eriagisassaqarfiusumi inatsisitigut illersugaasumi pitsaanngitsumik inissittoqarpat aammalu nunami inatsisit eriagisassanut sammisut imaluunniit Immikkut suliakkiissutit pineqartillugit.*

Eriagisassaqarfiit pillugit aqutsinermi ilisimagineqarsinnaasut suliassat: Misissueqqaartoqassanngilaq, piiaasoqassanngilaq imaluunniit ineriartortitsisoqassanngilaq akuerineqassanngilarlu eriagisassat illersugaasut sumiiffiini (Sumiiffik 1, Takussutissiaq 6.2), aamma pilersaarutaasut ingerlanneqassanngillat nalilerneqassappullu akuersissutit tusarniutigineqartullu Immikkut Suliakkiissutit nr. 38 oktonerip 1-at 2020 (Anon. 2020) naapertorlugit akuerineqaqqaassappullu NKA-mit aamma Kalaallit Nunaanni Eriagisassat Pillugit Ataatsimiititaliamit ('Kulturarvsrådet' Kalaallit Nunaani Eriagisassat Pillugit Inatsit).

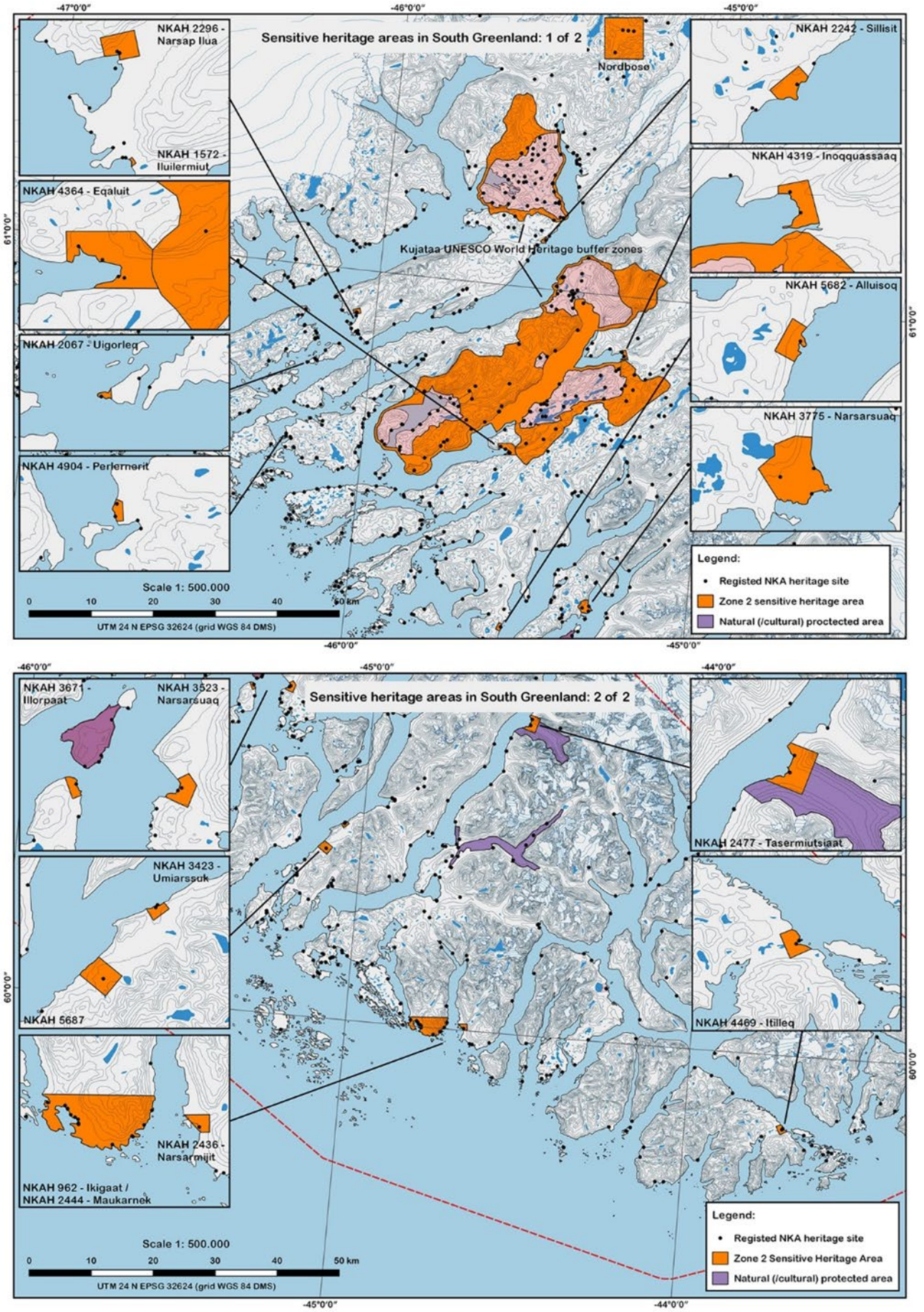


Takussutissiaq 6.2. Kujataani eriagisassaqarfiit illersugaasut pillugit nunap assingatigut takussutissaq (Sumiiffik 1 illersugaavoq).

Sumiiffik 2: Eriagisassaqarfiit mianernartut

Suussusersinera: *Eriagisassaqarfiit sumiiffiit qaqutigoortut, mianernartut aamma/imaluunniit eriagisassaqarfik/fiit pingaaruteqartut siunissamilu illersorneqarnissaannik pilersaaruteqarfigineqartut.*

Eriagisassaqarfimmik aqutsinissamut pilersaarut naatsorsuussaasoq: Misissueqqissaarnerit nalaani imaluunnit sanaartorniarnermi eriagisassaqarfiit mianernartuni ingerlatsitsisoqassanngilaq (Takussutissiaq 6.3), NKA nalinginnaasumik siunnersuuteqassaaq sanaartorniartut sumiiffinnut taama ittunut ajoqusersuissagaluarpata. Pingaartumik siunissami eriagisassaqarfiit eqqissisimatinneqarnissaat pilersaarutaappat imaluunniit ornigarneqassanngitsuunerat sumiffik pillugu erseqqissaasoqassaaq pinngitsoortinneqarsinnaallunilu itsarnisarsiuunit misissorneqarsimatinnagu sumilluunniit misissueqqaarnerit sanaartornerillu pitinnagit.



Takussutissiaq 6.3. Kujataani eriagisassaqarfiit mianernartut maannamut inissisimaffii pillugit nunap assingatigut takussutissaq (Sumiiffik 3).

Sumiiffik 3: Eriagisassaqarfiit sumiiffii killeqartinneqartut

Definition: *A buffer zone of 500 m diameter – 250 m radius from each central heritage site point in nunniffiit.natmus.gl – inside which ca. > 80% of the site's heritage features are expectedly located.*

Suussusersinera: *Sumiiffik killeqartinneqartoq tassaavoq 500 m diameter – 250 m radius isorartussuseqarluni eriagisassaqarfimmiit killiffimmut, allassimalulni uani nunniffiit.natmus.gl – iluani ca. > 80% eriagisassaqarfimmi takussutissaqartuniit inissisimaffissamut.*

Eriagisassaqarfiit pillugit nakkutilliinermi suliassatut ilimagisat: nunniffiit.natmus.gl maannamut atuuttoq naapertorlugu, eriagisassaqarfiit tamarmik nunap assinngorsimapput paasissutissat pitsaassusai naapertorlugit (qulaa takuuk). Taamaattoq, sumiiffiit eriagisassaqarfiit amerlanerit arlariinnik (ilaatigut tuperfiit qulit pallillugu) immikkut eriagisassatut nalunaarsorsimasarput ('fortidsminder Kalaallit Nunaanni Eriagisassat Pillugit Inatsit), tamarmik 2 m aamma 20 m illersugaallutik (100 m Tunumi nunami eqqissisimatitami) sumiiffiit nassuiarneqartut killeqartinneqarput. Taamaattoq, eriagisassaqarfiit sumiiffimmiissinnaasarput illersukkani arlariinni ilaatigut quleriissinnaallutik illersuuteqanngitsunik. Erseqqippoq, misissueqqissaarnerit, piiaanerit aammalu sanaartornerit ingerlanneqarsinnaaneri eriagisassanut navialanartorsiornartumiititsissammata. NKA -p taamaammat eqqarsaatersuutigaa pylogineqarnissaq 500 m -sut isorartutigisumik - 250 m radius isorartussuseqartumik erigisassaqarfimmiit allattorsimaffimmut uani nunniffiit. natmus.gl - eriagisassaqarfik sumiiffiimmi killeq (Sumiiffik 3), suulluunniit misissueqqissaarnerit, piiaanerit aammalu sanaartornerit ingerlanneqassanersut, minnerpaamilluunniit, aatsaat ingerlanneqarsinnaassasut eriagisassaqarfiit eqqoqqissaartumik nunap assiliorneqarsimappata.

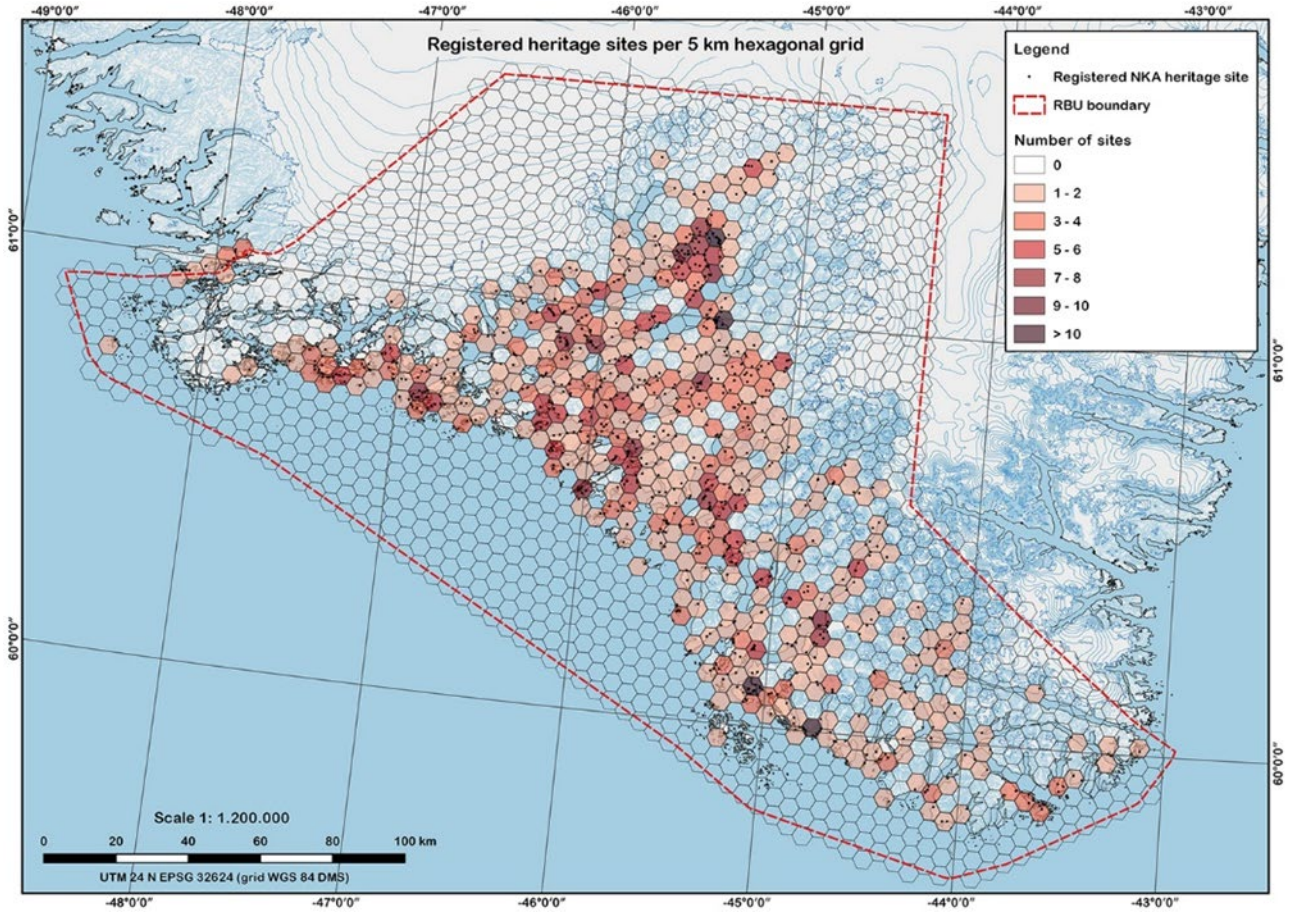
6.4 Eriagisassaqarfiit inissisimanerisa takussutissaa

Takussutissiaq 6.3-mi takutinneqarpoq eriagisassaqarfiit sumiiffii aammalu nalunaarsorsimasut qanoq amerlatigineri Kujataani nunami 5 km iluani akulikitsigisut pillugit takutinneqarlutik. Eriagisassaqarfiit akulikissusai aaliangerneqartarput qanoq annertutigisumik itsarnisarsiuuniit misissorneqarsimatiginersut kisianni aamma ilaatigut inoqarfiusimasut qanoq akulikitsisigisimaneri. Eriagisassaqarfiit akulikissusaasa aamma takutippaat KNA-miit piumasaqaatit eriagisassanut aqutsinissamut suliniutit qanoq annertutigisinnaanerinik ilisimasuutit suusinnaanerinut:

- Eriagisassaqarfiit 4-it sumiiffii: Sumiiffik ilimanarpoq annikitsuinnarmik misissuiffigineqarsimasoq imaluunniit misissuiffigineqarsimanngivissoq, ilisimasat qangaaniit apersuinermit katersorneqarsimasinnaapput imaluunniit nalaatsornerinnarmik sumiiffik pillugu nalunaaruteqartoqarsimasinnaalluni. NKA ilimagineqassaaq itsarnisarsiornikkut misissueqqaartoqassasoq ('arkæologisk besigtigelse', Kalaallit Nunaanni Eriagisassat Pillugit

Inatsit) misissueqqaarneq imaluunniit sanaartorneq sioqqullugu. Eriagisassaqarfiit sumiissusersineqarsimasut nassatarisinnaavai suli annerusumik misissueqqissaaqqaartoqassasoq ('arkæologisk undersøgelse' Kalaallit Nunaani Eriagisassat Pillugit Inatsit).

- Eriagisassaqarfiit 5-8 sumiiffiit: Sumiiffik tamanna ilisimarpoq annikitsuinnarmik naammaannartumik misissuiffigineqarsimasoq, aamma eriagisassanut ilisimasat qangarnitsanik aammalu nutaanerusunik paasissutissanik peqartoqarnera, eriagisassat allattorsimaffianni systemimi allassimasinnaalluni. Suna pineqarpiarnera aallaaviulluni aammalu eriagisassaqarfik pillugu paasissutissat apeqqutaallutik, NKA-mit itsarnisarsiornermik misissuinissamik piumasaqarsinnaaneq sumiiffinni pisinnaavoq, ilaatigut pingaarnertut eqqoqqissaarnerusunik, digitaliusunik nunap assiliornissaq siunertaralugu. Eriagisassaqarfiit tamakkiisumik imaluunniit ilaannakortumik itsarnisarsiuunit misissorneqartariaqassasut piumasaqaataasinnaavoq (arkæologisk undersøgelse' Kalaallit Nunaanni Eriagisassat Pillugit Inatsit).
- Eriagisassaqarfik 9 sumiiffik: Ilimanarpoq tamanna misissuiffigilluarneqarsimasoq aamma eriagisassanut paasissutissanik naammaginartunik peqareersoq, systemimi allattorsimasuusoq nalunaarsorsimallunilu. Sumiiffik qanga inoqarluarsimavoq aammalu atorluarneqartarsimalluni. NKA-mit sumiiffimmi itsarnisarsiornikkut misissueqqaartoqarnissaanut ilisimaateqanngilaq imaluunniit killilimmik misissueqqaarnissamik piumasaqartoqarsinnaavoq paasissutissat sumiissusersiornerisigut eqqoqqissaarnerusumik digitaliusumik peqartoqarnissaanik siunertaqarluni maannakkut paasissutissat taama ittut pigineqariinngippata. Eriagisassaqarfiit ilaannakortumik tamakkiisumilluunniit misissueqqissaarfigineqqarnissai piumasaqaataasinnaavoq ('arkæologisk undersøgelse' Kalaallit Nunaani Eriagisassat Pillugit Inatsit).



Takussutissiaq 6.4. Eriagisassaqarfiit 5 km isorartutigisup iluani akulikissusaanik takussutissiaq maannamut nalunaarsorsimasut.

6.5 Eriagisassaqarfiit nunami ilusaasa isikkuisa qanoq ittuunerinik ilimagisat takussutissartai

Eriagisassaqarfiit ilai immaqa 90%-ii sinerissamiittarput imaluunniit kangerlunni avammut imartanut qanittuni takussutissaalluarlutik inoqarnerini imartani inuussutissaqarniarneq pingaarluinnartuusimaneranik aammalu Kalaallit Nunaani inoqarnerani sineriap ingerlaarfiuneranik naqissusiisoq. Kalaallit Nunaani eriagisassaqarfiit sumi tamaani nassaassaagaluartut, pingaartumik nunami nassaarfigiuminartutut isikkulinni siornatigut nalunaarsorsimanngitsunik nassaarfigiuminarsinnaasarput - pingaartumik amerlasuunit uninngaarfiusarsimappat inoqarfiusarsimappalluunniit. Nunap ilusaa nalinginnaasumik qattuneqalaartarpoq itsarnisarsiuunut soqutiginaateqarluni aamma misissuineq eriagisassaqarfinni tamani maluginiarneqassaaq sanaartorniartoqartillugu misissueqqissaartoqarniartillugulu maluginiagassaapput nassaassaammata Takussutissami 6.1-mi takuneqarsinnaapput.

Tabel 6.1. Nunap isikkui nalinginnaasumik qattunersartaqartarput itsarnisarsiuunut soqutiginaateqartut misissuinissamut.

Maluginiaruk qattunerit isumaqanngimmat pinasuartumik pingaarnersiugassaasut.
Nunap isikkumigut ilisarnaatai
Sineriak/kangerluk kangerlunni oqquiffiusinnaasut imaluunniit nuunnguit
Nunami iluaassinnaasut (Siviganerit quppallu il. il.)
Kuuit naqqi
Kangerluit kooqarfillit/ikaarfillit
Qaqqartuut aallartiffii/sissalik
Sissaq tuapalik
Nuna ingerlaarfigissoq
Qaqqat koorullit
Isittarfigissut
Qooqqut imeqarfigissut
Ujarassiorneq eqqarsaatigalugu soqarluartoq (ukkusissalik, ujaralik kalcedonimik, skiferillik, ujaqaallu aqittut sanaassatut tulluartunik pilik il.il.)
Uumasoqarluartoq (timmiaqarfik innaq, ivigartorfigissoq, timmissaq ingerlaartut uninngaartarfiat il.il.)
Kujammut isikkivilik, siviganerit ivigallit

Inassuteqaatit

Anon. 1937. Skrivelse af 10. april 1973 angående Fredlysning af Fortidsminder i Grønland.

Anon. 1950. Cirkulære af 20. maj 1950 angående fredlynings af Qaqortoq kirkeruin og Sigssardlugtoq-ruinen.

Anon. 1954. Bekendtgørelse af 20. september 1954 angående fredlysning af arealerne ved Ny Herrnhut, Godthåb.

Anon. 1971. Bekendtgørelse af 14. juli 1971 om fredning af visse områder af Håbets Ø.

Anon. 1989. Hjemmestyrets bekendtgørelse nr. 31 af 20. oktober 1989 om fredning af Arnangarnup Qoorua, Maniitsoq kommune, Vestgrønland: https://lovgivning.gl/lov?rid={41CE08BB-2D47-4716-A02F-7A7436E7152B}.

Anon. 2003. Landstingslov nr. 29 af 18. december 2003 om naturbeskyttelse: http://lovgivning.gl/lov?rid=%7BB285FE79-D0A5-4C4A-92B4-B93D0C018161%7D.

Anon. 2005. Hjemmestyrets bekendtgørelse nr. 11 af 19. april 2005 om fredning af en del af øen Uunartoq, Nanortalik kommune: https://lovgivning.gl/lov?rid={2D76CCFA-8263-472C-BCB8-38257850596F}.

Anon. 2007. Hjemmestyrets bekendtgørelse nr. 10 af 15. juni 2007 om fredning af Ilulissat Isfjord: https://lovgivning.gl/lov?rid={C6681D09-AD38-44AA-88C1-0B5F9B0AC554}.

Anon. 2008. Hjemmestyrets bekendtgørelse nr. 23 af 14. juli 2008 om fredning af Austmannadalen: https://lovgivning.gl/lov?rid={5E3C668D-BEA7-4472-A8D9-520EEEF6C931}.

Anon. 2010. Selvstyrets bekendtgørelse nr. 4 af 12. april 2010 om fredning af et område ved Ivittuut og Kangilinnguit: https://lovgivning.gl/lov?rid={80A814FF-16FE-42E1-BCF0-6F0E7ED70768}.

Anon. 2016. Selvstyrets bekendtgørelse nr. 16 af 5. juli 2016 om anden kulturarvsbeskyttelse af et kulturhistorisk område i Sydgrønland, der består af afgrænsede arealer omkring lokaliteterne Qassiarsuk, Igaliku, Sissarluttoq, Tasikuluulik og Qaqortukulooq-Upernaviarsuk: http://lovgivning.gl/lov?rid={743F7122-CBD0-465B-A2BE-F5F0DA37B299}.

Anon. 2018. Selvstyrets bekendtgørelse nr. 1 af 30. januar 2018 om anden kulturarvsbeskyttelse af et nærmere afgrænset område i Vestgrønland omkring Aasivissuit-Nipisat: https://lovgivning.gl/lov?rid=%7B10517644-655F-46E0-861B-6CDAD106676C%7D.

Anon. 2019a. Inatsisartutlov nr. 5 af 12. juni 2019 om ændring af Inatsisartutlov om fredning og anden kulturarvsbeskyttelse af kulturminder (Skærpede beskyttelsesregler for Nationalparken i Nord- og Østgrønland, præcisering af regler om vedligeholdelse og restaurering af bygninger og vurdering af aktiviteters virkning på kulturarven i kulturhistoriske områder): http://lovgivning.gl/da-DK/Lov?rid={1D78601F-9F4D-4C33-9550-0C393BF397CE}.

Anon. 2019b. Inatsisartutlov nr. 4 af 12. juni 2019 om ændring af Inatsisartutlov om museumsvæsen (Skærpede udførselsregler for Nationalparken i Nord- og Østgrønland samt bestemmelser om Museumsnævnets sammensætning, funktionsperiode og vederlæggelse): http://lovgivning.gl/da-DK/Lov?rid={44AAE914-29CD-4856-9AC6-696B5796630E}.

Anon. 2020. Selvstyrets bekendtgørelse nr. 38 af 1. oktober 2020 om vurdering af aktiviteters virkning på kulturarven i kulturhistoriske områder: http://lovgivning.gl/lov?rid={37F8DA99-95FE-44FA-B801-EAEAAE670E6B}.

7 Soqutigisat qaleriiffianni qulaaniit isigalugu itisiliineq

Allaaserinnittoq Kasper Lambert Johansen[1], Karl Zinglersen[2], Katrine Raundrup[2] and Anders Mosbech[1]

[1]Department of Ecoscience, Aarhus University, [2]Greenland Institute of Natural Resources

7.1 Aallarniut

Kapitalini 4-6-mi nuna assingi assigiinngitsut saqqummiunneqarput, inuit atuinerat aammalu eriagisassaqarfiit sumiinneri ersersinneqarlutik sumiiffiit naasutigut uumasutigullu pingaaruteqartut erseqqissaatigineqarput. Takussutissat tamakku - timmiaqarfiuppata, takornariat pisuttarfigippassuk imaluunniit itsarnisarsiortut susassaqarfigippassuk - nunatut soqutiginaateqartutut isigineqarsinnaapput aammalu aatsitassarsiornissamut piaanissamullu suliaqarnissamut pilersaaruteqaraanni eqqarsaatigineqartariaqarput.

Kapitalimi uani nalilersuutivut naalisarlugit saqqummiutissavagut erseqqissarlugu nunami suut assigiinngitsut soqutigisami (AOI) qaleriiffeqarsinnaanersut. Misissuisimanerit siumut takorlooreersinnaasanik imaqanngimmata tamatuma erseqqissaaffiginissaa pingaaruteqarpoq. Naalisaassutigineqarpoq maannamut ilisimariikkat aammalu nalunaarummi uani saqqummiunneqareersut.

Qaleriiffiusinnaasut amerlanngitsutut isikkoqaraangata tamanna paasissutissanik amingaateqartoqarneranik peqquteqarsinnaavoq aammalu misissuisimanerit assigiinngitsuusimasinnaanerinik takussutissiisinnaalluni, assersuutigalugu aatsitassarsiorniartoqartillugu siunertat allaasarmata (takuuk Kapitali 8).

Misissueqqaarnerit naalisaassummik suliarineqarsimapput, GIS-mik misissuinertut taaneqarlutik, Pythonscript ArcGIS Pro 2.8.0. immikkut sanatinneqarsimasoq atorlugu. Tunngaviusumik, nunap assingi qaleriit kapitalimi 4-6 -mi takuneqarsinnaasut qaleriissaarneqarsimapput 250x250 m cell-kkut systemikkut AOI tamakkerlugu ilanngunniarlugu, nunap assingisa amerlassusai assiliartat kisinneqarlutik. Taamaattoq, cell nalingata nassaariniarnerani assersuutigalugu sumiiffiit ilimagineqarsinnaasut 3-it assiliartaat takutinneqarput, saqqummiussap qeqqani nunap assingini assigiinngitsuni pingasuni qaleriiusuni.

Katillugu, misissuinermi nunap assingi 51-it qaleriissinneqarput (Tabel 7.1). sumiiffik tamakkiisoq naatsorsuinermi ilanngunniarlugu assiliartat pisariaqartinneqarsimapput, assiliartat ilai siammasinnerutilaarlugit, iluaqutaasumilli sumiiffik isikkunitsillugu (takuuk "Geometry" Tabel 7.1-mi).

Sumiiffiit siammasinnerulaartumik matussuserneqarneri inatsisikkut piumasaqaatinik aallaaveqarput soorlu sumiiffiit illersukkat, timmiaqarfiit, ilaatigut qulaaniit nalileruminaassinnaasut aamma paasissutissatigut amigarfiusut (takuuk "Isorartunerusumik naliliiffik radiuk m) Tabel 7.1-mi).

Sumiiffimmut sunniuteqarneq peqqutaalluni assiliartat ilai isorartunerulaartumik suliaagamik inissaq immikkut isigineqarsinnaasarpoq: taama ungasissusilimmik suliaqarnermi assiliartat atorneqartussat eqqarsaatigineqartariaqarput (takuuk Kapitali 8). Pingaartumik assiliartat siammasinnerusumik inissikkaanni takorlooruminarnerusinnaapput ilusivimminni qanoq isikkoqarnersut soorlu, naasut allattorsimaffimmi aappalaartumi nalunaarsorsimasut sumiinneri aallaavigissagaanni isumaqanngilaq naasut imartaniittut massa misissukkat maluginiarneqarsimassut killissaliussap isorartusisap iluaniikkaluartut. Taamaattoq, qaleriissaat tamarmik ilanngunneqartut kisitassat suussutsillu immikkut ittunut ikkussugaapput "Inigineqarfik" ataani Tabel 7.1.-mi.

Tabel 7.1. Nunap assingi qaleriit misissueqqissaarsimanernit inerniliussaapput ilanngunneqartut Takussutissiaq 7.1. Immikkoortortaat imarisaat Immikkoortoq 7.2-mi nassuiarneqarput. Taassuma nassuiarsimasut avataatigut qaleriissaat 51-it misissuinermit inerneri allassimapput, marluk misissuinerit ilassutit ingerlanneqarsimapput, ataaseq uumassusillit pingaarnerutillugit assitaliaq qaleriinnut ilanngunneqarpoq (takuuk immikkortiternerit "Uumassusillit" aamma Takussutissiaq 7.2) aamma ataatsimut ilanngunneqarput inuit atuinerat/kulturikkut eriagisassat (takuuk immikkoortiternerit "Inuit atuinerat" aamma Takussutissiaq 7.3). Inigineqarsimasut assigiinngitsuussusai "nuna sermitaqanngitsoq" innersuussineruvoq nuna sumiiffiillu sermersuarmit qallerneqarsimanngitsoq.

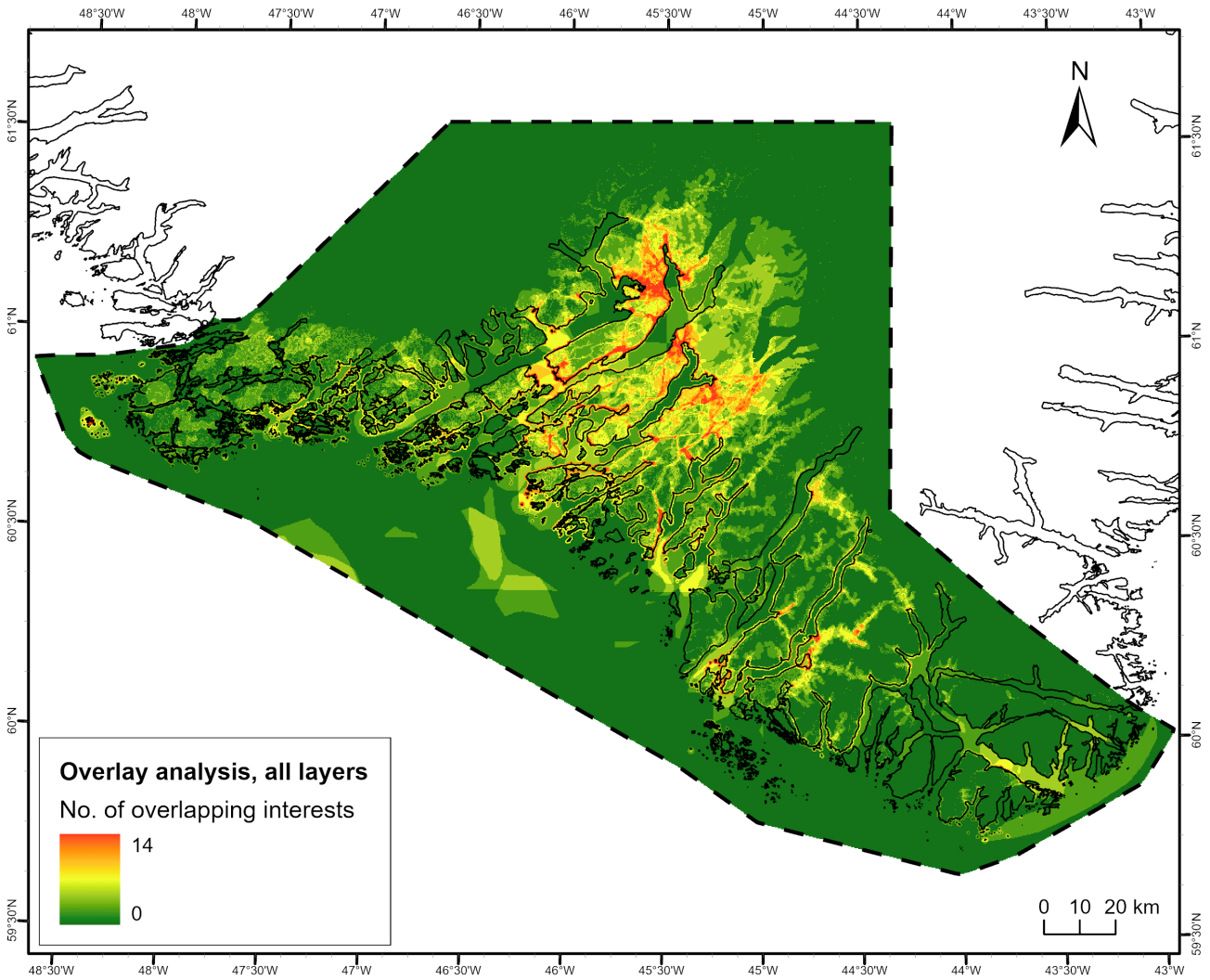
Ateq	Geometry	Killissap siammarnera(m)	Inigineqartoq	Misissuinermit ilassut	
				Uumassusillit	Inuit atuinerat
Raajarniarfiusoq	Polygons	0	Imaq	1	1
Nunaleriffiusut	Polygons	0	Nuna sermeqanngitsoq		1
Eqalunniarfiit	Polygons	400	Nuna sermeqanngitsoq	1	
Kuuit immamut kuunneri eqaloqarfillit	Points	1000	Imaq	1	1
Imeqqutaallat ineqarfii	Points	500	Imaq nunalu	1	
Saarullinniarfiit	Polygons	0	Imaq	1	1
Qilanngaqarfiit	Points	500	Nuna imarlu	1	
Timmissanut eqqissisimatitsivik	Polygons	0	Nuna imarlu	1	
Taateraaqarfiit	Points	1000	Nuna imarlu	1	
Ammassanniarfik	Polylines	500	Imaq	1	1
Mitit siorartuut	Points	500	Nuna imarlu	1	
Mitit ukiisarfii	Polygons	0	Imaq	1	
Appat sigguttooqarfiit	Points	1000	Nuna imarlu	1	
Kulturikkut eriagisassaqarfiit	Points	500	Nuna		1
Inerisaaffiit	Polygons	0	Nuna		1
Imeqarfiit killeqarfii	Polygons	0	Nuna		1
Erngup nukissiornermit ledningit siaarsimaffii	Polygons	177	Nuna		1
Nuna naggorissoq (NDVI>=0.5)	Polygons	0	Nuna sermeqanngitsoq	1	
Narsaatit	Polygons	0	Nuna sermeqanngitsoq		1
Ivigartorfiit	Polygons	0	Nuna sermeqanngitsoq		1
Qaleralinniarfiit	Polygons	0	Imaq	1	1
Qasigiaqarfiit	Polygons	0	Imaq	1	
Qasigissat mamaarfii	Polygons	0	Nuna	1	
Toornaviarsoqarfiit	Points	1000	Imaq	1	
Uunartunik puilasoqarfiit 100 m zone	Polygons	400	Nuna imarlu	1	
Nipisaat suanniarfiit	Polygons	0	Imaq	1	1
Aalisaluttartut nipisanniarfii	Polylines	500	Imaq	1	1
Umimmaateqarfiit	Polygons	0	Sermeqanngitsoq		1
Nunat eqqissisimatitat	Polygons	0	Nuna	1	
Qaqulloqarfiit	Points	1000	Nuna imarlu	1	
Raajarniarfiit	Polygons	0	Imaq	1	1
Sinerissat uuliakoornissamut mianernartumiittut	Polylines	500	Nuna imarlu	1	1
Pilersaaruteqarfiit sumiiffiit	Polygons	0	Nuna		1
Orpigaqarfiit	Points	1000	Nuna sermeqanngitsoq		1
Inoqarfiit	Polygons	0	Nuna sermeqanngitsoq		1
Ramsar sites	Polygons	0	Nuna imarlu	1	
Apparloqarfiit	Points	1000	Nuna imarlu	1	
Suluppaagarniarfiit	Polygons	0	Imaq	1	1
Allattorsimaffimmi aappalaartumi nalunaarsorsimasinnaasut	Polygons	0	Nuna	1	
Tuttuuteqarfiit	Polygons	0	Nuna sermeqanngitsoq		1
Aqquserngit (pioreersut/pilersaarutaasut)	Polygons	177	Nuna		1
Tatsit tarajullit 100 m zone	Polygons	400	Imaq nunalu	1	
Saattuarniarfiit	Polygons	0	Imaq	1	1
Qamuteralaat aqqutai	Polygons	177	Nuna		1
Kujataa	Polygons	0	Nuna sermeqanngitsoq	1	
Appaqarfiit	Points	3000	Nuna imarlu	1	
Takornariaqarfiit	Polygons	0	Nuna imarlu		1
Pisuttarfiit	Polylines	500	Nuna		1
UNESCO sumiiffiit	Polygons	0	Nuna		1
Nattoraleqarfiit	Points	1000	Nuna imarlu	1	
Qeerarniarfiit	Polygons	0	Imaq	1	1

7.2 Qulaaniit isigalugu itisiliisimanermit inernerit

Misissuinerit itisiliisut pingasut suliarineqarput - ataaseq nunap assingi 51-it qaleriit, sammillugit naasut uumasullu, inuit atuinerat aammalu kulturikkut eriagisassat (Takussutissiaq 7.1 aamma 7.2), ataaseq nunap assingi 34-it qaleriit sammillugit uumassusilinnut paasissutissat (Takussutissiaq 7.3) aamma ataaseq sammillugu nunap assingi 29-it inuit atuinerat kulturikkullu eriagisassat soqutigisat sammillugit (Takussutissiaq 7.4).

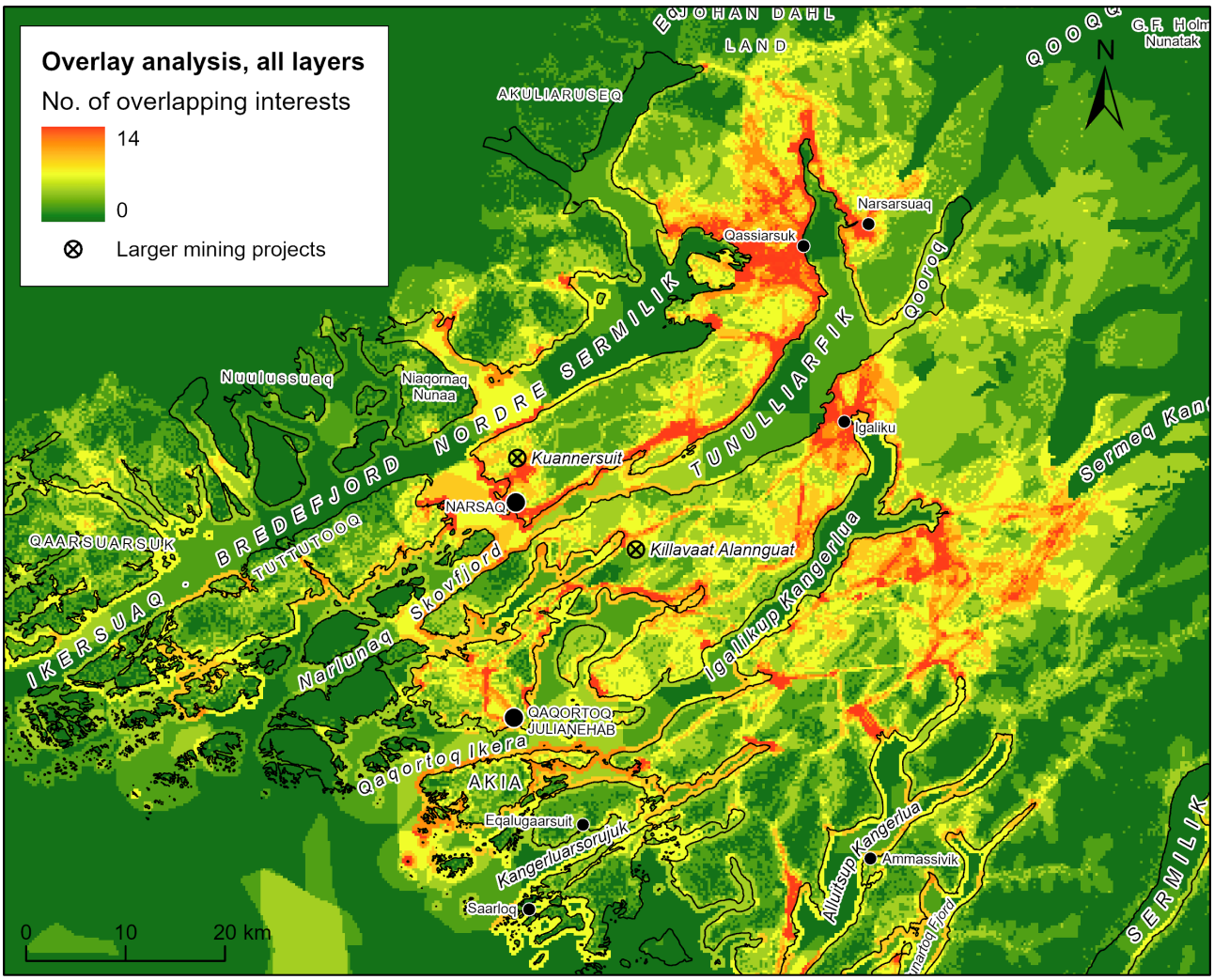
Tunulliarfiup qinngua (Narsarsuup avannaatungaa Qinnguata tungaanut aammalu Qassiarsuup kangerluarta illuatungaa) Igalikup eqqaa aammalu ilaatigut Igaliku Kujalleq tassaapput sumiiffiit arlariarlutuik uumasorsiuut isaanniit qaleriiffillit, kulturikkut eriagisaasatigut aammalu inuit atuinerisigut qaleriiffillit (Takussutissiaq 7.1 - 7.4). Nunami tamaani inuit atuinerat annertuumik piuvoq illoqarfiimmi ilanngullugit (Narsaq aamma Qaqortoq aammalu annikinnerusumik Nanortalik eqqaalu), nunaqarfiit aammalu savaatit ivigartorfiat minnerunngitsumillu eriagisassaqarfiit . Sineriak sinerlugu aalisarfiit aamma qaleriiffeqarput aammalu timmiaqarfiit qaleriiffeqarlutik.

Kitsissut silatinnguani qeqertat timmiaqarfiupput sumiiffimmut pingaarutillit uumassusillillu pillugit nunap assiliani immikkut taaneqarput Asiliartaq 7.3-mi.

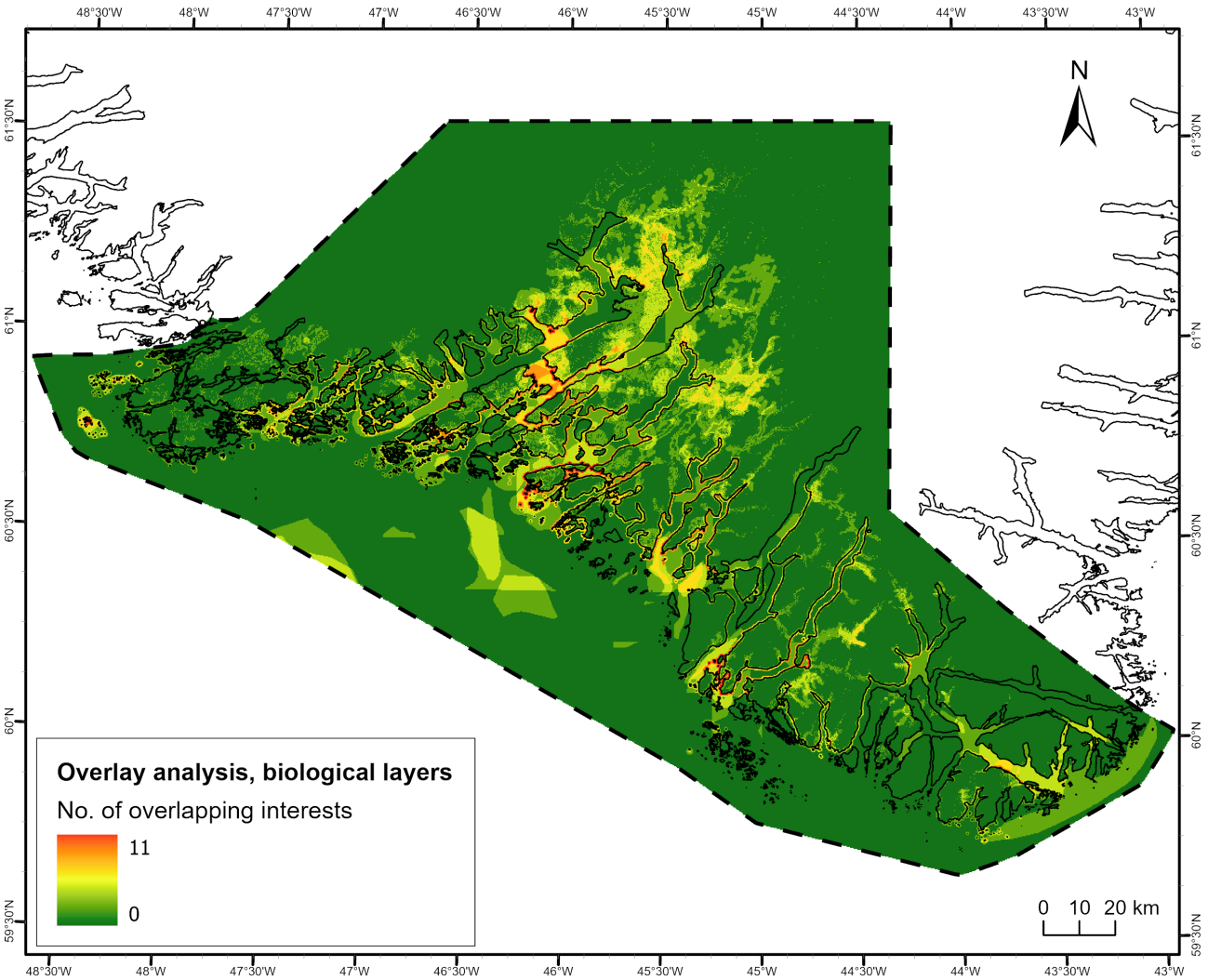


Takussutissiaq 7.1. Takussutissami 7.1-mi tulleriissaarneqartutuut nunap assingisa 51-usut qaleriissaarnerini misissueqqissaarnermi inerniuliussat, naasut uumasut, inuit atuinerat, kulturikkut eriagisassaqarfiit soqutiginartut tamaasa ilanngullugit. Cellip nalinga 14-uvoq takutillugu cellit assiliartai assigiinngitsut 14-niit qaleriittut.

