

**Foretaksnavn:** Wageningen Marine Research

**Navn:** Tammo Bult

**Mottaker:** Svalbards miljøvernfond - Sysselmesteren på Svalbard

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**SØKNAD**

**REFERANSEN R.: 18/35**

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## Aliens on the beach

### Beskrivelse av tiltaket/prosjektet:

Svalbard is increasingly visited by the public through ecotourism, scientific expeditions and shipping. These activities increase the potential introduction of alien (non-native) species. Beaches provide easy access to land-based activities by tourists and scientists, and may therefore become a port of entry for alien species. Despite studies in southern Svalbard, a biological description of beach habitats around the rest of Svalbard is largely lacking. Such baseline information is needed to assess changes in this remote region.

During this project, abiotic characteristics of a selection of Svalbard beaches will be described. Samples of soft substrate, hard substrate and washed ashore debris will be used to determine dominant species and identify alien species based on traditional and innovative techniques. Study sites will include both areas frequently visited by tourists and areas rarely visited by humans.

Information on both beach habitat description and presence of marine alien species will be used to assess which beaches around Svalbard are most vulnerable to invasion by alien species. This will be a valuable basis for future monitoring of alien species around Svalbard and for promoting and ensuring sustainable tourism. Understanding interactions between beach characteristics and invasibility by alien species is important for environmental monitoring and management.

## Utfyllende om tiltaket/prosjektet

**Søknadskategori:** Kartleggings- og overvåkningstiltak

### Utfyllende beskrivelse av tiltaket/prosjektet, formålet med tiltaket/prosjektet gjennomføring og metode:

Polar beaches are considered to be among the most pristine in the world. They are, however, no longer as isolated as they once were. Climate change enables increased human activities in the Arctic, and the changing conditions allow species to survive where they previously could not. Beaches vary greatly in habitat characteristics including substrate type, energy level, sediment chemistry, and heterogeneity. They are, therefore, differently suitable for species to colonize and survive. Understanding the interactions between beach characteristics and species communities is important for both environmental monitoring and the management of human activities.

Svalbard is an Arctic archipelago where boats are the main mode of transport. Increasing visitation by the public through ecotourism, scientific expeditions, the mining industry and shipping traffic puts the area at risk of both direct and indirect human impacts (e.g. Van den Heuvel-Greve et al., 2016; Wiencke & Hop, 2016; Renaud et al., 2015). While an extensive study of beaches in the southern part of Svalbard was conducted in the '80s and '90s (Weslawski et al., 1993, Weslawski et al 1997, Weslawski et al 2010), beach characteristics around the rest of the island of Svalbard remain largely undocumented.

Alien species are species that are not native to the receiving environment. They arrive via anthropogenic vectors such as shipping or aquaculture. Alien species have the potential to become invasive, impact the local environment and irreversibly change the ecosystem. Left unchecked by natural predators, invasive species can come to overwhelm and dominate the local biota. Invasive species can also have economic and social impacts in the invaded area such as negative impacts on human health and decreased efficiency, and therefore profitability of marine based activities like fisheries, tourism and marine infrastructure (Molnar et al., 2008; Blackburn et al., 2014). In Svalbard, alien species are most likely to be introduced via biofouling of ship hulls (e.g. tourist and recreational vessels), ballast water discharges (of coal bulk carriers) (Ware et al., 2014) and floating marine debris (Weslawski & Kotwicki, in press). Beaches provide areas on which these debris may eventually wash up, as well as areas where humans have easy access to land for various land-based activities. Beaches therefore are likely ports of entry and/or hotspots for alien species.

Whether an alien species can establish in a new environment depends on local scale interactions between physical (salinity, depth range, shallowness and the availability of a hard substrate) and biotic factors (native species richness or diversity, vacant niches, absence of enemies, and competitive abilities of resident species) (Zaiko et al., 2007). Local biodiversity is an important predictor of habitat invasibility, as a positive correlation between alien species richness and native species richness has been found in earlier studies (Zaiko et al., 2007; Van den Brink et al., in prep.).