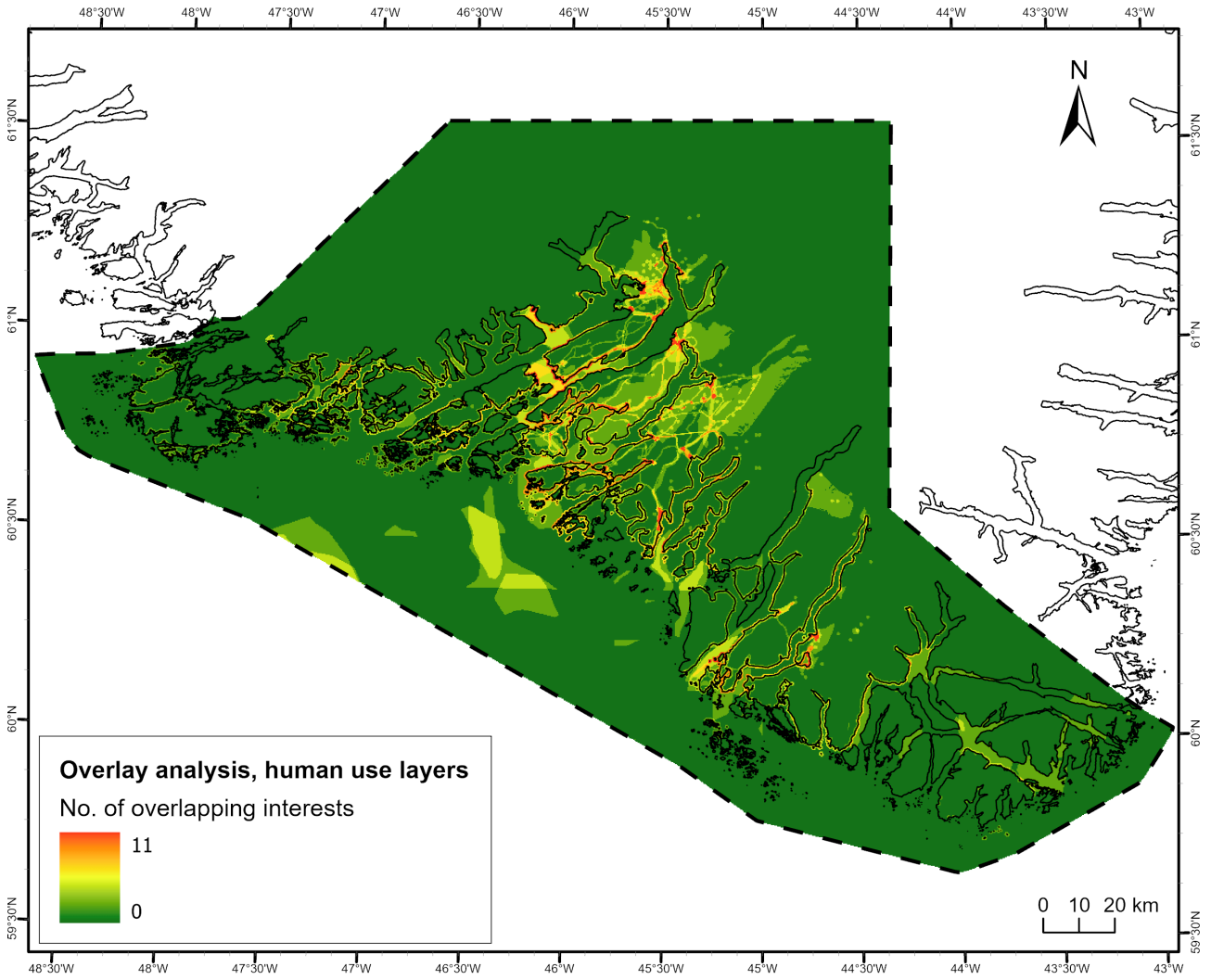
Sumiiffimmi qaleriiffiit amerlasuut pinngitsoorani isumaqanngilaq aatsitassarsiortoqartillugu avatangiisinut annertoorujussuarmik kinguneqartitsissasoq. Taamaattoq, erseqqissaassaaq maannamut ilisimasavut tunngavigalugit soqutigisat assigiinngitsut immikkut eqqaaneqartariaqarput aatsitassanit piiaasoqassappat. Sammisap tulliani minguttitsisinnaaneq aammalu avatangiisinut sunniutigisinnaasai uumassusilinnut naalisarneqassapput.



Takussutissiaq 7.2. Assiliartami 7.1-mi takuneqarsinnaavoq misissueqqissaarnermit qaleriiffiit assingi, uanili assigiinngequtaa tassaavoq allisinneqarluni sumiiffik nuna tamarmi soqutigisamiittoq ersersinneqarmat. Illoqarfiit aammalu nunaqarfiit qernertunik toorneqarput aammalu sumiiffiit aatsitassarsiorfiusinnaasut annerit ersersinneqarlutik.



Takussutissiaq 7.3. Uumassusillit pillugit paasissutissat misissueqqissaarnermit inerniliussat nunap assingini 34-ni qaleriffittut takussutissaq (Takuuk Takussutissiaq 7.1 nunap assingini ilanngussaq "misissuinermut ilassut uumassusillit pillugit").



Takussutissiaq 7.4. Inuit atuinerat aammalu kulturikkut eriagisassaqarfiit pillugit paasissutissat misissueqqissaarsimanermit 29-nngorlugit nunap assiliarineqarneri qaleriiffiit ersersillugit (takuuk immikkoortoq "misissuinernit ilassut, inuit atuinerat" Takussutissami 7.1-mi nunap assingini qaleriiffinni).

8 Aatsitassarsiorneq aamma avatangiisinut sunniutit

Allaaserinnittoq Anders Mosbech[1], David Boertmann[1], Kim Gustavson[1], Christian Juncher Jørgensen[1] and Janne Fritt-Rasmussen[1]

[1]Department of Ecoscience, Aarhus University

8.1 Aatsitassarsiornermit avatangiisinut sunniutit

Kapitalimi uani sammissavarput nalinginnaasumik ullutsinni aatsitassarsiortarnerni periutsit atuuttut naapertorlugit nunarsuarmilu piumasaqaatinut pitsaassutsimut qaffasinnerpaat atorlugit aatsitassarsiortoqarnerani avatangiisinut suut sunniutigisinnaanerai ilimanaataanersut.

Kapitalimi immikkoortoq kingullermi ajutoortoqarnerani avatangiisinut suut sunniutaasinnaanersut nassuiaatigineqassapput.

Misissuinerit aatsitassarsiorniarnermi alloriarnerit siullersarisarpaat tassunga ilaasarpoq aatsitassat suut atorluarneqarsinnaasut nassaarineqarsinnaanerisa assigiinngitsutigut misissuiffigineqarnissaat. Ujarassiuut amerlanngitsut suleqatigiit suliaqartartut, qulimingulimmik angallanneqarlutik, umiatsiamik angallanneqarlutik ATV-kkut angallanneqarlutik il.il. , ujarassiornikkut ilisimasalittut nuna ujarlerfigalugu misissoqqissaagassanillu assaannarminnik imaluunniit atortunik assaannartumik nassarisinnaasaminnikj atorlutik katersisarnerat nalinginnaasuuvoq. Suliaqarneq tamanna "nunami suliaqarnermi malittarisassanik tunngaveqartarput" (takuuk Ilassut 3 paasissutissanik annertunerusunut). Avatangiisinut sunniutaa annerpaaq taamatut suliaqarnermi amerlanertigut tassaasarpoq uumasoqatigiinnut sivikitsumik ajoqusersuuteqarsinnaaneq aammalu ATV-it angallatillu allat atornerisigut nunap naaneranut ajoqusiisinnaalluni. Qillerinikkut orsussanillu atuinikkut serpartaarinikkut aamma mingutsitsisinnaaneq aarlerinaateqarsinnaavoq.

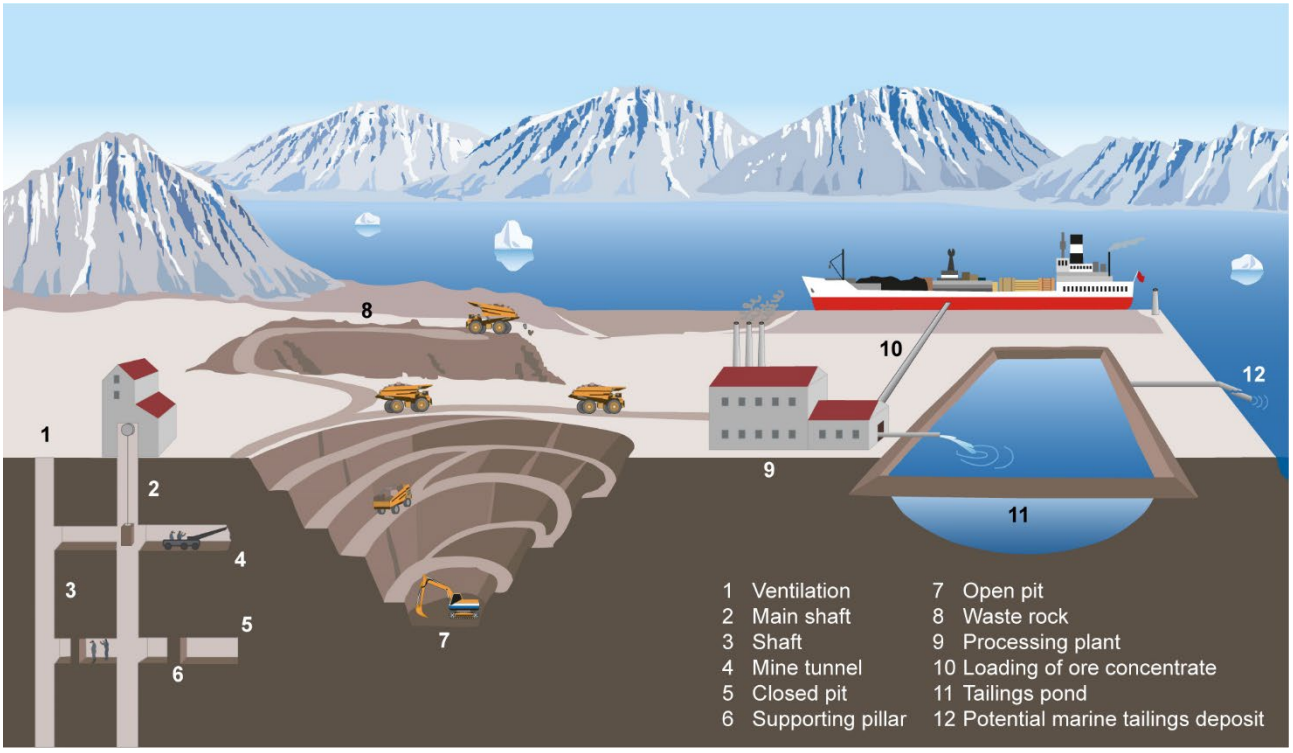
Misissueqqissaarnerup ingerlanerani aatsitassarsiorfiusinnaasup qiterisinnaasaa ujartortarpaat allallu soqutiginanngineerusinnaasut immikkoortertarlugit. Attaveqaatit suliarineri, illuliornerit, aqquserngit, mittarfiit il.il. malittaasinnaapput. Avatangiisinut aallussineq sunniutaasinnaasorlu sapinngisamik piffissaq ungasinnerusoq isigisoq tunngavigalugu suliaasariaqartarput. Avatangiisinut sunniutit kingorna misissueqqissaarnermit killiffimmi avatangiisinut sunniutai eqqummaariffigineqartariaqartut tassaapput makkununnga tunngasut: uumasoqatigiinnut ajoqusersuinerit, inigineqarsinnaasut annikillineri aqquserniornerit eqqaamiorisanillu mingutsitsinerit peqqutaanik, pujoralaat eqqakkat/imeq eqqagaq misissueqqissaarfinneersut.

Aatsitassarsiorfik pilersinneqarpat avatangiisinut unamminarnerpaasussaq tassaavoq isumannaatsumik toqqorsiveqarnissaq aatsitassarsiornermit eqqagassartaasunut avatangiisinut mingutsitsinissaq pinngitsoortinniarlugu suliaqarnissaq. Aatsitassarsiorfik ammasutut inissisimappat nunaminertat nivanneqartutut issapput avatangiisinut toqqaannartumik sunniuteqarluni (takuuk Takussutissiaq 8.1). Aatsitassarsiorfinnut matoqqasunut soorunami

sunniutai allaanerussapput. Angallaffik annertusineqassaaq aatsitassarsiorfiup talittarfeqarnissaa pillugu aammalu piiakkat avammut assartorneqarnissaa peqqutigalugu. Mingutsitsineq pinngitsoortinniarlugu piiaanermit avammut aallarussassat katersat peqqissaartumik passunneqartariaqarput, pingaartumik akuutissat pineqartillugit. Nukissamik atuineq amerlanertigut uuliamik tunngaveqartarpoq erngup nukissiutinik tunngaveqartumik atuisoqanngippat.

Naggataatigut, aatsitassarsiorfik matuppat aatsitassarsiorfiusimasoq ima suliarineqarluni naammaasineqassaaq sapinngisaq tamaat aatsitassarsiornerup aallartinngineranisut avatangiiseq iluseqarteqqilissallugu.

Tulliuttuni, aatsitassarsiortoqarnerani avatangiisinut sunniutaasinnaasut assigiinngitsut qimerloorneqassapput aamma assersuutinik nunamut ullutsinni aatsitassarsioriaaseq atuuttoq aallaavigalugu pisoqarpat sunniutigisinnaasai ersersinneqassallutik.



Takussutissiaq 8.1. Aatsitassarsiorfiup sunniutigisinnaasai tamakkiisumik isigalugu.

Taaguutit suussusersissutit sunniutinut takussutissaq

Nunamut sunniutaasinnaasut assigiinngitsuusinnaapput nikertuusinnaallutik. Ataatsimut isigalugu pingasoqiusamik sunniuteqarsinnaaneq imatut isikkoqarsinnaavoq:

- Sumiiffimmi: Aatsitassarsiorfimmi toqqaannartumik eqqaanilu kilometerialunnut sammisumik sunniuteqarsinnaaneranut tunngavoq.
- Immikkoortumi nunami: Nunami immikkoortumi aatsitassarsiornerup kingunerisaanik attuumassuteqartumik qulerarterutit arlariit tikillugit kilimeterisut isorartutigisumut tunngavoq.
- Nunarsuaq tamakkerlugu: Silaannarmut mingutsitsineq tunngavigalugu nunarsuarmut tamanut sunniutigisinnaasaanut tunngavoq.

Sunniutigisinnaasaasa sivisussusaat pingasoqiusamik inissisimassapput:

- Piffissami sivikitsumi: Ukiunut ikittuinnarnut tunngavoq.
- Piffissaq ungasinnerusumut kisiannili killissaqartumik: Ukiualunnit sivisunerusumut ilaatigullu ukiut qulikkaanut soorlu kinguaariinnut ataatsinut sivisutigisumik sammivoq, kisiannili sunniutaasut utimut aaqqiissutaasinnaasutut inissisimasunut tunngavoq.
- Ataavartoq: Sunniutit uterteqqissinnaajunnaarfiannut sammivoq naatsorsuutaanissallu minnerpaamik ukiuni 100-nut tunngalluni.

Inigineqartunut sunniutissat pingasoqiusamik inissisimapput:

- Najugarisat aammalu uumassuseqatigiinnut pitsaassutsimullu uumasoqatigiit amerlasuunut imaluunniit naasunut assigiinngitsunut sunniuteqarnerata tassaniiffigisaannik annikillisitsineq. Mingutsitsinerup annertussusaa killissaliussap ataaniilluni avatangiisinut pitsaassutsitigut iluaqutaassinnaavoq kisianni tunuliaqutaasut akuisa qaangersimasinnaavaa.
- Najugarisat pitsaassutsikkut appariaateqarnerat: Inigisat ingerlatsinerup kingunerisaanik annikillisinneqassapput soorlu pujoralatsigut, imeq eqqakkatigut imaluunniit ajoqusersuinikkut. Uumasoqatigiit amerlassusai imaluunniit nunap naanera annikillissaaq. Mingutsitsinerup annertussusaa killissaliussat qaangerpagu avatangiisinut pitsaassuseq akuutissaqassuserlu uumasoqatigiinnullumi sunniutai ersissapput.
- Najugarisat annaanerat: killiffiup taama ittup kingunerisarpaa uumassusillit tassaniissinnaajunnaarneri aammalu najugaqarfigisinnaajunnaartarpaat imaluunniit toqusarput. Tamanna amerlanertigut pisarpoq aatsitassarsiorfimmiit assaanerup sullinnerullu eqqakkatigut sulinerisa kinguneranik kingunerisarlugulu aatsitassarsiorfiup matunerata kingorna avatangiiseq iluarsaanniarlugu suliaqartariaqarneq.

8.2 Uumasunut ajoqusiinerit – Nipiliornerit inuit pilersitaat inuillu angallanneranit pilersitat

Aatsitassarsiorfimmi nipiliornerit ilagisarpaat soorlu qaartitsinerit, sakkut maskiinat ingerlatsinikkut qillerinikkullu nipiliornerit inuit angallannerullu avataatigut pisartut. Pissutsit tamakku tamarmik uumasoqatigiinnut soorlu timmissanut, miluumasunut imarmiunut, inigisaanniit qimagutsiterneqalersinnaaneq tamaasa pinngitsoortinniarlugu peqqissaartumik sunniutaasinnaasut pillugit aaliangersagaqartariaqarpoq. Ajoqusersuineq uumasunut sumiiffimmi sunniuteqartarpoq kisiannili ledningersuartut aqquteqartoqartillugu, aqqusineqartillugu, qulimingulimmik angallattoqartillugu il.il. ajoqusiinerit siammasissorujussuanngortarput. Piffissaq sivikitsoq aamma/imaluunniit inigineqarsinnaasut toqqagassaqartillugit, sunniutit uterteqqinneqarsinnaanatik sakkortuumik malunnaateqassapput, kisiannili piffissaq sivisunerusumi sunniutissat kingunerissavai neriniarfeerutissammat, piaqqiorfeerutissammat, mamaarfeerutissammat il.il. Uumasut ilai soorlu tuttut angallaffik qimanngoortassuaat najugaallu annikilliserujussuarlugu. Uumasut allat soorlu teriat, nannut aamma tulukkat aatsitassarsiorfinnut qaninngoorsinnaapput pissutigalugu eqqakkanik neriniarneq kajumerissagamikku taamaasilluni aatsitassarsiorfiup qanittuani uumasunik piniarsinnaanerat aamma annikillilluni.

Aatsitassarsiorfiup eqqaani angallannikkut aaqqissuussinerup kingunerisaanik uumasoqatigiinnut ajoqusersuutit killilersimaarniarlugit pilersaartoqartariaqarpoq aqquserngit suliariniarnerini uumasoqatigiit inigisaat ajoqusernaveersaarlugit qulimingullillu ingerlaartarfii sapinngisamik qullasissukkut ingerlaartarnissaat sapinngisamik sunniutit ajoqusersuutit pinngitsoortinneqarnissaat siunertaralugu.

Ilanngullugu, aqquserngit avataatigut suliaqarfiit, inuit pisuffii, sapinngisamik killilersimaarneqassapput ingerlaartarfiillu allanngorlugit. Uumasut ilai soorlu nerlerit inigisaminnik qimagussinnaapput ajoqusersuutit ingerlanneqartut taakkununnga mianerinninngippata.

Inuit uumasunit qaasuttutut isigineqalersinnaapput (piniartut) nujuarneruleriaannarsinnaappullu.

Taamaattumik, uumasoqatigiit inunnit ajoqusersorneqarnermik kingunerisaanik nujuarnerulerlutillu ersitunerulissapput uumasunut piniagaanngitsunut sanilliullugu. Tamanna angallannikkut aaqqissuussinermut aamma atuuppoq uumasunit inuit qaninnerunerat maluginiassammassuk.

Tabel 8.1-mi nipi ajoqusersuisoq nassuiarneqqarpoq nipillu assigiinngitsuuneri ersersinneqarluni. Ajoqusersuinermut tunngatillugu paassissutissat annerusut uani nassaarineqarsinnaapput Frederiksen et al. (2017).

Tabel 8.1. Nipit ajoqusersuutaasut

Suussuseq/suminngaanniit	**Sunniutip sivisussusaa**	**Nunami isorartussuseq**	**Sunniut aammalu sivisussusaa**
Qulimiguullit	Sivikitsumik/sivisuumik	Sumiiffimmi/km arlaqanngitsut	Inigisat annikillinerat uumasunut ajoqusersorneqarunik
Qulimiguullit pingaaruteqarput angallannermut aammalu inerisaanermi aatsitassarsiornerup ingerlanerani tamani. Qulimiguullit nipitoorujussuupput uumasoqatigiillu qimagutsissinnaavai soorlu mamaarfiit nerlerillu km amerlasuunik qimagutsissinnaallugit, sumiiffimmi aammalu qulimingullip ingerlaarfiani tamani (immikkoortumi nunami). Sunniutit malinnaaffigineqarsinnaapput, avaqqussinnaanatilli, ingerlaarfiit aaliangersimasuutinneqarpata qatsissuserlu aaliangersimasuutinneqarpat.			
Timmisartut	Sivikitsumik/sivisuumik	Sumiiffimmi/mittarfimmiit km amerlanngitsut	Uumasut ineqarfiisa annikillinerat ajoqusersuutit akulikippata
Timmisartut mittarfeqarneratigut atorneqassapput aatsitassarsiorfimmi pilersinneqarsimatillugit aammalu ilaatigut piiaanerup ilutigisaanik atorneqarlutik. Qangattalernermi milernermilu nipitoorujussuupput kisianni timmiffigineqartoq qatsissumiittarmat uumasunut ajoqusersuutaasaratik. Timmisartut qanoq ittuuneri peqqutigalugit sunniutaasinnaasut uumasunut mittarfiullu eqqaanut takorlooruminarnerupput.			
Qaartitsinerit	Sivikitsumi/sivisuumik	Sumiiffimmi/km ikitsut	Uumasut najugaat annikillissooq uumasoqatigiinnut ajoqusersuutit akulikippata
Qaartitsinerit nipituujupput, akulikippata inigisaq qimanneqariaannaavoq. Taamaattoq, qaartitsinerit ikitsuinnaappata sumiiffimmi sivikitsuinnarmik sunniuteqarsinnaavoq.			
Other noisy processes	ShorSivikitsumik/sivisuumikt-/long-term	Sumiiffimmi/km ikitsut iluani	Uumasut najugaat pitsaassuserlu annikillissooq ajoqusersuutit akulikippata

Pissutsit taama ittut aatsitassarsiorfiup qanittuani sumiiffinnilu sunniuteqasssapput.

8.3 Sanaartornerit illuliortiternerillu peqqutigisaanik uumasoqatigiit tammagarnerat

Uumasut inigisaminnit qimaguttarput sanaartornikkut allatigullu inigisaat sunnerneqarpat naasut nunallu naaneri aammalu uumasoqatigiit inigisaat inigineqarsinnaajunnaarpat. Annaasat sumiiffimmiinnaq pisinnaavoq soorlu illuliornerit, annertusaanerit assigisaalu sumiiffimmi assaaneq peqqutigisaannik. Ilassutigalugu, aatsitassarsiorfimmit eqqagassat katersivii aammalu eqqakkat sumiiffinni angisuujusinnaapput imerlu qillerinermit atorsimasoq igitaq tatsini ilaatigut katersuisoqarsimasinnaavoq. Kuuk supusiarineqarfigineqarpat eqaluit majorfii ajoquserneqassapput aammalu sumiiffimmi annertuumik sunnerneqassallutik.

Imartaqarfiit tasertaqarfiit aqqusinniornikkut sunnerneqarsinnaapput kinguneralugu imeq ingerlaartoq unitsinneqarsinnaalluni - masarsoqarfiit paqqerlugit. Aammalu Kalaallit Nunaanni nuna qeriuaannarpoq tamannalu sunnerneqarlunilu aserorneqarsinnaavoq (inuit pilersitaanik nunap qeriuaannartup sunnerneratigut) tamannalu sanaartornikkut assigiinngitsutigut pilersinneqarsinnaavoq.

Nalinginnaasumik, ineqarfiit aatsitassarsiorfimmit sunnerneqartut sumiiffimmiinnerusarput. Taamaakkaluartoq, aatsitassarsiorfimmut qanittumiinnaq naasut allattorsimaffimmi aappaalaartumi nalunaarsorsimasut naasimasinnaapput taakkualu naaneri innarlerneqarpat nunatut aarleqqutigisassaapput (Nunap Akisussaaffigisai uumassusillit). Aatsitassarsiorfiup peqqutigisaanik inigisaqarfiit annaaneri sumiiffimmuinnaq attuumassuteqaraluartut, sunniutai amerlasuutigut piffissamik sivisuumik pisarpoq. Ikiorsiiniarneq suliniuteqarnissarlu pisariaqarpoq inigisaqarfiit annaannginnissaat qulakkeerniarnarlugu. Ikiorsiiniarnerit aatsitassarsiorfiit matoreernerisa kingorna ajornakusoortuusinnaavoq nunap siornatigutulli iliseqqinniarnera kisianni inigisaqarfiit nutaat pilersinneqarsinnaapput.

Aatsitassarsiorfiit aaqqissuunnerini nakkutilliineq qaffasissumik pitsaassusilik tunuliaqutigalugulu pilersaarusiornermi atorneqarpat sumiiffimmi uumassusilinnit inigisaqarfik annikinnerusumik sunniuteqarfigineqarsinnaanerat anguneqarsinnaavoq.Ilisimasat tamakku pigineqalersinnaapput tunuliaqutissatut ilisimatusarnerit sumiiffimmilu uumassusillit pillugit sulianik aallartitsinnginnermi pigilersimagaanni.

Takussutissami 8.2-mi aatsitassarsioriaatsit nalinginnanerpaat takutinneqarpoq misissueqqissaarnermi piiaanermilu atukkatigut. Pilersaarutit erseqqissut aammalu malittarisassat pilersinneqartariaqarput akuersissutit aammalu piiaanermut akuersissutit piumasaqaataanni ilaatinneqarlutik. Malittarisassat taama ittut Teknikkikkut Pitsaanerpaamik Isiornikkut (BAT) aamma Avatangiisinut Pitsaanerpaamik Iliuuseq (BEP) atorneqartariaqarpoq piumasaqaataallunilu avatangiisinut sunniutigisinnaasai pisariaqanngitsut pinngitsoortinniarlugit.

Tabel 8.2. Aatsitassarsiornermi sunniutaasinnaasut erseqqissut

Suna ajoqusersuutaasoq	Sunniutaata sivisussusaa	Sumi isorartutigisumi	Sunniutaa taassumalu annertussusaa
Aqquserngit	Sivisuumik	Sumiiffimmi nunallu immikkoortuani	Uumasut najukkaminnik annaasaqarnerat
Qulimiguulinnut mittarfeeqqat aamma timmisartunut mittarfiit	Sivisuumik	Sumiiffimmi	Uumasut najukkaminnik annaasaqarnerat
Talittarfik	Sivisuumik	Sumiiffimmi	Uumasut najukkaminnik annaasaqarnerat
Assersuutit uku uumasut najugaasa annaanerinut takussutissaapput aqquserniornermi sanaartornermilu sumiiffinni nalinginnaasumik assigiinngitsunut killissaqartitsilernerinik takussutissaapput. Uumassuseqatigiinnut sunniutai amerlanertigut ataasiakkaanuusinnaavoq kisianni uumasut najugaasa annaaneqarneratigut uumasoqatigiit assigiinngisitaarnerat naasullu qaqutigoortut nunallu naaneri assigiinngitsut annaaneqassapput. Attaveqaatitigut allannguutit aammalu erngup kuunnerisa allanngorneri ineqarfinnut annertuumik sunniuteqqassapput. Mianersortumik pilersaaruteqarnikkut aammalu itisiliisumik ilisimasaqarnikkut sunniutit killilerneqarsimaarneqarsinnaapput.			
Sanaartukkat assigisaalu	Sivisuumik	Sumiiffiimmi	Ataasiakkaanut
Illuliat sanaartukkallu allat angissutsikkut amerlassutsikkullu assigiinngitsuusinnaapput, kisianni sunniutai sumiiffimmiittarput. Sunniutai pingaartumik naasunut qaqutigoortunut malinnaavigineqarsinnaapput mianersortumillu pilersaaruteqarnikkut inigisai naaffiilu ajornerusumik sunnerneqannginnissai anguneqarsinnaavoq.			
Aatsitassarsiorfik	Ataavartumik	Sumiiffiimmi	Uumasut najukkaminnik annaasaqarnerat
Ujaqqat ingitat aamma qillerinermit imeq ingitap katersorneqarfia	Ataavartumik	Sumiiffiimmi	Uumasut najukkaminnik annaasaqarnerat
Sapusiat erngullu kuunnerisa sunnerneqarneri	Ataavartumik	Sumiiffimmi killeqarfimmilu najugaqarfimmi	Uumasut najukkaminnik annaasaqarnerat/najukkap pitsaassusaanik annaasaqarneq
Aatsitassarsiorfimmi ujaqqat eqqakkat aammalu qillerinermit imeq atorsimasup iginneqarfii ataavartuusarput kingunerisarlugulu inigisaqarfiit suujunnaarneri sumiiffimmi tamani. Aatsitassarsiorfiup matuneranit sumiiffik tamanna aaqqeqqinniarneqarsinnaavoq; taamaattoq, ataatsimut isigalugu nalinginnaasumik siornatigutut tamakkiisumik uterteqqinneqarsinnaanngilaq. Sipusiaq peerneqarsinnaavoq kisianni eqaluit peerussimassapput, ingerlaannartumillu avatangiiseq aaqqinneqarsinnaanani. Eqaluliineq periarfissaasinnaavoq.			

8.4 Aatsitassarsiornermik ingerlatsinermit mingutsitsineq

Aatsitassarsiornermit mingutsitsisinnaanerit assiginngitsuminngaannersuusinnaapput tamakkulu tamarmik mianersortumik peqqissaartumillu avatangiisinut sunniutigisinnaasai pinngitsoorneqarsinnaasut ingerlanneqartariaqarput. Mingutsitsissutaasinnaasut soorlu eqqakkanik katersiviit qillerinermillu imeq atorneqarsimasup katersivii aatsitassarsiorfimmit katersat, pujoralaat, inigisanit anartarfeqarnikkut eqqakkat (eqqakkat qasersut aamma eqqakkat qernertut) il. il. pilersaaruteqarfigineqassapput. Sunnerneqartussat tassapput silaannaq (silaannakkut mingutsitsineq), imeq aatsitassarsiorfimmut qanittoq (kuuffiit, qillerinermit imeq eqqagaq aamma ujaqqat eqqakkat piianermiit) aamma sumiiffimmi avatangiisit (pujoralak, ujaqqat eqqakkat qillerinermillu imeq atorsimasup inginnera). Mingutsitsineq sunniutaalu akuerineqarsinnaasumik malinnaavigineqarluni aqunneqarlunilu inissisimatinneqartariaqarpoq.

Imeq eqqagaq - erngup mingutsinneqarnera

Erngup eqqakkap kingunerisarpaa aatsitassarsiorfimmit qillerisimanermit erngup atornikup eqqarneqarneratigut (kuuffeqarniikkut) inigisaqarfinniillu aallaaveqarnerat il.il.

Erngup eqqakkap salinneqarnera aatsitassarsiorfimmit sumiiffimmi nalinginnaasuuvoq sapinngisamik mingutsitsisinnaanerup avatangiisinut illersuutaasinnaasut pillugit pigisariaqarneratigut pisinnaasoq. Teknikkut periarfissaqarpoq assigiinngitsunik aatsitassarsiorfinnilu erngup eqqakkap salinneratigut avatangiisinut sunniutai killilerneqarsimaarsinnaapput.

Aatsitassarsiornermit imeq eqqagaq mingutsitsinermi namminerisamik annertuumik pilersitsisinnaavoq aamma imeq imaattariaqarpoq akuutissanik arrortinneqarsinnaanngitsunik ulorianartunillu avatangiisinut sunniuteqarsinnaalluni. Aatsitassarsiornermi qinngornerit ulorianartsinnaassut ilanngullugit ernumanartuusinnaapput.

Aatsitassarsiornermit imeq eqqagaq aamma akuutissanik ulorianarsinnaasumik akoqarsinnaavoq imartanut aammalu tatsit naqqanut sumiiffimmi ajoqusiisinnaalluni inigineerunnerinik kinguneqarluni aammalu naasoqassutsikkut nunallu naaneratigut ajoqusiisinnaalluni. Uani aamma aarlerinartut ilagaat akuutissat takussaanngiusartut sumut tamaannga teqqalasinnaaneri.

Aatsitassarsiorfimmit anartarfikkut eqqakkat kuuffitsigut avatangiisinut kuunneri akuutissatigut peqqissutsikkullu ulorianaarteqarsinnaapput. Kuuffiit salinneqarsinnapput akuersaarneqarsinnaasumillu mingutsitsinikkut killilersimaarneqarsinnallutik.

Tabel 8.3 aamma 8.4-mi assersuutit imermut mingutsitsisut takuneqarsinnaapput.

Tabel 8.3. Aatsitassarsiornermit imermut mingutsitsinermi qaleriissaakkatut sunniutai takuneqarsinnaaffii.

Sunniisoq	**Sunniutaata sivisussusaa**	**Nunami sunniut**	**Sunniutit aamma qanoq annertutigisumik sunniutai**
Tatsinut eqqaaneq	Aatsitassarsiorfiup atuunnera tamaat	Sumiiffimmi*, < 1 km iluani apeqqutaalluni malittarisassat	Uumasut najugaasa pitsaassusaata appariaateqarnera
Kuunnut eqqaaneq	Aatsitassarsiorfiup atuunnera tamaat	Regional downstream	Uumasut najugaasa pitsaassusaata appariaateqarnera
Immamut eqqaaneq	Aatsitassarsiorfiup atuunnera tamaat	Sumiiffimmi*, < 1 km iluani apeqqutaalluni malittarisassat	Uumasut najugaasa pitsaassusaata appariaateqarnera

Aatsitassarsiorfiup eqqagaatigut soorlu imerpalasukkut aatsitassarsiornermi qillerinermit imeq igitaq taassumalu katersivigineqarfia piffissaq ungasissumut sunniuteqassaaq aammalu eqqakkatigut mingutsinerit piiarneqanngitsut akuutissatigut, qinngornitsigut nerisaqarniarnikkut allatigullu aarlerinartumik tamanut kinguneqartitsissaaq. Akuutissat kuutsigut siaruarujussuarsinnaaneri aamma utimut aaqqiivigineqarsinnaanngitsut pisinnaapput. Eqqakkat killissaliussat ataaniippata sunniutigisinnaasai piffissamut qanittuinnarmut pisinnaavoq eqqaaneq unitsinneqarpaat. Malittarisassat piumasaqaatillu eqqakkanut sammisut qulakkeerinnissapput sapinngisaq tamaat suliaqarfimmi taassumalu minnerpaamik 1 km-sut ungasitsigisumi sunniutaassinnaasut pakkersimaarnissai.

*) Taamaakkaluartoq, kuuit kuunneri sunnerneqarpata sumiiffimmi tamani kuuffigineqartut tamarmik sunnerneqassapput. Ilanngullugu, nunap isorartussusaa mingutsitsinernit teqqalasunit sunnerneqassapput soorlu silaannakkut, mallitigut il.il. Inigisat annikillineri timikkut/ akuutissatigut sunniutai uumassusilinnut tikittartunut tamarmut ajortumik kinguneqarfigineqassapput. Akuutissat ulorianartut quiaatinut, qalerualinnut, aalisakkanut, timmissanut il.il. malittarisassiuunneqarsimanngikkunik nakkutigineqanngikkunilllu ajoquserujussuarneqarsinnaapput. Maluginiarneqassaaq immikkut sillimmartaarfissat periarfissaammata imeq akuilu eqqarneqartup killilerneqarsinnaanera.

Tabel 8.4. Aatsitassarsiorfimmit erngup eqqarneqarnera immanut sunniutigisinnaasai.

Suminngaanniit	Sunniutaata sivisussusaa	Geographical extend	sunniutit aamma sunniutit annertussusaat
Tatsinut eqqaaneq	Aatsitassarsiorfiup piunera tamaat	Nuna qanoq sunnertigisinnaavaa	Uumasut najugaasa pitsaassusaata appariaateqarnerat
Kuunnut eqqaaneq	Aatsitassarsiorfiup piunera tamaat	Sumiiffimmi*, < 1 km malittarisassat apeqqutaallutik	Uumasut najugaasa pitsaassusaata appariaateqarnerat
Immamut eqqaaneq	Aatsitassarsiorfiup piunera tamaat	Sumiiffimmi*, < 1 km malittarisassat apeqqutaallutik	Uumasut najugaasa pitsaassusaata appariaateqarnerat
Imeq eqqagaq aatsitassarsiorfimmeersoq sulianillu ingerlatanit tamaneersoq assigisaaniillu pisoq piffissami ungasinnerusumi isigisumik salinneqarsimanngippat imaluunniit imeq eqqagaq aarlerinartumik killeqartumik mingoqarpat soorlu akuutissat suliarininit, qinngornerit ulorinaatilinnik akoqarpat imaluunnit inuusutissatigut sunniuteqarsinnaasartut takuneqartareerpoq. Eqqakkat killissatigut piumasaqaatit ataappagit sunniutaassinnaasut piffissami killilimmi pissapput eqqaaneq unitsinneqarpat. Piumasaqaatit qulakkerinnissapput sapinngisamik ingerlatsiffiusup minnerpaamik 1 km-sut isorartutigisumi sunniuteqarfigineqannginnissaa. *) Taamaatoq, kuunnut eqqaneq pippat sunniutigisinnaasai kuuffigineqartunut tamanut sunniuteqassammat. Ilanngullugulu, nunap isorartussusaatigut mingutsitsineq annertooq sunnerneqassaaq. Inigisat pitsaassutsikkut appariaateqarnissaat ilimagineqassaq. Uumassuseqatigiit ataqatigiinnerat pineqarpoq aamma akuutissat sunniuteqassapput quiaatinut, qalerualinnut aalisakkanut, timmissanut aasigisaanullu eqqagaq eqqortumik malinnaavigineqarlunilu aqunneqanngippat. Maluginiarneqassaaq immikkut akuutissat imertigullu nunamut akuutissat akulerussinnaaneri pillugit isiginiarneqarnissai pisariaqarmat.			
Kuuffeqarnikkut imeq eqqagaq (nammineriSamik imeq eqqagassaasoq) immamut kuummullu iginneqartoq	Aatsitassarsiorfiup piunera tamaat	Sumiiffimmi, < 1 km apeqqutaalluni piumasaqaatit	Inigisaqarfiit pitsaassutsikkut appariarnerat
Kuuffeqarnikkut eqqakkat suliffissuaqarfimmit piffissami sivisunerusumi sunniuteqassaaq kisiannili saliinissamut periarfissat misissueqqissaarnerilli sioqqullugit qinnutigineqassapput ajoqusiisinnaanerit pakkersimaarniarlugit. Piffissaq ungasinnerusoq imaluunniit qaninnerusoq inuussutissatigut allatigullu sunniutaasinnaasut pakkersimaarniarlugit pisariaqarpoq eqqagassatigut aaqqissuussineq avatangiisinut sunniuteqarnissaanut killilersimaarnissaat. Killissaliussaq ataallugu eqqaaneq ingerlanneqarpat taava sunniutigisinnaasai sivikitsuinnaassapput eqqaaneq unitsinneqarpat. Eqqaaneq killilersimaarneqarpat annerusumik sumiiffimmi suliffiusumit 1 km iluani avasinerunngitsumik sunniuteqassaaq. Nunap isorartussusaa sunnerneqartussaq) arlariinnik peqquteqarsinnaavoq (immap itissusaa, mallit, qatsissuseq, anorip sakkortussusaa, sarfaq il.il.). Inigisat annikillinerat pitsaassutsillu apparneri ilanngullugu mingutsinerup teqqakkatigut siaruarsimasinnaaneranik aamma peqquteqarsinnaavoq.			

Sumiiffiup silaannaata mingutsinneqarnera

Uuliatortunik nukissiuteqarnerup (erngup nukiga atorlugu ingerlatsisoqanngippat) atorneqarnerani nassatarisarpaa angallatikkut, umiarsuakkut, timmisartukkut aamma allatigut maskinamik ingerlasisukkut orsussamikk atuineq annertooq. Mingutsitsineq silaannarmut aniatitaq annertusinnaavoq, aniatsitsineq avatangiisinut ulorianartoq (BC) aamma orsussap atorneratigut SOx aamma NOX kinguerisinnaavaa erngup aamma issup mingutsinneqarnera aammalu Issittumi silaannaap isugutattup ilusaa sunniuteqarfigisinnaavoq. Aatsitassarsiornerup silaannaap mingutsinneqaranut toqqaannartumik sunniuteqarsinnaavoq.

Nukissiutinit mingutsitsineq annikillisinneqarsinnaavoq aatsitassarsiorneq sioqqullugu nukissiuteqarnikkut naammaginartumik saligaatsumik ingerlatsinissamik qinnuteqannginnermili erseqqissumik siunertamik peqareernikkut aammalu pujup pilersitap saliiviitigut pilersaaruteqareernikkut. Tamanna peqqutigalugu sunniutaasinnaasut uumasunit najorneqarfiit sapinngisamik annikinnerpaamik ajoqusersorneqarsinnaapput. Aninatitsinerit allat silaannarmut soorlu aamma sumiiffimmi eqqakkat eqqarsaatigalugit annikillisinneqarsinnaapput

saliinermik ingerlatsivinnit peqartoqarpat BET aamma BAP atorlugit ingerlatsisoqarusuppat.

Takussutissami 8.5-mi mingutsitsinerit qanoq ittuusinnaaneri silaannarmut sunniuteqarsinnaasut assersuutit nassuiaatigineqarput.

Tabel 8.5. Silaannarmut mingutsitsineq.

Suminngaanniit	Sunniutaata sivisussusaa	Nunap isorartussusaa	Sunniut aamma sunniutip annertussusaa
Orsussaq nukissiutigineqarpat	Sivikitsuinnarmik (silaannaap pitsaassusaa)/sivisuumik (silaannaap allanngornera)	Nunarsuarmi/Killeqarfimmi/Sumiiffimmi	Sumiiffimmi/nunarsuarmi NOX, SOx,
Aatsitassarsiornermit orsussatigut nukissiutit atorneqartillugit silaannaap mingutsinneqarnera pisarpoq NOx, SOx, aniatitsinikkut paaq aqqutigalugu siaruartarmat sumiffimmi silaannaq sunnerneqarsinnaalluni. Silaannap mingutsinneqarnera aamma nunarsuarmi silaannaap allanngoriartorneranut ilaasinnaavoq. Annikillisinneqarsinnaavoq nukissiuteqarnikkut pitsaasumik atugassaqarumalluni putsullu salinneqarnissaanut uuliamik atuineq pinngitsoortinniarlugu nukissiutit mingutsitsinngitsut atorniarlugit siumoortumik qinnuteqaatigineqarpat.			
Eqqakkanik ikuallaaneq	Aatsitassarsiorfiup ammasinnaassusiata sivisussusia	Sumiiffimmi, < 1 km apeqqutaalluni piumasaqaatit	Uumasoqarfiit pitsaavallaarunnaarnerat

Eqqagassat ikuallanneqartarnerat aatsitassarsiorfiup piunera tamarmi pisarpoq. Aniatitsineq piumasaqaatit killissaliussat ataappagit sunniutigisinnaasai piffissami sivikitsuinnarmi pissapput aniatitsineq unitsinneqarpat. Annikillisinneqarsinnaapput aniatitsineq putsutigut saliinikkut aammalu sunniutissat ajornerusut annikilliumallugit qinnuteqarnikkut ilanngunneqarpat sunniutigisinnaasai killissaqarfiusumit 1 km-sut annikinnerusumik isorartutigisumik killeqartinneqassaaq. Silaannaap mingutsinneqarnera eqqagassat ikuallanneranit kinguneqarsinnaavoq gas ulorianartup / akuutissat arrortinneqarsinnaanngitsut aamma NOx aniatisinnaanera.

Sumiiffimmi silaannnaap mingutsinneqarnera - pujoralak

Maskinap atortorissaarutit amerlasuut soorlu qaartiterinermi, ujaqqanik aserorterinermi, assartuinermi, ingerlatsinermi aqquserngit aqqutigalugit il. il tamarmik ujaqqanit pinngortunit pujoralammik pilersitsisarput. Avatangiisiniileraagami akuutissat pujoralattut ittut inigineqarfinnut avatangiisimilu naasunut mingutsitsinikkut annikillisitsissapput avatangiiseq issutigut mingutsinneqassammat. Aatsitassatigut pujoralak pinngortoq aputip qaatigut aputillu qinngornermik utertitsisinnaanera sunnersinnaavaa taamaasilluni aput sukkanerusumik aassinnaassunngorlugu. Avatangiisitigut sunniutit aatsitassarsiorfimmeersut silaannakkut pujoralatsigut mingutsitsisut amerlanerpaartaatigut sumiiffimmut immikkoortumut sunniutaa malunnaatigineqassaaq kisianni pujoralak pujorak nunarsuup silaannaanut kaaviiaarneranut akuulissaaq taamaasillunilu putsup pilerneqarnut ataqatigiissusaanullu sunniuteqalissalluni. Pujoralak aatsitassaneersoq avatangiisinut akuleruttoq peqqissutsimut ajoqutaasinnaavoq.

Nakkutilleeriaaseq assigiinngitsuusinnaavoq aatsitassarsiornermi piiaanermilu aatsitassap piiarneqartup pujoralaa aqunniarlugu, kisianni tamakkerlugu pinngitsoortinneqarsinnaanngilaq. Immikkut pingaaruteqarluinnarpoq pujoralaap annikillisinnissaanut aatsitassarsiorfiup peqqissutsimut ulorianaateqanngitsumik ingerlatsiviginissaa.

Takussutissami 8.6-mi takutinneqarpoq pujoralak aqqutigalugu mingutsitsinerup nassuiarnera.

Tabel 8.6. Silaannakkut mingutsitsineq - pujoralak.

Pinngorfik	Sunniutaata sivisussusaa	Nunap sunnerneqartup isorartussusaa	Sunniutaa
Aatsitassarsiorneq (Assaaneq, qaartitsineq, immikkoortiterineq, suliareqqiineq)	Aatsitassarsiorfiup piunera tamaat	Sumiiffimmi, < 1 km apeqqutaalluni malittarisassat	Uumasut najugaqarfiata pitsaassutsikkut appariaateqarnera /ajornerpaaffiani inigsat qimanneqarnerat
Angallanneq	Aatsitassarsiorfiup piunera tamaat	Sumiiffimmi, < 1 km apeqqutaalluni malittarisassat	Uumasut najugaqarfiata pitsaassutsikkut appariaateqarnera /ajornerpaaffiani inigsat qimanneqarnerat
Ujaqqat eqqakkat qillerinermilu imeq atorsimasaq eqqagassartaa	Aatsitassarsiorfiup piunera tamaat	Sumiiffimmi, < 1 km apeqqutaalluni malittarisassat	Uumasut najugaqarfiata pitsaassutsikkut appariaateqarnera /ajornerpaaffiani inigsat qimanneqarnerat

Maskiinanik atuinermit pujoralak pilersinneqartoq, angallannikkut assartuinikkut aatsitassarsiornermit pisoq avatangiisinut naassunut inigsanullu pitsaassusaannut, ajornerpaaffiani inigisat qimanneqarneranik, kinguneqarsinnaavoq. Aatsitassarsiornermi ujaqqanit eqqagassanillu pujoralatsigut mingutsitsineq piginnaavoq. Piffissaq sivikitsuinnarmi sunniutaassinnaasut kisimik naatsorsuutaassinnaapput mingutsitsineq unitsinneqarpat imaluunniit killilersorluarneqarpat. Taamaakkaluartoq, piffissaq ungasinnerusoq eqqarsaatigalugu sunniutaasinnaasoq pujoralannit pisut killissatigut ulorianartumik pisoqaqqunagu pingaaruteqarpoq akuutissat suliareqqinnerini, akuutissat ulorianartut aammalu pujoralaat pillugit erseqqissumik sunniutai ilisimasariaqarneri. Pujoralannginnissaq anguniarlugu uuttuutit pigisariaqarput pujoralatsinerinerup killilersimaarnissaa aqutsinikkut anguniarlugu aammalu qulakkeerniarlugu sunniutit killilernissaat sunniutillu aatsitassarsiorfimmit minnerpaamik 1 km-sut isorartutigisumit ajornerulersinniarnagit.

8.5 Ajutoornerit

Qillerinermit imeq atorneqarsimasoq eqqarneqartillugu aarlerinartuaannarpoq isugutattut aammalu imeq mingutsinneqartillugu avatangiisinut ajoqusiisarmat. Ajutoornerit annerpaat pisarput aatsitassarsiornermi ajutoortoqartillugu soorlu qillerinermi imeq atorneqarsimasup katersivia ajutoorpat qanganitsernikkut imaluunniit sannarlutaanikkut naammaginartumillu nakkutiginninnginnerup peqqutigisaanik pisinnaasarluni. Ajutoornerit pinngitsoortinneqarsinnaapput mianersortumik BEP aamma BAT qinnutigalugu pilersaartoqarneratigut aamma nunat tamalaat akornanni pisortanit nakkutilliineq aaqqissuussinerlu ingerlanneqarpat.

Ajutoornerit allat toqqorsiveqarnermut attuumassuteqartut tassaapput uulia. Nunamiitinneqartut kisianni nunamut issumut kuunnullu naggataatigut immamut annertuumik sunniuteqarsinnaapput.

Pingaartumik, uuliakoortoqartillugu annertuumik soorlu tankerinit umiarsuarnit aatsitassarsiorfimmut pilersuisumut immami sineriammilu annertuumik piffissaq sivisoorsuarmit sineriammut uumasoqatigiinnullu tamarmut sunniuteqartumik kinguneqarsinnaavoq.

Uuliakoornerit nunami aammalu issumut mingutsitsineq Issittumi issoq annertuumik arriitsumik pitsaassutsikkut aserorsinnaavaa ukiunilu qulikkaani amerlasuuni pisoqareerneranit sunniuteqartumik mingutsitsisinnaalluni. Taammattoq, uuliakoornerit nunami amerlanertigut sumiiffimmi sunniutaasarput.

Tabel 8.7-mi ajutoornerit annerit assersuutitut takutinneqarput.

Tabel 8.7. Ajutoornerit.

Suussuseq	Sunniutaa	Nunap isorartussusaa	Uumassuseqartukkut sunniutaa
Kuunnut immamullu uuliakoornerit	Piffissaq sivisuujusinnaavoq	Sumiiffimmiusinnaavoq	Uumassuseqatigiinnikkuusinnaavoq
Uuliakoornerit orsussamik toqqorsivinniit imaluunnit umiarsuarnit tankeriniit. Piffissaq sivisooq atuutissaaq piffissaatillugu iliuuseqarfigineqanngippat. Sunniutaa ilimanarpoq sumiiffimmi pissasoq kisianni sumiiffimmiit killeqarfimmut siuaruarsinnaavoq kingunerisinnaallugulu inigineqartut annikillinerat pitsaassutsillu apparnera naggataatigut uuliakoorneq annertuppat immamullu sunniuteqarpat.			
Nunami uuliakoorneq	Piffissami sivisuumiusinnaavoq	Sumiiffimmi	Ataassiakkaarluni
Uuliakoornerit orsussanik toqqorsivinniit. Piffissaq sivisuumik sunniuteqarsinnaavoq iliuuseqarfigineqanngippat. Sunniutai amerlanertigut tassaasarput sumiiffimmi sunniutit kisiannili annertunerusinnnaanoq imaq qanittumiittoq ilanngunneqarpat.			
Qillerinermit imeq atorneqartut ingitaq ajutoorutigineqarpat	Piffissami sivisuumiusinnaavoq	Sumiiffimmi/Killeqarfimmi	Uumasut najugaqarfiata pitsaassutsimikkut appariaateqarnerat/-ajornerpaaffiani qimanneqarnerat
Qillerinermit imeq atorneqarnikoq iginneqarsimasup ajutoorutigineqarnerani killeqarfimmi imartatigut annertuumik sunniuteqarsinnaanera. Annertooq kuutsinneqarpat eqqakkat ulorianartut aatsitassarsiorfiullu eqqagai siaruarpata uumasut najugaqarfiata pitsaassusaat apparujussuassaaq aammalu uumassuseqatigiit avatangiisiniittut innarlerujussuarneqassapput.			

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9 Siunissami periarfissat paasissutissanillu amingaateqarnerit

Allaaserinnitto Katrine Raundrup[1], Janne Fritt-Rasmussen[2] and Anders Mosbech[2]

Greenland Institute of Natural Resources[1], Department of Ecoscience, Aarhus University[2]

9.1 Siunissamut takorluukkat

Silaannaq allanngoriartorpoq, aamma IPCC silaannaap pissusaanut tunngasutigut nalunaaruteqartut (IPCC 2014) nunarsuarmi silaannaap kissassusaa ukiut utritilikkaat makkua qaangitsinnagit 2 °C-nik kissarnerulissasoq siulittuutigaat. Pingaartumik Issittoq allanut sanilliullugu sukkanerpaamik sunnerneqassasoq oqaatigineqarpoq (Cohen et al. 2014). Killeqarfik eqqarsaatigalugu DMI silap allanngoriartornera Kalaallit Nunaanni qanoq isikkoqarsinnaanersoq pillugu suliaqarsimavoq. Kujataani sumiiffimmi killeqarfimmi nalunaarusiorfigineqartumi silap allanngoriartornera Kujataanut atuuttoq sananeqarpoq (Christensen et al. 2015). Killeqarfimmut silap allanngoriartorneranit peqquteqartut allannguutaasussat ilanngunneqartut silap kissassutaata 3-4 °C -nik kissarnerulernissaa ukiumullu nittaalaqartarnera 100-200 mm ukiut uku untritilikkaat qaangiutsinnagit pisalissasoq. Ilanngullugu, ullut anorersuaqarfiit aammalu silap sakkortuumik allanngorujussuarnissaa oqaatigaat. Tamassuma ilagaa siallerujussuartarnissaa (ullut ilaatigut 25 mm angullugu siallertarnissaa), ulluni allaat 5-7-kkaartuni siallertassasoq. Maannakkut nalunaarusiorfigineqartoq silap allannguutaatigut taama ittutigut ullut 10-25-it angusalereerpai. Piffissaq sivisunerpaaq panerneqarfia (sialuk 1 mm-mit annikinneq pineqarpoq) suli ilisimagineqassaaq ulluni 4-6-niit maannamut ullut 10-15-nit.

Silap allanngorneranit ilimagineqartussat ukiuni untritilikkaani maannamut atuuttuni nunamik naatitsiniarneq annertuumik sunnissagaa. Naatitsiviit aallartiffii (ullut kissassusaasa gradenik 5-nik kiannerulerfia) annertuseriassaaq ilimagineqartutut ullunik 30-nik. Naatitsivik piffissaq ilimagineqalerpoq aprillip maajillu aallartinneranit sanilliullugu ullumimut maajimiit/ juunimiit pisartoq. Naatitsisinnaanerup piffissaq sivisussusaa ilimagineqarput ullut 60-it angusalissagaat.

Sila kissarnerulerpat kingunerissavaa sermit aakkiartorneri taamaasillunilu aatsitassarsiorfiusinnaassut misissueqqaarfiusinnaassullu tikikkuminarnerulernissaat kisianni aamma nunalerinermut periarfissagissaarnerulerneq (Lehmann et al. 2016). Silap kissatsikkiartornera, siallernerulernera il.il. naasut, uumasut aammalu inuit najugaqarfii tamarmik nalunaarusiorfigineqartumiittut tamarmik sunniutigissavai. Allannguutit ilimanarpoq uumasoqatigiinnut ilaannut iluaqutaassasut allanulli ajoqutaassasut. Qanorluunniit, inuit inoqarfii, nunap naanera uumasullu tamarmik silap kissatsikkiartorneranut tamarmik tulluarsartariaqarmata.

Issittoq sukkasuumik allanngoriartorpoq, maannalu uumasoqatigiit tamarmik unamminartorsiorput. Sumiiffiit ullumikkut uumassuseqarnikkut pingaaruteqartut pingaaruteqarnerat allannguuteqarsinnaavoq aammalu

sumiiffiit nutaat malunnaatilimmik allannguuteqassapput ilai amerlasoorsuanngorsinnaallutik uumasoqassutsikkut. Inuit atuinerat allanngussaaq aammalu uumassuseqartut assigiinngisitaarnerat uumassuseqatigiinnut sunniuteqassaaq aamma nunalerinermi avatangiisit aqunneqarnerat aatsitassarsiornermit misissueqqaarnermillu assigiinngitsutigut piumasaqaatitigut eqqakkallu passunnerisigut tulluarsaanerit assigiinngitsut ukiut untritilikkaanut siunissamut sunniuteqartussat aqqusaarneqassapput. Mianersortumik pilersaaruteqarnikkut, nakkutilliinikkut assigiinngitsutigut aammalu aqutsinnikkut tulluarsarnikkut inassutigineqarpoq siumut takorloorneqarsinnaanngitsut ingerlatsiniarnermi sunniutit pinngitsoortinneqassasut.

9.2 Paasissutissat amingarnerat

Silap allanngoriartornerata sukkassusaa peqqutaalluni pisariaqartinneqarpoq nakkutilliinerit uumassuusillit assigiinngisitaarnerinut aammalu uumassuseqatigiinnut tunngasut tulluarsaavigineqartumik pilersaaruteqarfigineqarnissaat aammalu inuit aallutaannik malittarisassiortariaqarneq. Iluarnerpaassagaluarpoq, aatsitassarsiornikkut ingerlatsinerit nakkutigineqarneri killeqarfimmi nakkutilliinermi ingerlanut ilanngunneqassasut soorlu silap allanngoriartorneri, uumasoqatigiit assigiinngisitaarneri, uumassuseqartut ataqatigiinneri aammalu inuit aallutai tulluarsaanikkut aqunneqartariaqarnissaat.

Taamatut nakkutiginnilluni uumassuseqaqatigiit nakkutigineqarneri aaqqissuussami qulakkeerinnissagaluarput aqutsinerup malittarisassallu aatsitassat pillugit, sumiiffimmi killeqarfimmi paasissutissaalatsiffiusumi uumassusillit avatangiisimiittut nassuiaatigineqartutuut uani nalunaarummi suussusersineqarlutillu pitsanngorsaataasumik immikkut saqqumilaartinneqassagaluartut.

Sulluitsut, pupii imaluunniit orsuatsiaat pillugit paasissutissaalatsineq saqqummiussinermi ilisimatusaatigineqarsimanerata naammaginartumik piunnginnerat peqqutaalluni sumiiffimmi peqassuseq tamakkerlugu nalunaarusiarineqarsinnaasimanngilaq.

Sumiiffiit aamma ilai paasissutissartaqanngillat. Kapitali 7-mi misissuinerit qaleriinneri nassuiaatigineqarnerini ersersinneqarpoq paasissutissat sumiiffiit ilaanni soqannginneri imaluunniit paasissutissat qaleriiffeqanngitsut. Sumiiffiit annikitsuinnarmik naleqarfeqartut aammalu annikitsuinnarmik atorneqarniartut saqqummiunneqartut "ilisimatusarfigineqarneri - amigartutut" nalilerneqarsinnaapput.

Inernerit ilai uani nalunaarusiami ilanngunneqartut paasissutissanit qangarnisanit tigusaapput. Naasunut tunngasutigut suussutsinullu tunngasut pineqarput (Tabel 4.2, Takussutissiaq 4.11), aamma timmiaqarfiit arlallit ukiuni kingullerni misissuivigineqarsimanngillat.

Avatangiisinit misissugassat katersat Kujataaneersut killilimmik pigineqarput aammalu maannamut aatsitassarsiorfiit pioreersunut attuumassuteqarput soorlu Nalunaq, Killavaat Alanngua aamma Kuannersuit. Qallunaatsiaqarfiup Gardar eqqaanit 2020-mi nunami suliaqarnermi avatangiisit pillugit tunuliaqutit annertussusaanit katersat katersorneqarsimapput.

Paasissutissat misissugassallu katersat pitsaassutsikkut annikipput aammalu ujaqqat akuinut arlaatigut sanillersuullugit suliaaniaraluartut. Sumiiffimmi ujarassiornikkut annertuumik assigiinngisitaarfiusoq pingaartuuvoq aammalu avatangiisit pillugit misissugassanik katersiniarneq tulluarnerusoq periarfissaasariaqaraluarpoq.

Akuutitsineq aamma nunaqavissunik akuutitsineq RBA suliarinerani iliuusaapput. Taamaakkaluartoq, Covid-19 peqqutaalluni killilersuuteqarnikkut ajoraluartumik paasissutissat katersornerini nunaqavissut uumassusilinnik atuinerat pillugu aammalu nunamik atuinerat pillugu paasissutissat ilanngunneqanngillat.

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Appendix 1 Kalaallit Nunaata kujataani ujarassiornikkut inissisimaffik pillugu nalunaarusiaq

By Kristine Thrane and Simun Dalsenni Olsen[1]
[1]*Geological survey of Denmark and Greenland*

This appendix gives a short overview of the geological setting of South Greenland and descriptions of localities of economic and environmental relevance. GIS maps have been produced to show the distribution of selected elements of interest. The locations described and the distribution of geochemical data are restricted to the areas defined as South Greenland by GEUS. This report is based on a review of the geological, mineral occurrences and geochemical exploration data of South Greenland by Steenfelt et al. (2016) – this report can be accessed for further details and references.

Overview of geological setting of South Greenland

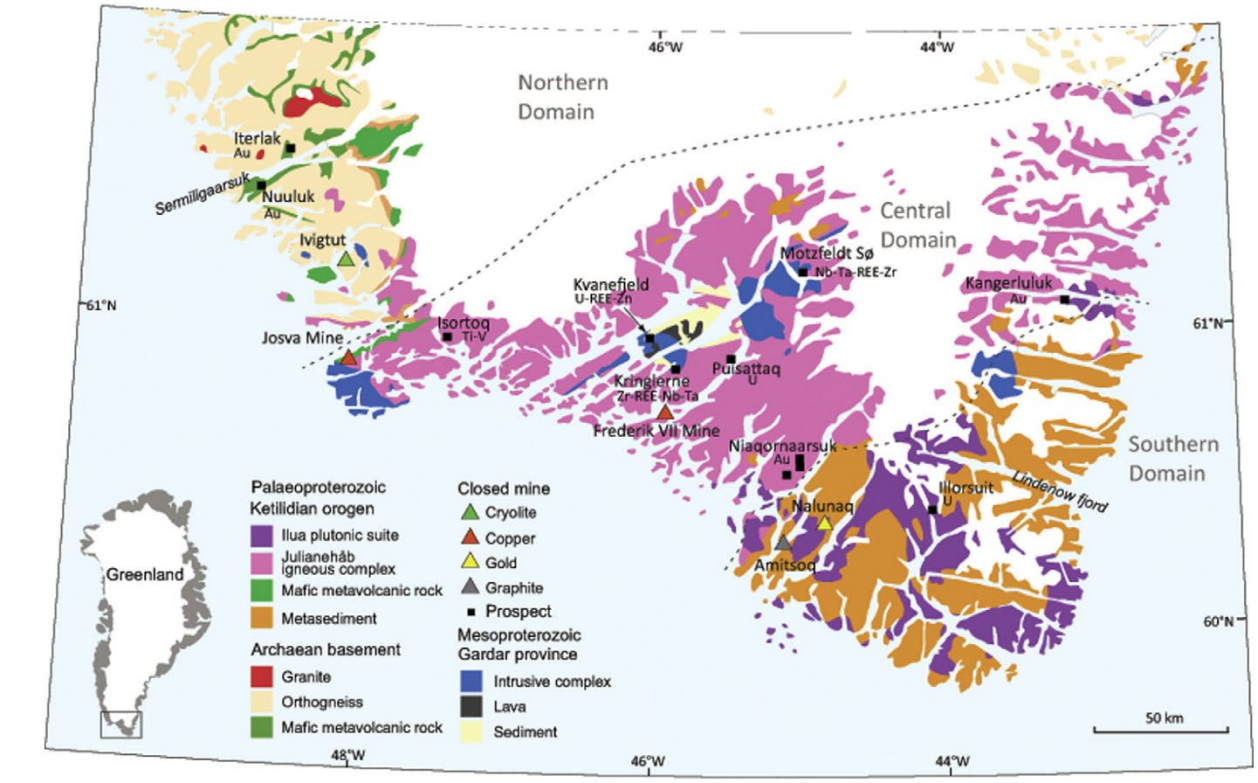
South Greenland comprises three main tectono-stratigraphic components: (1) Archaean basement, (2) Palaeoproterozoic Ketilidian orogen and (3) Mesoproterozoic Gardar alkaline igneous province (Fig. 1). Phanerozoic rocks are volumetrically insignificant and comprise Mesozoic dolerite as well as kimberlite sills and dykes. Quaternary glaciers covered the region with the possible exception of the highest peaks. The ice cap, the Inland Ice, remains over most of South Greenland with glaciers extending towards the coast through valleys and fjords.

South Greenland has been divided into four domains. The Northern Domain, Central and Southern Domains, covering Archaean and Palaeoproterozoic rocks, occupy geographically confined areas, while the Gardar Domain comprises Mesoproterozoic rocks distributed over most of South Greenland superposed on or intruding into the older rocks (Steenfelt et al., 2016).

The Northern Domain is composed of Meso- to Neoarchaean orthogneiss with enclaves of supracrustal units (Kalsbeek et al., 1990; Garde et al. 2002). The domain also includes Palaeoproterozoic supracrustal cover rocks, and it has been intruded by Palaeoproterozoic granites and of Mesoproterozoic Gardar alkaline complexes, as well as dyke swarms in Palaeoproterozoic, Mesoproterozoic and Mesozoic times. Two gold prospects (Nuuluk and Iterlak) are hosted by Mesoarchaean greenstones.

The Central Domain encompasses Palaeoproterozoic plutonic rocks of the c. 1850 to c. 1780 Ma Julianehåb igneous complex, comprising a variety of granitoids mainly granodiorites (Kalsbeek et al., 1990; Garde et al. 2002). Two age groups are discerned, an early igneous complex strongly deformed and a late igneous complex that is little deformed. The Central Domain has also been the site of most of the tectonism and magmatism related to the Gardar province. The most important mineral occurrences are located at the edges of the domain and include a small, closed copper mine (Josva Mine) and a number of shear zone hosted gold occurrences at Niaqornaarsuk. A

small copper mineralisation was exploited at Frederik VII mine. Many small vein-type uraninite occurrences, with Puisattaq as the best known, are hosted in fracture zones in the late Julianehåb igneous complex.



Takussutissiaq A1.1. Major tectonic units of South Greenland with main mineral occurrences and domains. After Steenfelt et al., 2016.

The Southern Domain comprises large volumes of supracrustal rocks and the c. 1755-1723 Ma Ilua plutonic suite of granitoids to noritic rocks (Allaart, 1976; Chadwick et al., 2000; Garde et al. 2002). Metasedimentary rocks predominate, but the supracrustal sequences also include mafic metavolcanic lavas and volcanoclastic rocks. The lower parts of the supracrustal sequences have a high proportion of metapelites that are strongly deformed; they are metamorphosed at high grade and partially melted. The upper parts of the supracrustal sequence, mainly metaarkose, have a low metamorphic grade overprint and they are less deformed. The peak of metamorphism and anatectic melting of the entire metasedimentary succession occurred around 1790 to 1770 Ma. The Southern Domain hosts two closed mines, the Nalunaq gold mine and the Amitsoq graphite mine, several prospects for gold, graphite and uranium, fx the stratabound uraninite occurrence at Illorsuit. Stream sediment data show the entire Southern Domain is enriched in As, and that Sb and Cs are enriched in certain areas associated with occurrences of metaarkose at low metamorphic grade. Enrichment of Cu and Zn also occur in the Southern Domain.

The Gardar Domain (also known as the Gardar province) encompasses Mesoproterozoic sedimentary and magmatic rocks emplaced during several episodes of continental rifting in the time interval 1300-1140 Ma (Emeleus and Upton, 1976; Upton et al., 2003). Sediments and lavas are preserved in the Eriksfjord Formation, along with large volumes of alkaline magma in the

form of dyke swarms and central intrusive complexes. The Gardar intrusive complexes are formed of very unusual rock compositions and host mineral deposits with a range of rare elements such as Be, Li, F, P, Y, Ga, Zr, Nb, REE, Hf, Ta, Th, U. The most famous was the cryolite mine at Ivittuut. Currently, Kvanefjeld, Kringlerne and Motzfeldt Sø are the main prospects for Zr, Nb, Ta, REE, U and Zn, and a dolerite at Isortoq hosts a Fe-Ti-V prospect.

Geological locations of economic and environmental significance in South Greenland

Northern Domain

1. Gold prospects in Tartoq Group: Nuuluk and Iterlak

The Mesoarchaean Tartoq Group (Szilas et al., 2013) occurs as six isolated remnants of a multiply deformed supracrustal belt tectonically squeezed in with orthogneiss in an over 40 km long and up to 5 km wide zone on both sides of Sermiligaarsuk. The Tartoq group is clearly outlined as anomalous in Au and As by stream sediment fine fraction and samples with elevated Sb occur locally (Steenfelt, 2000). Gold mineralisation was recognised in the Tartoq supracrustal rocks during the 1970s and several exploration campaigns (Renzy Mines Ltd. 1991, Greenex A/S, Nunaoil A/S, Nordic Mining ASA, and presently Nanoq Resources Ltd.) has since been conducted including dense sampling, electro-magnetic surveying and drilling on the best targets. As a result, high gold grades (up to 50 ppm Au) have been recorded in well-defined mineralised zones. At Nuuluk, gold is hosted in two distinct NNE-SSW trending, 50-100 m wide and 5 km long thrust zones. The western carbonate zone comprises a distal hydrothermal alteration assemblage with carbonate (calcite, dolomite or ankerite depending on host rock composition), chlorite, pyrite and tourmaline in veins. The proximal alteration zone comprises ankerite, muscovite (fuchsite), chlorite, quartz, pyrite, arsenopyrite, pyrrhotite, chalcopyrite, tennantite and gold. The highest gold concentrations (up to 41 ppm Au) are in samples from the eastern carbonate zone. A halo of elevated As and Cu occurs in the gold zone, which suggests that the auriferous fluids were also enriched in these elements (Kolb, 2011). The gold is hosted in either graphite and magnetite schists, or more competent greenschists in the form of quartz veins.

At Iterlak, gold is hosted in two NNE-SSW trending, approximately 100 m wide and 200-400 m long zones, namely the Western Valley zone and the Eastern Valley zone. Higher gold values are also recorded from carbonate-sericite alteration zones in the belt. The Western Valley zone comprises hydrothermally altered greenschist and banded iron formation. Gold mineralisation occurs in the proximal alteration zones and altered banded iron formation, mainly in quartz-rich samples, i.e. quartz-ankerite veins (Evans and King, 1993). In the carbonate-sericite alteration zone up to 25% volume increase is associated with higher K, Ba, Cs, Rb and loss on ignition (LOI), and lower Mg, Ca and Na; locally, Fe, Al and Ti are slightly enriched. Gold enrichment is associated with high base metal contents and LOI, indicating hydrothermal alteration, but is also located in Fe-rich samples. The recorded gold concentrations are up to 12 ppm in the Iterlak occurrence (Kolb et al., 2013).

The Eastern Valley zone is characterised by hydrothermally altered greenstone, talc schist and banded iron formation. The proximal alteration zone is confined to talc schist, forming a talc-ankerite-sericite-chlorite-pyrite assemblage. The banded iron formation shows a pyrite and minor chalcopyrite alteration. The hydrothermal alteration was not complete leaving magnetite as a primary or a metamorphic mineral in the banded iron formation and talc schist behind. Gold enrichment is most pronounced in magnetite rich talc schist, where magnetite is replaced by up to 7 mm, euhedral pyrite. The proximal hydrothermal alteration caused a slight mass increase together with Ca, Cu, LOI and minor K enrichment and depletion in Mg (Steenfelt et al., 2016).

Central Domain

1. Gold prospect on Niaqornaarsuk peninsula – Vagar prospect

Gold mineralisation on the Niaqornnarsuk peninsula was identified *in-situ* during follow-up of stream sediment Au anomalies (Olsen and Pedersen, 1991). Continued work by NunaOil A/S-NunaMinerals A/S and GEUS included surface mapping, stream sediment and rock sampling, drilling and assaying. Regional chip and grab samples in the structural lineament zones gave a wide range of gold values (up to 1000 ppb Au) and 14 samples in excess of 100 ppb (Chadwick et al., 1994). Gold at Niaqornaarsuk peninsula occurs preferably in quartz veins, which are 0.5-5m wide. The hydrothermal alteration assemblage consists of quartz, K-feldspar, muscovite, chlorite, biotite, epidote, calcite, monazite, pyrite, pyrrhotite, bismuth tellurides, sulphosalt minerals, fluorite and gold. Elements enriched during the hydrothermal alteration are Bi, Au, Ag, Ga, W, As, Te and Ba, whereas base metals are only slightly enriched (Schlatter et al., 2013).

2. Ilordleq Group and the Josva Mine

The Ilordleq Group is situated in the Kobberminebugt shear zone (McCaffrey et al., 2004). It consists of metavolcanic and metasedimentary rocks forming up to some hundred meters wide bands (Kalsbeek et al., 1990). The Group hosts Au-Cu-Ag mineralisation, and up to 5 vol.% sulphides.

The Josva mine at the south coast of Kobberminebugt was mined by Grønlands Minedrift Aktieselskab in two periods between 1853-1855 and 1905-1914. It is estimated that 90 tons of copper plus small amounts of gold (0.5 kg) and silver (50 kg) was extracted from 2200 tons of ore that were smelted at the site. The ore contained 4.1 % Cu with 0.8 ppm Au and 11 ppm Ag (Ball, 1923). The size of the remaining ore body at Josva Mine is estimated to be 2000-3000 tons of ore containing 30-40 tons of copper (Nielsen, 1976).

3. Nunatak - Nordre Sermilik uranium occurrences

North and northwest of Narsarsuaq, the basement complex contains several uranium-mineralised enclaves of fine-grained and porphyritic quartz-feldspar rich metamorphic rocks interpreted to be of volcanic origin (Allaart, 1976). Both aeroradiometric and stream sediment data showed that the area around Nordre Sermilik is generally enriched in uranium (Armour-Brown et al., 1983; Schjøth et al., 2000). During ground follow-up of one of the

radiometric anomalies, uranium mineralisations were discovered at Nunatak north of the head of Nordre Sermilik (Nyegaard and Armour-Brown, 1986).

Many rafts have 10-40 times higher background radioactivity than the surrounding granite owing to uranium and thorium mineralisation. The richest occurrence is within a 0.5 to 1 m thick gneissic raft. Uraninite and secondary U-minerals are concentrated in two small zones with concentrations of up to 1.3% U and 1131 ppm Th. In addition, vein-hosted pitchblende mineralisations were located in late fractures in the granodiorite. Two samples of vein material with uranium pitchblende returned 1.1 and 1.6 % U, respectively.

4. Uranium mineralisations in fracture zones: Puisattaq prospect and Vatnahverfi showings

The Central Domain is strongly fractured and clearly outlined by an abundance of stream sediment and stream water uranium anomalies and over 200 occurrences with more than 100 ppm U or Th were discovered (Armour-Brown et al., 1983). Uranium occurrences are commonly small lenses, but they occur along fractures traceable for distances of up to 10 km. Comprehensive descriptions are found in Nyegaard and Armour-Brown (1986). The radioactive occurrences comprise four types: (i) Pitchblende associated with faults, fractures and related joints. (ii) Brannerite, also associated with fractures and disseminated in altered granite along them. (iii) Thorium dominated fenitised veins. (iv) Allanite in pegmatites. Pitchblende or brannerite may be accompanied by secondary uranium minerals, galena, pyrite, chalcopyrite, while gangue minerals commonly comprise calcite, quartz and fluorite.

The densest population of known pitchblende veins occurs at Puisattaq (Armour-Brown et al., 1984). Four pitchblende veins lie in the northern part of a 150 - 200 m wide, EW-trending fault zone within 1 km of each other between 100 to 200 m above sea level. The veins are not exposed, and were found by tracing radioactive boulders back to their source. The veins are up to 11 m long and 5 cm wide. Vein samples contain from 0.75% to 6.3% U and very little Th. One vein is found in a 5 m wide red felsic dyke and is more like a joint filling a few metres long, but also with many radioactive spots located for 50 m along its strike in fractures in the dyke. Cracks in the pitchblende frequently contain small grains of galena which is probably radiogenic in origin. It is associated with specular hematite and minor pyrite and chalcopyrite. The pyrite is cataclastic and partly altered to limonite and may be replaced by hematite.

The frequency of faults and fractures in the Central Domain appears to increase towards the Vatnahverfi area to the south of Puisattaq. Veinlets or irregular bodies with pitchblende or more commonly brannerite have been observed in many of the faults together with fluorite, calcite and hematite (Armour-Brown et al., 1984). Individual occurrences are rarely more than one metre in length, but they are aligned along the faults. Samples from the richest locality returned up to 3.6 wt.% U. Armour-Brown et al. (1984) provides results of analyses of rocks and minerals. The landscape at Vatnahverfi is low-lying, has much vegetation and lakes, i.e. poor rock exposure, so that more and perhaps richer uranium occurrences are expected to exist in this area.

Southern Domain

1. Illorsuit uranium prospect

The Illorsuit prospect is the largest and richest of the occurrences recorded by the airborne radiometric survey (Armour-Brown, 1986; Steenfelt and Armour-Brown, 1988). More than 35 uranium mineral occurrences have been found scattered in the supracrustal rocks. Disseminated fine-grained uraninite is concentrated along layering in the metavolcanic rocks, or more commonly in small strata-bound fractures related to specific members of meta-arkose and metaandesite. The highest grade uranium mineralisation is about 50 m long and up to 5 m wide with grades up to 7 % U. It is estimated that the Illorsuit prospect contains 17,000 tons of uranium ore with a grade of 0.31 % U corresponding to 50 tons of uranium metal (Armour-Brown, 1986).

2. Graphite occurrences

The graphite occurrences in the Southern Domain comprise the closed mine site at Amitsoq and the prospect Sissarissoq (Kalsbeek et al. 1990; Bondam, 1992a and references therein). At Amitsoq, three parallel graphite-bearing horizons have been identified in the gneiss, the main horizon reaches 13.2 m width and approximately 600 m along strike, pinching to 3.5 m width in the northeast. The two minor horizons are 4 m wide and have a strike extent of approx. 100 m (Bondam, 1992b). The ore consists of finely disseminated crystalline graphite flakes in a quartz-rich groundmass, accompanied by minor pyrite and biotite. The graphite flakes are up to 15 mm in size and the graphite content varies between 20-24 vol.% (Ball, 1923; Bondam, 1992b). Only one geochemical analysis of an average ore grade was published as 21.0 wt.% C, 6.0 wt.% S and 0.2 wt. % H_2O (Høeg, 1915). Production in the Amitsoq mine was initiated 1914, when about 130 tons of graphite ore were excavated, followed by 2000 tons in 1915. After a break during World War I, mining was resumed, but only 571 tons of graphite concentrate were produced during 1918-1921 and exploitation ended in 1922 (Ball, 1923). The ore reserves were calculated at 250,000 t, but only 6,000 t graphite ore was produced.

At Sissarissoq, south of Amitsoq, a number of shallow north-dipping lens-shaped bodies of graphite occur in pelitic to semipelitic paragneisses. The occurrence was trenched and sampled, indicating 4,000 tons of graphite ore. A single analysed sample contains 24 % graphite and c. 7 % sulphur (Bondam, 1992b).

3. Gold deposits: Nalunaq, Lake 410 and Ippatit

These gold occurrences are located in quartz vein systems related to shear zones, and they have high contents of arsenopyrite, the Au-As association of Stendal and Frei (2000). High anomalies for Sb and Cs in stream sediment characterise all three areas.

The closed Nalunaq mine is situated in a main valley in the Nanortalik peninsula, where an epigenetic gold mineralisation associated with a narrow quartz vein system in amphibolite was exploited. The main vein is generally 0.8-2m in width and has a lateral extent of 1300 m vertically and 800 m horizontally. A comprehensive geochemical database of analyses of almost 16,000 samples and geochemical whole rock analyses of >4700 rock samples

from the mine or from areas near Nalunaq shows that the hydrothermal alteration zone is enriched in Si, K, Au, Sb, Ag, Sb, Bi and W (Schlatter and Olsen, 2011)

The Nalunaq mine was opened 2004 and closed 2014. The mine was initially owned by Nalunaq Gold Mine A/S, a subsidiary of Crew Gold Corporation, together with NunaMinerals A/S, and in the first years of operation, the ore was shipped abroad for processing. In 2009 Angel Mining (Gold) A/S took over the mine along with facilities and infrastructure. An underground processing plant was constructed and the first doré was produced on site in May 2011 (Sørensen, 2013). Approximately 714,000 t of ore at an average grade of approx. 15 g/t Au were produced from a 1700 m long and 0.1-2.0 m wide auriferous quartz vein, yielding 10.7 t gold metal.

At Lake 410, south of Nalunaq, two parallel, ≤ 2 m wide, locally laminated, gold-bearing quartz veins are hosted in amphibolite with hydrothermal graphite-arsenopyrite-chalcopyrite-pyrite alteration (Olsen and Petersen, 1995; Porrit, 2004). Auriferous amphibolite also shows quartz-carbonate-mica alteration and an early calc-silicate alteration. The quartz veins contain as much as 2.22 ppm Au over 2 m in drill core intersections (Porrit, 2004), and altered amphibolite contains up to 4.8 ppm Au over 2 m in chip samples (Olsen and Petersen, 1995).

At Ippatit, north of Nalunaq, a gold mineralisation with up to 832 ppb Au, is hosted in up to 2 m wide quartz veins in biotite schist associated with graphite-quartz-biotite-sulphide alteration (Olsen and Petersen, 1995). Similar quartz veins occur in amphibolite and meta-volcanoclastic rocks, which are separated from the biotite schist by a S-dipping shear zone displaying quartz-graphite-pyrrhotite alteration. Samples of silicified schist with disseminated arsenopyrite have As in the order of 2000 ppm, confirming the Au-As association.

4. S-type granites

The high temperature-low pressure conditions imposed upon the sedimentary succession resulted in metamorphism and partial melting. As a result, granitic melts are present as ubiquitous veins and pegmatites in the sedimentary packages, but they also accumulated into large coherent bodies (Chadwick et al., 2000). The largest is a regionally sub-horizontal granite sheet, more than 1000 m thick and covering over 2000 km^2 in the southernmost islands. The granitic melts were able to concentrate incompatible elements during magma differentiation and bring them upwards through the crust. Elevated to high U values in stream sediment is spatially associated with S-type granite, and pitchblende mineralisation was found in migmatitic neosome within metaarkose north of Nalunaq (Armour-Brown et al., 1983). Recorded uranium concentrations in the neosome are between 1000 and 8000 ppm. So far only U has been of interest although the granitic melts have the potential to form complex pegmatites enriched in Li, Sn, W as well as tourmaline and beryl (Steenfelt et al., 2007). High Th concentrations in stream sediment are spatially associated with the S-type granites.

Gardar Domain

1. Kvanefjeld (Kuannersuit) depostit

The Ilímaussaq intrusive complex is world famous for its unique rock types and wealth of rare minerals (Sørensen, 1967; Petersen, 2001). The intermediate sequence of the intrusion is represented by the most evolved rocks, lujavrites, and host the Kvanefjeld deposit, and the related Zone Sørensen and Zone 3. The lujavrite is a fine grained, commonly laminated, syenite. Highly evolved phases have the highest concentrations of the presently targeted ore elements U, REE, Zn and F. The mineralogy and petrology of the lujavrites are discussed in Rose-Hansen and Sørensen (2002), Sørensen et al. (2006).

The first investigations at Kvanefjeld were undertaken by collaboration between GGU, the University of Copenhagen and Risø National Laboratory and comprised geological and radiometric mapping, drilling, drill hole logging, drill core analyses, driving of adits, ore processing tests, feasibility studies, and environmental impact studies. The principal uranium ore mineral was found to be steenstrupine, but other U bearing minerals and substances are known, and the Th/U ratio of the ore is 2.5. Summaries of the investigations are given by Sørensen (2001).

Commercial exploration at Kvanefjeld was initiated in 1986 (drilling by Rimbal Pty Ltd.), and Greenland Minerals and Energy Ltd. (GMEL) took over in 2007 and conducted intensive drilling, chemical, mineralogical and metallurgical investigations with the objective of evaluating the lujavrite as a rare earth element resource. Steenstrupine was found to be the dominant host of rare earth elements (besides uranium), and it was realised that the lujavrite's content of sphalerite opened the possibility for extraction of Zn, thereby adding to the value of the ore. The total identified conventional mineral resource inventory for Kvanefjeld is 102,820 tonnes U. The company list ore grades as: U_3O_8 273 ppm, LREO 9524 ppm, HREO 392 ppm, Y_2O_3 882 ppm, Zn 2351 ppm.

2. Kringlerne Zr-Nb-Ta- REE deposite

The Ilímaussaq intrusive complex is world famous for its unique rock types and wealth of rare minerals (Sørensen, 1967; Petersen, 2001). The floor series of the intrusion, the kakortokites, crops out in the southern part of the Ilímaussaq complex, known as Kringlerne in a spectacular rhythmically layered series of black-red-white units (Bohse et al., 1971). The layered cumulates are formed by relative enrichment of the minerals arfvedsonite (black), eudialyte (red) and feldspar-nepheline (white). The kakortokite also contains aegirine, aenigmatite, sodalite, fluorite, analcime, rinkite and minor sulphides (sphalerite, galena, löllingite). Eudialyte (Na-Ca-(Fe, Mn)-Zr-silicate) is the main host of niobium, tantalum and rare earth elements, and the niobium and rare earth element bearing rinkite is a supplementary host. A particularly eudialyte-rich layer has been evaluated as raw material for production of zirconia (Bohse et al., 1971), whereas later exploration concerned niobium-tantalum and rare earth elements. The present licensee, Rimbal Pty Ltd, plans to treat the kakortokite as a bulk ore, from which a eudialyte concentrate can be made by magnetic mineral separation (www.tanbreez.com). Estimates are given as follows for the size and grades of this large (over 4 billion tons) low-grade deposit (1.8 % ZrO_2, 0.2 % Nb_2O_5, 0.5 % LREE, 0.15 % HREE).

3. The Igaliko complex - Motzfelt Sø prospect

The Igaliko complex is the largest igneous mass within the Gardar province. It comprises four intrusive centres, Motzfeldt, North Qôroq, South Qôroq and Igdlerfigssalik (Emeleus and Harry, 1970). The Motzfeldt centre covers an area of approximately 150 km^2 and consists of concentric units of peralkaline undersaturated syenites emplaced at the boundary between Julianehåb granitoids and Eriksfjord Formation. The outermost units, the Motzfeldt Sø Formation, underwent extreme magmatic differentiation thereby producing a residual liquid rich in volatiles and incompatible elements, which intruded the margin of the complex and formed a number of peralkaline microsyenite sheets and pegmatites. In addition, extensive hydrothermal alteration of the Motzfeldt Sø syenite occurred along the margins and especially at the roof. The associated pyrochlore mineralisation probably formed where the incompatible element/volatile enriched magmatic residuum received an influx of silica and meteoric water. The resulting increase in oxygen fugacity, acidity and hydrothermal activity facilitated migration with subsequent deposition of the pyrochlore together with zircon, thorite and abundant fluorite (Tukiainen, 1988). Mineralisation occurrences with Nb-Ta-U-Th-Zr-Ce-La are hosted in altered syenite and peralkaline microsyenite of the Motzfeldt Sø Formation. The metals occur mainly in pyrochlore (Nb, Ta, U, REE), thorite (Th), zircon (Zr) bastnaesite (REE, Th) and monazite (REE). Average concentrations of 50-80 ppm U and 80-120 ppm Th were recorded, with local peaks of 500-700 ppm U and 2000 ppm Th (Thomassen 1988, 1989). A minor sulphide mineralisation is associated with some fault zones and Thomassen (1988) mentions additional potential for Be (up to 797 ppm), Li (up to 1810 ppm) and Mo (up to 202 ppm). Commercial investigations by Angus and Ross Plc. (Armour-Brown, 2001) followed by RAM Resources concerned the Nb-Ta mineralisation at first and later included the REE resources. Typically the total rare earth oxide (TREO) comprises 82.5 % light rare earth oxides (La, Ce, Pr, Nd, Sm), 6.5 % heavy rare earth oxide (Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu) and 10.6 % Y_2O_3.

The North Qoroq centre of the large composite Igaliko complex consists of five concentric intrusions of nepheline syenite (Emeleus and Harry, 1970). The rocks include eudialyte bearing lujavrite and like in the nearby Motzfeldt centre, it shows areas of metasomatic alteration (Coulson and Chambers, 1996). Therefore, the complex could have a certain unrecognised/uninvestigated potential for REE mineralisation.

4. Ivigtut granite and cryolite deposite

The Ivigtut granite complex occupies a 270 m wide cylindrical stock that was intruded into Archaean gneiss and is surrounded by a 60 m wide intrusion breccia. Mineralised faults and crush zones (sulphides, carbonates, fluorite), often with high levels of radioactivity, Sr, Ba and REE, dissect the surrounding region (Bailey, 1980). The Ivigtut cryolite deposit (Bailey, 1980; Pauly and Bailey, 1999) was located within the roof zone of a 270 m wide cylindrical stock of alkali granite. The deposit of Ivigtut is unique and sustained mining for over 100 years with cryolite as the main product and galena and sphalerite as bi-products. The rich cryolite ore body is now exhausted, but minor amounts of low grade cryolite ore remains in addition to fluorite, siderite, galena, sphalerite and quartz (Pauly and Bailey, 1999). The cryolite body and its hydrothermally altered host-granite contain a long range of rare minerals (see references in Pauly and Bailey, 1999).

5. Grønnedal-Ika complex

This complex consists of two layered series of nepheline syenite that has been intruded by a small carbonatite plug. Stream sediment REE anomalies cluster in and around the Grønnedal-Íka complex, and also the Zn concentrations are high, with a mean of 309 ppm and maxium value at 540 ppm. A magnetite-siderite occurrence with minor sphalerite is located where a dolerite dyke cut the carbonatite. Exploration by Kryolitselskabet A/S comprised ground magnetic mapping followed by trenching and drilling. The occurrence was estimated to contain at least 0.8 million t magnetite grading 25-30% iron (Bondam, 1992a). A potential for Nb-Ta in pyrochlore, phosphorus in apatite and REE related to the carbonatite has been suggested (Sørensen and Kalvig, 2011).

A system of E-W or NE-SW striking fractures in the larger area around Ivittuut and Grønnedal-Ika was found to contain Th mineralisation associated with zones of cataclasis and with radioactive carbonatite veins also containing pyrite, chalcopyrite, sphalerite, galena, magnetite, apatite, barite, fluorite (Armour-Brown et al., 1982). The Th mineral is assumed to be thorite or thorogummite. Minor pyrochlore mineralisation (up to 1000 ppm U and 1 % Nb) within and next to a major N-S fault was reported by Armour-Brown et al. (1982). The carbonatite veins are considered possible hosts of REE mineralisation.

6. Giant dykes at Isortoq

Giant dykes differ from the majority of younger dykes by their impressive widths of 150 to 800 m and their textural and structural features more akin to those of the intrusive complexes (Emeleus and Upton, 1976; Upton and Fitton, 1985). The giant dykes at Isortoq hosts Fe-Ti-V mineralisation. The Isortoq area was initially examined by Hunter Minerals Pty Ltd. for magmatic Cu-Ni-PGE mineralisation similar to the Voisey's Bay deposits of Labrador, Canada, based on geological similarities. To date, no Cu-Ni-PGE mineralisation has been identified, but two areas of magnetite-rich olivine-gabbro (troctolite) were identified during helicopter-borne magnetic and electromagnetic survey (Turner and Nichols, 2013). Subsequent drilling intersected several zones up to 145 metres in true width and up to 231 metres vertically of magnetite-bearing troctolite. The Isortoq dykes show apparent widths of up to 200 m, and the mineralised troctolite can now be traced over a strike length of 16.3 kilometres using geophysical data and surficial structural features combined with current and historic core drilling confirmations. The mineralisation is made up of troctolite rich in titaniferous magnetite, where Ti and V occur in exsolved phases within the magnetite. West Melville Metals Inc. announced a NI 43-101 compliant inferred resource of 70.3 mill. t at 29.6 % Fe, 10.9 % TiO_2 and 0.144 % V_2O_5 (15 % Fe cutoff; Turner and Nichols, 2013).

7. The Qassiarsuk carbonatite complex

The Qassiarsuk carbonatite complex comprises lavas, pyroclastic rocks and subvolcanic intrusions of alkaline silicate rocks and carbonatites. The volcanic rocks are interlayered with sandstones and basalts belonging to the lower part of the Eriksfjord Formation. The carbonatites range in composition from calcite carbonatite to iron-poor dolomite carbonatite and ankerite ferrocarbonatite (Andersen, 2008). Sandstones, volcanic rocks and basement are penetrated by diatremes with (silico)carbonatitic, alkaline ultramafic and phonolitic matrix compositions interpreted as feeders to the

pyroclastic rocks (Upton et al., 2003). The carbonatitic rocks have been investigated for their contents of apatite (Knudsen, 1986). Samples of carbonatite have up to c. 3.5 % P_2O_5, while the highest contents (up to 35 % P_2O_5), were found in fenite adjacent to carbonatite and lamprophyre intrusions. The fenite zones rarely exceed a few metres in width. Local LREE mineralisation is a possibility that have not been documented. Several uranium anomalies in stream water and stream sediment are spatially associated with faults within an area near Qassiarsuk complex. Many small occurrences of pitchblende, coffinite and brannerite have been located in fractures and joints in the surrounding rocks (Nyegaard and Armour-Brown, 1986).

Summary

The main elements of economic and environmental interest at the various geological locations described in the section above are listed in Table A1.

Table A1. Summary of the geological locations of economic and environmental interest in South Greenland, including the main enriched elements.

Domain	Name	Main enriched elements
Northern Domain		
	Nuuluk + Iterlak	Au, As
Central Domain		
	Niaqornaarsuk/Vagar	Au, Ag, As, (F)
	Josva Mine – Ilordleq Group	Cu, Ag, Au
	Nunatak – Nordre Sermilik	U, Th
	Puisattaq + Vatnahverfi	U, Th, F
Southern Domain		
	Illorsuit	U, Th
	Amitsoq + Sissarissoq	Graphite
	Nalunaq + Lake 410 + Ippatit	Au, As
	S-type granites	U, Th
Gardar Domain		
	Kvanefjeld	REE, U, Th, Zn, F
	Kringlerne	Zr, Nb, Ta, REE, F
	Igaliko - Motzfelt Sø	Nb, Ta, U, Th, Zr, Ce, La, F
	Ivigtut	Cryolite, F, Zn, P
	Grønnedal-Ika	REE, Zn, Fe
	Isortoq	Fe, Ti, V

GIS maps

The GIS maps presenting the content of different metals is based on geochemical stream sediment analyses from the GEUS database. The fluorine content was not analysed from the stream sediments, instead the fluorine content was measured from water samples (Steenfelt, 2001;

Steenfelt, 2004) and rock samples from selected areas (Larsen, 1979; Kihler et al., 20009; Pearce and Leng, 1996; Schjøth et al., 2000; Upton and Thomas, 1980). As only a limited number of fluorine analyses are measured in the study area, conductivity of the streams have been included in the dataset; these are not a direct link, but correlated well to the fluorine content of stream water (see Steenfelt and Dam, 1982).