Observations of marine alien species in the Arctic (Molnar et al., 2008), and around Svalbard (Hopkins, 2001; Ware et al., 2016) are sparse. The presence of the snow crab, *Chionoecetes opilio*, has been recently described in Raudfjorden (<https://www.unis.no/snow-crab-arrived/>), and initial results of a new study identified the presence of a non-native tunicate, *Botrylloides violaceus*, in Kongsfjorden harbour sediment based on innovative DNA metabarcoding techniques (Van den Heuvel-Greve et al., in prep). Additionally, Atlantic (southern) marine species such as mackerel, and helmet jellyfish are moving northwards and are found settling in and around Svalbard (<https://www.unis.no/svalbard-blue-mussels-on-the-menu/>). Some species that used to be endemic to the Arctic in ancient times are returning, such as the blue mussel, *Mytilus* sp. (Berge et al., 2005). Without a monitoring programme, changes in species composition cannot be followed and the spread of more problematic alien species could go unnoticed until mitigation efforts become futile.

#### Objectives

This project includes the following objectives:

1. A habitat classification of several beaches around Svalbard according to a standardised methodology.
2. A first assessment of the presence of alien species on several beaches around Svalbard using both traditional taxonomic techniques and innovative DNA metabarcoding techniques.
3. A further validation of the suitability of eDNA metabarcoding techniques as tool for monitoring the presence of alien species in Arctic marine environments.
4. Insight into the role of the tourist industry as potential route for the introduction of alien species on beaches around Svalbard.
5. Insight into dispersion of alien species and repatriates (such as blue mussels) via floating debris as potential route for the introduction of alien species on beaches around Svalbard.
6. Development of simple field assessment methods for future monitoring of beach habitats and alien species around Svalbard.

#### Approach

The project will be conducted in three phases:

1. Coordination and preparation

To ensure a standardised survey on all beaches by the three research groups, several skype meetings will be organised to discuss the field work protocols, sampling logistics, sample storage and transport.

2. Beach survey and sampling

The beach habitat survey and monitoring of alien species consists of a beach survey and sample collection. Prior to and during the beach survey, each beach will be visually characterised based on a number of parameters. This is complemented with photography and videography. Soft and hard substrate samples will be collected to assess dominant and alien marine species living on the beach, using both taxonomic

identification techniques and innovative metabarcoding techniques. Samples will be transported to the lab for further analysis.

### 3. Sample analysis and data processing

After taxonomic and metabarcoding analysis, each beach will be classified into a beach habitat type based on the visual parameters, taxonomic and metabarcoding results. Along with beach classification, data on tourist activities and dominant water masses will be used to assign a risk level for alien species to each beach. General mitigation strategies will be proposed for high-risk habitats, and monitoring protocols and habitat assessment techniques will be refined.

The product of the project will consist of a report and a (digital) poster that describes the habitats of selected beaches around Svalbard (including a risk level for alien species), a list of marine alien species found on beaches around Svalbard, the relevance of tourists as route for alien species and potential measures for sustainable tourism, the relevance of dispersion via floating debris as route for alien species. The report will also contain standard operating procedures for beach habitat classification system surveys and sample collection. If the data are complete enough, a scientific manuscript will be developed based on these results (outside scope of this project). Data will be presented and/or made available to Syssemmann, Artsdatabanken, Norwegian Polar Institute, Norwegian Environmental Directorate, and Svalbard tourist organisations.

### **Miljøeffekt av tiltaket/prosjektet:**

This project will result in a standardised description of several beaches around Svalbard and a further overview of the possible presence of marine alien species around Svalbard. This overview is necessary to assess the establishment of marine alien species as a result of tourism, dispersal via floating debris and natural range extension as a result of climate change; elements that are specifically recommended in a recent report to the Environmental Directorate of Norway (Thomassen et al., 2017). This project therefore covers the aim to ensure knowledge of the impact of climate change on the natural environment, and the impact of climate change on the vulnerability of traffic and other local impacts.

This project is also directly applicable to the aim to promote sustainable tourism, recreation and experience around the larger communities in the Isfjord area. The obtained results can be used to further promote sustainable tourism and recreation by making managers and the general public aware of the problem of alien species and show them how they can help to prevent the spreading and settlement of alien species themselves.