Stream sediment samples

The stream sediment samples were collected by GEUS during several individual field campaigns. They are sampled throughout South Greenland as evenly as possible from second or third order streams preferably with catchment areas less than 10 Km^2. The high-density of sampling document local variations. At each sampling site c. 500 g of composite stream sediment was collected. The dry samples were sieved at GEUS and the <0.1 mm faction was analysed for major and trace elements (for further details see Steenfelt, 1999; Steenfelt et al., 2016). The geochemical data from the stream sediment samples are interpreted to represent the surrounding catchment area, and is therefore a good exploration tool. All the geochemical stream sediment analyses are stored in GEUS database.

Fluorine

Water samples: In the study area 448 water samples are analysed for fluorine, the results have laid the background for a drinking water survey reports (Steenfelt, 2000, 2004). The conductivity of stream water have been measured for 3268 samples and are reported by Armour-Brown et al. (1982).

Rock samples GEUS: Rock samples collected for mapping-, classification-, petrogenetic- and economic purposes. 170 samples in the GEUS database were analysed for fluorine (Schjøth et al., 2000).

Rock samples from GEOROC: Precompiled files of geographic and geological provinces are available at the GEOROC database (URL: http://georoc.mpch-mainz.gwdg.de/georoc/). In South Greenland, only samples from the Gardar Province were analysed for fluorine, a total of 105 fluorine analyses are presented.

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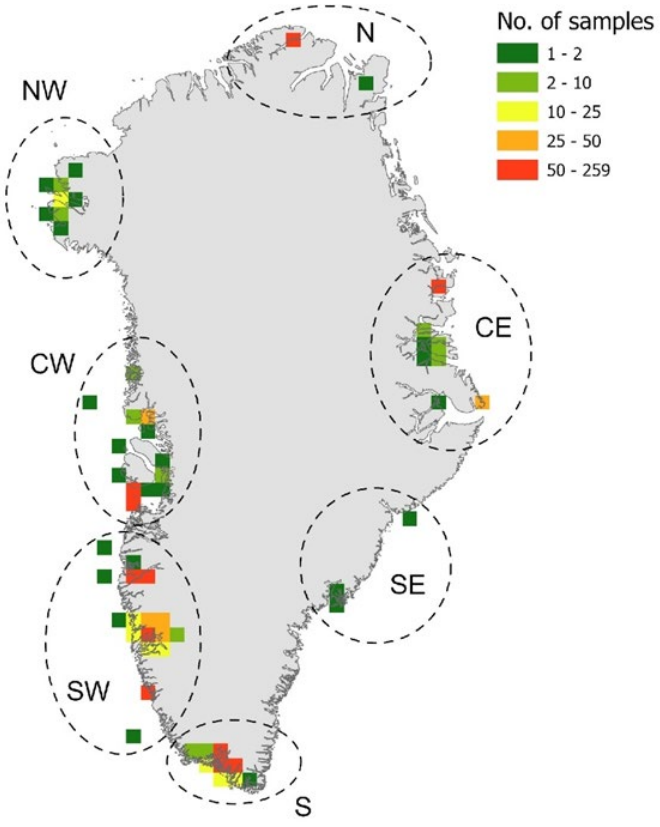
Appendix 2 Avatangiisini akuutissat pillugit killiliussat nalingi

By Janne Fritt-Rasmussen1 and Kasper Lambert Johansen 1
[1]Department of Ecoscence, Aarhus University

Immikkoortumi killeqarfimmi avatangiisit pillugit killiuliussat nalingi

Based on baseline data (samples representing unpolluted conditions) in the AMDA database, regional median concentration values and ranges of approx. 70 different elements in eight different sample types (seaweed, crinkled snow lichen, blue mussel, short-horn sculpin, sediment, soil, filtered water and unfiltered water) have been calculated. In total 1480 samples with geographical coordinates were included. Takussutissiaq A 2.1 shows the distribution of samples across Greenland, and the sub-division of the dataset into seven different regions. In the tables that follow, the naming of the regions from Takussutissiaq A 2.1 is used. Most of the columns in the tables should be self-explicatory, but a few need mentioning: q25 refers to the 25% percentile (1st quatile) and q75 to the 75% percentile (3rd quatile). "No of meas." refers to the number of concentration measurements of the particular element, in the particular sample type, for the particular region. As some samples were sub-divided prior to measurement (e.g. a sculpin spilt in liver, bone, muscle etc), the number of measurements may be greater than the number of individual samples. Among the values, "<DL" means that the concentration is below the detection limit of the instrument.



Takussutissiaq A2.1. Distribution of baseline samples (unpolluted conditions) with geographical coordinates in the AMDA database (n=1480), and the sub-division of Greenland used for calculating the regional baseline element concentration values

Table A2.1 Regional environmental baseline element concentration values for the region “South Greenland” (S). q25 refers to the 25% percentile (1st quatile) and q75 to the 75% percentile (3rd quatile). “No of meas.” refers to the number of concentration measurements of the particular element, in the particular sample type, for the particular region. DL refers to detection limit.

GRL region	Category	Element	Unit	Min	q25	Median	q75	Max	No. of meas.	No. of samples
S	Blue mussel	Ag	mg/kg	<DL	0.022	0.055	0.062	0.096	41	37
S	Blue mussel	Al	mg/kg	108.322	242.565	383.012	466.11575	11550.883	30	26
S	Blue mussel	As	mg/kg	1.836	4.573	12.5	14.36	19.316	61	42
S	Blue mussel	Au	mg/kg	<DL	<DL	<DL	<DL	<DL	30	26
S	Blue mussel	B	mg/Kg	2.9	3.200	4.7	11.4	20	11	11
S	Blue mussel	Ba	mg/kg	<DL	1.656	3.404	5.337	24.899	41	37
S	Blue mussel	Be	mg/Kg	<DL	0.011	0.018	0.154	24.681	51	42
S	Blue mussel	Bi	mg/kg	<DL	<DL	0.005	0.006	0.013	41	37
S	Blue mussel	Ca	mg/kg	260	1467.755	2567.941	3708.607	7500	41	37
S	Blue mussel	Cd	mg/kg	0.3	1.895	2.4395	2.869	5.78	68	57
S	Blue mussel	Ce	mg/Kg	0.804	2.208	3.6265	7.101475	43.542	40	31
S	Blue mussel	Co	mg/Kg	0.076	0.394	0.529	0.754	0.882	51	42
S	Blue mussel	Cr	mg/Kg	<DL	0.436	0.753	1.022	4.581	51	42
S	Blue mussel	Cs	mg/kg	0.018	0.026	0.037	0.051	3.223	30	26
S	Blue mussel	Cu	mg/kg	1.3	6.239	7.122	7.714	8.981	41	37
S	Blue mussel	d.m.%	%	9.62	13.510	14.7	16.8	22.9	71	57
S	Blue mussel	Dy	mg/Kg	0.039	0.090	0.133	0.436	1.580	40	31
S	Blue mussel	Er	mg/Kg	0.02	0.045	0.0715	0.334	0.890	40	31
S	Blue mussel	Eu	mg/Kg	0.014	0.033	0.042	0.111	0.247	40	31
S	Blue mussel	Fe	mg/kg	23	210	303.724	500.216	672.248	41	37
S	Blue mussel	Ga	mg/kg	0.061	0.161	0.2155	0.266	7.205	30	26
S	Blue mussel	Gd	mg/Kg	0.093	0.221	0.3465	1.789	4.295	40	31
S	Blue mussel	Hf	mg/kg	0.004	0.007	0.0085	0.014	0.089	30	26
S	Blue mussel	Hg	mg/kg	0.059	0.077	0.089	0.098	0.121	57	46
S	Blue mussel	Ho	mg/Kg	0.008	0.017	0.027	0.085	0.325	40	31
S	Blue mussel	K	mg/kg	2100	9795.595	11000	12278.343	14407.694	41	37
S	Blue mussel	La	mg/Kg	0.815	1.958	3.7345	11.635	48.733	40	31
S	Blue mussel	Li	mg/kg	0.091	0.221	0.2625	0.413	1.173	30	26
S	Blue mussel	Lu	mg/Kg	0.002	0.005	0.0095	0.021	0.082	40	31
S	Blue mussel	Mg	mg/kg	440	1700.881	2563.073	2865.142	3304.842	41	37
S	Blue mussel	Mn	mg/Kg	1.2	9.540	11.677	15.969	24.948	51	42
S	Blue mussel	Mo	mg/Kg	<DL	0.065	0.454	0.569	1.748	51	42
S	Blue mussel	Na	mg/kg	2300	7488.873	14418.954	19000	24771.202	41	37
S	Blue mussel	Nb	mg/Kg	0.077	0.137	0.21237	0.596	3.515	40	31
S	Blue mussel	Nd	mg/Kg	0.41	1.072	1.694	5.695	23.023	40	31
S	Blue mussel	Ni	mg/Kg	0.14	0.758	1.1217	1.2935	2.598	51	42
S	Blue mussel	P	mg/kg	1800	9200	10000	11159.657	12911.895	41	37
S	Blue mussel	Pb	mg/kg	0.16	0.701	1.011	2.220	11.139	68	57
S	Blue mussel	Pb-210	Bq/kg	<DL	<DL	<DL	<DL	<DL	8	8

S	Blue mussel	Pd	mg/kg	0.009	0.022	0.042	0.049	0.091	30	26
S	Blue mussel	Po-210	Bq/kg	10	13	22	51.96	72	13	13
S	Blue mussel	Pr	mg/Kg	0.112	0.302	0.4955	1.815	6.840	40	31
S	Blue mussel	Pt	mg/kg	<DL	<DL	<DL	<DL	<DL	28	24
S	Blue mussel	Ra-226	Bq/kg	<DL	<DL	<DL	<DL	25	11	11
S	Blue mussel	Ra-228	Bq/kg	<DL	<DL	<DL	<DL	<DL	8	8
S	Blue mussel	Rb	mg/Kg	4.658	5.699	6.1895	6.872	180.37	40	31
S	Blue mussel	Re	mg/kg	<DL	<DL	<DL	<DL	3.36E-04	30	26
S	Blue mussel	Ru	mg/Kg	<DL	<DL	<DL	<DL	0.001	30	26
S	Blue mussel	Sb	mg/kg	<DL	<DL	0.012	0.014	0.026	41	37
S	Blue mussel	Sc	mg/kg	0.05	0.089	0.102	0.156	0.228	30	26
S	Blue mussel	Se	mg/kg	0.7	3.750	4.393	4.892	6.383	68	57
S	Blue mussel	Sm	mg/Kg	0.066	0.166	0.238	0.702	2.861	40	31
S	Blue mussel	Sn	mg/Kg	<DL	<DL	<DL	0.019	0.036	21	16
S	Blue mussel	Sr	mg/kg	3.2	15	31.539	35.49	65	41	37
S	Blue mussel	Ta	mg/kg	0.002	0.003	0.003	0.004	0.052	30	26
S	Blue mussel	Tb	mg/Kg	0.009	0.021	0.0305	0.168	0.357	40	31
S	Blue mussel	Te	mg/kg	<DL	<DL	0.002	0.004	0.007	30	26
S	Blue mussel	Th	mg/Kg	<DL	0.080	0.132	0.256	1.575	51	42
S	Blue mussel	Ti	mg/kg	2.3	9.600	11.533	24.217	35.703	41	37
S	Blue mussel	Tl	mg/kg	<DL	<DL	<DL	<DL	0.131	41	37
S	Blue mussel	Tm	mg/Kg	0.003	0.006	0.01	0.028	0.112	40	31
S	Blue mussel	U	mg/Kg	<DL	0.040	0.247	0.404	0.867	62	42
S	Blue mussel	V	mg/Kg	0.09	0.577	0.83	1.034	2.179	51	42
S	Blue mussel	W	mg/kg	0.013	0.018	0.0255	0.038	0.054	30	26
S	Blue mussel	Y	mg/Kg	0.24	0.506	0.8045	4.710	14.588	40	31
S	Blue mussel	Yb	mg/Kg	0.017	0.033	0.059	0.151	0.591	40	31
S	Blue mussel	Zn	mg/Kg	16	68.965	74.227	81.804	244.548	51	42
S	Blue mussel	Zr	mg/Kg	0.143	0.271	0.402	1.398	5.001	40	31
S	Crinkled snow lichen	Ag	mg/kg	<DL	0.001	0.002	0.008	0.1	53	50
S	Crinkled snow lichen	Al	mg/kg	79.327	156.795	289.393	410.621	802.194	50	47
S	Crinkled snow lichen	As	mg/kg	<DL	0.040	0.051	0.076	0.237	54	51
S	Crinkled snow lichen	Au	mg/kg	<DL	<DL	<DL	<DL	<DL	51	48
S	Crinkled snow lichen	B	mg/Kg	<DL	<DL	<DL	0.35	0.7	3	3
S	Crinkled snow lichen	Ba	mg/kg	4.031	7.442	9.843	17.846	108.629	53	50
S	Crinkled snow lichen	Be	mg/kg	<DL	0.027	0.042	0.130	2.2	53	50
S	Crinkled snow lichen	Bi	mg/kg	<DL	0.002	0.003	0.004	0.011	53	50
S	Crinkled snow lichen	Ca	mg/kg	579.614	1030.952	2312.046	3673.034	11728.483	53	50
S	Crinkled snow lichen	Cd	mg/kg	0.017	0.041	0.074	0.111	0.230	60	56
S	Crinkled snow lichen	Ce	mg/kg	1.113	2.443	4.043	13.629	115.518	50	47
S	Crinkled snow lichen	Co	mg/kg	0.041	0.067	0.110	0.194	1.011	54	51
S	Crinkled snow lichen	Cr	mg/kg	<DL	0.136	0.251	0.518	3.936	53	50
S	Crinkled snow lichen	Cs	mg/kg	0.014	0.032	0.059	0.119	1.787	50	47
S	Crinkled snow lichen	Cu	mg/kg	0.268	0.478	0.659	0.935	4	54	51
S	Crinkled snow lichen	Dy	mg/kg	0.041	0.090	0.139	0.417	5.032	50	47

S	Crinkled snow lichen	Er	mg/kg	0.020	0.044	0.066	0.189	2.482	50	47
S	Crinkled snow lichen	Eu	mg/kg	0.011	0.028	0.051	0.102	0.751	50	47
S	Crinkled snow lichen	Fe	mg/kg	54.584	144.046	226.611	421.102	1144.165	54	51
S	Crinkled snow lichen	Ga	mg/kg	0.067	0.144	0.233	0.547	3.240	50	47
S	Crinkled snow lichen	Gd	mg/kg	0.062	0.151	0.274	0.797	7.583	50	47
S	Crinkled snow lichen	Hf	mg/kg	0.003	0.011	0.020	0.037	0.223	50	47
S	Crinkled snow lichen	Hg	mg/kg	0.020	0.028	0.032	0.038	0.062	56	52
S	Crinkled snow lichen	Ho	mg/kg	0.008	0.016	0.025	0.074	0.957	50	47
S	Crinkled snow lichen	K	mg/kg	924.725	1343.928	1641.467	1891.197	2313.793	53	50
S	Crinkled snow lichen	La	mg/kg	0.598	1.298	2.215	8.119	119.516	50	47
S	Crinkled snow lichen	Li	mg/kg	<DL	0.055	0.125	0.213	1.041	50	47
S	Crinkled snow lichen	Lu	mg/kg	0.002	0.004	0.007	0.016	0.191	50	47
S	Crinkled snow lichen	Mg	mg/kg	352.553	597.200	721.598	981.806	1206.669	53	50
S	Crinkled snow lichen	Mn	mg/kg	16.830	32.186	51.414	73.633	135.183	53	50
S	Crinkled snow lichen	Mo	mg/kg	<DL	0.032	0.041	0.056	0.19	53	50
S	Crinkled snow lichen	Na	mg/kg	140.363	420.938	600	724.394	1242.014	53	50
S	Crinkled snow lichen	Nb	mg/kg	0.138	0.370	0.618	1.117	5.045	50	47
S	Crinkled snow lichen	Nd	mg/kg	0.466	0.997	1.616	5.058	60.595	50	47
S	Crinkled snow lichen	Ni	mg/kg	<DL	0.118	0.169	0.374	4.941	54	51
S	Crinkled snow lichen	P	mg/kg	262.105	486.725	606.965	787.435	1298.859	53	50
S	Crinkled snow lichen	Pb	mg/kg	0.176	0.549	0.818	1.729	11.408	55	52
S	Crinkled snow lichen	Pb-210	Bq/kg	260	260	260	260	260	1	1
S	Crinkled snow lichen	Pd	mg/kg	6.29E-04	0.002	0.013	0.044	0.156	50	47
S	Crinkled snow lichen	Po-210	Bq/kg	114.9	235.075	299.15	456.6	680.1	22	22
S	Crinkled snow lichen	Pr	mg/kg	0.131	0.278	0.449	1.458	18.622	50	47
S	Crinkled snow lichen	Pt	mg/kg	<DL	<DL	<DL	<DL	0.003	50	47
S	Crinkled snow lichen	Ra-226	Bq/kg	<DL	14.500	29	58.5	88	3	3
S	Crinkled snow lichen	Ra-228	Bq/kg	<DL	<DL	<DL	<DL	<DL	1	1
S	Crinkled snow lichen	Rb	mg/kg	0.929	2.144	3.256	4.259	10.097	50	47
S	Crinkled snow lichen	Re	mg/kg	<DL	<DL	<DL	6.83E-05	0.001	50	47
S	Crinkled snow lichen	Ru	mg/Kg	<DL	<DL	<DL	<DL	0.001	50	47
S	Crinkled snow lichen	Sb	mg/kg	<DL	0.003	0.005	0.008	0.059	53	50
S	Crinkled snow lichen	Sc	mg/kg	0.026	0.070	0.096	0.13	1.321	50	47
S	Crinkled snow lichen	Se	mg/kg	<DL	0.047	0.060	0.076	0.2	59	55
S	Crinkled snow lichen	Sm	mg/kg	0.074	0.162	0.267	0.809	8.687	50	47
S	Crinkled snow lichen	Sn	mg/kg	<DL	<DL	<DL	0.35	0.7	3	3
S	Crinkled snow lichen	Sr	mg/kg	5.354	11.832	20.081	29.636	104.551	53	50
S	Crinkled snow lichen	Ta	mg/kg	0.002	0.004	0.011	0.020	0.061	50	47
S	Crinkled snow lichen	Tb	mg/kg	0.008	0.018	0.027	0.093	0.968	50	47
S	Crinkled snow lichen	Te	mg/kg	<DL	<DL	<DL	6.55E-04	0.004	50	47
S	Crinkled snow lichen	Th	mg/Kg	<DL	0.080	0.128	0.389	4.7	53	50
S	Crinkled snow lichen	Ti	mg/kg	5.9	17.181	32	53.869	94.508	53	50
S	Crinkled snow lichen	Tl	mg/kg	<DL	<DL	<DL	0.006	0.047	53	50
S	Crinkled snow lichen	Tm	mg/kg	0.003	0.006	0.008	0.023	0.298	50	47
S	Crinkled snow lichen	U	mg/Kg	<DL	0.031	0.062	0.206	1.6	56	50

S	Crinkled snow lichen	V	mg/kg	0.114	0.217	0.417	0.646	3.156	53	50
S	Crinkled snow lichen	W	mg/kg	<DL	0.008	0.016	0.020	0.110	50	47
S	Crinkled snow lichen	Y	mg/kg	0.267	0.502	0.782	2.673	47.257	50	47
S	Crinkled snow lichen	Yb	mg/kg	0.015	0.032	0.049	0.127	1.530	50	47
S	Crinkled snow lichen	Zn	mg/kg	8.397	16.503	22.183	28.413	90	55	52
S	Crinkled snow lichen	Zr	mg/kg	0.131	0.433	0.871	1.798	12.639	50	47
S	Filtered water	Ag	µg/l	<DL	<DL	0.004	0.009	0.051	119	110
S	Filtered water	Al	µg/l	2.8	15.065	25.2	31.7	233.15	119	110
S	Filtered water	As	µg/l	<DL	<DL	0.105	0.506	4.827	119	110
S	Filtered water	Au	µg/l	<DL	<DL	0.003	0.007	0.022	119	110
S	Filtered water	B	µg/l	0.224	0.649	0.815	1.121	2.829	19	19
S	Filtered water	Ba	µg/l	0.217	0.525	2	5.421	46.597	119	110
S	Filtered water	Be	µg/l	0.002	0.023	0.051	0.122	0.771	119	110
S	Filtered water	Bi	µg/l	<DL	<DL	<DL	2.50E-04	0.008	119	110
S	Filtered water	Ca	µg/l	275	1632.5	2060	3207.5	7677	119	110
S	Filtered water	Cd	µg/l	<DL	0.002	0.004	0.010	0.039	119	110
S	Filtered water	Ce	µg/l	0.001	0.020	0.042	0.094	0.493	119	110
S	Filtered water	Cl	µg/l	3209	4965	6824	10640.5	19655	83	83
S	Filtered water	Co	µg/l	<DL	0.002	0.005	0.008	0.086	119	110
S	Filtered water	Cr	µg/l	<DL	<DL	<DL	0.025	0.14	119	110
S	Filtered water	Cs	µg/l	0.001	0.006	0.01	0.014	0.181	119	110
S	Filtered water	Cu	µg/l	<DL	0.108	0.186	0.284	3.802	119	110
S	Filtered water	Dy	µg/l	3.00E-04	0.007	0.010	0.022	0.484	118	110
S	Filtered water	Er	µg/l	3.10E-04	0.004	0.006	0.0102	0.278	118	110
S	Filtered water	Eu	µg/l	<DL	0.001	0.002	0.007	0.051	118	110
S	Filtered water	F	µg/l	<DL	153.000	1039	1914	28302	91	91
S	Filtered water	Fe	µg/l	<DL	2.546	7.37	40.203	257.1	118	110
S	Filtered water	Ga	µg/l	<DL	0.008	0.027	0.093	0.968	119	110
S	Filtered water	Gd	µg/l	5.00E-04	0.011	0.016	0.036	0.622	118	110
S	Filtered water	Ge	µg/l	0.018	0.023	0.028	0.0327	0.038	2	2
S	Filtered water	Hf	µg/l	<DL	0.004	0.009	0.019	0.471	118	110
S	Filtered water	Hg	µg/l	<DL	<DL	<DL	<DL	0.013	119	110
S	Filtered water	Ho	µg/l	5.00E-05	0.001	0.002	0.004	0.098	118	110
S	Filtered water	K	µg/l	45	272	333	437.5	972	119	110
S	Filtered water	La	µg/l	0.007	0.046	0.08	0.222	0.604	119	110
S	Filtered water	Li	µg/l	<DL	0.175	0.39	3.482	5.87	119	110
S	Filtered water	Lu	µg/l	<DL	1.85E-04	5.00E-04	0.001	0.004	43	43
S	Filtered water	Mg	µg/l	59.2	283.800	425	700	1585	119	110
S	Filtered water	Mn	µg/l	<DL	0.380	3.165	3.82	53.61	94	86
S	Filtered water	Mo	µg/l	<DL	0.371	1.565	2.590	29.018	119	110
S	Filtered water	Na	µg/l	670.8	5387.5	7970	10168	62174	119	110
S	Filtered water	Nb	µg/l	<DL	0.004	0.008	0.014	1.608	118	110
S	Filtered water	Nd	µg/l	0.005	0.036	0.07	0.171	0.579	119	110
S	Filtered water	Ni	µg/l	<DL	<DL	0.026	0.054	0.289	119	110
S	Filtered water	P	µg/l	<DL	<DL	1.15	2.13	98.5	119	110

S	Filtered water	Pb	µg/l	<DL	<DL	0.059	0.102	7.064	119	110
S	Filtered water	Pd	µg/l	<DL	<DL	0.001	0.002	0.005	119	110
S	Filtered water	Pr	µg/l	0.001	0.019	0.027	0.066	0.916	118	110
S	Filtered water	Pt	µg/l	<DL	<DL	<DL	<DL	0.003	119	110
S	Filtered water	Rb	µg/l	0.227	0.694	0.982	1.825	7.34	119	110
S	Filtered water	Re	µg/l	<DL	<DL	1.00E-04	2.00E-04	0.005	118	110
S	Filtered water	Rh	µg/l	0.001	0.001	0.001	0.001	0.002	2	2
S	Filtered water	Ru	µg/l	<DL	<DL	<DL	<DL	0.001	119	110
S	Filtered water	S	µg/l	228	423.250	457	506	1851	86	86
S	Filtered water	Sb	µg/l	<DL	<DL	0.035	0.087	1.408	119	110
S	Filtered water	Sc	µg/l	<DL	0.010	0.02	0.021	0.156	119	110
S	Filtered water	Se	µg/l	<DL	0.029	0.064	0.116	0.39	119	110
S	Filtered water	Si	µg/l	4.89	20.660	26.42	41.35	73.8	19	19
S	Filtered water	Sm	µg/l	0.001	0.012	0.018	0.044	0.545	118	110
S	Filtered water	Sn	µg/l	<DL	<DL	0.002	0.02	0.179	95	86
S	Filtered water	Sr	µg/l	1.98	8.585	9.54	18.43	41	119	110
S	Filtered water	Ta	µg/l	<DL	<DL	2.50E-04	0.007	0.054	118	110
S	Filtered water	Tb	µg/l	1.50E-04	0.001	0.002	0.004	0.082	118	110
S	Filtered water	Te	µg/l	<DL	<DL	<DL	0.002	0.014	119	110
S	Filtered water	Th	µg/l	<DL	0.002	0.003	0.005	0.031	119	110
S	Filtered water	Ti	µg/l	<DL	0.030	0.05	0.1	0.335	119	110
S	Filtered water	Tl	µg/l	<DL	<DL	0.002	0.009	0.125	119	110
S	Filtered water	Tm	µg/l	<DL	5.00E-04	8.15E-04	0.001	0.037	118	110
S	Filtered water	U	µg/l	0.004	0.024	0.081	0.175	2.823	119	110
S	Filtered water	V	µg/l	<DL	0.020	0.05	0.06	0.431	119	110
S	Filtered water	W	µg/l	<DL	0.004	0.015	0.030	0.882	119	110
S	Filtered water	Y	µg/l	0.007	0.027	0.051	0.094	0.619	119	110
S	Filtered water	Yb	µg/l	4.80E-04	0.003	0.005	0.008	0.227	118	110
S	Filtered water	Zn	µg/l	0.133	0.790	1.413	2.005	14.167	119	110
S	Filtered water	Zr	µg/l	<DL	0.019	0.055	0.113	0.637	119	110
S	Seaweed	Ag	mg/kg	<DL	0.062	0.087	0.100	0.15	20	19
S	Seaweed	Al	mg/kg	27.612	55.386	315.724	536.015	821.404	14	13
S	Seaweed	As	mg/kg	1.06	32.200	38.92	43.934	58.24	39	28
S	Seaweed	Au	mg/kg	<DL	<DL	<DL	<DL	0.031	17	15
S	Seaweed	B	mg/Kg	15	16	64.5	117.5	120	6	6
S	Seaweed	Ba	mg/Kg	1.1	12.374	15.487	30.537	168.194	36	26
S	Seaweed	Be	mg/Kg	<DL	0.004	0.024	0.068	0.227	36	26
S	Seaweed	Bi	mg/kg	<DL	<DL	0.001	0.002	0.006	20	19
S	Seaweed	Ca	mg/kg	970	9250	12834.617	16388.848	19552.58	20	19
S	Seaweed	Cd	mg/Kg	0.164	0.485	0.773	1.133	1.632	39	28
S	Seaweed	Ce	mg/Kg	<DL	0.442	0.836	1.477	2.046	30	20
S	Seaweed	Co	mg/Kg	0.089	0.319	0.448	0.684	1.176	39	28
S	Seaweed	Cr	mg/Kg	<DL	0.093	0.183	0.306	1.1	39	28
S	Seaweed	Cs	mg/kg	0.029	0.040	0.058	0.076	0.104	14	13
S	Seaweed	Cu	mg/kg	<DL	1.766	2.116	2.588	4.175	23	21

S	Seaweed	d.m.%	%	11.7	11.970	15.58	17.61	20.48	23	7
S	Seaweed	Dy	mg/Kg	0.020	0.059	0.077	0.101	0.205	30	20
S	Seaweed	Er	mg/Kg	0.011	0.030	0.050	0.076	0.130	30	20
S	Seaweed	Eu	mg/Kg	0.014	0.028	0.044	0.066	0.184	30	20
S	Seaweed	Fe	mg/Kg	9	36.561	66.147	191.742	639.101	39	28
S	Seaweed	Ga	mg/kg	0.027	0.052	0.142	0.212	0.308	14	13
S	Seaweed	Gd	mg/Kg	0.032	0.116	0.160	0.241	0.370	30	20
S	Seaweed	Hf	mg/kg	<DL	0.005	0.009	0.012	0.017	14	13
S	Seaweed	Hg	mg/kg	<DL	0.002	0.005	0.007	0.02	33	22
S	Seaweed	Ho	mg/Kg	0.003	0.011	0.014	0.021	0.044	30	20
S	Seaweed	K	mg/kg	3100	19321.078	24240.486	26925.848	32126.829	20	19
S	Seaweed	La	mg/Kg	<DL	0.345	0.845	1.165	2.691	30	20
S	Seaweed	Li	mg/kg	0.212	0.416	0.569	0.685	1.045	14	13
S	Seaweed	Lu	mg/Kg	0.001	0.004	0.006	0.007	0.013	30	20
S	Seaweed	Mg	mg/kg	1000	8060.584	8415.778	8721.788	9607.26	20	19
S	Seaweed	Mn	mg/Kg	2.4	21.866	31.427	46.162	121.042	36	26
S	Seaweed	Mo	mg/Kg	<DL	<DL	<DL	0.107	0.142	36	26
S	Seaweed	Na	mg/kg	1600	12096.082	19002.002	23948.742	39000	20	19
S	Seaweed	Nb	mg/Kg	0.029	0.086	0.150	0.269	0.597	30	20
S	Seaweed	Nd	mg/Kg	0.154	0.566	0.808	1.256	2.061	30	20
S	Seaweed	Ni	mg/Kg	<DL	0.551	0.83	1.324	2.294	39	28
S	Seaweed	P	mg/kg	200	960.858	1121.279	1326.842	1882.325	20	19
S	Seaweed	Pb	mg/Kg	<DL	0.091	0.231	0.340	0.85	39	28
S	Seaweed	Pb-210	Bq/kg	<DL	<DL	<DL	<DL	<DL	3	3
S	Seaweed	Pd	mg/kg	0.021	0.957	1.223	1.548	1.698	14	13
S	Seaweed	Po-210	Bq/kg	<DL	<DL	<DL	11.66	19.6	9	9
S	Seaweed	Pr	mg/Kg	0.034	0.132	0.213	0.311	0.561	30	20
S	Seaweed	Pt	mg/kg	<DL	<DL	<DL	<DL	<DL	13	12
S	Seaweed	Ra-226	Bq/kg	<DL	<DL	<DL	<DL	11	6	6
S	Seaweed	Ra-228	Bq/kg	<DL	<DL	<DL	<DL	<DL	3	3
S	Seaweed	Rb	mg/Kg	8.129	11.616	15.033	19.112	26.217	30	20
S	Seaweed	Re	mg/kg	0.009	0.015	0.023	0.056	0.087	14	13
S	Seaweed	Ru	mg/Kg	<DL	0.006	0.008	0.010	0.011	14	13
S	Seaweed	Sb	mg/Kg	<DL	0.008	0.012	0.015	0.022	36	26
S	Seaweed	Sc	mg/kg	0.017	0.062	0.143	0.222	0.317	14	13
S	Seaweed	Se	mg/kg	<DL	0.012	0.021	0.030	0.04	47	28
S	Seaweed	Sm	mg/Kg	0.022	0.092	0.137	0.202	0.313	30	20
S	Seaweed	Sn	mg/kg	<DL	<DL	<DL	<DL	<DL	6	6
S	Seaweed	Sr	mg/kg	68	672.768	785.360	912.644	1148.521	20	19
S	Seaweed	Ta	mg/kg	<DL	0.001	0.002	0.004	0.007	14	13
S	Seaweed	Tb	mg/Kg	0.004	0.013	0.018	0.033	0.052	30	20
S	Seaweed	Te	mg/kg	<DL	0.001	0.002	0.003	0.004	14	13
S	Seaweed	Th	mg/Kg	<DL	0.018	0.044	0.129	0.316	36	26
S	Seaweed	Ti	mg/kg	0.6	2.099	4.561	28.548	52.207	20	19
S	Seaweed	Tl	mg/kg	<DL	<DL	<DL	0.006	0.016	20	19

S	Seaweed	Tm	mg/Kg	0.001	0.004	0.005	0.007	0.016	30	20
S	Seaweed	U	mg/Kg	0.15	0.552	0.854	1.149	1.560	42	26
S	Seaweed	V	mg/Kg	0.06	0.148	0.307	0.465	1.111	36	26
S	Seaweed	W	mg/kg	<DL	0.003	0.007	0.015	0.027	14	13
S	Seaweed	Y	mg/Kg	<DL	0.238	0.357	0.478	1.711	30	20
S	Seaweed	Yb	mg/Kg	0.009	0.026	0.037	0.051	0.089	30	20
S	Seaweed	Zn	mg/Kg	<DL	11.144	19.614	36.226	129.617	39	28
S	Seaweed	Zr	mg/Kg	0.138	0.388	0.560	0.866	2.4	30	20
S	Sediment	Ag	mg/kg	<DL	<DL	<DL	0.065	0.26	4	4
S	Sediment	Al	mg/kg	0.045	35000	63439	65940	68618	9	9
S	Sediment	As	mg/kg	3.72E-04	2.600	5.6	7.485	11	7	6
S	Sediment	Au	mg/kg	1.40E-06	1.98E-06	2.55E-06	3.13E-06	3.70E-06	2	2
S	Sediment	B	mg/Kg	0.001	0.001	3.201	9.3	18	4	4
S	Sediment	Ba	mg/kg	8.86E-04	8.94E-04	22.000	50.75	71	4	4
S	Sediment	Be	mg/kg	8.90E-05	1.04E-04	15.000	42.75	81	4	4
S	Sediment	Bi	mg/kg	<DL	<DL	<DL	1.25E-07	5.00E-07	4	4
S	Sediment	Ca	mg/kg	2.72E+00	2.784	4051.404	9075	12000	4	4
S	Sediment	Cd	mg/kg	4.30E-06	0.168	0.2	0.215	0.42	9	9
S	Sediment	Ce	mg/kg	7.00E-06	8.00E-06	9.00E-06	1.00E-05	1.10E-05	2	2
S	Sediment	Cl	mg/Kg	6.24E+00	6.250	6.261	6.271	6.281	2	2
S	Sediment	Co	mg/kg	1.00E-06	2.50E-06	1.400	3.225	4.5	4	4
S	Sediment	Cr	mg/kg	<DL	5.25E-06	1.100	2.9	5	4	4
S	Sediment	Cs	mg/kg	1.70E-05	1.78E-05	1.85E-05	1.93E-05	2.00E-05	2	2
S	Sediment	Cu	mg/kg	<DL	4.900	13	22.623	29.906	9	9
S	Sediment	Dy	mg/Kg	2.99E-06	3.01E-06	3.03E-06	3.04E-06	3.06E-06	2	2
S	Sediment	Er	mg/Kg	1.64E-06	1.90E-06	2.16E-06	2.41E-06	2.67E-06	2	2
S	Sediment	Eu	mg/Kg	2.00E-07	2.50E-07	3.00E-07	3.50E-07	4.00E-07	2	2
S	Sediment	F	mg/Kg	3.12E+00	3.119	3.1205	3.122	3.124	2	2
S	Sediment	Fe	mg/kg	<DL	<DL	11500	24000	27000	4	4
S	Sediment	Ga	mg/kg	3.97E-04	4.03E-04	4.08E-04	4.14E-04	4.19E-04	2	2
S	Sediment	Gd	mg/Kg	3.60E-06	3.65E-06	3.70E-06	3.75E-06	3.80E-06	2	2
S	Sediment	Hf	mg/Kg	9.80E-06	1.17E-05	1.37E-05	1.56E-05	1.75E-05	2	2
S	Sediment	Hg	mg/kg	<DL	0.031	0.04615	0.076	0.128	32	10
S	Sediment	Ho	mg/Kg	7.00E-07	7.30E-07	7.60E-07	7.90E-07	8.20E-07	2	2
S	Sediment	K	mg/kg	4.66E-01	0.480	600.242	1275	1500	4	4
S	Sediment	La	mg/kg	2.00E-05	2.10E-05	2.20E-05	2.30E-05	2.40E-05	2	2
S	Sediment	Li	mg/kg	0.002	5.439	19.652	26.88	29.035	7	7
S	Sediment	Lu	mg/Kg	1.10E-07	1.48E-07	1.85E-07	2.23E-07	2.60E-07	2	2
S	Sediment	Mg	mg/kg	4.31E-01	0.444	1350.224	2900	3500	4	4
S	Sediment	Mn	mg/kg	0.00001	0.00001	600	1400	2000	4	4
S	Sediment	Mo	mg/kg	0.004	0.004	1.102	2.275	2.5	4	4
S	Sediment	Na	mg/kg	13.688	13.990	10507.045	21500	23000	4	4
S	Sediment	Nb	mg/Kg	1.00E-07	6.00E-07	1.10E-06	1.60E-06	2.10E-06	2	2
S	Sediment	Nd	mg/kg	2.20E-05	2.28E-05	2.35E-05	2.43E-05	2.50E-05	2	2
S	Sediment	Ni	mg/kg	<DL	2.300	5	9.138	10.278	9	9

S	Sediment	P	mg/kg	<DL	<DL	400	817.5	870	4	4
S	Sediment	Pb	mg/kg	<DL	13.650	18.14	19.33	110	9	9
S	Sediment	Pb-210	Bq/kg	240	240	240	240	240	1	1
S	Sediment	Pd	mg/kg	<DL	<DL	<DL	<DL	<DL	2	2
S	Sediment	Po-210	Bq/kg	230	230	230	230	230	1	1
S	Sediment	Pr	mg/Kg	4.90E-06	5.38E-06	5.85E-06	6.33E-06	6.80E-06	2	2
S	Sediment	Pt	mg/kg	<DL	2.50E-08	5.00E-08	7.50E-08	1.00E-07	2	2
S	Sediment	Ra-226	Bq/kg	340	407.5	475	542.5	610	2	2
S	Sediment	Ra-228	Bq/kg	230	230	230	230	230	1	1
S	Sediment	Rb	mg/kg	0.003	0.003	0.003	0.003	0.003	2	2
S	Sediment	Re	mg/Kg	2.00E-07	2.25E-07	2.50E-07	2.75E-07	3.00E-07	2	2
S	Sediment	Ru	mg/Kg	<DL	<DL	<DL	<DL	<DL	2	2
S	Sediment	S	mg/kg	5.63E-01	0.578	0.593	0.608	0.623	2	2
S	Sediment	Sb	mg/kg	1.93E-04	1.98E-04	0.210	0.445	0.52	4	4
S	Sediment	Sc	mg/kg	8.90E-05	8.93E-05	8.95E-05	8.98E-05	9.00E-05	2	2
S	Sediment	Se	mg/kg	7.60E-05	7.98E-05	0.850	1.825	2.2	4	4
S	Sediment	Si	mg/Kg	4.26E-02	0.043	0.044	0.044	0.045	2	2
S	Sediment	Sm	mg/kg	3.00E-06	3.55E-06	4.10E-06	4.65E-06	5.20E-06	2	2
S	Sediment	Sn	mg/kg	<DL	<DL	8	18.75	27	4	4
S	Sediment	Sr	mg/kg	1.30E-02	0.013	36.007	89	140	4	4
S	Sediment	Ta	mg/Kg	<DL	2.50E-07	5.00E-07	7.50E-07	1.00E-06	2	2
S	Sediment	Tb	mg/Kg	3.50E-07	4.20E-07	4.90E-07	5.60E-07	6.30E-07	2	2
S	Sediment	Te	mg/kg	9.00E-06	1.03E-05	1.15E-05	1.28E-05	1.40E-05	2	2
S	Sediment	Th	mg/Kg	1.20E-06	1.80E-06	30.5	93.25	190	4	4
S	Sediment	Ti	mg/kg	2.04E-04	2.07E-04	350	715	760	4	4
S	Sediment	Tl	mg/kg	1.20E-05	2.18E-05	0.445	0.918	1	4	4
S	Sediment	Tm	mg/Kg	2.40E-07	2.75E-07	3.10E-07	3.45E-07	3.80E-07	2	2
S	Sediment	U	mg/Kg	3.27E-04	5.750	30	46.75	61	6	4
S	Sediment	V	mg/kg	4.80E-05	5.85E-05	4.750	11.125	16	4	4
S	Sediment	W	mg/kg	1.06E-04	1.06E-04	1.06E-04	1.06E-04	1.06E-04	2	2
S	Sediment	Y	mg/kg	2.70E-05	2.80E-05	2.90E-05	3.00E-05	3.10E-05	2	2
S	Sediment	Yb	mg/Kg	1.77E-06	1.79E-06	1.82E-06	1.84E-06	1.86E-06	2	2
S	Sediment	Zn	mg/kg	0.002	56.690	92.62	104.93	730	9	9
S	Sediment	Zr	mg/kg	3.70E-05	4.93E-05	6.15E-05	7.38E-05	8.60E-05	2	2
S	Shorthorn sculpin	Ag	mg/kg	<DL	<DL	<DL	<DL	<DL	5	5
S	Shorthorn sculpin	As	mg/kg	1.3	1.300	2	4.4	10	5	5
S	Shorthorn sculpin	B	mg/Kg	<DL	<DL	0.5	0.6	1.8	5	5
S	Shorthorn sculpin	Ba	mg/kg	<DL	<DL	<DL	<DL	<DL	5	5
S	Shorthorn sculpin	Be	mg/kg	<DL	<DL	<DL	<DL	<DL	5	5
S	Shorthorn sculpin	Bi	mg/kg	<DL	<DL	<DL	<DL	<DL	5	5
S	Shorthorn sculpin	Ca	mg/kg	68	160	220	710	1400	5	5
S	Shorthorn sculpin	Cd	mg/kg	<DL	0.330	0.465	0.657	2.853	32	31
S	Shorthorn sculpin	Co	mg/kg	0.006	0.006	0.013	0.023	0.028	5	5
S	Shorthorn sculpin	Cr	mg/kg	<DL	<DL	<DL	<DL	<DL	5	5
S	Shorthorn sculpin	Cu	mg/kg	0.9	1.100	1.2	1.6	1.9	5	5

S	Shorthorn sculpin	d.m.%	%	22.64	31.165	34.695	38.075	53	46	46
S	Shorthorn sculpin	Fe	mg/kg	4	4	5	11	33	5	5
S	Shorthorn sculpin	Hg	mg/kg	0.005	0.007	0.009	0.014	0.036	27	26
S	Shorthorn sculpin	K	mg/kg	2500	2800	3400	3600	3600	5	5
S	Shorthorn sculpin	Mg	mg/kg	200	210	240	240	250	5	5
S	Shorthorn sculpin	Mn	mg/kg	<DL	<DL	0.4	0.6	1.1	5	5
S	Shorthorn sculpin	Mo	mg/kg	<DL	<DL	<DL	<DL	0.09	5	5
S	Shorthorn sculpin	Na	mg/kg	980	1300	1400	1400	2400	5	5
S	Shorthorn sculpin	Ni	mg/kg	<DL	<DL	<DL	<DL	<DL	5	5
S	Shorthorn sculpin	P	mg/kg	1500	1500	1800	2600	3400	5	5
S	Shorthorn sculpin	Pb	mg/kg	<DL	4.40E-04	0.007	0.015	0.058	31	30
S	Shorthorn sculpin	Pb-210	Bq/kg	<DL	<DL	<DL	<DL	<DL	2	2
S	Shorthorn sculpin	Po-210	Bq/kg	<DL	<DL	<DL	<DL	<DL	4	4
S	Shorthorn sculpin	Ra-226	Bq/kg	<DL	<DL	<DL	<DL	<DL	5	5
S	Shorthorn sculpin	Ra-228	Bq/kg	<DL	<DL	<DL	<DL	<DL	2	2
S	Shorthorn sculpin	Sb	mg/kg	<DL	<DL	<DL	<DL	<DL	5	5
S	Shorthorn sculpin	Se	mg/kg	0.2	0.755	0.880	0.958	1.425	32	31
S	Shorthorn sculpin	Sn	mg/kg	<DL	<DL	<DL	<DL	<DL	5	5
S	Shorthorn sculpin	Sr	mg/kg	0.6	0.700	1.5	5.3	8.1	5	5
S	Shorthorn sculpin	Th	mg/Kg	<DL	<DL	<DL	<DL	<DL	5	5
S	Shorthorn sculpin	Ti	mg/kg	1	1.200	1.3	1.7	2	5	5
S	Shorthorn sculpin	Tl	mg/kg	<DL	<DL	<DL	<DL	<DL	5	5
S	Shorthorn sculpin	U	mg/Kg	<DL	<DL	<DL	<DL	0.02	10	5
S	Shorthorn sculpin	V	mg/Kg	<DL	<DL	0.06	0.06	0.07	5	5
S	Shorthorn sculpin	Zn	mg/kg	8	9	10	18	61	5	5
S	Soil	Ag	mg/Kg	<DL	0.107	0.1285	0.196	0.266	24	22
S	Soil	Al	mg/kg	8788.775	11128.991	15700.517	31594.816	75039	30	27
S	Soil	As	mg/Kg	<DL	0.906	1.133	1.392	7.1	30	27
S	Soil	Au	mg/Kg	<DL	<DL	<DL	<DL	<DL	21	19
S	Soil	B	mg/Kg	<DL	<DL	<DL	<DL	<DL	3	3
S	Soil	Ba	mg/Kg	49.683	62.347	72.334	108.198	694.597	24	22
S	Soil	Be	mg/Kg	1.1	2.253	2.668	3.686	24	24	22
S	Soil	Bi	mg/Kg	<DL	0.051	0.062	0.087	0.194	24	22
S	Soil	Ca	mg/Kg	3200	4321.276	7436.674	8681.887	11018.383	24	22
S	Soil	Cd	mg/kg	<DL	0.195	0.366	0.479	0.854	30	27
S	Soil	Ce	mg/Kg	76.532	121.082	155.643	164.796	205.363	21	19
S	Soil	Co	mg/Kg	1.8	3.712	4.939	5.579	39.949	24	22
S	Soil	Cr	mg/kg	6.639	16.327	26.595	39.413	196.44	30	27
S	Soil	Cs	mg/Kg	0.691	0.811	1.333	1.523	2.144	21	19
S	Soil	Cu	mg/kg	2.46	4.864	6.539	13.026	83.779	30	27
S	Soil	Dy	mg/kg	3.154	4.022	5.754	6.444	10.114	21	19
S	Soil	Er	mg/kg	1.517	2.012	2.916	3.326	5.136	21	19
S	Soil	Eu	mg/kg	0.811	1.347	1.534	1.676	2.875	21	19
S	Soil	Fe	mg/kg	17216.379	28129.934	31431.712	50645.686	70756	30	27
S	Soil	Ga	mg/Kg	8.473	10.845	11.657	14.544	18.073	21	19

S	Soil	Gd	mg/kg	6.738	11.663	13.25	14.037	20.666	21	19
S	Soil	Hf	mg/kg	0.768	1.601	1.798	2.092	2.754	21	19
S	Soil	Hg	mg/kg	0.018	0.031	0.038	0.055	0.09	29	27
S	Soil	Ho	mg/kg	0.588	0.767	1.091	1.235	1.943	21	19
S	Soil	K	mg/Kg	400	2516.432	2673.33	3319.457	11665.205	24	22
S	Soil	La	mg/Kg	37.652	57.846	75.338	86.79	107.626	21	19
S	Soil	Li	mg/Kg	6.864	7.646	9.076	15.835	25.622	21	19
S	Soil	Lu	mg/kg	0.192	0.216	0.313	0.432	0.652	21	19
S	Soil	Mg	mg/Kg	1620.447	2838.243	3377.623	4318.213	12167.14	24	22
S	Soil	Mn	mg/Kg	220	523.374	608.795	773.855	1254.968	24	22
S	Soil	Mo	mg/Kg	0.204	0.599	0.772	1.243	7.9	24	22
S	Soil	Na	mg/Kg	210	1095.712	1220.503	2206.164	6099.437	24	22
S	Soil	Nb	mg/kg	0.075	0.261	0.734	2.093	5.475	21	19
S	Soil	Nd	mg/Kg	26.199	46.500	54.345	57.639	85.349	21	19
S	Soil	Ni	mg/kg	2.643	4.323	7.080	16.250	201.869	30	27
S	Soil	P	mg/Kg	722.46	983.815	1052.042	1513.253	2668.727	24	22
S	Soil	Pb	mg/kg	5.07	12.198	13.284	17.551	87	30	27
S	Soil	Pd	mg/Kg	0.119	0.141	0.189	0.203	0.296	21	19
S	Soil	Pr	mg/kg	7.537	12.734	15.135	16.503	22.891	21	19
S	Soil	Pt	mg/Kg	0.019	0.030	0.036	0.041	0.05	21	19
S	Soil	Ra	mg/Kg	0.125	0.263	0.4	0.435	0.47	3	3
S	Soil	Rb	mg/Kg	19.234	26.225	31.549	41.589	61.864	21	19
S	Soil	Re	mg/kg	0.003	0.004	0.006	0.008	0.012	21	19
S	Soil	Ru	mg/kg	<DL	<DL	<DL	<DL	0.002	21	19
S	Soil	Sb	mg/Kg	<DL	<DL	<DL	<DL	0.46	24	22
S	Soil	Sc	mg/Kg	2.336	4.089	5.762	6.341	11.98	21	19
S	Soil	Se	mg/kg	<DL	0.100	0.1785	0.266	1.4	30	27
S	Soil	Sm	mg/kg	4.555	7.941	9.49	9.959	15.268	21	19
S	Soil	Sn	mg/Kg	<DL	4.750	9.5	10.75	12	3	3
S	Soil	Sr	mg/Kg	27	40.163	59.902	87.048	159.454	24	22
S	Soil	Ta	mg/Kg	0.01	0.020	0.028	0.04	0.056	21	19
S	Soil	Tb	mg/kg	0.668	0.928	1.283	1.363	2.125	21	19
S	Soil	Te	mg/Kg	<DL	<DL	<DL	<DL	0.04	21	19
S	Soil	Th	mg/Kg	5.835	8.171	9.826	11.811	79	24	22
S	Soil	Ti	mg/Kg	254.886	347.494	401.030	439.367	1200	24	22
S	Soil	Tl	mg/Kg	<DL	0.100	0.1125	0.161	0.86	24	22
S	Soil	Tm	mg/kg	0.212	0.267	0.397	0.475	0.721	21	19
S	Soil	U	mg/Kg	1.866	2.710	3.472	4.834	74	27	22
S	Soil	V	mg/kg	8.611	22.231	37.145	47.503	234.965	30	27
S	Soil	W	mg/Kg	<DL	0.016	0.02	0.047	0.101	21	19
S	Soil	Y	mg/Kg	13.433	17.166	24.223	28.594	45.05	21	19
S	Soil	Yb	mg/kg	1.309	1.534	2.309	2.999	4.377	21	19
S	Soil	Zn	mg/kg	35.16	60.557	68.538	100.651	380	30	27
S	Soil	Zr	mg/Kg	36.16	78.836	85.347	123.98	174.49	21	19
S	Unfiltered water	Ag	µg/l	<DL	<DL	<DL	<DL	0.287	30	25

S	Unfiltered water	Al	µg/l	<DL	1.262	14	27.475	65.1	30	25
S	Unfiltered water	As	µg/l	<DL	0.118	0.735	1.818	2.83	30	25
S	Unfiltered water	Au	µg/l	<DL	0.004	0.007	0.012	0.021	30	25
S	Unfiltered water	Ba	µg/l	0.098	0.323	1.142	2.573	6.93	30	25
S	Unfiltered water	Be	µg/l	0.001	0.010	0.021	0.043	0.142	30	25
S	Unfiltered water	Bi	µg/l	<DL	2.25E-04	0.001	0.002	0.005	30	25
S	Unfiltered water	Ca	µg/l	1361	1750	2076.65	2849.75	3505	30	25
S	Unfiltered water	Cd	µg/l	<DL	0.004	0.01	0.023	0.091	30	25
S	Unfiltered water	Ce	µg/l	<DL	0.004	0.032	0.080	0.115	30	25
S	Unfiltered water	Co	µg/l	<DL	<DL	0.003	0.009	0.019	30	25
S	Unfiltered water	Cr	µg/l	<DL	0.016	0.024	0.038	0.151	30	25
S	Unfiltered water	Cs	µg/l	<DL	0.005	0.013	0.0198	0.063	30	25
S	Unfiltered water	Cu	µg/l	0.005	0.049	0.078	0.315	11.58	30	25
S	Unfiltered water	Fe	µg/l	<DL	0.577	2.638	4.717	24.35	30	25
S	Unfiltered water	Ga	µg/l	0.009	0.034	0.089	0.153	0.213	30	25
S	Unfiltered water	Hg	µg/l	<DL	<DL	<DL	<DL	0.127	30	25
S	Unfiltered water	K	µg/l	167	327.703	347.71	370.75	651	30	25
S	Unfiltered water	La	µg/l	0.014	0.027	0.121	0.210	0.301	30	25
S	Unfiltered water	Li	µg/l	0.22	0.556	0.818	0.888	1.59	30	25
S	Unfiltered water	Mg	µg/l	342	412.500	478.8	518.8	644	30	25
S	Unfiltered water	Mn	µg/l	<DL	0.003	0.055	0.208	0.41	30	25
S	Unfiltered water	Mo	µg/l	0.432	2.324	4.484	5.374	6.218	30	25
S	Unfiltered water	Na	µg/l	3937	5530.750	7726	9512.225	11857	30	25
S	Unfiltered water	Nd	µg/l	0.018	0.033	0.116	0.265	0.479	30	25
S	Unfiltered water	Ni	µg/l	<DL	<DL	0.032	0.099	0.374	30	25
S	Unfiltered water	P	µg/l	<DL	<DL	<DL	0.724	5.3	30	25
S	Unfiltered water	Pb	µg/l	0.001	0.021	0.055	0.167	0.487	30	25
S	Unfiltered water	Pd	µg/l	<DL	<DL	0.002	0.004	0.011	30	25
S	Unfiltered water	Pt	µg/l	<DL	<DL	<DL	<DL	<DL	18	13
S	Unfiltered water	Rb	µg/l	0.579	1.721	2.14	2.474	4.85	30	25
S	Unfiltered water	Rh	µg/l	<DL	<DL	<DL	0.002	0.004	12	12
S	Unfiltered water	S	µg/l	73.951	503.128	904.915	1186.75	1540	30	25
S	Unfiltered water	Sb	µg/l	<DL	0.027	0.037	0.064	0.124	30	25
S	Unfiltered water	Sc	µg/l	0.097	0.168	0.231	0.311	0.883	30	25
S	Unfiltered water	Se	µg/l	<DL	0.010	0.199	0.284	0.433	30	25
S	Unfiltered water	Si	µg/l	44.403	71.947	89.887	110.008	114.02	12	12
S	Unfiltered water	Sn	µg/l	<DL	0.018	0.048	0.093	1.187	30	25
S	Unfiltered water	Sr	µg/l	6.23	8.990	11.552	14.505	20.97	30	25
S	Unfiltered water	Ta	µg/l	<DL	<DL	0.015	0.020	0.052	30	25
S	Unfiltered water	Te	µg/l	<DL	<DL	0.002	0.005	0.015	30	25
S	Unfiltered water	Th	µg/l	0.0009	0.005	0.007	0.013	0.032	30	25
S	Unfiltered water	Ti	µg/l	<DL	0.197	0.282	0.525	1.195	30	25
S	Unfiltered water	Tl	µg/l	<DL	<DL	<DL	0.004	0.087	30	25
S	Unfiltered water	U	µg/l	0.0088	0.035	0.054	0.286	0.695	30	25
S	Unfiltered water	V	µg/l	<DL	0.010	0.031	0.046	0.12	30	25

S	Unfiltered water	W	µg/l	0.013	0.032	0.091	0.149	0.299	30	25
S	Unfiltered water	Y	µg/l	0.032	0.078	0.109	0.311	0.622	30	25
S	Unfiltered water	Zn	µg/l	<DL	0.079	2.27	3.214	16.29	30	25
S	Unfiltered water	Zr	µg/l	0.029	0.057	0.101	0.154	0.284	30	25

Table A2.2 Regional environmental baseline element concentration values for the region "Southwest Greenland" (SW). q25 refers to the 25% percentile (1st quatile) and q75 to the 75% percentile (3rd quatile). "No of meas." refers to the number of concentration measurements of the particular element, in the particular sample type, for the particular region. DL refers to detection limit.

GRL region	Category	Element	Unit	Min	q25	Median	q75	Max	No. of meas.	No. of samples
SW	Blue mussel	Ag	mg/kg	<DL	<DL	0.069	0.079	0.112	39	36
SW	Blue mussel	Al	mg/kg	0.141	102.88	188.94	428.474	1500	69	63
SW	Blue mussel	As	mg/kg	<DL	10.320	11.75	14.912	20.094	69	63
SW	Blue mussel	Au	mg/kg	<DL	<DL	0.008	0.014	0.034	39	36
SW	Blue mussel	Ba	mg/kg	<DL	0.820	1.871	7.088	15	39	36
SW	Blue mussel	Be	mg/Kg	9.00E-04	0.002	0.003	0.005	0.008	27	24
SW	Blue mussel	Bi	mg/kg	<DL	<DL	0.001	0.003	0.011	39	36
SW	Blue mussel	Ca	mg/kg	3	2740.5	3294	4015.5	10000	27	26
SW	Blue mussel	Cd	mg/kg	0.107	2.661	3.205	4.307	8.643	69	63
SW	Blue mussel	Ce	mg/Kg	<DL	0.262	0.419	1.052	15	39	36
SW	Blue mussel	Co	mg/Kg	0.01	0.42	0.6	1.28	3.3	39	36
SW	Blue mussel	Cr	mg/Kg	0.04	0.948	1.268	1.94	6.2	69	63
SW	Blue mussel	Cs	mg/kg	0.006	0.018	0.022	0.026	0.03	27	24
SW	Blue mussel	Cu	mg/kg	0.13	5.8	7.14	8.18	25	69	63
SW	Blue mussel	d.m.%	%	11.66	16.72	18.63	20.965	24.84	128	125
SW	Blue mussel	Dy	mg/Kg	0.013	0.016	0.020	0.025	0.029	12	10
SW	Blue mussel	Er	mg/Kg	0.006	0.008	0.010	0.011	0.012	12	10
SW	Blue mussel	Eu	mg/Kg	0.006	0.007	0.007	0.010	0.023	12	10
SW	Blue mussel	Fe	mg/kg	<DL	160.672	210.9	351.334	1500	69	63
SW	Blue mussel	Ga	mg/kg	0.035	0.068	0.094	0.115	0.4	27	24
SW	Blue mussel	Gd	mg/Kg	0.052	0.067	0.077	0.096	0.127	12	10
SW	Blue mussel	Ge	mg/kg	0.03	0.040	0.0435	0.0485	0.062	12	10
SW	Blue mussel	Hf	mg/kg	<DL	<DL	<DL	<DL	0.021	12	10
SW	Blue mussel	Hg	mg/kg	0.029	0.099	0.118	0.145	0.816	69	63
SW	Blue mussel	Ho	mg/Kg	0.003	0.003	0.004	0.005	0.005	12	10
SW	Blue mussel	K	mg/kg	38	14000	18053	23496.5	39686	27	26
SW	Blue mussel	La	mg/Kg	<DL	0.336	0.514	0.699	19	35	32
SW	Blue mussel	Li	mg/kg	0.005	0.578	0.879	1.106	1.482	27	24
SW	Blue mussel	Lu	mg/Kg	7.26E-04	8.73E-04	0.001	0.001	0.002	12	10
SW	Blue mussel	Mg	mg/kg	0.2	3312.044	3825	4902.573	9936	57	53
SW	Blue mussel	Mn	mg/Kg	0.03	5.431	6.399	8.07	39	69	63
SW	Blue mussel	Mo	mg/Kg	0.063	0.543	0.637	0.761	1.095	69	63
SW	Blue mussel	Na	mg/kg	95	16500	33804	57030.5	94661	27	26
SW	Blue mussel	Nb	mg/Kg	<DL	0.01	0.012	0.0145	0.024	12	10
SW	Blue mussel	Nd	mg/Kg	<DL	0.210	0.286	0.463	5.7	39	36
SW	Blue mussel	Ni	mg/Kg	<DL	1.450	2.039	3.41	19.009	69	63

SW	Blue mussel	P	mg/kg	33	9561.5	10496	11000	16344	39	36
SW	Blue mussel	Pb	mg/kg	0.005	0.395	0.479	0.655	6.6	69	63
SW	Blue mussel	Pd	mg/kg	<DL	0.002	0.005	0.007	0.020	15	14
SW	Blue mussel	Pr	mg/Kg	0.045	0.067	0.069	0.095	0.108	12	10
SW	Blue mussel	Pt	mg/kg	0.001	0.001	0.001	0.002	0.002	12	10
SW	Blue mussel	Rb	mg/Kg	0.021	6.205	6.641	8.776	10.47	27	24
SW	Blue mussel	Re	mg/kg	1.81E-04	3.08E-04	3.55E-04	3.96E-04	8.04E-04	12	10
SW	Blue mussel	Rh	mg/kg	9.00E-04	0.002	0.002	0.002	0.003	27	24
SW	Blue mussel	S	mg/kg	1574	23159	24072	26212	33721	15	14
SW	Blue mussel	Sb	mg/kg	<DL	<DL	0.007	0.013	0.026	39	36
SW	Blue mussel	Sc	mg/kg	<DL	<DL	0.562	1.215	4.148	39	36
SW	Blue mussel	Se	mg/kg	0.03	2.985	3.48	5.6	9.8	39	36
SW	Blue mussel	Si	mg/kg	8.232	242.29	386.28	467.935	814.02	27	24
SW	Blue mussel	Sm	mg/Kg	<DL	<DL	0.014	0.040	0.063	24	22
SW	Blue mussel	Sn	mg/Kg	<DL	<DL	<DL	<DL	0.031	39	36
SW	Blue mussel	Sr	mg/kg	<DL	30.55	43.5	51.95	76.3	39	36
SW	Blue mussel	Ta	mg/kg	<DL	<DL	<DL	3.00E-04	0.009	27	24
SW	Blue mussel	Tb	mg/Kg	0.003	0.004	0.004	0.005	0.006	12	10
SW	Blue mussel	Te	mg/kg	<DL	0.003	0.003	0.004	0.006	12	10
SW	Blue mussel	Th	mg/Kg	<DL	<DL	0.010	0.019	0.070	39	36
SW	Blue mussel	Ti	mg/kg	0.177	29.215	43.408	110.275	173.45	47	43
SW	Blue mussel	Tl	mg/kg	<DL	<DL	0.004	0.01	0.019	39	36
SW	Blue mussel	Tm	mg/Kg	7.76E-04	8.85E-04	0.001	0.001	0.002	12	10
SW	Blue mussel	U	mg/Kg	2.00E-04	0.161	0.23	0.3	0.43	39	36
SW	Blue mussel	V	mg/Kg	0.522	0.756	1.029	1.543	4.5	54	49
SW	Blue mussel	W	mg/kg	<DL	<DL	0.003	0.017	0.113	24	22
SW	Blue mussel	Y	mg/Kg	<DL	<DL	0.079	0.124	0.185	39	36
SW	Blue mussel	Yb	mg/Kg	0.004	0.005	0.007	0.008	0.009	12	10
SW	Blue mussel	Zn	mg/Kg	0.17	66.031	80.485	98	135.48	69	63
SW	Blue mussel	Zr	mg/Kg	0.002	0.034	0.047	0.067	0.155	35	31
SW	Crinkled snow lichen	Ag	mg/kg	<DL	<DL	<DL	0.005	0.038	64	61
SW	Crinkled snow lichen	Al	mg/kg	24	142.67	231.458	390	2200	103	97
SW	Crinkled snow lichen	As	mg/kg	<DL	<DL	0.03	0.051	0.76	103	97
SW	Crinkled snow lichen	Au	mg/kg	<DL	<DL	<DL	<DL	0.015	64	61
SW	Crinkled snow lichen	Ba	mg/kg	1.144	7.726	28.5	42.25	140	64	61
SW	Crinkled snow lichen	Be	mg/kg	6.00E-04	0.002	0.002	0.003	0.007	25	22
SW	Crinkled snow lichen	Bi	mg/kg	<DL	<DL	<DL	0.001	0.008	64	61
SW	Crinkled snow lichen	Ca	mg/kg	500	5167.5	9700	13000	27000	52	51
SW	Crinkled snow lichen	Cd	mg/kg	0.015	0.060	0.095	0.138	0.525	108	99
SW	Crinkled snow lichen	Ce	mg/kg	<DL	0.307	1.002	5.075	11	64	61
SW	Crinkled snow lichen	Co	mg/kg	<DL	0.11	0.43	0.908	4.6	64	61
SW	Crinkled snow lichen	Cr	mg/kg	<DL	0.204	0.416	1.25	3.3	103	97
SW	Crinkled snow lichen	Cs	mg/kg	0.006	0.017	0.03	0.057	0.087	25	22
SW	Crinkled snow lichen	Cu	mg/kg	<DL	0.561	0.883	2.2	13	103	97
SW	Crinkled snow lichen	d.m.%	%	100	100	100	100	100	13	12

SW	Crinkled snow lichen	Dy	mg/kg	0.009	0.012	0.015	0.017	0.019	12	10
SW	Crinkled snow lichen	Er	mg/kg	0.004	0.006	0.007	0.008	0.009	12	10
SW	Crinkled snow lichen	Eu	mg/kg	0.004	0.005	0.006	0.007	0.008	12	10
SW	Crinkled snow lichen	Fe	mg/kg	27	78.701	129.2	475	1500	103	97
SW	Crinkled snow lichen	Ga	mg/kg	0.017	0.033	0.06	0.285	0.551	25	22
SW	Crinkled snow lichen	Gd	mg/kg	0.033	0.042	0.051	0.066	0.081	12	10
SW	Crinkled snow lichen	Ge	mg/kg	0.012	0.016	0.018	0.025	0.03	12	10
SW	Crinkled snow lichen	Hf	mg/kg	<DL	<DL	<DL	<DL	<DL	12	10
SW	Crinkled snow lichen	Hg	mg/kg	<DL	0.026	0.034	0.094	0.31	107	98
SW	Crinkled snow lichen	Ho	mg/kg	0.002	0.002	0.003	0.003	0.003	12	10
SW	Crinkled snow lichen	K	mg/kg	86	2164.5	2400.000	2600	3200	52	51
SW	Crinkled snow lichen	La	mg/kg	0.090	0.181	1.7	2.8	6.5	59	56
SW	Crinkled snow lichen	Li	mg/kg	0.012	0.026	0.037	0.049	0.100	25	22
SW	Crinkled snow lichen	Lu	mg/kg	4.70E-04	7.31E-04	8.61E-04	9.72E-04	0.001	12	10
SW	Crinkled snow lichen	Mg	mg/kg	88	857.6	1300	1800	3532	91	87
SW	Crinkled snow lichen	Mn	mg/kg	1.7	26.405	41.34	62.338	122.319	103	97
SW	Crinkled snow lichen	Mo	mg/kg	<DL	<DL	0.013	0.025	0.23	103	97
SW	Crinkled snow lichen	Na	mg/kg	<DL	677.5	810	1300	4262	52	51
SW	Crinkled snow lichen	Nb	mg/kg	0.009	0.016	0.018	0.026	0.031	12	10
SW	Crinkled snow lichen	Nd	mg/kg	<DL	0.064	0.184	1.525	5.3	64	61
SW	Crinkled snow lichen	Ni	mg/kg	<DL	0.285	0.696	2.15	6.5	103	97
SW	Crinkled snow lichen	P	mg/kg	<DL	525	654	740	1300	64	61
SW	Crinkled snow lichen	Pb	mg/kg	<DL	0.428	0.532	0.718	6.3	104	98
SW	Crinkled snow lichen	Pd	mg/kg	<DL	<DL	<DL	9.00E-04	0.004	13	12
SW	Crinkled snow lichen	Pr	mg/kg	0.027	0.034	0.040	0.053	0.056	12	10
SW	Crinkled snow lichen	Pt	mg/kg	<DL	<DL	<DL	<DL	<DL	12	10
SW	Crinkled snow lichen	Rb	mg/kg	0.513	1.015	1.835	3.437	6.582	25	22
SW	Crinkled snow lichen	Re	mg/kg	<DL	<DL	<DL	1.07E-05	6.92E-05	12	10
SW	Crinkled snow lichen	Rh	mg/kg	<DL	3.00E-04	5.00E-04	9.00E-04	0.002	25	22
SW	Crinkled snow lichen	S	mg/kg	167	310	427	599	945	13	12
SW	Crinkled snow lichen	Sb	mg/kg	<DL	<DL	<DL	6.00E-04	0.2	64	61
SW	Crinkled snow lichen	Sc	mg/kg	<DL	<DL	<DL	0.235	1.11	64	61
SW	Crinkled snow lichen	Se	mg/kg	<DL	0.049	0.325	1.125	3.3	68	62
SW	Crinkled snow lichen	Si	mg/kg	64.916	105.97	140.39	163.8	255.65	25	22
SW	Crinkled snow lichen	Sm	mg/kg	<DL	<DL	<DL	<DL	0.033	51	49
SW	Crinkled snow lichen	Sn	mg/kg	<DL	<DL	<DL	3.00E-04	0.032	64	61
SW	Crinkled snow lichen	Sr	mg/kg	<DL	19.125	36.65	54.75	100	64	61
SW	Crinkled snow lichen	Ta	mg/kg	<DL	<DL	<DL	1.00E-04	0.003	25	22
SW	Crinkled snow lichen	Tb	mg/kg	0.002	0.002	0.003	0.003	0.004	12	10
SW	Crinkled snow lichen	Te	mg/kg	<DL	<DL	<DL	<DL	<DL	12	10
SW	Crinkled snow lichen	Th	mg/Kg	<DL	<DL	<DL	0.011	0.032	64	61
SW	Crinkled snow lichen	Ti	mg/kg	1.4	15.123	27.873	47.75	110	74	71
SW	Crinkled snow lichen	Tl	mg/kg	<DL	<DL	<DL	<DL	0.033	64	61
SW	Crinkled snow lichen	Tm	mg/kg	5.30E-04	7.51E-04	9.46E-04	0.001	0.001	12	10
SW	Crinkled snow lichen	U	mg/Kg	<DL	<DL	<DL	0.007	0.024	64	61

SW	Crinkled snow lichen	V	mg/kg	<DL	0.181	0.320	1.475	4.3	90	85
SW	Crinkled snow lichen	W	mg/kg	<DL	<DL	<DL	<DL	6.3	51	49
SW	Crinkled snow lichen	Y	mg/kg	<DL	<DL	<DL	0.054	1	64	61
SW	Crinkled snow lichen	Yb	mg/kg	0.004	0.005	0.006	0.007	0.008	12	10
SW	Crinkled snow lichen	Zn	mg/kg	<DL	14.929	18.495	23.278	39.79	104	98
SW	Crinkled snow lichen	Zr	mg/kg	0.053	0.089	0.113	0.155	0.222	35	32
SW	Filtered water	Ag	µg/l	<DL	<DL	0.003	0.010	0.195	67	47
SW	Filtered water	Al	µg/l	2	10.86	18.8	25	206.2	77	57
SW	Filtered water	As	µg/l	<DL	<DL	0.025	0.059	0.177	66	47
SW	Filtered water	Au	µg/l	<DL	<DL	0.003	0.007	0.065	67	47
SW	Filtered water	B	µg/l	0.196	0.2645	0.316	0.458	2.297	27	27
SW	Filtered water	Ba	µg/l	<DL	4.434	21.894	38.146	263.79	67	47
SW	Filtered water	Be	µg/l	<DL	<DL	0.004	0.009	0.024	37	37
SW	Filtered water	Bi	µg/l	<DL	3.00E-04	6.00E-04	8.50E-04	0.008	51	39
SW	Filtered water	Ca	µg/l	949	1900.65	8058.4	16072.5	24362	67	47
SW	Filtered water	Cd	µg/l	<DL	<DL	0.005	0.013	0.106	66	47
SW	Filtered water	Ce	µg/l	<DL	0.121	0.246	0.39	1.03	67	47
SW	Filtered water	Co	µg/l	0.002	0.02	0.051	0.104	0.372	67	47
SW	Filtered water	Cr	µg/l	<DL	0.116	0.194	0.293	0.57	77	57
SW	Filtered water	Cs	µg/l	<DL	<DL	<DL	0.006	0.015	37	37
SW	Filtered water	Cu	µg/l	0.058	0.5	3.304	5	8.45	77	57
SW	Filtered water	Dy	µg/l	4.00E-04	0.006	0.010	0.014	0.028	35	35
SW	Filtered water	Er	µg/l	2.10E-04	0.003	0.004	0.007	0.012	35	35
SW	Filtered water	Eu	µg/l	2.00E-04	0.003	0.008	0.012	0.037	35	35
SW	Filtered water	Fe	µg/l	<DL	6	23.1	51.47	239.4	77	57
SW	Filtered water	Ga	µg/l	<DL	0.006	0.013	0.021	0.054	37	37
SW	Filtered water	Gd	µg/l	9.00E-04	0.011	0.023	0.031	0.086	35	35
SW	Filtered water	Ge	µg/l	0.0064	0.017	0.022	0.027	0.057	17	17
SW	Filtered water	Hf	µg/l	1.00E-04	0.002	0.004	0.005	0.008	35	35
SW	Filtered water	Hg	µg/l	<DL	<DL	0.004	0.009	0.021	66	47
SW	Filtered water	Ho	µg/l	<DL	8.65E-04	0.002	0.003	0.005	35	35
SW	Filtered water	K	µg/l	203	826.6	1725	3014	4989	67	47
SW	Filtered water	La	µg/l	<DL	0.176	0.323	0.41	0.736	67	47
SW	Filtered water	Li	µg/l	<DL	0.151	0.330	0.416	1.537	48	47
SW	Filtered water	Lu	µg/l	1.00E-05	3.75E-04	6.80E-04	0.001	0.002	35	35
SW	Filtered water	Mg	µg/l	107.98	420	2754	4911	18390	77	57
SW	Filtered water	Mn	µg/l	0.06	0.236	1.46	3.76	99.368	77	57
SW	Filtered water	Mo	µg/l	0.008	0.104	0.223	0.299	3.13	66	47
SW	Filtered water	Na	µg/l	351	1214.500	2397	4596.5	127430	67	47
SW	Filtered water	Nb	µg/l	<DL	0.001	0.004	0.007	0.021	35	35
SW	Filtered water	Nd	µg/l	<DL	0.129	0.242	0.324	0.878	67	47
SW	Filtered water	Ni	µg/l	<DL	0.58	1.533	2.741	7.488	77	57
SW	Filtered water	P	µg/l	1.7	3.2	5.1	7.855	27.4	67	47
SW	Filtered water	Pb	µg/l	<DL	0.011	0.025	0.059	0.548	77	57
SW	Filtered water	Pd	µg/l	<DL	<DL	3.00E-04	0.004	0.018	37	37

SW	Filtered water	Pr	µg/l	0.0045	0.028	0.058	0.077	0.207	35	35
SW	Filtered water	Pt	µg/l	<DL	9.00E-04	0.001	0.002	0.007	48	47
SW	Filtered water	Rb	µg/l	<DL	1.076	1.545	2.075	3.23	48	47
SW	Filtered water	Re	µg/l	<DL	3.50E-04	0.001	0.002	0.020	35	35
SW	Filtered water	Rh	µg/l	5.00E-04	0.001	0.0011	0.001	0.002	17	17
SW	Filtered water	Ru	µg/l	<DL	<DL	3.00E-04	0.001	0.002	35	35
SW	Filtered water	S	µg/l	445	866	1398.2	2806.6	21048	48	47
SW	Filtered water	Sb	µg/l	0.012	0.024	0.037	0.05	0.342	56	37
SW	Filtered water	Sc	µg/l	0.011	0.034	0.053	0.074	0.131	67	47
SW	Filtered water	Se	µg/l	<DL	0.038	0.102	0.156	0.407	56	37
SW	Filtered water	Si	µg/l	4.95	8.12	13.76	16.755	53.31	35	35
SW	Filtered water	Sm	µg/l	0.002	0.024	0.034	0.046	0.12	54	35
SW	Filtered water	Sn	µg/l	<DL	<DL	0.008	0.02	0.165	67	47
SW	Filtered water	Sr	µg/l	3.63	8.032	47.263	115.02	210.75	67	47
SW	Filtered water	Ta	µg/l	<DL	3.25E-04	0.002	0.004	0.011	48	47
SW	Filtered water	Tb	µg/l	9.00E-05	0.001	0.002	0.003	0.008	35	35
SW	Filtered water	Te	µg/l	<DL	<DL	0.001	0.004	0.019	29	29
SW	Filtered water	Th	µg/l	<DL	0.009	0.016	0.025	0.121	67	47
SW	Filtered water	Ti	µg/l	0.007	0.135	0.237	0.378	6.39	77	57
SW	Filtered water	Tl	µg/l	<DL	0.002	0.007	0.016	0.049	56	37
SW	Filtered water	Tm	µg/l	1.00E-05	3.40E-04	6.80E-04	0.001	0.003	35	35
SW	Filtered water	U	µg/l	<DL	0.021	0.035	0.075	0.175	56	37
SW	Filtered water	V	µg/l	<DL	0.048	0.167	0.215	0.848	77	57
SW	Filtered water	W	µg/l	0.001	0.005	0.010	0.024	0.161	56	37
SW	Filtered water	Y	µg/l	0.004	0.035	0.053	0.073	0.138	67	47
SW	Filtered water	Yb	µg/l	3.40E-04	0.002	0.004	0.005	0.009	35	35
SW	Filtered water	Zn	µg/l	0.048	0.49	1.19	1.845	60.42	77	57
SW	Filtered water	Zr	µg/l	<DL	0.010	0.053	0.109	0.223	58	57
SW	Seaweed	Ag	mg/kg	<DL	0.099	0.119	0.168	0.215	30	25
SW	Seaweed	Al	mg/kg	3.527	19.63	47.859	83.998	382.735	49	43
SW	Seaweed	As	mg/kg	15.417	30.94	42.089	46.72	91	49	43
SW	Seaweed	Au	mg/kg	<DL	0.005	0.009	0.011	0.035	30	25
SW	Seaweed	Ba	mg/Kg	3.674	7.922	10.136	12.453	67	30	25
SW	Seaweed	Be	mg/Kg	<DL	4.50E-04	0.001	0.003	0.005	27	22
SW	Seaweed	Bi	mg/kg	<DL	0.001	0.001	0.002	0.006	30	25
SW	Seaweed	Ca	mg/kg	4722	6272	6673	7751	22879	17	16
SW	Seaweed	Cd	mg/Kg	0.860	1.393	1.847	2.407	3.466	49	43
SW	Seaweed	Ce	mg/Kg	<DL	0.077	0.134	0.190	0.364	30	25
SW	Seaweed	Co	mg/Kg	0.42	0.55	0.69	0.935	3.5	30	25
SW	Seaweed	Cr	mg/Kg	0.095	0.26	0.45	0.621	5.9	49	43
SW	Seaweed	Cs	mg/kg	0.019	0.022	0.025	0.033	0.047	27	22
SW	Seaweed	Cu	mg/kg	1.18	1.512	1.968	2.613	12	49	43
SW	Seaweed	d.m.%	%	100	100	100	100	100	14	13
SW	Seaweed	Dy	mg/Kg	0.006	0.010	0.014	0.015	0.022	13	10
SW	Seaweed	Er	mg/Kg	0.003	0.006	0.008	0.009	0.012	13	10

SW	Seaweed	Eu	mg/Kg	0.002	0.004	0.005	0.008	0.009	13	10
SW	Seaweed	Fe	mg/Kg	15.7	46.407	75.3	120	386	49	43
SW	Seaweed	Ga	mg/kg	0.024	0.033	0.045	0.382	0.78	27	22
SW	Seaweed	Gd	mg/Kg	0.023	0.043	0.049	0.082	0.105	13	10
SW	Seaweed	Ge	mg/kg	0.013	0.022	0.025	0.033	0.067	13	10
SW	Seaweed	Hf	mg/kg	<DL	<DL	<DL	<DL	<DL	13	10
SW	Seaweed	Hg	mg/kg	<DL	<DL	0.007	0.018	0.15	49	43
SW	Seaweed	Ho	mg/Kg	0.001	0.002	0.003	0.003	0.005	13	10
SW	Seaweed	K	mg/kg	28966	30032	34171	37000	44000	17	16
SW	Seaweed	La	mg/Kg	0.037	0.113	0.161	0.208	0.567	27	22
SW	Seaweed	Li	mg/kg	0.283	0.358	0.433	0.660	1.188	27	22
SW	Seaweed	Lu	mg/Kg	5.55E-04	9.62E-04	0.001	0.001	0.002	13	10
SW	Seaweed	Mg	mg/kg	4776.9	7006.912	7742	8031.25	12000	36	34
SW	Seaweed	Mn	mg/Kg	8.4	13.35	18.52	24.372	59.42	49	43
SW	Seaweed	Mo	mg/Kg	<DL	0.112	0.167	0.224	0.416	49	43
SW	Seaweed	Na	mg/kg	22037	30785	32778	38155	51000	17	16
SW	Seaweed	Nb	mg/Kg	0.003	0.006	0.008	0.011	0.024	13	10
SW	Seaweed	Nd	mg/Kg	<DL	0.085	0.134	0.155	0.300	30	25
SW	Seaweed	Ni	mg/Kg	0.587	1.786	2.3	3.56	8.696	49	43
SW	Seaweed	P	mg/kg	1951	2576.25	2908.5	3131.25	6198	30	25
SW	Seaweed	Pb	mg/Kg	<DL	0.05	0.078	0.131	0.314	49	43
SW	Seaweed	Pd	mg/kg	0.022	0.027	0.032	0.038	0.046	14	13
SW	Seaweed	Pr	mg/Kg	0.013	0.034	0.038	0.056	0.084	13	10
SW	Seaweed	Pt	mg/kg	0.002	0.002	0.002	0.003	0.005	13	10
SW	Seaweed	Rb	mg/Kg	5.518	6.794	8.348	11.912	16.951	27	22
SW	Seaweed	Re	mg/kg	0.052	0.057	0.070	0.077	0.090	13	10
SW	Seaweed	Rh	mg/kg	0.015	0.022	0.024	0.028	0.042	27	22
SW	Seaweed	S	mg/kg	28734	31408.75	34243	35306.75	39674	14	13
SW	Seaweed	Sb	mg/Kg	<DL	0.026	0.034	0.040	0.056	30	25
SW	Seaweed	Sc	mg/kg	<DL	0.083	0.336	0.683	2.821	30	25
SW	Seaweed	Se	mg/kg	0.12	0.203	0.255	0.288	1.8	30	25
SW	Seaweed	Si	mg/kg	15.897	32.609	65.658	189.61	495.29	27	22
SW	Seaweed	Sm	mg/Kg	<DL	0.016	0.022	0.026	0.041	16	13
SW	Seaweed	Sn	mg/kg	<DL	<DL	0.005	0.008	0.029	30	25
SW	Seaweed	Sr	mg/kg	342.2	623.4	704.4	888.75	1256.1	30	25
SW	Seaweed	Ta	mg/kg	<DL	<DL	<DL	9.50E-04	0.003	27	22
SW	Seaweed	Tb	mg/Kg	9.71E-04	0.002	0.002	0.003	0.005	13	10
SW	Seaweed	Te	mg/kg	0.005	0.008	0.008	0.011	0.013	13	10
SW	Seaweed	Th	mg/Kg	<DL	0.007	0.009	0.014	0.022	30	25
SW	Seaweed	Ti	mg/kg	1.459	9.287	20.002	35.539	46.482	34	28
SW	Seaweed	Tl	mg/kg	<DL	0.002	0.006	0.008	0.037	30	25
SW	Seaweed	Tm	mg/Kg	4.10E-04	8.13E-04	0.001	0.001	0.002	13	10
SW	Seaweed	U	mg/Kg	0.24	0.440	0.569	0.657	0.762	30	25
SW	Seaweed	V	mg/Kg	<DL	0.203	0.447	0.789	1.733	35	31
SW	Seaweed	W	mg/kg	<DL	0.003	0.006	0.007	0.011	16	13

SW	Seaweed	Y	mg/Kg	<DL	0.048	0.069	0.093	0.182	30	25
SW	Seaweed	Yb	mg/Kg	0.004	0.005	0.007	0.009	0.011	13	10
SW	Seaweed	Zn	mg/Kg	7.616	10.620	13.17	16	26.881	49	43
SW	Seaweed	Zr	mg/Kg	0.108	0.18	0.217	0.253	0.441	31	25
SW	Sediment	Al	mg/kg	34471.601	39524.713	41602.015	52153.927	57910.718	10	8
SW	Sediment	As	mg/kg	0.859	1.094	3.017	4.978	19.074	16	12
SW	Sediment	Cd	mg/kg	0.071	0.099	0.161	0.221	0.531	12	9
SW	Sediment	Cr	mg/kg	66.689	74.170	91.695	98.147	116.609	10	8
SW	Sediment	Cu	mg/kg	18.480	28.971	40.496	57.433	72.643	12	9
SW	Sediment	Fe	mg/kg	21052.969	22720.893	25292.210	30382.457	51452.921	10	8
SW	Sediment	Hg	mg/kg	<DL	0.035	0.05	0.072	0.2861	61	12
SW	Sediment	LoI%	mg/kg	0.47	0.47	0.47	0.47	0.47	1	1
SW	Sediment	Mg	mg/kg	4915.908	6153.760	8732.886	13322.570	15827.554	10	8
SW	Sediment	Mn	mg/kg	249.819	281.118	321.591	1585.937	2104.600	10	8
SW	Sediment	Mo	mg/kg	0.599	2.407	10.477	13.434	30.346	10	8
SW	Sediment	Ni	mg/kg	28.010	35.349	40.540	47.306	63.141	12	9
SW	Sediment	Pb	mg/kg	9.363	10.171	11.86	13.561	23.410	12	9
SW	Sediment	Se	mg/kg	1.115	1.121	1.127	1.133	1.139	2	1
SW	Sediment	V	mg/kg	38.653	43.752	46.253	48.363	52.549	10	8
SW	Sediment	Water%	mg/kg	16.8	18.125	19.45	20.775	22.1	2	2
SW	Sediment	Zn	mg/kg	44.493	53.142	61.283	68.773	84.96	12	9
SW	Shorthorn sculpin	Ag	mg/kg	0.130	0.246	0.409	0.482	0.699	23	20
SW	Shorthorn sculpin	Al	mg/kg	0.284	0.732	0.948	1.382	2.641	23	20
SW	Shorthorn sculpin	As	mg/kg	1.92	2.72	3.97	7.415	64.51	23	20
SW	Shorthorn sculpin	Au	mg/kg	0.001	0.002	0.003	0.004	0.006	23	20
SW	Shorthorn sculpin	Ba	mg/kg	0.004	0.005	0.006	0.010	0.016	23	20
SW	Shorthorn sculpin	Be	mg/kg	4.00E-04	5.50E-04	7.00E-04	8.50E-04	0.004	23	20
SW	Shorthorn sculpin	Bi	mg/kg	0.001	0.002	0.003	0.004	0.007	23	20
SW	Shorthorn sculpin	Ca	mg/kg	32	57	73	88	128	23	20
SW	Shorthorn sculpin	Cd	mg/kg	0.353	0.707	0.894	1.575	8.224	23	20
SW	Shorthorn sculpin	Ce	mg/kg	0.001	0.001	0.003	0.006	0.039	23	20
SW	Shorthorn sculpin	Co	mg/kg	0.04	0.05	0.07	0.11	0.24	23	20
SW	Shorthorn sculpin	Cr	mg/kg	0.04	0.05	0.06	0.06	0.44	23	20
SW	Shorthorn sculpin	Cs	mg/kg	0.011	0.019	0.02	0.024	0.031	23	20
SW	Shorthorn sculpin	Cu	mg/kg	1.25	2.155	3.65	6.63	11.15	23	20
SW	Shorthorn sculpin	d.m.%	%	15.57	19.52	22.5	23.593	33.58	22	19
SW	Shorthorn sculpin	Fe	mg/kg	58.7	123.5	179.2	285.5	858.7	23	20
SW	Shorthorn sculpin	Ga	mg/kg	0.026	0.03	0.032	0.035	0.039	23	20
SW	Shorthorn sculpin	Hg	mg/kg	0.046	0.080	0.156	0.198	0.274	23	20
SW	Shorthorn sculpin	K	mg/kg	2400	3640	3963	4296	4848	23	20
SW	Shorthorn sculpin	La	mg/kg	0.002	0.003	0.004	0.006	0.043	23	20
SW	Shorthorn sculpin	Li	mg/kg	0.008	0.022	0.027	0.037	0.066	23	20
SW	Shorthorn sculpin	Mg	mg/kg	118.3	199.75	219.4	251.05	316	23	20
SW	Shorthorn sculpin	Mn	mg/kg	0.32	0.495	0.58	0.73	1.04	23	20
SW	Shorthorn sculpin	Mo	mg/kg	0.061	0.094	0.116	0.126	0.176	23	20

SW	Shorthorn sculpin	Na	mg/kg	1064	2475.5	3118	3880	5987	23	20
SW	Shorthorn sculpin	Nd	mg/kg	0.002	0.003	0.004	0.005	0.015	23	20
SW	Shorthorn sculpin	Ni	mg/kg	<DL	<DL	<DL	0.012	0.102	23	20
SW	Shorthorn sculpin	P	mg/kg	2383	2806	3088	3316.5	3808	23	20
SW	Shorthorn sculpin	Pb	mg/kg	0.007	0.008	0.011	0.016	0.021	23	20
SW	Shorthorn sculpin	Pd	mg/kg	0.002	0.002	0.003	0.003	0.005	23	20
SW	Shorthorn sculpin	Rb	mg/kg	0.277	0.442	0.531	0.605	0.769	23	20
SW	Shorthorn sculpin	Rh	mg/kg	3.00E-04	4.00E-04	4.00E-04	5.00E-04	6.00E-04	23	20
SW	Shorthorn sculpin	S	mg/kg	2790	3708	4005	4410.5	4827	23	20
SW	Shorthorn sculpin	Sb	mg/kg	0.003	0.004	0.004	0.005	0.007	23	20
SW	Shorthorn sculpin	Sc	mg/kg	0.093	0.101	0.11	0.120	0.149	23	20
SW	Shorthorn sculpin	Se	mg/kg	0.94	1.07	1.33	1.525	5.13	23	20
SW	Shorthorn sculpin	Si	mg/kg	6.954	8.277	9.587	11.143	16.672	23	20
SW	Shorthorn sculpin	Sn	mg/kg	0.005	0.007	0.008	0.009	0.012	23	20
SW	Shorthorn sculpin	Sr	mg/kg	0.3	0.5	0.7	0.9	1.8	23	20
SW	Shorthorn sculpin	Ta	mg/kg	0.001	0.001	0.002	0.002	0.003	23	20
SW	Shorthorn sculpin	Th	mg/Kg	4.00E-04	6.00E-04	7.00E-04	9.00E-04	0.001	23	20
SW	Shorthorn sculpin	Ti	mg/kg	24.197	27.633	30.048	33.05	38.491	23	20
SW	Shorthorn sculpin	Tl	mg/kg	0.002	0.003	0.003	0.005	0.023	23	20
SW	Shorthorn sculpin	U	mg/Kg	3.00E-04	8.00E-04	0.002	0.003	0.007	23	20
SW	Shorthorn sculpin	Y	mg/kg	<DL	0.001	0.001	0.002	0.006	23	20
SW	Shorthorn sculpin	Zn	mg/kg	38.7	44.275	53.57	62.16	99.44	23	20
SW	Shorthorn sculpin	Zr	mg/kg	0.002	0.004	0.004	0.006	0.011	23	20
SW	Soil	Ag	mg/Kg	<DL	<DL	<DL	<DL	<DL	1	1
SW	Soil	Al	mg/kg	0.035	58086.5	67587	71102	72590	7	5
SW	Soil	As	mg/Kg	<DL	0.009	0.019	0.139	0.533	7	5
SW	Soil	Au	mg/Kg	<DL	<DL	<DL	<DL	<DL	1	1
SW	Soil	Ba	mg/Kg	0.009	0.009	0.009	0.009	0.009	1	1
SW	Soil	Be	mg/Kg	<DL	<DL	<DL	<DL	<DL	1	1
SW	Soil	Bi	mg/Kg	1.30E-06	1.30E-06	1.30E-06	1.30E-06	1.30E-06	1	1
SW	Soil	Ca	mg/Kg	3.445	3.445	3.445	3.445	3.445	1	1
SW	Soil	Cd	mg/kg	<DL	0.033	0.039	0.044	0.049	7	5
SW	Soil	Ce	mg/Kg	1.87E-04	1.87E-04	1.87E-04	1.87E-04	1.87E-04	1	1
SW	Soil	Co	mg/Kg	<DL	<DL	<DL	<DL	<DL	1	1
SW	Soil	Cr	mg/kg	1.10E-04	40.855	42.118	46.318	84.376	7	5
SW	Soil	Cs	mg/Kg	1.40E-06	1.40E-06	1.40E-06	1.40E-06	1.40E-06	1	1
SW	Soil	Cu	mg/kg	4.42E-04	2.288	3.116	6.138	15.81	7	5
SW	Soil	Fe	mg/kg	0.003	11804.5	12866	14229	15570	7	5
SW	Soil	Ga	mg/Kg	<DL	<DL	<DL	<DL	<DL	1	1
SW	Soil	Hg	mg/kg	<DL	0.006	0.019	0.03	0.041	6	5
SW	Soil	K	mg/Kg	0.467	0.467	0.467	0.467	0.467	1	1
SW	Soil	La	mg/Kg	2.57E-04	2.57E-04	2.57E-04	2.57E-04	2.57E-04	1	1
SW	Soil	Li	mg/Kg	<DL	<DL	<DL	<DL	<DL	1	1
SW	Soil	Mg	mg/Kg	0.423	0.423	0.423	0.423	0.423	1	1
SW	Soil	Mn	mg/Kg	<DL	<DL	<DL	<DL	<DL	1	1