### **Forvaltningsrelevansen i prosjektet:**

This project will:

- benefit the Governor of Svalbard by providing more knowledge of climate change impacts on the marine environment, in this case the presence and possible settlement of alien marine species. Hands-on and practical mitigation measures are required to prevent new introductions of alien species to the waters of Svalbard by identifying routes of introduction and likely locations of 'first contact'. Other measures may be required to restrict the spread of already established alien species.
- provide site-based information on habitats, species and vulnerability in marine environments of Svalbard, as identified as knowledge need for the environmental management of Svalbard (Norwegian Polar Institute).
- provide enhanced background information for advancing sustainable tourism by identifying and mitigating the introduction of alien marine species via fouling of tourist and recreational vessels or other possible routes.
- address the importance of dispersal of alien species via floating debris that moves with the currents to Svalbard beaches. This project will provide information of which species are found attached to both natural (wood, macroalgae) and human-made (macroplastics) debris.
- spread environmental information on the presence, impact and mitigation of marine alien species in Svalbard to tourists at Svalbard.

-benefit the working group CAFF (Conservation of Arctic Flora and Fauna) of the Arctic Council. This working group is developing a strategy to prevent the introduction of alien species in Arctic ecosystems. An overview of presence and distribution of alien species in the Arctic is urgently needed for this strategy. An overview for the Svalbard region will be an asset to this group. The Netherlands participates in CAFF as an observer to the Arctic Council and information will be fed into the working group via the Dutch representative in CAFF.

**Ris ID:** 11004 3423

**Har det tidligere vært utført tilsvarende prosjekt innenfor samme type hovedkategori eller lignende prosjekter?** Nei

**Trengs det særskilt teknisk og/eller faglig kompetanse?** Ja

**Beskriv hvilken kompetanse søker besitter i forhold til oppgaven som skal løses og hvilken metode som skal anvendes:**

Martine van den Heuvel-Greve, scientist at Wageningen Marine Research (WMR). Martine holds an MSc in Marine Biology with a specialization in Toxicology (University of Groningen, 1997). Her research is focused on the effects of stressors such as pollutants and alien species in estuarine and marine environments of temperate and polar regions. She is the coordinator of Arctic R&D within Wageningen University & Research and conducted multiple field expeditions to Antarctica (1997) and Svalbard (2012-2017). Task: project coordination, field work, report.

Anneke van den Brink PhD, scientist at Wageningen Marine Research (WMR). Anneke has a varied background in marine biology, ecology and ecological engineering with a focus on alien species, their vectors and potential ecological impacts. She is involved in studying changes in biodiversity and community interactions as a result of human activities in various research projects both in the Arctic and Europe. Anneke also coordinates and lectures in biology at HZ University of Applied Sciences. Task: field work, beach habitat classification, report.

Sander Glorius, scientist at Wageningen Marine Research (WMR). Sander holds an MSc in Aquatic Ecology and Water Quality (Wageningen University, 2009). At WMR he studies the effects of human impacts, such as fishing, on benthic communities and the natural undisturbed development of these communities in areas like the Dutch Wadden Sea. He is specialised in the statistical analysis and since 2015, on analysing high throughput sequence data in order to detect the presence of (alien) species. Task: data and statistical analyses DNA metabarcoding.

Arjen de Groot, scientist at Wageningen Environmental Research (WEnR). In 2012 Arjen defended his PhD thesis on the establishment of plant species and genetic diversity in pristine nature areas at Utrecht University. Since then, his research at WEnR has focused on the development and use of DNA tools in studying plant and animal population viability, tracking migration patterns, and eDNA monitoring of eukaryotic diversity in soils, air, fresh and marine waters. Task: eDNA metabarcoding, report.

Paul Renaud, senior researcher at Akvaplan-niva (APN, Tromsø) and an Adjunct Professor at UNIS. He is a community ecologist with more than 10 years' experience working on Svalbard. He has recently been a co-author of several reports, including one on existing time series on Svalbard (Renaud et al., 2016), monitoring alien species on Svalbard (Thomassen et al., 2017), and establishing a station net on Svalbard for fulfilling the requirements of the Water Framework Directive (Evenset et al., 2017). Task: coordination soft substrate analysis, report.

Jan Marcin Weslawski, professor and director of Institute of Oceanology Polish Academy of sciences (IOPAS). He is involved in Arctic research since 40 years, specialised in littoral and fjordic ecosystems, biodiversity and climate related environmental changes. Crustaceans are his main tool to illustrate these processes. He worked and led a number of international projects, especially in Norwegian-Polish Research Funds. Task: coordination hard substrate analysis, report.