SW	Soil	Mo	mg/Kg	<DL	<DL	<DL	<DL	<DL	1	1
SW	Soil	Na	mg/Kg	2.535	2.535	2.535	2.535	2.535	1	1
SW	Soil	Nd	mg/Kg	2.32E-04	2.32E-04	2.32E-04	2.32E-04	2.32E-04	1	1
SW	Soil	Ni	mg/kg	1.08E-04	16.732	18.193	24.647	28.357	7	5
SW	Soil	P	mg/Kg	<DL	<DL	<DL	<DL	<DL	1	1
SW	Soil	Pb	mg/kg	1.53E-05	10.42	12.73	13.91	15.22	7	5
SW	Soil	Pd	mg/Kg	1.20E-06	1.20E-06	1.20E-06	1.20E-06	1.20E-06	1	1
SW	Soil	Pt	mg/Kg	<DL	<DL	<DL	<DL	<DL	1	1
SW	Soil	Rb	mg/Kg	6.14E-04	6.14E-04	6.14E-04	6.14E-04	6.14E-04	1	1
SW	Soil	Rh	mg/Kg	<DL	<DL	<DL	<DL	<DL	1	1
SW	Soil	S	mg/Kg	1.911	1.911	1.911	1.911	1.911	1	1
SW	Soil	Sb	mg/Kg	<DL	<DL	<DL	<DL	<DL	1	1
SW	Soil	Sc	mg/Kg	<DL	<DL	<DL	<DL	<DL	1	1
SW	Soil	Se	mg/kg	<DL	0.065	0.117	0.137	0.333	7	5
SW	Soil	Sn	mg/Kg	9.70E-06	9.70E-06	9.70E-06	9.70E-06	9.70E-06	1	1
SW	Soil	Sr	mg/Kg	0.015	0.015	0.015	0.015	0.015	1	1
SW	Soil	Ta	mg/Kg	2.00E-06	2.00E-06	2.00E-06	2.00E-06	2.00E-06	1	1
SW	Soil	Te	mg/Kg	<DL	<DL	<DL	<DL	<DL	1	1
SW	Soil	Th	mg/Kg	1.00E-05	1.00E-05	1.00E-05	1.00E-05	1.00E-05	1	1
SW	Soil	Ti	mg/Kg	8.37E-05	8.37E-05	8.37E-05	8.37E-05	8.37E-05	1	1
SW	Soil	Tl	mg/Kg	<DL	<DL	<DL	<DL	<DL	1	1
SW	Soil	U	mg/Kg	6.54E-05	6.54E-05	6.54E-05	6.54E-05	6.54E-05	1	1
SW	Soil	V	mg/kg	1.36E-04	29.455	33.349	36.060	38.705	7	5
SW	Soil	W	mg/Kg	<DL	<DL	<DL	<DL	<DL	1	1
SW	Soil	Y	mg/Kg	3.90E-05	3.90E-05	3.90E-05	3.90E-05	3.90E-05	1	1
SW	Soil	Zn	mg/kg	1.25E-04	14.47	18.74	20.895	25.83	7	5
SW	Soil	Zr	mg/Kg	4.20E-06	4.20E-06	4.20E-06	4.20E-06	4.20E-06	1	1
SW	Unfiltered water	Ag	µg/l	<DL	<DL	<DL	0.004	0.015	78	63
SW	Unfiltered water	Al	µg/l	1.8	21.375	42.913	477.923	2816	88	73
SW	Unfiltered water	As	µg/l	<DL	<DL	0.034	0.1	0.34	88	73
SW	Unfiltered water	Au	µg/l	<DL	<DL	0.003	0.012	0.287	78	63
SW	Unfiltered water	B	µg/l	0.213	0.262	0.273	0.304	0.618	18	18
SW	Unfiltered water	Ba	µg/l	0.58	14.316	23.096	35.031	267.27	78	63
SW	Unfiltered water	Be	µg/l	<DL	0.003	0.011	0.022	0.086	65	63
SW	Unfiltered water	Bi	µg/l	<DL	9.33E-04	0.002	0.004	0.009	62	55
SW	Unfiltered water	Ca	µg/l	492	1954.25	4021	10410.2	22428	78	63
SW	Unfiltered water	Cd	µg/l	<DL	<DL	0.005	0.014	0.134	88	73
SW	Unfiltered water	Ce	µg/l	0.021	0.226	0.526	4.346	17.319	78	63
SW	Unfiltered water	Co	µg/l	<DL	0.048	0.087	0.425	3.036	78	63
SW	Unfiltered water	Cr	µg/l	0.006	0.161	0.313	1.34	12.858	88	73
SW	Unfiltered water	Cs	µg/l	<DL	<DL	0.009	0.153	0.41	65	63
SW	Unfiltered water	Cu	µg/l	0.199	1.139	4.315	6.703	21.99	88	73
SW	Unfiltered water	Dy	µg/l	0.004	0.011	0.015	0.019	0.469	26	26
SW	Unfiltered water	Er	µg/l	0.002	0.006	0.007	0.010	0.196	26	26
SW	Unfiltered water	Eu	µg/l	0.004	0.008	0.010	0.014	0.182	26	26

SW	Unfiltered water	Fe	µg/l	<DL	11.56	100.145	459.075	3481	88	73
SW	Unfiltered water	Ga	µg/l	<DL	0.005	0.026	0.267	0.998	65	63
SW	Unfiltered water	Gd	µg/l	0.011	0.025	0.033	0.042	0.925	26	26
SW	Unfiltered water	Ge	µg/l	0.004	0.019	0.028	0.041	0.417	18	18
SW	Unfiltered water	Hf	µg/l	0.003	0.005	0.006	0.007	0.009	26	26
SW	Unfiltered water	Hg	µg/l	<DL	<DL	0.004	0.009	0.068	88	73
SW	Unfiltered water	Ho	µg/l	6.40E-04	0.002	0.003	0.004	0.078	26	26
SW	Unfiltered water	K	µg/l	126	825.6	1166	2738	4135	78	63
SW	Unfiltered water	La	µg/l	0.022	0.334	0.551	2.212	9.743	78	63
SW	Unfiltered water	Li	µg/l	0.06	0.3	0.53	1.46	4.06	65	63
SW	Unfiltered water	Lu	µg/l	1.80E-04	8.00E-04	0.001	0.002	0.021	26	26
SW	Unfiltered water	Mg	µg/l	56	342.04	1107	3986	9821	79	64
SW	Unfiltered water	Mn	µg/l	0.01	0.52	4.192	23.172	109.17	88	73
SW	Unfiltered water	Mo	µg/l	0.008	0.078	0.154	0.271	3.38	88	73
SW	Unfiltered water	Na	µg/l	215	646.25	1495.4	2809	20195	78	63
SW	Unfiltered water	Nb	µg/l	0.001	0.004	0.006	0.011	0.107	26	26
SW	Unfiltered water	Nd	µg/l	0.02	0.260	0.403	2.033	6.452	78	63
SW	Unfiltered water	Ne	µg/l	1208	1231	1332	1358	2213	9	9
SW	Unfiltered water	Ni	µg/l	0.018	0.924	2.325	3.396	12.351	88	73
SW	Unfiltered water	P	µg/l	<DL	2.825	7.35	26.825	710.5	78	63
SW	Unfiltered water	Pb	µg/l	0.004	0.040	0.091	0.640	2.399	88	73
SW	Unfiltered water	Pd	µg/l	<DL	<DL	0.001	0.003	0.02	65	63
SW	Unfiltered water	Pr	µg/l	0.026	0.070	0.086	0.116	1.756	26	26
SW	Unfiltered water	Pt	µg/l	<DL	<DL	<DL	0.002	0.019	65	63
SW	Unfiltered water	Rb	µg/l	0.324	1.327	1.897	4.889	15.293	65	63
SW	Unfiltered water	Re	µg/l	<DL	<DL	0.003	0.006	0.017	26	26
SW	Unfiltered water	Rh	µg/l	2.00E-04	9.00E-04	0.001	0.002	0.003	18	18
SW	Unfiltered water	Ru	µg/l	<DL	1.25E-04	6.00E-04	0.001	0.003	26	26
SW	Unfiltered water	S	µg/l	<DL	293	1210.6	1766	8705	65	63
SW	Unfiltered water	Sb	µg/l	<DL	0.003	0.011	0.025	0.099	78	63
SW	Unfiltered water	Sc	µg/l	<DL	0.04	0.067	0.093	0.907	78	63
SW	Unfiltered water	Se	µg/l	<DL	0.01	0.051	0.13	0.26	78	63
SW	Unfiltered water	Si	µg/l	4.94	10.453	14.17	16.018	31.51	26	26
SW	Unfiltered water	Sm	µg/l	0.015	0.035	0.044	0.061	0.999	39	26
SW	Unfiltered water	Sn	µg/l	<DL	<DL	0.017	0.074	0.378	78	63
SW	Unfiltered water	Sr	µg/l	1.02	4.896	14.509	63.303	176.95	78	63
SW	Unfiltered water	Ta	µg/l	<DL	4.00E-04	0.004	0.018	0.064	65	63
SW	Unfiltered water	Tb	µg/l	8.20E-04	0.003	0.003	0.004	0.093	26	26
SW	Unfiltered water	Te	µg/l	<DL	<DL	0.0027	0.006	0.043	57	55
SW	Unfiltered water	Th	µg/l	0.001	0.013	0.027	0.194	1.114	78	63
SW	Unfiltered water	Ti	µg/l	<DL	0.201	0.419	11.55	129.09	88	73
SW	Unfiltered water	Tl	µg/l	<DL	<DL	0.009	0.017	0.042	78	63
SW	Unfiltered water	Tm	µg/l	1.20E-04	9.80E-04	0.001	0.002	0.025	26	26
SW	Unfiltered water	U	µg/l	<DL	0.023	0.062	0.346	1.395	78	63
SW	Unfiltered water	V	µg/l	<DL	0.103	0.250	0.86	6.812	88	73

SW	Unfiltered water	W	µg/l	<DL	0.005	0.01	0.021	0.064	78	63
SW	Unfiltered water	Y	µg/l	0.004	0.056	0.097	0.435	2.124	78	63
SW	Unfiltered water	Yb	µg/l	0.001	0.004	0.007	0.008	0.146	26	26
SW	Unfiltered water	Zn	µg/l	<DL	1.229	2.132	4.228	14.01	88	73
SW	Unfiltered water	Zr	µg/l	<DL	0.018	0.095	0.154	0.878	75	73

Table A2.3 Regional environmental baseline element concentration values for the region "Southeast Greenland" (SE). q25 refers to the 25% percentile (1st quatile) and q75 to the 75% percentile (3rd quatile). "No of meas." refers to the number of concentration measurements of the particular element, in the particular sample type, for the particular region. DL refers to detection limit.

GRLregion	Category	Element	Unit	Min	q25	Median	q75	Max	No. of meas.	No. of samples
SE	Sediment	As	mg/kg	1.260	1.605	2.050	2.435	2.508	6	4
SE	Sediment	Cd	mg/kg	0.155	0.156	0.157	0.158	0.159	2	1
SE	Sediment	Cu	mg/kg	53.115	54.380	55.645	56.910	58.175	2	1
SE	Sediment	Hg	mg/kg	0.006	0.009	0.012	0.036	0.044	52	6
SE	Sediment	Ni	mg/kg	86.378	87.099	87.820	88.541	89.261	2	1
SE	Sediment	Pb	mg/kg	12.550	12.665	12.780	12.895	13.010	2	1
SE	Sediment	Se	mg/kg	0.002	0.011	0.021	0.030	0.039	2	1
SE	Sediment	Zn	mg/kg	169.060	170.093	171.125	172.158	173.190	2	1

Table A2.4 Regional environmental baseline element concentration values for the region "Central West Greenland" (CW). q25 refers to the 25% percentile (1st quatile) and q75 to the 75% percentile (3rd quatile). "No of meas." refers to the number of concentration measurements of the particular element, in the particular sample type, for the particular region. DL refers to detection limit.

GRLregion	Category	Element	Unit	Min	q25	Median	q75	Max	No. of meas.	No. of samples
CW	Blue mussel	Cd	mg/kg	0.399	1.283	2.85	4.58	9.03	53	45
CW	Blue mussel	d.m.%	%	13	15.64	17.19	18.068	22.1	48	43
CW	Blue mussel	Hg	mg/kg	0.008	0.015	0.078	0.094	0.121	53	45
CW	Blue mussel	Pb	mg/kg	0.316	0.552	0.693	0.765	1.144	35	30
CW	Blue mussel	Se	mg/kg	0.360	0.508	4.401	6.092	7.319	53	45
CW	Crinkled snow lichen	Cd	mg/kg	0.07	0.075	0.08	0.1	0.12	3	3
CW	Crinkled snow lichen	Pb	mg/kg	1.1	1.4	1.7	3.05	4.4	3	3
CW	Crinkled snow lichen	Zn	mg/kg	14	17.5	21	21.5	22	3	3
CW	Sediment	Al	mg/kg	54858	59205	62829	65510	67818	5	5
CW	Sediment	As	mg/kg	1.523	3.463	5.986	9.603	19.83	40	24
CW	Sediment	Cd	mg/kg	0.088	0.090	0.146	0.176	0.249	5	5
CW	Sediment	Cu	mg/kg	17.919	19.918	22.926	34.314	43.844	5	5
CW	Sediment	Hg	mg/kg	0.004	0.010	0.025	0.042	0.178	236	24
CW	Sediment	Li	mg/kg	5.812	12.111	16.133	17.144	18.403	5	5
CW	Sediment	LoI%	mg/kg	6.34	6.4	6.46	7.57	8.68	3	3
CW	Sediment	Pb	mg/kg	10.69	10.87	11.56	12.27	13.91	5	5
CW	Sediment	Water%	mg/kg	56.1	56.1	56.1	56.1	56.1	1	1
CW	Sediment	Zn	mg/kg	33.78	47.23	48.78	52.5	61.97	5	5
CW	Shorthorn sculpin	Cd	mg/kg	0.203	0.662	0.848	1.401	6.484	112	101

CW	Shorthorn sculpin	d.m.%	%	18.45	27.5525	31.46	34.56	45.79	174	122
CW	Shorthorn sculpin	Hg	mg/kg	0.005	0.011	0.016	0.027	0.064	112	101
CW	Shorthorn sculpin	Pb	mg/kg	<DL	0.005	0.0105	0.019	0.05	72	45
CW	Shorthorn sculpin	Se	mg/kg	0.529	0.810	0.915	1.066	1.560	112	101

Table A2.5 Regional environmental baseline element concentration values for the region “Central East Greenland” (CE).

GRL region	Category	Element	Unit	Min	q25	Median	q75	Max	No. of meas.	No. of samples
CE	Crinkled snow lichen	As	mg/kg	0.171	0.1715	0.172	0.2035	0.235	3	3
CE	Crinkled snow lichen	Cd	mg/kg	0.014	0.024	0.047	0.2	0.27	5	5
CE	Crinkled snow lichen	Cr	mg/kg	0.315	0.3405	0.366	0.4325	0.499	3	3
CE	Crinkled snow lichen	Cu	mg/kg	0.832	0.8835	0.935	0.9385	0.942	3	3
CE	Crinkled snow lichen	Fe	mg/kg	183	193.5	204	223.5	243	3	3
CE	Crinkled snow lichen	Hg	mg/kg	0.03	0.03075	0.032	0.0355	0.043	4	3
CE	Crinkled snow lichen	Ni	mg/kg	0.606	0.65325	0.7065	0.7625	0.818	4	3
CE	Crinkled snow lichen	Pb	mg/kg	0.909	1.025	1.38	2.005	3.7	6	5
CE	Crinkled snow lichen	Se	mg/kg	0.037	0.037	0.037	0.0405	0.044	3	3
CE	Crinkled snow lichen	V	mg/kg	0.418	0.4445	0.471	0.4805	0.49	3	3
CE	Crinkled snow lichen	Zn	mg/kg	7	8.31	10.095	13.35	16	6	5
CE	Filtered water	Ag	µg/l	0.154	0.2085	0.238	0.274	0.524	99	92
CE	Filtered water	Al	µg/l	1.9	6	8.6	11.65	87.4	99	92
CE	Filtered water	Au	µg/l	0.0008	0.0038	0.0058	0.0082	0.0381	99	92
CE	Filtered water	Ba	µg/l	0.22	0.455	0.88	1.675	5.24	99	92
CE	Filtered water	Bi	µg/l	0.0002	0.0008	0.0012	0.0019	0.0058	99	92
CE	Filtered water	Ca	µg/l	2622	4617	6086	11685.5	106500	99	92
CE	Filtered water	Cd	µg/l	0.02	0.03	0.04	0.05	0.11	9	9
CE	Filtered water	Ce	µg/l	0.001	0.014	0.021	0.0455	0.278	99	92
CE	Filtered water	Co	µg/l	0.01	0.02	0.03	0.05	0.76	99	92
CE	Filtered water	Cr	µg/l	0.07	0.09	0.11	0.14	0.63	99	92
CE	Filtered water	Cu	µg/l	0.49	0.76	0.92	1.14	3.24	99	92
CE	Filtered water	Fe	µg/l	3	7	9	12	79	99	92
CE	Filtered water	K	µg/l	540	688	767	1048	2167	99	92
CE	Filtered water	La	µg/l	0.001	0.009	0.014	0.02	0.17	99	92
CE	Filtered water	Li	µg/l	0.47	0.68	0.79	0.955	21.78	99	92
CE	Filtered water	Mg	µg/l	431	860.5	1106	1709.5	19540	99	92
CE	Filtered water	Mn	µg/l	0.18	1.115	2.13	5.045	41.4	99	92
CE	Filtered water	Na	µg/l	211	292.5	328	516	1490	99	92
CE	Filtered water	Nd	µg/l	0.002	0.009	0.014	0.0215	0.149	99	92
CE	Filtered water	Ni	µg/l	0.06	0.2	0.28	0.35	3.29	99	92
CE	Filtered water	P	µg/l	3.8	4.25	4.8	5.35	11.3	99	92
CE	Filtered water	Pb	µg/l	0.01	0.02	0.03	0.05325	1.5	108	101
CE	Filtered water	Pt	µg/l	0.0011	0.0016	0.0019	0.0023	0.0043	99	92
CE	Filtered water	Rb	µg/l	0.67	0.915	1.06	1.235	2.16	99	92

CE	Filtered water	S	µg/l	963	1962.5	2431	4561	62450	99	92
CE	Filtered water	Sc	µg/l	0.24	0.445	0.56	0.715	1.51	99	92
CE	Filtered water	Sn	µg/l	0.02	0.03	0.04	0.06	0.78	99	92
CE	Filtered water	Sr	µg/l	7.42	13.05	15.75	23.815	163.48	99	92
CE	Filtered water	Ta	µg/l	0.0016	0.0032	0.0039	0.00585	0.0335	99	92
CE	Filtered water	Th	µg/l	0.0005	0.00235	0.0036	0.00455	0.0227	99	92
CE	Filtered water	Ti	µg/l	0.26498	0.56368	0.72255	1.10935	4.9225	99	92
CE	Filtered water	V	µg/l	0.12	0.195	0.23	0.265	0.48	99	92
CE	Filtered water	Y	µg/l	0.001	0.003	0.004	0.006	0.062	99	92
CE	Filtered water	Zn	µg/l	0.05	0.335	0.595	1.315	158.23	108	101
CE	Filtered water	Zr	µg/l	0.009	0.0255	0.036	0.0545	0.13	99	92
CE	Sediment	As	mg/kg	9.02	10.07	11.12	11.83	12.54	3	2
CE	Sediment	Hg	mg/kg	0.017	0.02025	0.0325	0.05875	0.089	54	4
CE	Shorthorn sculpin	Cd	mg/kg	0.234	0.498	0.687	0.925	2.081	55	47
CE	Shorthorn sculpin	d.m.%	%	17.18	24.6025	28.095	33.5775	44.44	52	47
CE	Shorthorn sculpin	Hg	mg/kg	0.0236	0.0399	0.054	0.079	0.2243	55	47
CE	Shorthorn sculpin	Pb	mg/kg	<DL	<DL	<DL	<DL	0.19	9	3
CE	Shorthorn sculpin	Se	mg/kg	0.491	0.759	0.878	0.994	1.531	43	38

Table A2.6. Regional environmental baseline element concentration values for the region “Northwest Greenland” (NW). q25 refers to the 25% percentile (1st quatile) and q75 to the 75% percentile (3rd quatile). “No of meas.” refers to the number of concentration measurements of the particular element, in the particular sample type, for the particular region. DL refers to detection limit.

GRL region	Category	Element	Unit	Min	q25	Median	q75	Max	No. of meas.	No. of samples
NW	Crinkled snow lichen	As	mg/kg	0.104	0.123	0.142	0.148	0.153	3	3
NW	Crinkled snow lichen	Cd	mg/kg	0.088	0.096	0.114	0.138	0.16	4	4
NW	Crinkled snow lichen	Cr	mg/kg	0.315	0.55	0.785	0.993	1.2	3	3
NW	Crinkled snow lichen	Cu	mg/kg	0.908	0.935	0.961	1.006	1.05	3	3
NW	Crinkled snow lichen	Fe	mg/kg	142	164	186	236.5	287	3	3
NW	Crinkled snow lichen	Hg	mg/kg	0.059	0.061	0.065	0.074	0.089	4	3
NW	Crinkled snow lichen	Ni	mg/kg	0.705	0.920	0.995	1.007	1.03	4	3
NW	Crinkled snow lichen	Pb	mg/kg	1.1	1.1	1.1	1.1	1.1	1	1
NW	Crinkled snow lichen	Se	mg/kg	0.036	0.038	0.04	0.045	0.05	3	3
NW	Crinkled snow lichen	V	mg/kg	0.375	0.462	0.548	0.752	0.956	3	3
NW	Crinkled snow lichen	Zn	mg/kg	11	11	11	11	11	1	1
NW	Sediment	Al	mg/kg	42444	56691.5	60532	64391	65902	7	5
NW	Sediment	As	mg/kg	2.01	4.235	6.56	16.065	24.6	11	8
NW	Sediment	Cd	mg/kg	0.0639	0.133	0.1468	0.276	0.301	7	5
NW	Sediment	Cu	mg/kg	12.471	18.226	25.938	29.266	34.81	7	5
NW	Sediment	Hg	mg/kg	0.004	0.013	0.025	0.040	0.194	58	13
NW	Sediment	Li	mg/kg	16.12	18.682	34.849	42.014	46.196	7	5
NW	Sediment	Ni	mg/kg	1.218	3.905	4.921	6.817	7.884	7	5
NW	Sediment	Pb	mg/kg	5.26	9.1	14.37	17.29	17.9	7	5
NW	Sediment	Zn	mg/kg	25.78	44.53	46.94	73.24	104.76	7	5
NW	Shorthorn sculpin	Cd	mg/kg	0.631	1.233	1.745	2.424	3.381	21	20

NW	Shorthorn sculpin	d.m.%	%	16.99	21.68	24.79	27.34	31.54	21	20
NW	Shorthorn sculpin	Hg	mg/kg	0.038	0.051	0.082	0.1	0.225	21	20
NW	Shorthorn sculpin	Se	mg/kg	0.591	0.746	0.872	0.986	1.066	21	20

Table A2.7 Regional environmental baseline element concentration values for the region "North Greenland" (N). q25 refers to the 25% percentile (1st quatile) and q75 to the 75% percentile (3rd quatile). "No of meas." refers to the number of concentration measurements of the particular element, in the particular sample type, for the particular region. DL refers to detection limit.

GRLregion	Category	Element	Unit	Min	q25	Median	q75	Max	No. of meas.	No. of samples
N	Crinkled snow lichen	Cd	mg/kg	0.07	0.07	0.07	0.07	0.07	1	1
N	Crinkled snow lichen	Pb	mg/kg	2	2	2	2	2	1	1
N	Crinkled snow lichen	Zn	mg/kg	14	14	14	14	14	1	1
N	Sediment	Ag	mg/kg	0.01	0.04	0.07	0.11	0.27	53	43
N	Sediment	Al	mg/kg	27297	35837	41828	54898	76900	53	43
N	Sediment	As	mg/kg	3.54	4.76	5.65	7.72	11.59	53	43
N	Sediment	Au	mg/kg	<DL	<DL	0.008	0.02	0.105	53	43
N	Sediment	Ba	mg/kg	176.15	226.4	291.81	347.74	470.54	53	43
N	Sediment	Be	mg/kg	0.68	1.14	1.39	1.73	2.35	53	43
N	Sediment	Bi	mg/kg	0.08	0.14	0.18	0.22	0.3	53	43
N	Sediment	Ca	mg/kg	32017	44450	54985	84664	152030	53	43
N	Sediment	Cd	mg/kg	0.063	0.12	0.144	0.187	1.395	53	43
N	Sediment	Ce	mg/kg	26.77	36.76	41.58	48.07	66.49	53	43
N	Sediment	Co	mg/kg	6.02	8.19	9.33	11.86	17.72	53	43
N	Sediment	Cr	mg/kg	35.26	50.44	61.85	76.25	111.97	53	43
N	Sediment	Cs	mg/kg	1.72	2.21	2.69	3.92	6.08	53	43
N	Sediment	Cu	mg/kg	10.36	14.04	17.26	22.11	91.03	53	43
N	Sediment	d.m.%	%	100	100	100	100	100	53	43
N	Sediment	Fe	mg/kg	20470	23570	28540	34430	49320	53	43
N	Sediment	Ga	mg/kg	6.97	9.71	11.32	14.66	21.43	53	43
N	Sediment	Hg	mg/kg	<DL	0.025	0.047	0.065	0.195	53	43
N	Sediment	K	mg/kg	7850.8	10918	12260	15393	20708	53	43
N	Sediment	La	mg/kg	12.81	17.03	19.94	23.1	32.34	53	43
N	Sediment	Li	mg/kg	17.66	25.65	30.25	37.51	51.97	53	43
N	Sediment	Mg	mg/kg	9498	11410	14250	17270	26430	53	43
N	Sediment	Mn	mg/kg	227.64	269.17	308.46	353.2	705.32	53	43
N	Sediment	Mo	mg/kg	0.13	0.33	0.58	0.81	1.65	53	43
N	Sediment	N	mg/kg	110	220	325	685	1700	40	40
N	Sediment	Na	mg/kg	3559.9	5003.4	5605.8	11355	13169	53	43
N	Sediment	Nd	mg/kg	13.33	16.99	19.02	21.39	30.26	53	43
N	Sediment	Ni	mg/kg	20.94	24.69	36.59	45.29	62.83	53	43
N	Sediment	P	mg/kg	373.06	449.5	539.74	656.77	1058.7	53	43
N	Sediment	Pb	mg/kg	10.97	13.37	16.68	23.09	124.6	53	43
N	Sediment	Pd	mg/kg	<DL	<DL	0.01	0.03	0.09	53	43
N	Sediment	Pt	mg/kg	<DL	0.001	0.005	0.011	0.027	53	43

N	Sediment	Rb	mg/kg	52.13	63.95	75.78	94.44	133.85	53	43
N	Sediment	S	mg/kg	<DL	245.38	453.93	814.66	2608.3	53	43
N	Sediment	Sb	mg/kg	0.27	0.44	0.66	0.83	2.55	53	43
N	Sediment	Sc	mg/kg	6.26	7.46	8.88	11.37	16.69	53	43
N	Sediment	Se	mg/kg	<DL	0.02	0.44	0.75	3.93	53	43
N	Sediment	Sm	mg/kg	2.92	3.5	3.91	4.3	6.34	53	43
N	Sediment	Sn	mg/kg	0.87	1.46	1.69	2.11	3.08	53	43
N	Sediment	Sr	mg/kg	65.52	87	100.81	129.59	244.34	53	43
N	Sediment	Te	mg/kg	<DL	<DL	0.02	0.07	0.21	53	43
N	Sediment	Th	mg/Kg	3.74	5.18	6.27	7.63	9.53	53	43
N	Sediment	Ti	mg/kg	1652.5	2171.1	2526.5	2954	4512.1	53	43
N	Sediment	Tl	mg/kg	0.21	0.39	0.47	0.62	2.98	53	43
N	Sediment	U	mg/Kg	1.33	1.62	1.89	2.11	3.22	53	43
N	Sediment	V	mg/kg	38.3	49.99	67.33	84.16	118.77	53	43
N	Sediment	W	mg/kg	0.67	1.05	1.32	1.64	3.3	53	43
N	Sediment	Y	mg/kg	14.29	15.79	17.03	19.6	31.26	53	43
N	Sediment	Zn	mg/kg	43.51	57.13	74	88	638.15	53	43
N	Sediment	Zr	mg/kg	60.76	91.11	108.19	126.96	224.31	53	43
N	Unfiltered water	Ag	µg/l	<DL	<DL	<DL	<DL	0.01	19	18
N	Unfiltered water	Al	µg/l	1.2	7.4	13.6	102.8	389.8	19	18
N	Unfiltered water	As	µg/l	<DL	0.06	0.1	0.14	0.33	19	18
N	Unfiltered water	Au	µg/l	<DL	<DL	<DL	<DL	0.018	19	18
N	Unfiltered water	Ba	µg/l	1.49	2.43	3.76	5.92	22.16	19	18
N	Unfiltered water	Be	µg/l	<DL	0.003	0.009	0.012	0.043	19	18
N	Unfiltered water	Bi	µg/l	<DL	0.0003	0.0005	0.001	0.003	19	18
N	Unfiltered water	Ca	µg/l	14547	19326	25422	35403.5	101830	19	18
N	Unfiltered water	Cd	µg/l	<DL	0.002	0.006	0.025	1.785	19	18
N	Unfiltered water	Ce	µg/l	0.006	0.017	0.081	0.102	0.504	19	18
N	Unfiltered water	Co	µg/l	0.01	0.021	0.049	0.084	0.389	19	18
N	Unfiltered water	Cr	µg/l	0.048	0.058	0.073	0.165	0.8	19	18
N	Unfiltered water	Cs	µg/l	0.001	0.004	0.005	0.018	0.07	19	18
N	Unfiltered water	Cu	µg/l	0.03	0.19	0.43	0.555	3.92	19	18
N	Unfiltered water	Fe	µg/l	1.2	3.7	15.7	55.465	458	19	18
N	Unfiltered water	Ga	µg/l	0.0007	0.005	0.008	0.035	0.108	19	18
N	Unfiltered water	Hg	µg/l	<DL	<DL	<DL	<DL	0.099	19	18
N	Unfiltered water	K	µg/l	103	164	251	304	1271	19	18
N	Unfiltered water	La	µg/l	0.005	0.009	0.031	0.0465	0.24	19	18
N	Unfiltered water	Li	µg/l	0.13	0.315	0.45	0.9	4.39	19	18
N	Unfiltered water	Mg	µg/l	1201	2559	3841	8675	82230	19	18
N	Unfiltered water	Mn	µg/l	0.17	1.06	1.98	7.14	40.14	19	18
N	Unfiltered water	Mo	µg/l	0.02	0.040	0.05	0.087	0.215	19	18
N	Unfiltered water	Na	µg/l	148	390.5	1181	1968.5	7574	19	18
N	Unfiltered water	Nd	µg/l	0.007	0.019	0.086	0.106	0.539	19	18

N	Unfiltered water	Ni	µg/l	0.032	0.083	0.139	0.322	1.424	19	18
N	Unfiltered water	P	µg/l	0.5	1.25	3.2	5.7	57.3	19	18
N	Unfiltered water	Pb	µg/l	0.03	0.051	0.116	0.364	5.219	19	18
N	Unfiltered water	Pd	µg/l	0.004	0.006	0.007	0.011	0.034	19	18
N	Unfiltered water	Pt	µg/l	<DL	<DL	<DL	<DL	<DL	19	18
N	Unfiltered water	Rb	µg/l	0.015	0.05	0.104	0.253	0.816	19	18
N	Unfiltered water	S	µg/l	825	3144.5	8036	14250	231360	19	18
N	Unfiltered water	Sb	µg/l	<DL	0.008	0.019	0.037	0.164	19	18
N	Unfiltered water	Sc	µg/l	0.021	0.031	0.043	0.079	0.129	19	18
N	Unfiltered water	Se	µg/l	<DL	0.07	0.14	0.19	1.18	19	18
N	Unfiltered water	Sn	µg/l	<DL	0.008	0.012	0.019	0.06	19	18
N	Unfiltered water	Sr	µg/l	20.24	30.445	40.04	54.185	217.74	19	18
N	Unfiltered water	Ta	µg/l	<DL	<DL	<DL	0.012	0.017	19	18
N	Unfiltered water	Te	µg/l	<DL	<DL	0.001	0.004	0.009	19	18
N	Unfiltered water	Th	µg/l	0.0002	0.0009	0.004	0.009	0.021	19	18
N	Unfiltered water	Ti	µg/l	0.003	0.031	0.124	0.411	3.499	19	18
N	Unfiltered water	Tl	µg/l	<DL	<DL	<DL	<DL	<DL	19	18
N	Unfiltered water	U	µg/l	0.0656	0.137	0.205	0.276	2.502	19	18
N	Unfiltered water	V	µg/l	<DL	0.009	0.026	0.095	0.753	19	18
N	Unfiltered water	W	µg/l	<DL	<DL	<DL	<DL	0.038	19	18
N	Unfiltered water	Y	µg/l	0.023	0.031	0.075	0.106	0.441	19	18
N	Unfiltered water	Zn	µg/l	0.2	0.44	1.05	10.875	838.4	19	18
N	Unfiltered water	Zr	µg/l	<DL	0.012	0.026	0.056	0.204	19	18

Kalaallit Nunaanni avatangiisit killiliussat akuneqanngitsut nalingi

Based on all available baseline data (samples representing unpolluted conditions) in the AMDA database, "Greenland median" concentration values of approx. 70 different elements in eight different sample types have been calculated. The "Greenland median" values are calculated from a total of 2115 samples from all over Greenland (seaweed: 71; crinkled snow lichen: 194; blue mussel: 364; short-horn sculpin: 854; sediment: 123; soil: 43; filtered water: 288, and unfiltered water: 178). Note that for some elements and sample types very few data exist. Also note that the "Greenland median" values are not geographically/spatially weighed, but represent unweighted medians of baseline samples, which typically cluster in areas where there has been an interest in mining operations, but also supplemented with other environmental samples.

Most of the columns in the tables that follow should be self-explanatory, but a few need mentioning: q25 refers to the 25% percentile (1st quatile) and q75 to the 75% percentile (3rd quatile). "No of meas." refers to the number of concen-tration measurements of the particular element in the particular sample type. As some samples were sub-divided prior to measurement (e.g. a sculpin spilt in liver, bone, muscle etc), the number of measurements may be greater than the number of individual samples. Among the values, "<DL" means that the concentration is below the detection limit of the instrument.

The results for each sample type are found in Table A2.8-A2.15.

Table A2.8 Greenland environmental baseline element concentration values for blue mussels. q25 refers to the 25% percentile (1st quatile) and q75 to the 75% percentile (3rd quatile). "No of meas." refers to the number of concentration measurements of the particular element, in the particular sample type, for the particular region. DL refers to detection limit.

Sample Type	Element	Unit	Min	q25	Median	q75	Max	No. of meas.	No. of samples
Blue mussel	Ag	mg/kg	<DL	0.021	0.06	0.071	3.004	90	81
Blue mussel	Al	mg/kg	0.141	131.718	259.178	495.119	15767	106	96
Blue mussel	As	mg/kg	<DL	10.065	12.656	15	32.19	148	118
Blue mussel	Au	mg/kg	<DL	<DL	<DL	0.015	0.047	84	74
Blue mussel	B	mg/Kg	2.9	3.2	4.7	11.4	20	11	11
Blue mussel	Ba	mg/kg	<DL	1.1	3.217	6.675	73.6	87	80
Blue mussel	Be	mg/Kg	<DL	0.003	0.011	0.115	24.681	85	73
Blue mussel	Bi	mg/kg	<DL	<DL	0.003	0.005	0.169	87	80
Blue mussel	Ca	mg/kg	3	2246.33	3073.376	4582	68138	75	70
Blue mussel	Cd	mg/kg	0.107	1.956	2.736	4.087	9.03	221	190
Blue mussel	Ce	mg/Kg	<DL	0.499	2.4475	8.013	51.396	86	74
Blue mussel	CH3Hg	mg/kg	<DL	0.009	0.011	0.015	0.019	6	6
Blue mussel	Co	mg/Kg	0.01	0.42	0.582	0.849	6.419	108	91
Blue mussel	Cr	mg/Kg	<DL	0.701	1.058	1.514	18.46	138	118
Blue mussel	Cs	mg/kg	0.006	0.022	0.028	0.049	3.223	64	57
Blue mussel	Cu	mg/kg	0.13	6.134	7.366	8.167	40.73	128	113
Blue mussel	d.m.%	%	9.62	14.925	17.06	19	25.344	299	274
Blue mussel	Dy	mg/Kg	0.013	0.049	0.096	0.313	1.580	52	41
Blue mussel	Er	mg/Kg	0.006	0.025	0.050	0.225	0.890	52	41
Blue mussel	Eu	mg/Kg	0.006	0.02	0.036	0.067	0.247	52	41
Blue mussel	Fe	mg/kg	<DL	163.946	247.617	436.903	12999.3	128	113
Blue mussel	Ga	mg/kg	0.035	0.097	0.162	0.271	7.233	64	57
Blue mussel	Gd	mg/Kg	0.052	0.125	0.252	1.129	4.295	52	41
Blue mussel	Ge	mg/kg	0.03	0.040	0.044	0.049	0.062	12	10
Blue mussel	Hf	mg/kg	<DL	0.001	0.008	0.013	0.089	42	36
Blue mussel	Hg	mg/kg	0.005	0.068	0.09	0.111	0.816	223	191
Blue mussel	Ho	mg/Kg	0.003	0.010	0.019	0.066	0.325	52	41
Blue mussel	K	mg/kg	38	10450.745	12405.711	14703.847	39686	75	70
Blue mussel	La	mg/Kg	<DL	0.537	2.046	6.997	48.733	82	70
Blue mussel	Li	mg/kg	0.005	0.264	0.609	1.099	17.078	64	57
Blue mussel	Lu	mg/Kg	0.001	0.003	0.006	0.018	0.082	52	41
Blue mussel	Mg	mg/kg	0.2	2601.762	3262.55	4532.198	9936	105	97
Blue mussel	Mn	mg/Kg	0.03	5.71	9.205	14.266	358.75	127	112
Blue mussel	Mo	mg/Kg	<DL	0.468	0.594	0.729	2.29	127	112
Blue mussel	Na	mg/kg	95	12000	17223.798	24771.202	94661	73	68
Blue mussel	Nb	mg/Kg	<DL	0.084	0.166	0.425	3.515	52	41

Blue mussel	Nd	mg/Kg	<DL	0.320	1.179	3.730	23.274	86	74
Blue mussel	Ni	mg/Kg	<DL	1.007	1.475	2.608	19.009	138	118
Blue mussel	P	mg/kg	33	9301	10217	11000	16344	87	80
Blue mussel	Pb	mg/kg	0.005	0.479	0.694	1.218	15.63	190	163
Blue mussel	Pb-210	Bq/kg	<DL	<DL	<DL	<DL	<DL	8	8
Blue mussel	Pd	mg/kg	<DL	0.007	0.022	0.046	0.091	45	40
Blue mussel	Po-210	Bq/kg	10	13	22	51.96	72	13	13
Blue mussel	Pr	mg/Kg	0.045	0.138	0.362	1.057	6.840	52	41
Blue mussel	Pt	mg/kg	<DL	<DL	<DL	0.001	0.05	47	41
Blue mussel	Ra-226	Bq/kg	<DL	<DL	<DL	<DL	25	11	11
Blue mussel	Ra-228	Bq/kg	<DL	<DL	<DL	<DL	<DL	8	8
Blue mussel	Rb	mg/Kg	0.021	6.041	6.563	8.207	180.37	74	62
Blue mussel	Re	mg/kg	<DL	<DL	<DL	0.000	0.001	42	36
Blue mussel	Rh	mg/kg	<DL	0.001	0.002	0.002	0.007	34	31
Blue mussel	Ru	mg/Kg	<DL	<DL	<DL	<DL	0.001	30	26
Blue mussel	S	mg/kg	1574	23159	24072	26212	33721	15	14
Blue mussel	Sb	mg/kg	<DL	<DL	0.009	0.014	0.04	87	80
Blue mussel	Sc	mg/kg	<DL	0.089	0.194	0.951	10.36	76	69
Blue mussel	Se	mg/kg	0.03	2.968	4.085	5.304	12.08	191	163
Blue mussel	Si	mg/kg	8.232	137.005	287.56	444.593	814.02	34	31
Blue mussel	Sm	mg/Kg	<DL	0.039	0.154	0.285	2.861	64	53
Blue mussel	Sn	mg/Kg	<DL	<DL	<DL	0.011	1.16	67	59
Blue mussel	Sr	mg/kg	<DL	28	35.200	51.5	408.9	87	80
Blue mussel	Ta	mg/kg	<DL	<DL	0.002	0.003	0.052	64	57
Blue mussel	Tb	mg/Kg	0.003	0.011	0.0225	0.093	0.357	52	41
Blue mussel	Te	mg/kg	<DL	<DL	0.0028	0.004	0.059	49	43
Blue mussel	Th	mg/Kg	<DL	0.006	0.055	0.187	8.62	97	85
Blue mussel	Ti	mg/kg	0.177	11.388	29.693	79.552	932.75	95	87
Blue mussel	Tl	mg/kg	<DL	<DL	<DL	0.008	0.19	87	80
Blue mussel	Tm	mg/Kg	0.0008	0.003	0.007	0.022	0.112	52	41
Blue mussel	U	mg/Kg	<DL	0.15	0.256	0.369	1.376	108	85
Blue mussel	V	mg/Kg	0.09	0.688	0.928	1.234	30.04	112	98
Blue mussel	W	mg/kg	<DL	<DL	0.017	0.031	0.113	61	55
Blue mussel	Y	mg/Kg	<DL	0.085	0.302	1.274	14.588	86	74
Blue mussel	Yb	mg/Kg	0.004	0.02	0.04	0.120	0.591	52	41
Blue mussel	Zn	mg/Kg	0.17	66.486	75.699	94.696	244.548	138	118
Blue mussel	Zr	mg/Kg	0.002	0.0553	0.243	0.928	6.11	82	69

Table A2.9 Greenland environmental baseline element concentration values for crinkled snow lichen. q25 refers to the 25% percentile (1st quatile) and q75 to the 75% percentile (3rd quatile). “No of meas.” refers to the number of concentration measurements of the particular element, in the particular sample type, for the particular region. DL refers to detection limit.