Piotr Kuklinski, senior research scientist at IOPAS. He is specialised in taxonomy and ecology of Bryozoa. He is an experienced scientific diver with underwater works around the world and in numerous Arctic expeditions. He maintains a long term observatory under water in Adventfjorden. Task: field work, hard substrate analysis, report.

**Inngår det flere faglige og/eller økonomiske samarbeidspartnere i tiltaket/prosjektet? Ja**

**Navngi samarbeidspartnere og eventuelt prosjektnavn:**

This project enables cooperation between three international research groups (WMR/WEnR, Akvaplan-niva/UNIS and IOPAS) at Svalbard strengthening knowledge and expertise on taxonomy and DNA analyses, as well as on alien species monitoring.

All research groups will be involved in the first stage of the project coordinating and preparing the field work expeditions. Field work for this project will be conducted by WMR, UNIS and IOPAS, and will be largely conducted during already planned expeditions, with only some minor additional costs for additional sampling and other related field work costs.

Sample analysis will be divided between the research groups. WMR/WEnR (the Netherlands) will focus on DNA metabarcoding including data analysis. Akvaplan-niva/UNIS will focus on soft substrate analysis including data treatment. IOPAS will focus on hard substrate analysis and data treatment.

The overall beach habitat classification and alien species risk assessment will be conducted together, as well as reporting of findings.

## Gjennomføring av tiltak/prosjekt

**Varighet:** 01.06.2018 - 30.06.2019

**Prosjektleder / kontaktperson:**

**Navn:** Martine van den Heuvel-Greve

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**Hjemmeside:** www.wur.eu/marine-research

Fremdriftsplan		
Start	Slutt	Milepæl/aktivitet
01.06.2018	31.07.2018	Preparation
01.08.2018	31.08.2018	Field Work
01.09.2018	15.10.2018	Transport
15.10.2018	31.12.2018	Analyses
01.01.2019	28.02.2019	Data Processing and Interpretation
01.03.2019	30.04.2019	Beach Classification
01.05.2019	30.06.2019	Report

## Kostnadsoverslag

Kostnadsoverslag			Beløp
Eget arbeid	Sats	Timer	
Dugnad	200,-	0	0
Lønnsutgifter	1 280	624	798 720
Kjøp/leie av tjenester (håndverkere, konsulenter m.m)			
Analysis - eDNA metabarcoding (150 samples)			250 000
Analysis – taxonomic identification soft substrate (108 samples)			100 000
Analysis – taxonomic identification hard substrate (108 samples)			120 000
Andre kostnader			
Materialkostnader			5 000
Fraktkostnader			2 000
Reiser, transport, opphold			50 000
local transport			150 000
<b>Totale prosjektkostnader</b>			<b>1 475 720</b>

## Finansiering


Finansieringsplan			Beløp
Egeninnsats	Sats	Timer	
Dugnad	200,-	0	0
Lønnsmidler	1 280	360	460 800
Egenkapital			
Egne midler utenom lønnsmidler			120 000
Verdi av egne materialer			0
Lån (långiver)			0
Private tilskudd (stipend, fond, sponsorer, gaver)			
Spesifiser			0
Spesifiser			0
Spesifiser			0
Offentlige tilskudd (søknad sendt til: navn/status)			
Svalbard Intertidal Project (IOPAS) – supported by Miljøvernfond Sysselemanden			120 000
Spesifiser			0
Spesifiser			0

Omsøkt tilskudd fra Svalbards miljøvernfond	774 920
Total finansiering	1 475 720

**Kan tiltaket/deler av tiltaket gjennomføres med mindre tilskudd enn omsøkt? Ja**

It is possible to reduce the number of beach surveys from the sampling plan. This would reduce the number of samples to analyse.

## Vedlegg

 SEPF\_feb2018round\_Proposal\_Aliens\_on\_the\_beach\_v31jan2018\_final..pdf (Prosjektbeskrivelse)

**Merknad:**

*Ingen merknad*

**Ettersende vedlegg per post: Nei**

**Er nødvendige tillatelser vedlagt søknaden? Nei**

[sign] **Tammo Bult** for **Wageningen Marine Research**

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Lvert 31.01.2018