Sample Type	Element	Unit	Min	q25	Median	q75	Max	No. of meas.	No. of samples
Crinkled snow lichen	Ag	mg/kg	<DL	<DL	0.00	0.01	0.10	122	116
Crinkled snow lichen	Al	mg/kg	0.08	150.97	242.75	410.62	2.200.00	158	149

Crinkled snow lichen	As	mg/kg	<DL	0.02	0.04	0.10	0.76	187	176
Crinkled snow lichen	Au	mg/kg	<DL	<DL	<DL	<DL	0.02	118	112
Crinkled snow lichen	B	mg/Kg	<DL	<DL	<DL	0.35	0.70	3	3
Crinkled snow lichen	Ba	mg/kg	0.00	7.40	12.23	33.75	140.00	122	116
Crinkled snow lichen	Be	mg/kg	<DL	0.00	0.03	0.07	2.20	79	73
Crinkled snow lichen	Bi	mg/kg	<DL	<DL	0.00	0.00	0.01	120	114
Crinkled snow lichen	Ca	mg/kg	1.37	1.649.00	3.985.34	9.925.00	27.000.00	110	106
Crinkled snow lichen	Cd	mg/kg	0.00	0.06	0.09	0.13	0.52	213	194
Crinkled snow lichen	Ce	mg/kg	<DL	0.51	3.20	6.80	115.52	117	111
Crinkled snow lichen	Co	mg/kg	<DL	0.09	0.18	0.58	4.60	122	116
Crinkled snow lichen	Cr	mg/kg	<DL	0.19	0.33	0.83	3.94	186	175
Crinkled snow lichen	Cs	mg/kg	0.01	0.03	0.05	0.09	1.79	76	70
Crinkled snow lichen	Cu	mg/kg	<DL	0.558	0.762	1.385	13	188	176
Crinkled snow lichen	d.m.%	%	100	100	100	100	100	13	12
Crinkled snow lichen	Dy	mg/kg	0.009	0.060	0.109	0.349	5.032	63	58
Crinkled snow lichen	Er	mg/kg	0.004	0.029	0.052	0.153	2.482	63	58
Crinkled snow lichen	Eu	mg/kg	0.004	0.020	0.030	0.092	0.751	63	58
Crinkled snow lichen	Fe	mg/kg	0.056	92.876	158.433	411.377	1500	188	176
Crinkled snow lichen	Ga	mg/kg	0.017	0.109	0.207	0.433	3.240	76	70
Crinkled snow lichen	Gd	mg/kg	0.033	0.102	0.190	0.667	7.583	63	58
Crinkled snow lichen	Ge	mg/kg	0.012	0.016	0.018	0.025	0.03	12	10
Crinkled snow lichen	Hf	mg/kg	<DL	0.007	0.017	0.032	0.223	63	58
Crinkled snow lichen	Hg	mg/kg	<DL	0.029	0.034	0.049	0.31	201	182
Crinkled snow lichen	Ho	mg/kg	0.002	0.011	0.020	0.062	0.957	63	58
Crinkled snow lichen	K	mg/kg	86	1584.077	2024.346	2400	3200	108	104
Crinkled snow lichen	La	mg/kg	0.090	0.702	1.875	4.192	119.516	112	106
Crinkled snow lichen	Li	mg/kg	<DL	0.030	0.073	0.157	1.041	76	70
Crinkled snow lichen	Lu	mg/kg	4.70E-04	0.003	0.005	0.014	0.191	63	58
Crinkled snow lichen	Mg	mg/kg	0.771	729.565	940.486	1600	3532	149	142
Crinkled snow lichen	Mn	mg/kg	0.017	27.064	47	66.110	135.183	160	151
Crinkled snow lichen	Mo	mg/kg	<DL	<DL	0.021	0.039	0.23	159	150
Crinkled snow lichen	Na	mg/kg	<DL	565.691	704.883	900.810	4262	108	104
Crinkled snow lichen	Nb	mg/kg	0.009	0.222	0.528	0.904	5.045	63	58
Crinkled snow lichen	Nd	mg/kg	<DL	0.144	1.005	2.1	60.595	117	111
Crinkled snow lichen	Ni	mg/kg	<DL	0.188	0.441	1.205	6.5	188	176
Crinkled snow lichen	P	mg/kg	<DL	510	634.5	757.214	1300	120	114
Crinkled snow lichen	Pb	mg/kg	<DL	0.483	0.665	1.08	11.408	193	182
Crinkled snow lichen	Pb-210	Bq/kg	260	260	260	260	260	1	1
Crinkled snow lichen	Pd	mg/kg	<DL	0.001	0.004	0.035	0.156	64	60
Crinkled snow lichen	Po-210	Bq/kg	114.9	237.85	297.3	454.4	680.1	23	23
Crinkled snow lichen	Pr	mg/kg	0.027	0.187	0.315	1.210	18.622	63	58
Crinkled snow lichen	Pt	mg/kg	<DL	<DL	<DL	<DL	0.003	63	58
Crinkled snow lichen	Ra-226	Bq/kg	<DL	14.5	29	58.5	88	3	3
Crinkled snow lichen	Ra-228	Bq/kg	<DL	<DL	<DL	<DL	<DL	1	1
Crinkled snow lichen	Rb	mg/kg	0.513	1.864	2.749	3.933	10.097	76	70

Crinkled snow lichen	Re	mg/kg	<DL	<DL	<DL	5.77E-05	0.001	63	58
Crinkled snow lichen	Rh	mg/kg	<DL	3.00E-04	5.00E-04	9.00E-04	0.002	25	22
Crinkled snow lichen	Ru	mg/Kg	<DL	<DL	<DL	<DL	0.001	51	48
Crinkled snow lichen	S	mg/kg	167	310	427	599	945	13	12
Crinkled snow lichen	Sb	mg/kg	<DL	<DL	5.00E-04	0.005	0.2	120	114
Crinkled snow lichen	Sc	mg/kg	<DL	<DL	0.077	0.148	1.321	117	111
Crinkled snow lichen	Se	mg/kg	<DL	0.046	0.061	0.103	3.3	165	149
Crinkled snow lichen	Si	mg/kg	64.916	105.97	140.39	163.8	255.65	25	22
Crinkled snow lichen	Sm	mg/kg	<DL	<DL	0.033	0.247	8.687	104	99
Crinkled snow lichen	Sn	mg/kg	<DL	<DL	<DL	1.00E-04	0.7	69	66
Crinkled snow lichen	Sr	mg/kg	<DL	13.520	25.847	48.239	104.551	120	114
Crinkled snow lichen	Ta	mg/kg	<DL	5.50E-04	0.004	0.013	0.061	76	70
Crinkled snow lichen	Tb	mg/kg	0.002	0.013	0.022	0.077	0.968	63	58
Crinkled snow lichen	Te	mg/kg	<DL	<DL	<DL	6.43E-04	0.004	63	58
Crinkled snow lichen	Th	mg/Kg	<DL	<DL	0.02	0.119	4.7	120	114
Crinkled snow lichen	Ti	mg/kg	1.4	16.162	30.729	49.857	110	130	124
Crinkled snow lichen	Tl	mg/kg	<DL	<DL	<DL	0.002	0.047	120	114
Crinkled snow lichen	Tm	mg/kg	5.30E-04	0.004	0.007	0.0195	0.298	63	58
Crinkled snow lichen	U	mg/Kg	<DL	<DL	0.011	0.056	1.6	123	114
Crinkled snow lichen	V	mg/kg	<DL	0.203	0.356	0.956	4.3	173	162
Crinkled snow lichen	W	mg/kg	<DL	<DL	0.004	0.015	6.3	104	99
Crinkled snow lichen	Y	mg/kg	<DL	<DL	0.083	0.711	47.257	117	111
Crinkled snow lichen	Yb	mg/kg	0.004	0.022	0.038	0.1035	1.530	63	58
Crinkled snow lichen	Zn	mg/kg	<DL	14.589	19.247	24.3	90	193	182
Crinkled snow lichen	Zr	mg/kg	0.053	0.136	0.315	1.050	12.639	86	80

Table A2.10 Greenland environmental baseline element concentration values for filtered water. q25 refers to the 25% percentile (1st quatile) and q75 to the 75% percentile (3rd quatile). “No of meas.” refers to the number of concentration measurements of the particular element, in the particular sample type, for the particular region. DL refers to detection limit.

Sample Type	Element	Unit	Min	q25	Median	q75	Max	No. of meas.	No. of samples
Filtered water	Ag	µg/l	<DL	<DL	0.008	0.208	0.524	305	269
Filtered water	Al	µg/l	<DL	8.35	16.5	28.25	233.15	315	279
Filtered water	As	µg/l	<DL	0.001	0.054	0.319	4.827	205	177
Filtered water	Au	µg/l	<DL	<DL	0.004	0.007	0.065	305	269
Filtered water	B	µg/l	0.196	0.283	0.459	0.72	2.829	50	50
Filtered water	Ba	µg/l	<DL	0.58	2.18	5.688	263.79	305	269
Filtered water	Be	µg/l	<DL	0.005	0.024	0.095	0.771	176	167
Filtered water	Bi	µg/l	<DL	<DL	5.00E-04	0.001	0.008	289	261
Filtered water	Ca	µg/l	275	1661	3790	7330	106500	305	269
Filtered water	Cd	µg/l	<DL	<DL	0.004	0.010	0.11	214	186
Filtered water	Ce	µg/l	<DL	0.019	0.045	0.14	1.03	305	269
Filtered water	Cl	µg/l	3209	4965	6824	10640.5	19655	83	83
Filtered water	Co	µg/l	<DL	0.005	0.02	0.046	0.76	305	269
Filtered water	Cr	µg/l	<DL	0.01	0.08	0.14	0.63	315	279

Filtered water	Cs	µg/l	<DL	0.003	0.008	0.013	0.186	176	167
Filtered water	Cu	µg/l	<DL	0.186	0.61	1.185	8.45	315	279
Filtered water	Dy	µg/l	<DL	0.004	0.009	0.017	0.484	173	165
Filtered water	Er	µg/l	<DL	0.002	0.005	0.009	0.278	173	165
Filtered water	Eu	µg/l	<DL	0.001	0.002	0.008	0.051	173	165
Filtered water	F	µg/l	<DL	153	1039	1914	28302	91	91
Filtered water	Fe	µg/l	<DL	5.174	9.7	33.52	257.1	314	279
Filtered water	Ga	µg/l	<DL	0.007	0.015	0.084	0.968	176	167
Filtered water	Gd	µg/l	<DL	0.006	0.014	0.033	0.622	173	165
Filtered water	Ge	µg/l	0.0064	0.017	0.022	0.028	0.057	19	19
Filtered water	Hf	µg/l	<DL	0.003	0.006	0.012	0.471	173	165
Filtered water	Hg	µg/l	<DL	<DL	<DL	0.003	0.021	205	177
Filtered water	Ho	µg/l	<DL	7.40E-04	0.002	0.003	0.098	173	165
Filtered water	K	µg/l	45	360	687	972	4989	305	269
Filtered water	La	µg/l	<DL	0.016	0.065	0.218	0.736	305	269
Filtered water	Li	µg/l	<DL	0.22	0.61	0.988	21.78	286	269
Filtered water	Lu	µg/l	<DL	1.03E-04	4.35E-04	8.08E-04	0.004	98	98
Filtered water	Mg	µg/l	59.2	319	721.4	1576.5	19540	315	279
Filtered water	Mn	µg/l	<DL	0.532	2.16	3.848	99.368	290	255
Filtered water	Mo	µg/l	<DL	0.164	0.364	2.197	29.018	205	177
Filtered water	Na	µg/l	211	470	2258	6875	127430	305	269
Filtered water	Nb	µg/l	<DL	0.002	0.006	0.009	1.608	173	165
Filtered water	Nd	µg/l	<DL	0.017	0.057	0.173	0.878	305	269
Filtered water	Ni	µg/l	<DL	0.034	0.18	0.43	7.488	315	279
Filtered water	P	µg/l	<DL	1.16	3.9	5.1	98.5	305	269
Filtered water	Pb	µg/l	<DL	0.019	0.03	0.079	7.064	324	288
Filtered water	Pd	µg/l	<DL	<DL	0.001	0.002	0.018	176	167
Filtered water	Pr	µg/l	0.0009	0.014	0.027	0.066	0.916	173	165
Filtered water	Pt	µg/l	<DL	<DL	9.35E-04	0.002	0.007	286	269
Filtered water	Rb	µg/l	<DL	0.793	1.165	1.758	7.34	286	269
Filtered water	Re	µg/l	<DL	<DL	1.00E-04	3.00E-04	0.020	157	149
Filtered water	Rh	µg/l	<DL	<DL	5.00E-04	0.001	0.002	35	35
Filtered water	Ru	µg/l	<DL	<DL	<DL	<DL	0.002	174	165
Filtered water	S	µg/l	206	458	1044	2414	62450	253	245
Filtered water	Sb	µg/l	<DL	0.009	0.033	0.056	1.408	195	167
Filtered water	Sc	µg/l	<DL	0.02	0.055	0.45	1.51	289	253
Filtered water	Se	µg/l	<DL	0.027	0.064	0.128	0.407	195	167
Filtered water	Si	µg/l	4.89	8.778	15.68	27.095	73.8	58	58
Filtered water	Sm	µg/l	0.0004	0.010	0.023	0.043	0.545	192	165
Filtered water	Sn	µg/l	<DL	<DL	0.02	0.03	0.78	281	245
Filtered water	Sr	µg/l	1.755	8.65	13.9	24.14	210.75	305	269
Filtered water	Ta	µg/l	<DL	<DL	0.003	0.005	0.054	285	269
Filtered water	Tb	µg/l	<DL	0.001	0.002	0.004	0.082	173	165
Filtered water	Te	µg/l	<DL	<DL	<DL	0.003	0.019	168	159
Filtered water	Th	µg/l	<DL	0.002	0.004	0.007	0.121	305	269

Filtered water	Ti	µg/l	<DL	0.060	0.183	0.594	6.39	315	279
Filtered water	Tl	µg/l	<DL	<DL	0.004	0.013	0.125	195	167
Filtered water	Tm	µg/l	<DL	2.40E-04	7.00E-04	0.001	0.037	173	165
Filtered water	U	µg/l	<DL	0.019	0.059	0.114	2.823	195	167
Filtered water	V	µg/l	<DL	0.048	0.14	0.228	0.98	315	279
Filtered water	W	µg/l	<DL	0.005	0.015	0.029	0.882	195	167
Filtered water	Y	µg/l	0.001	0.006	0.033	0.064	0.619	305	269
Filtered water	Yb	µg/l	<DL	0.001	0.004	0.007	0.227	173	165
Filtered water	Zn	µg/l	<DL	0.437	0.991	1.839	158.23	324	288
Filtered water	Zr	µg/l	<DL	0.018	0.038	0.083	0.637	296	279

Table A2.11 Greenland environmental baseline element concentration values for seaweed (the "seaweed" category contains two types of brown fucoid macroalgae). q25 refers to the 25% percentile (1st quatile) and q75 to the 75% percentile (3rd quatile). "No of meas." refers to the number of concentration measurements of the particular element, in the particular sample type, for the particular region. DL refers to detection limit.

Sample Type	Element	Unit	Min	q25	Median	q75	Max	No. of meas.	No. of samples
Seaweed	Ag	mg/kg	<DL	0.086	0.103	0.130	0.215	50	44
Seaweed	Al	mg/kg	3.527	25.555	55.752	101.628	821.404	63	56
Seaweed	As	mg/kg	1.06	31.285	40.591	45.2	91	88	71
Seaweed	Au	mg/kg	<DL	<DL	0.006	0.011	0.035	47	40
Seaweed	B	mg/Kg	15	16	64.5	117.5	120	6	6
Seaweed	Ba	mg/Kg	1.1	8.411	12.990	19.553	168.194	66	51
Seaweed	Be	mg/Kg	<DL	0.0007	0.004	0.032	0.227	63	48
Seaweed	Bi	mg/kg	<DL	1.12E-04	0.001	0.002	0.006	50	44
Seaweed	Ca	mg/kg	970	6375	8200	14144.733	22879	37	35
Seaweed	Cd	mg/Kg	0.164	0.811	1.340	1.967	3.466	88	71
Seaweed	Ce	mg/Kg	<DL	0.121	0.288	0.806	2.046	60	45
Seaweed	Co	mg/Kg	0.089	0.439	0.58	0.778	3.5	69	53
Seaweed	Cr	mg/Kg	<DL	0.165	0.293	0.546	5.9	88	71
Seaweed	Cs	mg/kg	0.019	0.024	0.032	0.045	0.104	41	35
Seaweed	Cu	mg/kg	<DL	1.635	1.97	2.635	12	72	64
Seaweed	d.m.%	%	11.7	14.81	18.05	100	100	37	20
Seaweed	Dy	mg/Kg	0.006	0.018	0.061	0.094	0.205	43	30
Seaweed	Er	mg/Kg	0.003	0.010	0.033	0.060	0.130	43	30
Seaweed	Eu	mg/Kg	0.002	0.008	0.028	0.059	0.184	43	30
Seaweed	Fe	mg/Kg	9	41.438	74.75	134.175	639.101	88	71
Seaweed	Ga	mg/kg	0.024	0.035	0.118	0.301	0.78	41	35
Seaweed	Gd	mg/Kg	0.023	0.055	0.123	0.196	0.370	43	30
Seaweed	Ge	mg/kg	0.013	0.022	0.025	0.033	0.067	13	10
Seaweed	Hf	mg/kg	<DL	<DL	<DL	0.009	0.017	27	23
Seaweed	Hg	mg/kg	<DL	0.002	0.006	0.011	0.15	82	65
Seaweed	Ho	mg/Kg	0.001	0.003	0.012	0.019	0.044	43	30
Seaweed	K	mg/kg	3100	23810.532	29267	33780	44000	37	35
Seaweed	La	mg/Kg	<DL	0.1527	0.284	0.847	2.691	57	42
Seaweed	Li	mg/kg	0.212	0.364	0.459	0.674	1.188	41	35

Seaweed	Lu	mg/Kg	5.55E-04	0.001	0.004	0.006	0.013	43	30
Seaweed	Mg	mg/kg	1000	7215.367	8000.100	8465.171	12000	56	53
Seaweed	Mn	mg/Kg	2.4	14.038	21.7	35	121.042	85	69
Seaweed	Mo	mg/Kg	<DL	0.079	0.112	0.188	0.416	85	69
Seaweed	Na	mg/kg	1600	18380.471	25729.785	32778	51000	37	35
Seaweed	Nb	mg/Kg	0.003	0.018	0.093	0.176	0.59662	43	30
Seaweed	Nd	mg/Kg	<DL	0.135	0.221	0.806	2.061	60	45
Seaweed	Ni	mg/Kg	<DL	0.869	1.635	2.784	8.696	88	71
Seaweed	P	mg/kg	200	1300	2415.5	3010.25	6198	50	44
Seaweed	Pb	mg/Kg	<DL	0.063	0.120	0.231	0.85	88	71
Seaweed	Pb-210	Bq/kg	<DL	<DL	<DL	<DL	<DL	3	3
Seaweed	Pd	mg/kg	0.021	0.028	0.040	1.22	1.698	28	26
Seaweed	Po-210	Bq/kg	<DL	<DL	<DL	11.66	19.6	9	9
Seaweed	Pr	mg/kg	0.013	0.049	0.139	0.258	0.561	43	30
Seaweed	Pt	mg/kg	<DL	<DL	0.001	0.002	0.005	26	22
Seaweed	Ra-226	Bq/kg	<DL	<DL	<DL	<DL	11	6	6
Seaweed	Ra-228	Bq/kg	<DL	<DL	<DL	<DL	<DL	3	3
Seaweed	Rb	mg/kg	5.518	8.348	11.826	16.714	26.217	57	42
Seaweed	Re	mg/kg	0.009	0.023	0.057	0.071	0.090	27	23
Seaweed	Rh	mg/kg	0.0148	0.022	0.024	0.028	0.042	27	22
Seaweed	Ru	mg/kg	<DL	0.006	0.008	0.010	0.011	14	13
Seaweed	S	mg/kg	28734	31408.75	34243	35306.750	39674	14	13
Seaweed	Sb	mg/Kg	<DL	0.010	0.016	0.033	0.056	66	51
Seaweed	Sc	mg/kg	<DL	0.066	0.2215	0.535	2.821	44	38
Seaweed	Se	mg/kg	<DL	0.017	0.032	0.22	1.8	77	53
Seaweed	Si	mg/kg	15.897	32.609	65.658	189.61	495.29	27	22
Seaweed	Sm	mg/Kg	<DL	0.023	0.086	0.159	0.313	46	33
Seaweed	Sn	mg/kg	<DL	<DL	0.002	0.007	0.029	36	31
Seaweed	Sr	mg/kg	68	631.978	726.428	899.075	1256.1	50	44
Seaweed	Ta	mg/kg	<DL	<DL	0.001	0.002	0.007	41	35
Seaweed	Tb	mg/Kg	0.001	0.004	0.014	0.022	0.052	43	30
Seaweed	Te	mg/kg	<DL	0.002	0.004	0.008	0.013	27	23
Seaweed	Th	mg/Kg	<DL	0.008	0.016	0.046	0.316	66	51
Seaweed	Ti	mg/kg	0.6	5.107	13.314	34.086	52.207	54	47
Seaweed	Tl	mg/kg	<DL	<DL	0.003	0.008	0.037	50	44
Seaweed	Tm	mg/Kg	0.000	0.001	0.004	0.006	0.016	43	30
Seaweed	U	mg/Kg	0.15	0.492	0.645	1.020	1.560	72	51
Seaweed	V	mg/Kg	<DL	0.181	0.347	0.683	1.733	71	57
Seaweed	W	mg/kg	<DL	0.003	0.006	0.010	0.027	30	26
Seaweed	Y	mg/Kg	<DL	0.059	0.108	0.355	1.711	60	45
Seaweed	Yb	mg/Kg	0.004	0.009	0.030	0.0458	0.089	43	30
Seaweed	Zn	mg/Kg	<DL	10.98	13.978	24.1353	129.617	88	71
Seaweed	Zr	mg/Kg	0.108	0.217	0.347	0.551	2.4	61	45

Table A2.12 Greenland environmental baseline element concentration values for sediment. q25 refers to the 25% percentile (1st quatile) and q75 to the 75% percentile (3rd quatile). "No of meas." refers to the number of concentration measurements of the particular element, in the particular sample type, for the particular region. DL refers to detection limit.

Sample Type	Element	Unit	Min	q25	Median	q75	Max	No. of meas.	No. of samples
Sediment	Ag	mg/kg	<DL	0.04	0.065	0.108	0.27	58	48
Sediment	Al	mg/kg	0.045	38076.5	48751	63464.25	85920	92	77
Sediment	As	mg/kg	3.72E-04	3.551	5.37	8.825	24.6	146	106
Sediment	Au	mg/kg	<DL	<DL	0.006	0.019	0.105	56	46
Sediment	B	mg/Kg	0.001	0.001	3.201	9.3	18	4	4
Sediment	Ba	mg/kg	8.86E-04	221.493	280.875	344.108	470.54	58	48
Sediment	Be	mg/kg	8.90E-05	1.105	1.38	1.753	81	58	48
Sediment	Bi	mg/kg	<DL	0.133	0.18	0.21	0.3	58	48
Sediment	Ca	mg/kg	2.716	43410	51561	83675.25	152030	58	48
Sediment	Cd	mg/kg	4.30E-06	0.104	0.146	0.191	1.395	100	81
Sediment	Ce	mg/kg	7.00E-06	36.273	41.3	47.275	66.49	56	46
Sediment	Cl	mg/Kg	6.24	6.250	6.261	6.271	6.281	2	2
Sediment	Co	mg/kg	1.00E-06	7.93	9.105	11.623	17.72	58	48
Sediment	Cr	mg/kg	<DL	50.123	66.775	77.976	116.609	68	56
Sediment	Cs	mg/kg	1.70E-05	2.168	2.66	3.883	6.08	56	46
Sediment	Cu	mg/kg	<DL	14.708	20.44	29.023	99.812	100	81
Sediment	d.m.%	%	100	100	100	100	100	55	45
Sediment	Dy	mg/Kg	2.99E-06	3.01E-06	3.03E-06	3.04E-06	3.06E-06	2	2
Sediment	Er	mg/Kg	1.64E-06	1.90E-06	2.16E-06	2.41E-06	2.67E-06	2	2
Sediment	Eu	mg/Kg	2.00E-07	2.50E-07	3.00E-07	3.50E-07	4.00E-07	2	2
Sediment	F	mg/Kg	3.117	3.119	3.121	3.122	3.124	2	2
Sediment	Fe	mg/kg	<DL	23240	27190	32730	51452.921	68	56
Sediment	Ga	mg/kg	3.97E-04	9.463	11.205	14.465	21.43	56	46
Sediment	Gd	mg/Kg	3.60E-06	3.65E-06	3.70E-06	3.75E-06	3.80E-06	2	2
Sediment	Hf	mg/Kg	9.80E-06	1.17E-05	1.37E-05	1.56E-05	1.75E-05	2	2
Sediment	Hg	mg/kg	<DL	0.015	0.029	0.049	0.286	565	121
Sediment	Ho	mg/Kg	7.00E-07	7.30E-07	7.60E-07	7.90E-07	8.20E-07	2	2
Sediment	K	mg/kg	0.466	10769.25	12153	14918.75	20708	58	48
Sediment	La	mg/kg	2.00E-05	16.9475	19.93	22.583	32.34	56	46
Sediment	Li	mg/kg	0.002	21.18	29.128	35.53	51.97	80	67
Sediment	LoI%	mg/kg	0.47	4.873	6.4	7.015	8.68	4	4
Sediment	Lu	mg/Kg	1.10E-07	1.48E-07	1.85E-07	2.23E-07	2.60E-07	2	2
Sediment	Mg	mg/kg	0.431	10747.5	13405	16797.5	26430	68	56
Sediment	Mn	mg/kg	1.00E-05	268.815	308.96	376.468	2104.600	68	56
Sediment	Mo	mg/kg	0.004	0.338	0.625	1.01	30.346	68	56
Sediment	N	mg/kg	110	227.5	330	677.5	1700	42	42
Sediment	Na	mg/kg	13.688	5003.1	5607.65	11366.25	23000	58	48
Sediment	Nb	mg/Kg	1.00E-07	6.00E-07	1.10E-06	1.60E-06	2.10E-06	2	2
Sediment	Nd	mg/kg	2.20E-05	16.778	18.925	21.375	30.26	56	46

Sediment	Ni	mg/kg	<DL	22.87	34.24	45.04	89.261	89	71
Sediment	P	mg/kg	<DL	448.375	546.01	661.833	1058.7	58	48
Sediment	Pb	mg/kg	<DL	12.355	14.125	21.775	124.6	100	81
Sediment	Pb-210	Bq/kg	240	240	240	240	240	1	1
Sediment	Pd	mg/kg	<DL	<DL	0.01	0.03	0.09	56	46
Sediment	Po-210	Bq/kg	230	230	230	230	230	1	1
Sediment	Pr	mg/Kg	4.90E-06	5.38E-06	5.85E-06	6.33E-06	6.80E-06	2	2
Sediment	Pt	mg/kg	<DL	7.50E-04	0.005	0.010	0.027	56	46
Sediment	Ra-226	Bq/kg	340	407.5	475	542.5	610	2	2
Sediment	Ra-228	Bq/kg	230	230	230	230	230	1	1
Sediment	Rb	mg/kg	0.003	63.39	74.835	93.555	133.85	56	46
Sediment	Re	mg/Kg	2.00E-07	2.25E-07	2.50E-07	2.75E-07	3.00E-07	2	2
Sediment	Ru	mg/Kg	<DL	<DL	<DL	<DL	<DL	2	2
Sediment	S	mg/kg	<DL	229.065	444.56	821.353	2608.3	56	46
Sediment	Sb	mg/kg	1.93E-04	0.44	0.635	0.825	2.55	58	48
Sediment	Sc	mg/kg	8.90E-05	7.31	8.815	11.213	16.69	56	46
Sediment	Se	mg/kg	<DL	0.023	0.435	0.8	3.93	66	52
Sediment	Si	mg/Kg	0.043	0.043	0.044	0.044	0.045	2	2
Sediment	Sm	mg/kg	3.00E-06	3.408	3.88	4.263	6.34	56	46
Sediment	Sn	mg/kg	<DL	1.453	1.685	2.125	27	58	48
Sediment	Sr	mg/kg	0.013	83.645	99.945	130.565	244.34	58	48
Sediment	Ta	mg/Kg	<DL	2.50E-07	5.00E-07	7.50E-07	1.00E-06	2	2
Sediment	Tb	mg/Kg	3.50E-07	4.20E-07	4.90E-07	5.60E-07	6.30E-07	2	2
Sediment	Te	mg/kg	<DL	<DL	0.02	0.063	0.21	56	46
Sediment	Th	mg/Kg	1.20E-06	5.173	6.305	7.758	190	58	48
Sediment	Ti	mg/kg	2.04E-04	2058.1	2422.6	2951.15	4512.1	58	48
Sediment	Tl	mg/kg	1.20E-05	0.39	0.465	0.65	2.98	58	48
Sediment	Tm	mg/Kg	2.40E-07	2.75E-07	3.10E-07	3.45E-07	3.80E-07	2	2
Sediment	U	mg/Kg	3.27E-04	1.618	1.945	2.14	61	60	48
Sediment	V	mg/kg	4.80E-05	45.995	61.355	78.29	118.77	68	56
Sediment	W	mg/kg	1.06E-04	0.975	1.285	1.588	3.3	56	46
Sediment	Water%	mg/kg	16.8	19.45	22.1	39.1	56.1	3	3
Sediment	Y	mg/kg	2.70E-05	15.553	17.015	19.128	31.26	56	46
Sediment	Yb	mg/Kg	1.77E-06	1.79E-06	1.82E-06	1.84E-06	1.86E-06	2	2
Sediment	Zn	mg/kg	0.002	52.926	69.105	86.42	730	100	81
Sediment	Zr	mg/kg	3.70E-05	89.033	106.89	126.03	224.31	56	46

Table A2.13 Greenland environmental baseline element concentration values for shorthorn sculpin. q25 refers to the 25% percentile (1st quatile) and q75 to the 75% percentile (3rd quatile). "No of meas." refers to the number of concentration measurements of the particular element, in the particular sample type, for the particular region. DL refers to detection limit.

Sample Type	Element	Unit	Min	q25	Median	q75	Max	No. of meas.	No. of samples
Shorthorn sculpin	Ag	mg/kg	<DL	0.038	0.072	0.171	0.699	94	85
Shorthorn sculpin	Al	mg/kg	<DL	0.15	0.4	0.934	7.88	89	80
Shorthorn sculpin	As	mg/kg	1.099	3.303	7.08	12.163	64.51	102	93

Shorthorn sculpin	Au	mg/kg	<DL	<DL	9.50E-05	0.002	0.006	62	55
Shorthorn sculpin	B	mg/Kg	<DL	<DL	0.5	0.6	1.8	5	5
Shorthorn sculpin	Ba	mg/kg	<DL	<DL	0.004	0.008	0.046	88	80
Shorthorn sculpin	Be	mg/kg	<DL	<DL	3.00E-04	5.00E-04	0.004	76	70
Shorthorn sculpin	Bi	mg/kg	<DL	<DL	3.00E-04	0.001	0.007	94	85
Shorthorn sculpin	Ca	mg/kg	32	70.5	95	156.175	1400	94	85
Shorthorn sculpin	Cd	mg/kg	<DL	0.65	0.996	1.68	10.521	801	737
Shorthorn sculpin	Ce	mg/kg	2.00E-04	5.00E-04	0.001	0.003	0.039	89	80
Shorthorn sculpin	CH3Hg	mg/kg	0.136	0.230	0.401	0.708	1.68	22	20
Shorthorn sculpin	Co	mg/kg	0.006	0.03	0.046	0.068	0.24	102	93
Shorthorn sculpin	Cr	mg/kg	<DL	<DL	0.008	0.04	0.44	101	92
Shorthorn sculpin	Cs	mg/kg	0.01	0.016	0.02	0.02	0.031	89	80
Shorthorn sculpin	Cu	mg/kg	0.45	1.053	1.595	2.87	11.15	102	93
Shorthorn sculpin	d.m.%	%	13.84	24.775	29.55	34.385	53.714	868	765
Shorthorn sculpin	Dy	mg/Kg	<DL	1.25E-05	4.00E-05	1.10E-04	4.80E-04	66	60
Shorthorn sculpin	Er	mg/Kg	<DL	<DL	3.00E-05	1.00E-04	3.20E-04	53	48
Shorthorn sculpin	Eu	mg/Kg	<DL	<DL	1.00E-05	4.00E-05	1.28E-04	50	45
Shorthorn sculpin	Fe	mg/kg	4	25.025	44.04	103.675	858.7	102	93
Shorthorn sculpin	Ga	mg/kg	<DL	<DL	5.00E-04	0.029	0.039	72	65
Shorthorn sculpin	Gd	mg/Kg	<DL	3.00E-05	8.00E-05	1.64E-04	6.87E-04	63	58
Shorthorn sculpin	Hf	mg/Kg	<DL	<DL	<DL	<DL	<DL	22	20
Shorthorn sculpin	Hg	mg/kg	<DL	0.024	0.047	0.078	1.776	812	736
Shorthorn sculpin	Ho	mg/Kg	<DL	<DL	1.40E-05	4.75E-05	1.10E-04	42	38
Shorthorn sculpin	K	mg/kg	1229	2020	2411.5	3352.25	4848	94	85
Shorthorn sculpin	La	mg/kg	1.00E-04	7.00E-04	0.002	0.003	0.043	89	80
Shorthorn sculpin	Li	mg/kg	0.008	0.024	0.029	0.047	1.784	89	80
Shorthorn sculpin	Lu	mg/Kg	<DL	<DL	<DL	<DL	<DL	22	20
Shorthorn sculpin	Mg	mg/kg	94	160.5	191.45	229.825	374	94	85
Shorthorn sculpin	Mn	mg/kg	<DL	0.375	0.495	0.628	1.49	94	85
Shorthorn sculpin	Mo	mg/kg	<DL	0.039	0.055	0.09	0.176	94	85
Shorthorn sculpin	Na	mg/kg	980	1763.75	2278.5	3086.25	5987	94	85
Shorthorn sculpin	Nb	mg/Kg	<DL	<DL	<DL	<DL	<DL	22	20
Shorthorn sculpin	Nd	mg/kg	1.30E-04	3.80E-04	9.40E-04	0.003	0.015	89	80
Shorthorn sculpin	Ni	mg/kg	<DL	<DL	0.004	0.022	0.102	97	89
Shorthorn sculpin	P	mg/kg	1110	1774.5	2198	2854	3808	94	85
Shorthorn sculpin	Pb	mg/kg	<DL	0.001	0.007	0.015	0.19	264	215
Shorthorn sculpin	Pb-210	Bq/kg	<DL	<DL	<DL	<DL	<DL	2	2
Shorthorn sculpin	Pd	mg/kg	<DL	<DL	1.00E-04	0.002	0.005	79	72
Shorthorn sculpin	Po-210	Bq/kg	<DL	<DL	<DL	<DL	<DL	4	4
Shorthorn sculpin	Pr	mg/Kg	5.00E-05	1.00E-04	1.60E-04	0.0003	0.001	58	54
Shorthorn sculpin	Pt	mg/Kg	<DL	<DL	<DL	<DL	<DL	22	20
Shorthorn sculpin	Ra-226	Bq/kg	<DL	<DL	<DL	<DL	<DL	5	5
Shorthorn sculpin	Ra-228	Bq/kg	<DL	<DL	<DL	<DL	<DL	2	2
Shorthorn sculpin	Rb	mg/kg	0.26	0.39	0.44	0.53	0.79	89	80
Shorthorn sculpin	Re	mg/Kg	<DL	7.00E-05	1.20E-04	4.28E-04	0.009	66	60

Shorthorn sculpin	Rh	mg/kg	3.00E-04	4.00E-04	4.00E-04	5.00E-04	6.00E-04	23	20
Shorthorn sculpin	Ru	mg/Kg	<DL	<DL	<DL	<DL	<DL	22	20
Shorthorn sculpin	S	mg/kg	1896.165	2573.923	3479.094	4005	4827	45	40
Shorthorn sculpin	Sb	mg/kg	<DL	<DL	0.001	0.004	0.007	77	69
Shorthorn sculpin	Sc	mg/kg	<DL	<DL	0.093	0.11	0.149	45	40
Shorthorn sculpin	Se	mg/kg	0.2	0.72	0.857	1.030	5.13	752	691
Shorthorn sculpin	Si	mg/kg	6.954	8.277	9.587	11.143	16.672	23	20
Shorthorn sculpin	Sm	mg/Kg	<DL	3.00E-05	9.95E-05	1.83E-04	7.22E-04	66	60
Shorthorn sculpin	Sn	mg/kg	<DL	<DL	0.007	0.013	0.052	82	75
Shorthorn sculpin	Sr	mg/kg	0.3	0.803	1.2	1.7	8.1	94	85
Shorthorn sculpin	Ta	mg/kg	<DL	<DL	6.00E-05	0.001	0.003	67	60
Shorthorn sculpin	Tb	mg/Kg	<DL	<DL	5.00E-06	2.75E-05	9.00E-05	42	37
Shorthorn sculpin	Te	mg/Kg	<DL	<DL	1.00E-04	3.00E-04	7.00E-04	53	49
Shorthorn sculpin	Th	mg/Kg	<DL	<DL	2.40E-05	5.00E-04	1.20E-03	78	71
Shorthorn sculpin	Ti	mg/kg	<DL	<DL	1.5	29.901	38.491	50	45
Shorthorn sculpin	Tl	mg/kg	<DL	<DL	0.001	0.003	0.023	76	69
Shorthorn sculpin	Tm	mg/Kg	<DL	<DL	<DL	1.70E-05	6.00E-05	32	29
Shorthorn sculpin	U	mg/Kg	<DL	7.00E-04	0.002	0.002	0.021	93	79
Shorthorn sculpin	V	mg/Kg	<DL	0.01	0.027	0.072	0.55	70	64
Shorthorn sculpin	W	mg/Kg	<DL	<DL	<DL	<DL	<DL	22	20
Shorthorn sculpin	Y	mg/kg	<DL	2.00E-04	5.70E-04	0.001	0.006	89	80
Shorthorn sculpin	Yb	mg/Kg	<DL	<DL	1.00E-05	4.50E-05	2.20E-04	55	50
Shorthorn sculpin	Zn	mg/kg	8	26.358	33.705	44.185	99.44	102	93
Shorthorn sculpin	Zr	mg/kg	<DL	8.00E-04	0.002	0.004	0.014	89	80

Table A2.14 Greenland environmental baseline element concentration values for soil. q25 refers to the 25% percentile (1st quatile) and q75 to the 75% percentile (3rd quatile). “No of meas.” refers to the number of concentration measurements of the particular element, in the particular sample type, for the particular region. DL refers to detection limit.

Sample Type	Element	Unit	Min	q25	Median	q75	Max	No. of meas.	No. of samples
Soil	Ag	mg/Kg	<DL	0.103	0.124	0.192	0.266	25	23
Soil	Al	mg/kg	0.035	11752.746	30100	58640	93597	49	42
Soil	As	mg/Kg	<DL	0.147	0.963	1.302	7.1	49	42
Soil	Au	mg/Kg	<DL	<DL	<DL	<DL	<DL	22	20
Soil	B	mg/Kg	<DL	<DL	<DL	<DL	<DL	3	3
Soil	Ba	mg/Kg	0.009	61.965	70.667	107.001	694.597	25	23
Soil	Be	mg/Kg	<DL	2.14	2.667	3.642	24	25	23
Soil	Bi	mg/Kg	<DL	0.05	0.062	0.086	0.194	25	23
Soil	Ca	mg/Kg	3.445	4261.771	7162.601	8672.452	11018.383	25	23
Soil	Cd	mg/kg	<DL	0.042	0.1066	0.39	0.854	49	42
Soil	Ce	mg/Kg	1.87E-04	111.045	155.485	164.614	205.363	22	20
Soil	Co	mg/Kg	<DL	3.7	4.908	5.544	39.949	25	23
Soil	Cr	mg/kg	1.10E-04	18	27.739	47.849	368.9	49	42
Soil	Cs	mg/Kg	1.40E-06	0.808	1.313	1.520	2.144	22	20
Soil	Cu	mg/kg	4.42E-04	4.855	7.668	15.645	83.779	49	42

Soil	Dy	mg/kg	3.154	4.022	5.754	6.444	10.114	21	19
Soil	Er	mg/kg	1.517	2.012	2.916	3.326	5.136	21	19
Soil	Eu	mg/kg	0.811	1.347	1.534	1.676	2.875	21	19
Soil	Fe	mg/kg	0.003	15570	29177.644	47357	80108	49	42
Soil	Ga	mg/Kg	<DL	10.8	11.381	14.416	18.073	22	20
Soil	Gd	mg/kg	6.738	11.663	13.25	14.037	20.666	21	19
Soil	Hf	mg/kg	0.768	1.601	1.798	2.092	2.754	21	19
Soil	Hg	mg/kg	<DL	0.015	0.031	0.044	0.09	46	42
Soil	Ho	mg/kg	0.588	0.767	1.091	1.235	1.943	21	19
Soil	K	mg/Kg	0.467	2513.356	2639.8	3296.394	11665.205	25	23
Soil	La	mg/Kg	2.57E-04	57.285	71.979	85.879	107.626	22	20
Soil	Li	mg/Kg	<DL	7.5275	9.004	15.831	25.622	22	20
Soil	Lu	mg/kg	0.192	0.216	0.313	0.432	0.652	21	19
Soil	Mg	mg/Kg	0.423	2796.958	3133.773	4292.613	12167.14	25	23
Soil	Mn	mg/Kg	<DL	472.403	606.963	766.646	1254.968	25	23
Soil	Mo	mg/Kg	<DL	0.567	0.76	1.091	7.9	25	23
Soil	Na	mg/Kg	2.535	1049.873	1200.122	2200	6099.437	25	23
Soil	Nb	mg/kg	0.075	0.261	0.734	2.093	5.475	21	19
Soil	Nd	mg/Kg	2.32E-04	38.72925	54.0625	57.367	85.349	22	20
Soil	Ni	mg/kg	1.08E-04	7.003	11.325	28.357	201.869	49	42
Soil	P	mg/Kg	<DL	983.744	1036.598	1500.773	2668.727	25	23
Soil	Pb	mg/kg	1.53E-05	9.235	12.551	14.776	87	49	42
Soil	Pd	mg/Kg	1.20E-06	0.140	0.176	0.203	0.296	22	20
Soil	Pr	mg/kg	7.537	12.734	15.135	16.503	22.891	21	19
Soil	Pt	mg/Kg	<DL	0.026	0.0355	0.0405	0.05	22	20
Soil	Ra	mg/Kg	0.125	0.263	0.4	0.435	0.47	3	3
Soil	Rb	mg/Kg	6.14E-04	25.920	31.292	41.531	61.864	22	20
Soil	Re	mg/kg	0.003	0.004	0.006	0.008	0.012	21	19
Soil	Rh	mg/Kg	<DL	<DL	<DL	<DL	<DL	1	1
Soil	Ru	mg/kg	<DL	<DL	<DL	<DL	0.002	21	19
Soil	S	mg/Kg	1.911	1.911	1.911	1.911	1.911	1	1
Soil	Sb	mg/Kg	<DL	<DL	<DL	<DL	0.46	25	23
Soil	Sc	mg/Kg	<DL	3.830	5.158	6.320	11.98	22	20
Soil	Se	mg/kg	<DL	0.068	0.132	0.328	1.4	49	42
Soil	Sm	mg/kg	4.555	7.941	9.49	9.959	15.268	21	19
Soil	Sn	mg/Kg	<DL	7.28E-06	4.750	10.125	12	4	4
Soil	Sr	mg/Kg	0.015	36	58.713	86.964	159.454	25	23
Soil	Ta	mg/Kg	2.00E-06	0.018	0.028	0.040	0.056	22	20
Soil	Tb	mg/kg	0.668	0.928	1.283	1.363	2.125	21	19
Soil	Te	mg/Kg	<DL	<DL	<DL	<DL	0.04	22	20
Soil	Th	mg/Kg	1.00E-05	7.937	9.81	11.716	79	25	23
Soil	Ti	mg/Kg	8.37E-05	315.163	395.039	432.265	1200	25	23
Soil	Tl	mg/Kg	<DL	0.099	0.112	0.155	0.86	25	23
Soil	Tm	mg/kg	0.212	0.267	0.397	0.475	0.721	21	19
Soil	U	mg/Kg	6.54E-05	2.588	3.450	4.744	74	28	23

Soil	V	mg/kg	1.36E-04	24.831	36.463	116.595	234.965	49	42
Soil	W	mg/Kg	<DL	0.016	0.020	0.043	0.101	22	20
Soil	Y	mg/Kg	3.90E-05	15.277	24.162	28.314	45.05	22	20
Soil	Yb	mg/kg	1.309	1.534	2.309	2.999	4.377	21	19
Soil	Zn	mg/kg	1.25E-04	25.83	64.852	100.725	380	49	42
Soil	Zr	mg/Kg	4.20E-06	73.07	84.439	122.388	174.49	22	20

Table A2.15 Greenland environmental baseline element concentration values for unfiltered water. q25 refers to the 25% percentile (1st quatile) and q75 to the 75% percentile (3rd quatile). "No of meas." refers to the number of concentration measurements of the particular element, in the particular sample type, for the particular region. DL refers to detection limit.

Sample Type	Element	Unit	Min	q25	Median	q75	Max	No. of meas.	No. of samples
Unfiltered water	Ag	µg/l	<DL	<DL	<DL	0.004	0.287	194	168
Unfiltered water	Al	µg/l	<DL	13.675	32.146	112.375	2816	204	178
Unfiltered water	As	µg/l	<DL	0.03	0.081	0.16	2.83	204	178
Unfiltered water	Au	µg/l	<DL	<DL	<DL	0.007	0.287	194	168
Unfiltered water	B	µg/l	0.213	0.262	0.273	0.304	0.618	18	18
Unfiltered water	Ba	µg/l	0.098	2.603	5.58	21.418	267.27	194	168
Unfiltered water	Be	µg/l	<DL	0.005	0.012	0.023	0.142	179	166
Unfiltered water	Bi	µg/l	<DL	4.33E-04	0.001	0.002	0.009	178	160
Unfiltered water	Ca	µg/l	492	2153.075	13963.5	21518	113650	194	168
Unfiltered water	Cd	µg/l	<DL	0.003	0.011	0.024	10.86	204	178
Unfiltered water	Ce	µg/l	<DL	0.081	0.192	0.578	17.319	194	168
Unfiltered water	Co	µg/l	<DL	0.018	0.075	0.298	4.131	194	168
Unfiltered water	Cr	µg/l	<DL	0.056	0.108	0.340	12.858	204	178
Unfiltered water	Cs	µg/l	<DL	0.004	0.009	0.026	0.41	181	168
Unfiltered water	Cu	µg/l	0.005	0.26	0.68	4.06	21.99	204	178
Unfiltered water	Dy	µg/l	0.004	0.011	0.015	0.022	0.469	28	28
Unfiltered water	Er	µg/l	0.002	0.006	0.007	0.012	0.196	28	28
Unfiltered water	Eu	µg/l	0.004	0.008	0.010	0.015	0.182	28	28
Unfiltered water	Fe	µg/l	<DL	7.755	35.755	145.95	4025	204	178
Unfiltered water	Ga	µg/l	<DL	0.008	0.026	0.106	0.998	181	168
Unfiltered water	Gd	µg/l	0.011	0.026	0.034	0.049	0.925	28	28
Unfiltered water	Ge	µg/l	0.004	0.019	0.028	0.041	0.417	18	18
Unfiltered water	Hf	µg/l	7.00E-04	0.004	0.005	0.007	0.009	28	28
Unfiltered water	Hg	µg/l	<DL	<DL	<DL	<DL	0.127	204	178
Unfiltered water	Ho	µg/l	6.40E-04	0.002	0.003	0.005	0.078	28	28
Unfiltered water	K	µg/l	97	246.25	397.5	973.575	4135	194	168
Unfiltered water	La	µg/l	0.005	0.056	0.192	0.443	9.743	194	168
Unfiltered water	Li	µg/l	0.06	0.31	0.53	1.07	4.94	181	168
Unfiltered water	Lu	µg/l	1.80E-04	8.40E-04	0.001	0.002	0.021	28	28
Unfiltered water	Mg	µg/l	56	537.5	2123	3998.5	82230	195	169
Unfiltered water	Mn	µg/l	<DL	0.403	3.956	17.86	377.23	204	178
Unfiltered water	Mo	µg/l	0.006	0.04	0.08	0.272	6.218	204	178
Unfiltered water	Na	µg/l	137	406.25	1164.45	3385.5	20195	194	168

Unfiltered water	Nb	µg/l	<DL	0.004	0.006	0.011	0.107	28	28
Unfiltered water	Nd	µg/l	0.007	0.095	0.251	0.479	6.452	194	168
Unfiltered water	Ne	µg/l	1208	1231	1332	1358	2213	9	9
Unfiltered water	Ni	µg/l	<DL	0.102	0.362	2.442	12.351	204	178
Unfiltered water	P	µg/l	<DL	1.4	5.05	13.7	710.5	194	168
Unfiltered water	Pb	µg/l	0.001	0.054	0.105	0.329	21.38	204	178
Unfiltered water	Pd	µg/l	<DL	0.001	0.005	0.008	0.034	181	168
Unfiltered water	Pr	µg/l	0.026	0.070	0.086	0.112	1.756	28	28
Unfiltered water	Pt	µg/l	<DL	<DL	<DL	<DL	0.019	169	156
Unfiltered water	Rb	µg/l	0.015	0.15	1.104	2.057	15.293	181	168
Unfiltered water	Re	µg/l	<DL	<DL	0.002	0.005	0.017	28	28
Unfiltered water	Rh	µg/l	<DL	5.00E-05	0.001	0.002	0.004	30	30
Unfiltered water	Ru	µg/l	<DL	1.00E-04	0.001	0.001	0.003	28	28
Unfiltered water	S	µg/l	<DL	828	1541.3	3815.5	231360	179	166
Unfiltered water	Sb	µg/l	<DL	0.005	0.022	0.040	0.164	194	168
Unfiltered water	Sc	µg/l	<DL	0.038	0.065	0.144	0.907	194	168
Unfiltered water	Se	µg/l	<DL	0.013	0.07	0.15	1.18	194	168
Unfiltered water	Si	µg/l	4.94	11.55	15.945	64.766	114.02	38	38
Unfiltered water	Sm	µg/l	0.0152	0.035	0.045	0.068	0.999	41	28
Unfiltered water	Sn	µg/l	<DL	0.01	0.019	0.051	1.187	192	166
Unfiltered water	Sr	µg/l	1.02	11.202	29.9	45.510	217.74	194	168
Unfiltered water	Ta	µg/l	<DL	<DL	0.009	0.017	0.064	181	168
Unfiltered water	Tb	µg/l	8.20E-04	0.003	0.004	0.005	0.093	28	28
Unfiltered water	Te	µg/l	<DL	<DL	0.002	0.005	0.043	173	160
Unfiltered water	Th	µg/l	2.00E-04	0.004	0.010	0.027	1.114	194	168
Unfiltered water	Ti	µg/l	<DL	0.131	0.345	1.106	129.09	204	178
Unfiltered water	Tl	µg/l	<DL	<DL	<DL	0.008	0.087	194	168
Unfiltered water	Tm	µg/l	1.20E-04	0.001	0.001	0.002	0.025	28	28
Unfiltered water	U	µg/l	<DL	0.042	0.117	0.211	2.502	194	168
Unfiltered water	V	µg/l	<DL	0.028	0.095	0.284	6.812	204	178
Unfiltered water	W	µg/l	<DL	<DL	0.006	0.02	0.299	194	168
Unfiltered water	Y	µg/l	0.004	0.066	0.122	0.363	2.124	194	168
Unfiltered water	Yb	µg/l	0.0015	0.005	0.007	0.009	0.146	28	28
Unfiltered water	Zn	µg/l	<DL	1.190	2.561	5.763	3657.3	204	178
Unfiltered water	Zr	µg/l	<DL	0.028	0.058	0.130	0.878	191	178

Appendix 3 Kalaallit Nunaata kujataani nunap naanerata assilinera

By Drude Fritzbøger Christensen[1,2]
[1]Department of Ecoscience, Aarhus University, [2]Current address: Department of Geosciences and Natural Resource Management, University of Copenhagen

The extension and density of vegetation

The vegetation cover in South Greenland can vary in type and abundance within a few metres to kilometres due to changes in e.g., terrain. snow cover. soil type, temperature, and precipitation. The extension, degree of coverage and health of the vegetation are often approximated by use of the "Normalized Difference Vegetation Index" (NDVI).

$$\mathrm{NDVI} = \frac{\text{Near infrared light} - \text{Visible red light}}{\text{Near infra light} + \text{Visible red light}}$$

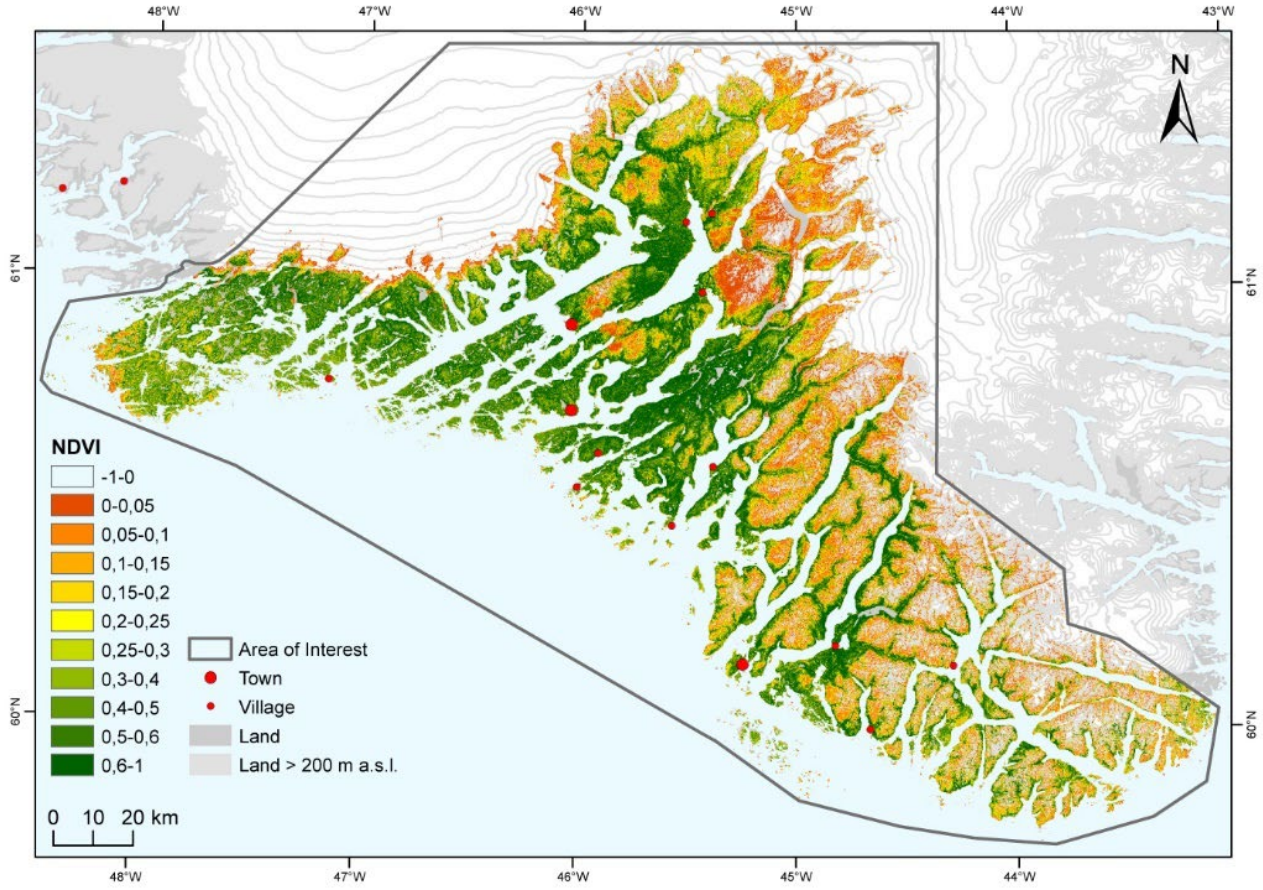
NDVI is an indicator of photosynthetically active biomass by comparison of the amount of reflected visible red and near-infrared light by the vegetation.

The chlorophyll pigments of healthy vegetation absorb the visible red light for the purpose of photosynthesis, while near-infrared light is mostly reflected to prevent the plant from overheating. Unhealthy (with less chlorophyll pigments) or sparse vegetation (more exposed soil), on the other hand, will absorb less visible red light and at the same time absorb more of the near-infrared light (due to deterioration of the leaf's spongy layer that reflects near-infrared light). This means that dense, healthy vegetation has NDVI values close to one, while sparse (i.e., bare soil) or unhealthy vegetation has NDVI values close to zero. Negative values correspond to other land cover types such as snow and water bodies, but certain types of gravel may also give this signal.

NDVI is thus useful for the monitoring of temporal and spatial variations in vegetation growth and cover. However, in areas or during periods with dense vegetation cover, NDVI can saturate, resulting in lack of correlation between vegetation abundance and NDVI. Moreover, the index is highly sensitive to background variations (e.g., visible soil), with high NDVI values for dark backgrounds (Jensen 2007).

Takussutissiaq A3.1 shows NDVI values in South Greenland calculated using Sentinel-2 band 4 and 8. The map is a composite image of satellite measurements from 3 and 4 July 2019. The spatial resolution of the image is 10 m. Gradients in NDVI can be seen from the outer parts of the fjords, close to the cold open ocean and towards the inner, protected parts, and from low-lying areas (< 200 m a.s.l.) to higher massifs. NDVI values are largest in sheltered, low-lying areas with values of up to 0.9, indicating high density of green leaves.

Several other studies (see "Studies on NDVI and relation to biomass") have estimated NDVI in South Greenland based on satellite measurements. These studies show a general increase in NDVI over the last decades (Epstein et al. 2012), with the highest NDVI occurring in low-lying (< 200 m a.s.l.), coastal areas in the inner parts of the fjords (Westergaard-Nielsen et al. 2015; Lehmann et al. 2020) in accordance with the results presented in Takussutissiaq A3.1. The temperature dependence of the vegetation also results in higher NDVI (i.e., more dense vegetation) on south-facing slopes (Westergaard-Nielsen et al. 2015). NDVI values in South Greenland are typically within the range 0.1-0.7, indicating that the land cover spans from very sparse vegetation with dominance of rock/bare soil to dense vegetation cover.



Takussutissiaq A3.1. NDVI values for South Greenland calculated using Sentinel-2 data from 3 and 4 July 2019.

Studies on NDVI and relation to biomass

Epstein et al. (2012) studied the biomass dynamics in the Arctic over a 29-year period (1982-2010) by developing a regression model between NDVI and above-ground tundra biomass. Above-ground biomass was sampled in the field between 2002-2010 at 13 locations covering different Arctic bioclimate subzones (following the Circumpolar Arctic Vegetation Map by Walker et al. 2005). from zones in the north dominated by bare ground, mosses and lichens to zones in the south characterised by dense vegetation cover and abundance of dwarf shrubs. NDVI was calculated based on data from the Advanced Very-High-Resolution Radiometer instrument (AVHRR) with a spatial resolution of 12.5 km, and maximum annual NDVI was extracted for each biomass sampling location. A strong, positive correlation between NDVI and biomass enabled an estimation of the trend in biomass during the period 1982-

2010. In South Greenland, an increase in mean biomass from 230.8 g/m² to 241.7 g/m² was observed, corresponding to an average yearly increase of 0.6 g/m². In comparison, the above-ground biomass in dense, intact tropical forests is observed to range between ca. 30.000 g/m² and 50.000 g/m² (Cummings et al. 2002).

Westergaard-Nielsen et al. (2015) also studied changes in biomass using the relation between NDVI and biomass found by Jia et al. (2006) in Southwest Greenland during 2000-2012. In addition, they predicted the future above-ground biomass (2090-2099) based on a relation between NDVI and a satellite-based summer warmth index. The summer warmth index was estimated for the period 2090-2099 based on a climate projection model. The purpose of the study was to assess the current state and future potential for sheep farming through examination of the spatial heterogeneity of vegetation greenness and above-ground biomass. For calculation of NDVI, MODIS satellite data with a spatial resolution of 250 m were used. The results showed a spatial distribution of above-ground biomass (NDVI), with the highest biomass occurring in low-lying coastal areas. The predictions for the future indicated a general increase in the relative above-ground biomass of up to 489 g/m² (increase per year = 5.7 g/m²), with the largest increase taking place in areas of current high biomass (2000-2012).

Lehmann et al. (2020) also studied NDVI in relation to farming in South Greenland. Their aim was to investigate a possible relation between lamb carcass weight/quality and feed availability. MODIS satellite data with a spatial resolution of 1 km for the period 2010-2017 were used to calculate NDVI. The results showed a distribution of average annual NDVI in South Greenland (from approximately Narsaq in the north to Nanortalik in the south) with the highest NDVI in the low-lying coastal areas between Narsaq and Alluitsup Paa. The relations between NDVI and carcass weight were shown to be spatially varying with a positive correlation between NDVI and carcass weight for 18 out of 22 grazing areas.

The vegetation types

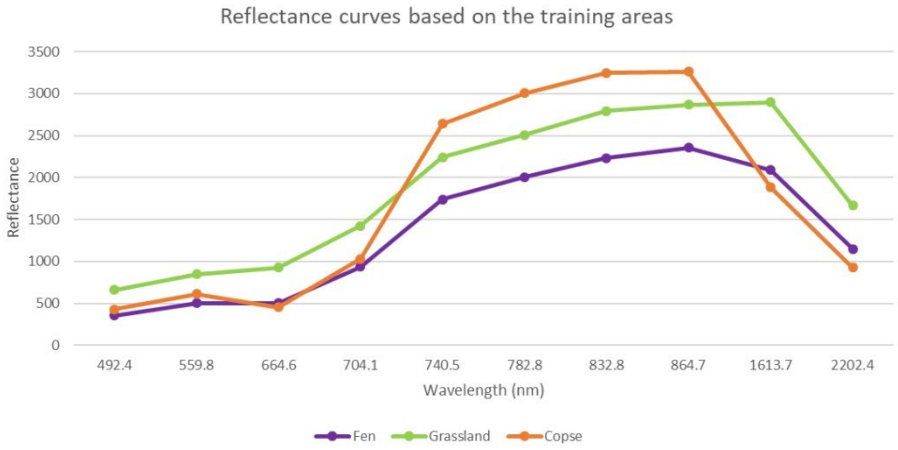
Vegetation mapping

Based on previous field observations (e.g., Tamstorf 2001; Aastrup et al. 2004; Karami et al. 2018), the vegetation cover of South Greenland can generally be assigned to the following main types: agricultural fields, shrub heaths, grasslands, copse, and fen. Snow-patch, seashore, herb-slope, and woodland (incl. plantations) vegetations are also present in South Greenland (Feilberg 1984) but not relevant for the spatial vegetation mapping in the present analysis. To map the spatial distribution of the vegetation types in the area, multispectral satellite images with a (sampled) spatial resolution of 10 m were used. Seven, almost cloud-free, satellite images obtained by the Sentinel-2 satellite on 3 and 4 July 2019 were used to cover South Greenland. The downloaded satellite images were level 2a products, meaning that data are geometrically and atmospherically corrected. The multispectral data thus consist of bottom-of-atmosphere surface reflection measured at 13 different wavelengths in the visible, infrared, and short-wave infrared spectrum (Table A3.1). Due to different properties of the dominant vegetation classes (e.g., differences in leaf pigments, number of leaf layers and moisture content), the reflection of the different wavelengths will vary between the vegetation types.

Table A3.1. Sentinel-2 band wavelengths and spatial resolution. NIR: near infrared; SWIR: short wave infrared.

Sentinel-2 Bands	Central wavelength (nm)	Resolution (m)
Band 1 – Coastal aerosol	433	60
Band 2 – Blue	490	10
Band 3 – Green	560	10
Band 4 – Red	665	10
Band 5 – Vegetation red edge	705	20
Band 6 – Vegetation red edge	740	20
Band 7 – Vegetation red edge	783	20
Band 8 – NIR	842	10
Band 8a – Vegetation red edge	865	20
Band 9 – Water vapor	945	60
Band 10 – SWIR. cirrus	1375	60
Band 11 – SWIR	1610	20
Band 12 – SWIR	2190	20

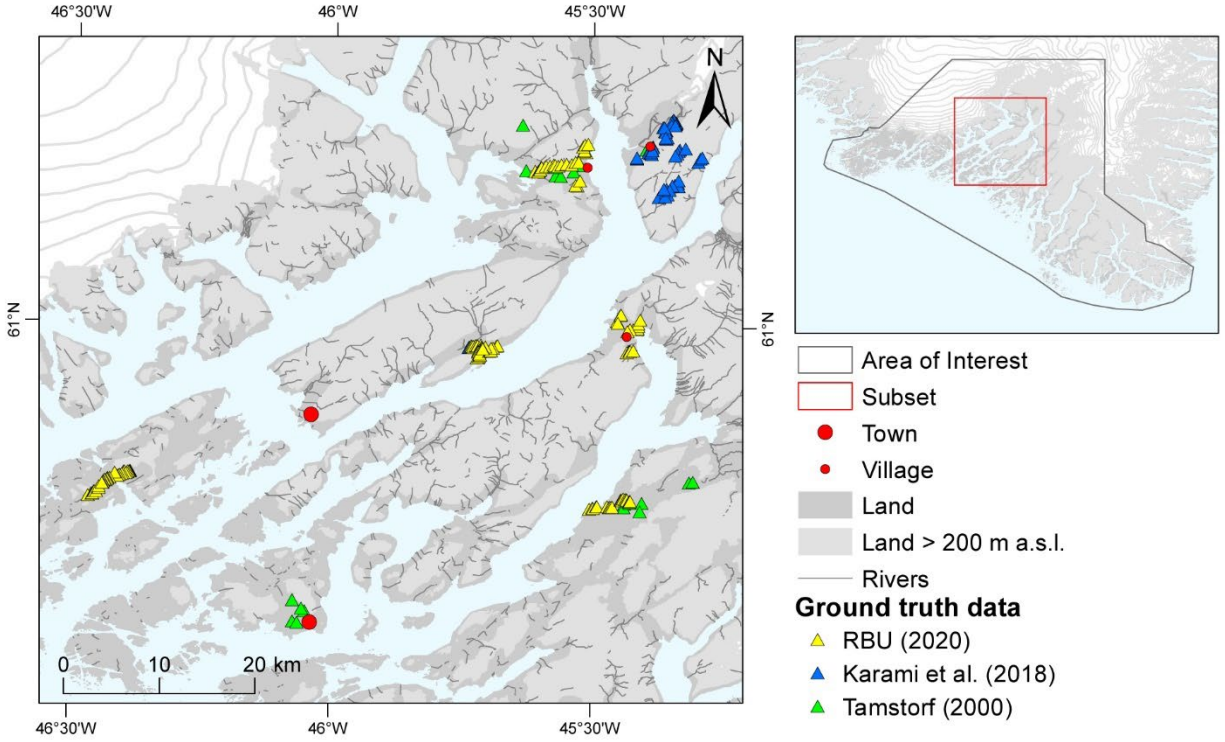
Takussutissiaq A3.2 shows examples of reflection curves for fen, grassland, and copse, respectively. It appears that these vegetation types are best separated in the near infrared part of the spectrum. By comparing the reflectance values of the image pixels to defined spectral signatures (i.e., the reflectance as a function of wavelength) of the vegetation types, a satellite image can be converted to a vegetation map. Field observations are, however, necessary to produce the statistically representative spectral signatures of the vegetation types (e.g., Takussutissiaq A3.2).



Takussutissiaq A3.2. Mean reflectance as a function of wavelengths for fen, grassland and copse based on Sentinel-2 surface reflectance values in areas with field observations.

In the present analysis, the supervised classification method 'Maximum Likelihood Classification' was applied. In this method, prior knowledge (obtained in the field) of the vegetation cover at specific locations is used to make training classes, from which spectral statistics (mean, standard deviation etc.) are calculated. Subsequently, every pixel in the image is assigned to a vegetation class based on the statistical likelihood that the pixel belongs to the specific class (Lillesand et al. 2007). The accuracy of the classification is highly dependent on the training classes and thus the field observations.

Field data were collected between 21 July and 3 August 2020 and consisted of vegetation analyses (identification of the vegetation types and the dominant species) with associated GPS positions. The field sites were chosen to achieve a broad sample of the present vegetation types and to cover the spatial variations in vegetation types caused by climate gradients. Hence, field observations were made both near the open ocean and in the inner parts of the fjords (Takussutissiaq A3.3).



Takussutissiaq A3.3. Overview map of South Greenland and a zoom in on the area where field observations were carried out (RBA: 138 plots, Karami et al.: 71 plots, Tamstorf: 17 plots, see Table A3.3).

The ground cover was classified into seven different vegetation types based on the classes used by Tamstorf (2001, Table A3.2). Due to time constraints, non-vegetated areas (fell-field) were not classified in the field, instead the observations by Karami et al. (2018) were used in the maximum likelihood classification. In addition to the vegetation classes, lakes and riverbeds/deltas were classified based on visual interpretation of the satellite image to mask out these areas in the final vegetation map.

The number of observations per ground cover class are shown in Table A3.3. Field data obtained by Karami et al. (2018) and Tamstorf (2001) were included in the analysis to increase the total number of observations and thereby gain more robust reflectance statistics. In addition, due to the limited number of observations of agricultural fields, vector data on the location of agricultural fields in South Greenland created by Agency for Data Supply and Efficiency (SDFE) were used instead of the field observations (SDFE 2017). However, as the crop types are mostly unidentified, the data could not be used as ground truth data in the maximum likelihood classification. Instead, the agricultural fields were masked during the classification and added to the final vegetation map afterwards.

Table A3.2. Description of the ground cover classes forming the basis for the maximum likelihood classification.

Ground cover class	Description
Dwarf shrub heath	Mostly on gently sloping (5°) terrain with moist soil conditions. Dominated by *Salix* and *Vaccinium ulignosum*.
Lichen-rich dwarf shrub heath	Mostly in weakly sloping (5°). well-drained areas. Dominated by *Salix* and *Betula* with widespread lichen (> 25%) and moss (> 40%) cover.
Agricultural fields*	Mostly in low-lying areas (< 200 m a.s.l.) in the inner parts of the fjords. Crops are typically grasses but can also be vegetables or potatoes (Lehmann et al. 2016).
Fen	Horizontal terrain along rivers and lakes and in local wet depressions. Dominated by *Carex* and with widespread moss cover (> 50%).
Grassland	Mostly in weakly sloping (5°). moist areas. Dominated by *Deschampsia flexuosa*.
Copse	Mostly on sloping (up to 45°) terrain with moist soil conditions. Dominated by *Betula* and *Salix* with heights of > 0.5 m
Riverbed/delta	Sandy sediments of subaerial delta plains and riverbanks.
Lakes	Water areas of varying depth and turbidity.
Non-vegetated	Mostly rocks or wind-blown surfaces in high elevations (after Karami et al. 2018)

* Agricultural fields are not included in the maximum likelihood classification due to limited field observations and lack of information on crop types in vector data from SDFE (Styrelsen for Dataforsyning og Effektivisering/Agency for Data Supply and Efficiency).

Table A3.3. Number of ground truth observations in each ground cover class. Column 5 is not based on field observations but on a visual interpretation of the satellite data.

Vegetation class	RBA 2020	Karami et al. (2018)	Tamstorf (2000)	Visual interpretation
Dwarf shrub heath	32	3	4	-
Lichen-rich dwarf shrub heath	16	-	-	-
Agricultural fields*	3	-	-	-
Fen	27	2	2	-
Grassland	31	-	5	-
Copse	29	45	6	-
Riverbed/delta	-	-	-	18
Lakes	-	-	-	106
Non-vegetated	-	21	-	-

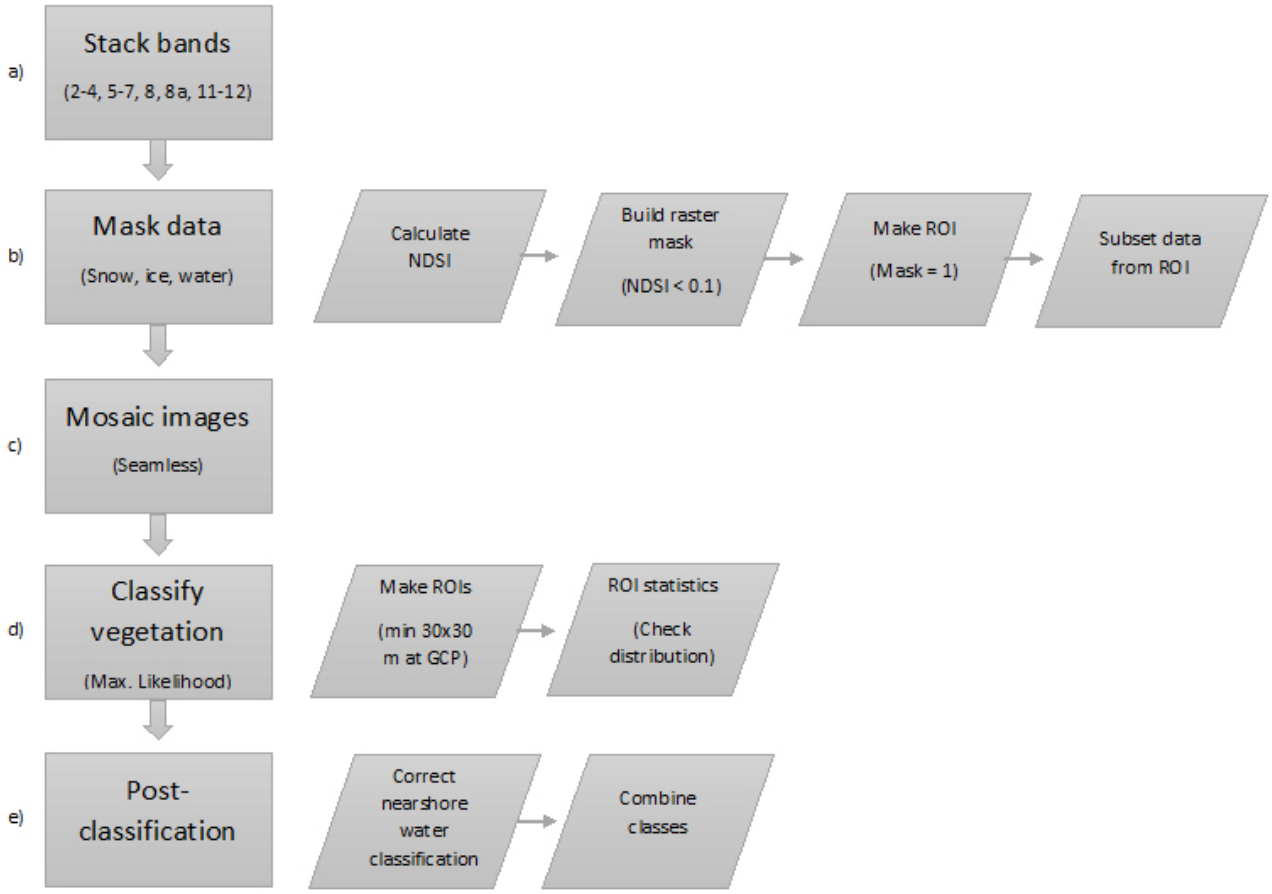
* Fields with timothe *(Phleum pratense)* and *Poa glauca*

Takussutissiaq A3.4 shows the data processing steps for drawing up a vegetation map for South Greenland. Step a-c) are preprocessing steps. First, the wavelength bands with a resolution of 10 m and 20 m, respectively, were stacked and resampled to a "new" image with a spatial resolution of 10 m using the nearest neighbor resampling method (Step a). Then, the ocean, snow and ice were masked (Step b) to facilitate the subsequent vegetation classification. To mask these classes, the Normalized Difference Snow Index was calculated:

$$\text{NDSI} = \frac{\text{Visible green light} - \text{Short wave infrared}}{\text{Visible green light} + \text{Short wave infrared}}$$

Snow cover is highly reflective in the visible part of the spectrum, while snow reflectance drops towards zero in the short-wave infrared part. Likewise, clear water has the highest reflectance in the visible part of the spectrum and then drops towards zero in the infrared part (Jensen 2007). Based on a visual inspection of NDSI values and the satellite images, an NDSI threshold of > 0.1 was found useful for separating snow-free land from ice, ocean and land covered by snow. A raster mask was built based on

this threshold, and the stacked satellite images were clipped by this mask. In addition, the agricultural fields were masked based on the vector dataset Croplanda from SDFE (SDFE 2017). Subsequently, the masked satellite images were mosaicked (Step c) into one image covering the entire snow-free land surface of South Greenland.

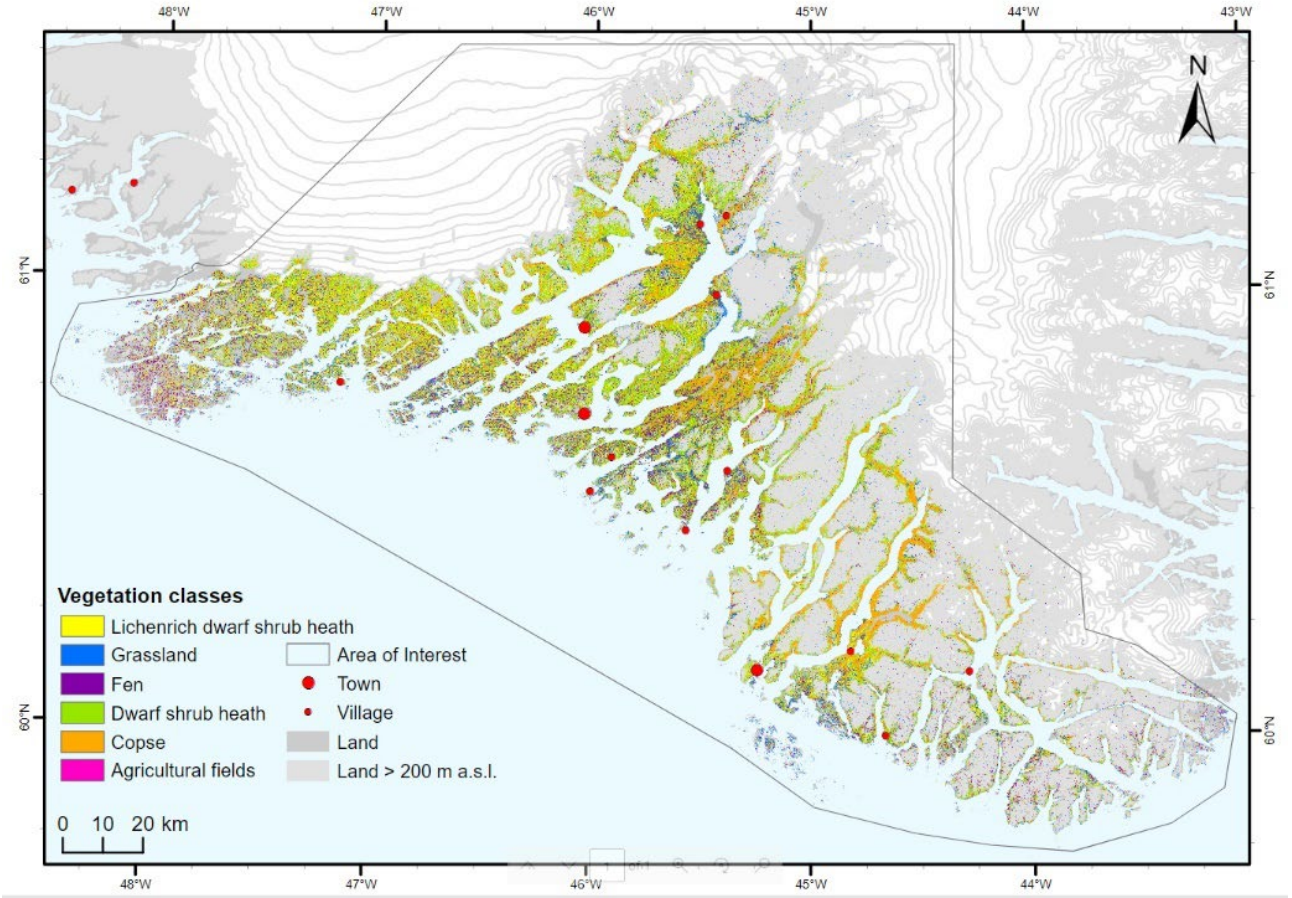


Takussutissiaq A3.4. Diagram showing the processing steps of transforming Sentinel-2 satellite images into a vegetation map.

In Step d, the snow-free land cover image of South Greenland was classified by use of the maximum likelihood method. Training classes were defined as homogenous areas of at least 30x30 m around the ground observations. Statistics were calculated for each vegetation class based on these training areas, and the distribution of the reflection values in each band for each class was examined to ensure that the data were normally distributed. This is a prerequisite for the maximum likelihood classification. If data have a bi- or trimodal distribution, it is most likely because more classes are included in the same training class, and data should therefore be re-grouped (Jensen 1996). The riverbed/delta class showed a bimodal distribution, and the class was therefore split into three classes of sand with different degrees of vegetation cover.

In the last step (e), the vegetation map was post-processed. The output vegetation map showed a misclassification of pixels at the water/land boundary. Nearshore waters (ca. one pixel from the shore) were classified as copse vegetation. To correct this misclassification, a decision tree was applied to the vegetation map by which copse pixels located less than 10 m from water were changed into water pixels. For this reclassification, a distance-to-water map was calculated. Finally, the different riverbed/delta classes were combined into one class.

Takussutissiaq A3.5 shows the final vegetation map.



Takussutissiaq A3.5. Vegetation map of South Greenland.

Spatial variations in vegetation types and their dominant species

The vegetation map (Takussutissiaq A3.5) shows some general tendencies in the spatial distribution of the different vegetation types. Dwarf shrub heath and copse are the dominant vegetation types, accounting for more than 50% of the vegetated area. They are most widespread in low-lying areas (elevations < approx. 200 m) in the inland/inner parts of the fjords. In the outer parts, close to the open ocean, lichen-rich dwarf shrub heath is more pronounced. Moreover, fen is widespread in these areas as it occurs in proximity to water, and lakes are abundant in the outer areas. Fen vegetation is observed throughout South Greenland within ca. 30-40 m of most lakes. Grassland is the least common vegetation type, accounting for about 12% of the vegetated area, but it occurs all over the area. The largest continuous areas of grassland are found near Igaliku, Qassiarsuk and in an area between Kangerluarsorujuk and Nuugaarsuk. Agricultural fields make up a very small area (ca. 1.200 ha. see Chapter 5 "Human use") and are also mostly present in the regions of Qassiarsuk and Igaliku.

The vegetation analyses performed in this study not only included determining the dominant vegetation type at specific locations in South Greenland but also a determination of the dominant species at the field locations. The dominant species that make up the vegetation classes are summarised in Table A3.4.

Table A3.4. Field observations of the dominant species of the different vegetation types in South Greenland.

Vegetation type	Dominant species
Dwarf shrub heath	*Salix glauca, Salix arctophila, Vaccinium ulignosum, Betula glandulosa, Deschampsia flexuosa*
Lichen-rich dwarf shrub heath	*Salix glauca, Salix arctophila, Vaccinium ulignosum, Betula glandulosa*
Fen	*Carex bigelowii, Carex rostrata, Carex rariflora, Carex microglochin, Scirpus caespitosus*
Grassland	*Deschampsia flexuosa, Carex bigelowii, Poa pratensis, Agrostis sp., Agrostis hyp., Kobresia simplicius-cula, Kobresia myosuroides, Calamagrostis langsdorfii*
Copse	*Salix glauca, Betula pubescens*

The mapped spatial variations in vegetation types are generally in accordance with previous observations (Tamstorf 2001; Aastrup et al. 2004; Karami et al. 2018). Copse and dwarf shrub heath vegetation were thus also previous observed to be most prevalent in low-lying areas in the inner parts of the fjords, while fen vegetation dominated near rivers, lakes and in local depressions. However, grasslands were found to be less widespread in this study compared to the findings of Tamstorf (2001), who found that grassland accounted for twice the area of the present results (Table A3.5). Some of this difference may be attributed to a difference in the delimitation of the AOI in South Greenland, but a decrease in the number of sheep in the area is a more likely cause (see Chapter 5 "Human use"). The latter could result in a smaller grazing pressure and hence an increase in dwarf shrub vegetation to the exclusion of grassland. Moreover, the proportion of lichen-rich dwarf shrub heath to dwarf shrub heath is significantly higher in this study, and fen was also found to be more widespread (Table A3.5). However, in a long-term perspective, a changing climate with increasing temperatures and precipitation (Christensen et al. 2015) will expectedly result in a reduction of lichen cover in favour of denser shrub vegetation (Normand et al. 2013).

Table A3.5. The proportion of the different vegetation types in South Greenland.

	Coverage in % of all the vegetation classes	
	RBA 2020	**Tamstorf (2000)**
Dwarf shrub heath	34.7	52.2
Lichen-rich dwarf shrub heath	17.3	1.5
Fen	15.1	4.6
Grassland	11.9	23.9
Copse	21.0	17.8

In addition to the mapped and mentioned vegetation types, also woodland is found in South Greenland but to a limited extent, and it is therefore not included in the vegetation analysis. According to Meilby et al. (2019), there are several larger, mainly spruce, plantations in the inner fjords in South Greenland (Takussutissiaq 5.3 in the main report) as well as tall copse vegetation with tree heights of more than 3 m. These areas provide favourable conditions for the existence of high-diversity forest floors, including a large number of epiphytic lichen and basidia mushrooms (Christensen et al. 2016). In the future, areas suitable for woodland are expected to increase due to the changing climate. However, natural expansion will likely be slow and local due to dispersal constraints (Normand et al. 2013).

Previous studies on vegetation types

Feilberg and Folving (1990) carried out two individual projects of, respectively, vegetation mapping and monitoring of potential pastures in Qinngua Valley based on field work during the summers of 1984 and 1985. The area is a sub-Arctic oasis with woodland and shrub heath. The latter was characterised by Labrador tea (*Ledum groenlandicum*), bog bilberry (*Vaccinium ulignosum*), glandular birch (*Betula glandulosa*) and common juniper (*Juniperus communis*). Woodland existed up to an altitude of ca. 200 m and was dominated by downy birch (*Betula Pubescens*) with an average height of 6 m. Greenland mountain-ash (*Sorbus groenlandica*) was also frequently observed in the valley. Grasslands were found to be less frequent than in other parts of South Greenland and were only observed at sites where the snow persisted for long periods. The grasslands were dominated by mat-grass (*Nardus stricta*).

Feilberg (1984) also published a major phytogeographical study of South Greenland based on more than 30.000 herbarium specimens and field studies in 1974, 1975 and 1976. His study focused on the distribution of the individual species of vascular plants but included delimitation of vegetation zones and vegetation types.

Møller-Lund et al. (1996) studied food sources for the reindeer herd at Isortoq and mapped the vegetation cover in the area. The vegetation mapping was conducted by interpretation of Landsat satellite images with a spatial resolution of 30 m. In the coastal areas, the soil was poor and thin, and vegetation was therefore sparse and mainly made up of crowberry (*Empetrum nigrum*). In the more sheltered areas, grasslands and shrub were prevalent with dominance of stiff sedge (*Carex bigelowii*) and grey-leaf willow (*Salix glauca*), respectively.

Tamstorf (2001) also mapped Greenland vegetation as part of a project on the food sources for caribou and reindeer (Aastrup et al. 2004). The land cover was mapped in the areas of Kangerlussuaq, Nuuk and South Greenland based on Landsat satellite images (spatial resolution: 25 m) and field observations in the summers of 1997, 1998 and 1999. In South Greenland, shrub and fell-field constituted up to 70% of the vegetation cover, while grassland and copse accounted for about 25%. The vegetation was most widespread near the coast, while bare soil/rocks dominated in the inland at higher elevations where wind and lack of precipitation resulted in poor growing conditions.

Orbicon A/S prepared the background report "Kvanefjeld multi-element project – the natural environment of the study area" for the Environmental Impact Assessment for the mining project at Kvanefjeld (Orbicon 2018). The report included a description of the existing environment and, accordingly, a description of the vegetation in the Narsaq Valley. The description was based on field work carried out in August 2013 and September 2014. The lowland (0 – ca. 200 m a.s.l.) was found to be dominated by dwarf-shrub heath consisting mainly of bog bilberry, crowberry, glandular birch, and willow species but with patches of mosses, grasses, and sedges. Close to the Narsaq river mouth some rare species such as autumn gentian (*Gentiana amarella*), golden gentian (*Gentiana aurea*) and common butterwort (*Pinguicula vulgaris*) were found. At higher altitudes (ca. 200 – 680 m m.a.s.l.), dwarf-shrub heath was still prevalent, but larger areas with mosses and lichens and open rocky terrain, snow beds and smaller fens became more

widespread. On the Kvanefjeld plateau, the rare species bog rosemary (*Andromeda polifolia*) was found. At the upper northern slopes (ca. 350 – 650 m a.s.l.), vegetation was sparse, and the ground was mostly covered by loose stones and rocks. The limited plant cover consisted mostly of three-leaved rush (*Juncus trifidus*), moss campion (*Silene acaulis*), trailing azalea (*Loiseleuria procumbens*), purple saxifrage (*Saxifraga oppositifolia*) and stiff sedge (*Carex bigelowii*).

Karami et al. (2018) developed a large-scale classification approach for classifying Arctic tundra based on multi-temporal Landsat satellite images with a spatial resolution of 30 m. The resultant vegetation map of Greenland was validated with *in situ* field data. The overall aim was to add to the foundation for ecosystem monitoring, upscaling, and simulation of the ecosystems' response to climate changes. In South Greenland, the classification showed in consistence with other studies in that vegetation was most widespread near the coast in the inner part of the fjords with dominance of heath, grasslands, copse, and shrubs. Along streams and lakes, fen was dominant.

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Appendix 4 Kalaallit Nunaata kujataani nunami suliniarnermi qinnuteqarniarnermi malitassat – uumassusillit assigiinngisitaarnerat aamma inuit atuinerat pillugu paasissutissat kingulliit

By Ida Bomholt Dyrholm Jacobsen[1] and Anders Mosbech[2]
[1]Greenland Institute of Natural Resources, [2]Department of Ecoscience, Aarhus University

The main report describes what we know about the occurrence of biodiversity and human use areas that may be impacted by fieldwork related to mineral resources. In this Appendix 4, we assess to which extent the current regulation provides sufficient protection and mitigation within these areas, and we give specific advice to EAMRA on updates on areas not currently regulated by the field rules for mineral exploration.

Thus, in this Appendix specific recommendations are found for updates to the regulation of mineral resource field work activities in South Greenland according to the *Rules for field work and reporting regarding mineral resources (excluding hydrocarbons) in Greenland* hereafter '*the field rules*' (Anon. 2000). The recommendations relate to important biological occurrences and areas that GINR and DCE recommend should be protected but which are not currently covered by *the field rules*. Areas and occurrences already mentioned in *the field rules* in South Greenland need to be updated and revised, but this is not included in these recommendations. In spring 2020, GINR and DCE provided EAMRA with recommendations for a major revision of *the field rules*, reworking these to be included in two executive orders. This Appendix should be seen as an addendum to those recommendations (referred to as the Executive Order Project. These recommendations are being processed by EAMRA and thus, not yet published).

Rules for fieldwork applied in South Greenland

The field rules issued by Government of Greenland regulate all fieldwork related to non-hydrocarbon mineral resources activities in Greenland. *The field rules* comprise 7 chapters dealing with different topics and the present recommendations relate to chapter 2) Areas Important to Wildlife and chapter 3) The National Park in North and East Greenland and other protected areas.

Protected areas in South Greenland

As mentioned in Chapter 4, there are three protected areas (according to the Nature Conservation order) in South Greenland:

- Uunartoq (Anon. 2005a)
- Klosterdalen (Anon. 1970)
- Qinnguadalen (Anon. 2005b).

The areas are included on NatureMap (http://naturemap.eamra.gl. 2021) and referenced and included in advice that GINR and DCE give. However, they are not yet included in the field rules. GINR and DCE recommend that

these protected areas are included in the field rules as separate sections with regulations identical to those stated in the orders of each protected area (Anon. 2005a; Anon. 1970; Anon. 2005b).

Ramsar areas

Similar to protected areas, GINR and DCE recommend that Ramsar areas are included in *the field rules* or future executive orders. In South Greenland, the Ramsar Area 388 Ydre Kitsissut is not included in *the field rules*. This area is included in NatureMap, and GINR and DCE recommend including Ydre Kitsissut in the field rules and in future executive orders with requirements for regulations of activities corresponding to those stated in *Selvstyrets bekendtgørelse nr. 12 af 1. juni 2016 om beskyttelse af Grønlands internationalt udpegede vådområder og beskyttelse af visse vandfuglearter* (Anon. 2016).

New biologically important areas

The current field rules regulate the so-called "Areas important to wildlife" that include larger terrestrial mammals and birds. We recommend that the chapter is renamed to "Biologically important areas" to support inclusion of e.g., other animal species, habitats, and plants. The following includes new areas and their sections to be included.

Red-listed vascular plants

The current field rules do not mention species of plants or regulation of any specific areas related to the occurrence of plants besides vegetation in general ("surface and vegetation shall not unnecessarily be damaged"). With the Greenland Red List from 2018, an assessment of the vascular plants in Greenland now exists (Boertmann and Bay 2018). The previous red list from 2007 only contained five species of orchids. With the Greenland Red List assessment now available for vascular plants, GINR and DCE recommend that (areas with) vascular plants be included in *the field rules* and NatureMap. Christensen et al. (2016) delimitate areas with high plant production, important specific vegetation types and endemic and rare species. With the availability of the Greenland Red List, this should be included in any delimitation of areas regulated with regard to plants and vegetation.

The historically known occurrences of red-listed plant species in South Greenland are based on data with low accuracy (digitisation of reports). However, these data remain important in identifying areas where particular attention should be paid when fieldwork is conducted that may affect vegetation by e.g., covering larger areas, disturb or destroy vegetation, alter water flow, emit dust etc.

GINR and DCE recommend that regulations are included in *the field rules* to make it possible to require surveys and investigations to map occurrences of red-listed plant species with exact positions when fieldwork may affect vegetation.

Harbour seals

Harbour seals are sensitive to disturbance while giving birth (mid-May to mid-July), for 3-4 weeks when nursing their pups, and subsequent moulting

(moulting finishing in mid-September) (Rosing-Asvid et al. 2020; Teilmann & Dietz. 1994).

GINR and DCE recommend regulating mineral resource activities disturbing harbour seals during this period (15 May – 15 September):

Areas with breeding and moulting harbour seals: During the period 15 May – 15 September the activities indicated in section 2.02.01 in the field rules are subject to approval.

Rivers with Arctic char (and salmon)

GINR and DCE recommend regulating mineral resource activities in and near these rivers and rivers found to host Arctic char (and salmon, but this is only relevant further north in West Greenland) corresponding to the regulation found in *Landstingslov nr. 29 af 18. december 2003 om naturbeskyttelse* (Anon. 2003).

GINR and DCE recommend that it is not permitted to place buildings, do planting, farming or drainage or any other form of changes in the terrain within 100 m from rivers known to host char or salmon.

Saline lakes

Information on saline lakes is included on NatureMap, but it is not exhaustive. Further research and field investigations are needed to obtain data of higher quality on saline lakes in Greenland.

GINR and DCE recommend regulating mineral resource activities in and near saline lakes corresponding to the regulation found in *Landstingslov nr. 29 af 18. december 2003 om naturbeskyttelse* (Anon. 2003).

GINR and DCE recommend that *the field rules* make it possible to require that occurrences of saline lakes in field work areas are identified. Furthermore, it is recommended that it is not permitted to place buildings, do drainage, changes in the terrain, or conduct any other harmful activities within 100 m from saline lakes.

Homeothermic spring

Many more homeothermic springs are thought to exist, and current data may be inaccurate. Further research and investigations are needed to obtain data of higher quality.

GINR and DCE recommend regulating mineral resource activities in and near homothermic springs corresponding to the regulation found in *Landstingslov nr. 29 af 18. december 2003 om naturbeskyttelse* (Anon. 2003).

GINR and DCE recommend that *the field rules* make it possible to require that occurrences of homeothermic springs in field work areas are identified with exact positions. Furthermore, it is recommended that it is not permitted to place buildings, do drainage, changes in the terrain, or conduct any other harmful activities within 100 m from homeothermic springs.

Wintering areas for eiders

Large flocks of eiders occur in the fjords during winter (see Chapter 4). It is not known to which extent the eiders show site fidelity during recurrent disturbance and to what extent they could be affected by recurrent disturbance. Research is needed on eiders use of areas in South Greenland in winter. Should research reveal that eiders show site fidelity to specific areas in South Greenland and could be significantly impacted by recurrent disturbances, GINR and DCE would make recommendations to apply a general regulation of these areas in the field rules or future executive orders.

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KALAALLIT NUNAATA KUJATAA - IMMIKKOORTUMI KILLEQARFIMMI NALILIINEQ KALAALLIT NUNAATA KUJATAANUT ATUUTTOQ AATSITASSARSIORNERMUT SULIAQARNERMUT SAMMITITAQ

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ISBN: 978-87-7156-659-8
ISSN: 2244-9981