Załącznik nr 3 do uchwały Rady NCN nr 82/2017 z dnia 14 września 2017 r.

DAINA – Polish-Lithuanian Funding Initiative
Call for proposals 2017

JOINT PROJECT DESCRIPTION TEMPLATE

A complete proposal consists of the joint project description (this document), the CVs of the Principal Investigators, as well as supplementary documents as needed. The proposal must be written in English. Please note that this document has to be submitted in font size: 11 or 12, line spacing: 1.15. Applicants are obliged to ensure that the proposal contains sufficient information for evaluation.

I. CORE DATA

1. Title of the Research Project
   In English: "Arctic benthic ecosystems under change: the impact of deglaciation and boreal species transportation by macroplastic"
   In Lithuanian: “Arkties bentoso ekosistemų kaita: ledyno tirpsmo ir borealinių rūšių pernašos makroplastiku poveikis“

2. Acronym (one word, 12 characters maximum; the same as in the OSF system) [here are options in my priority order]:
   ADAMANT

3. Name and affiliation of the Polish Principal Investigator
   Name, title: prof. dr hab. Jan Marcin Węsławski
   Host institution (implementing the project): Institute of Oceanology Polish Academy of Sciences
   Email address: weslaw@iopan.gda.pl
   Tel: +48602422516
   Has the principal investigator within 10 years of submitting the proposal benefited from maternity leave, adoption leave, additional maternity leave, additional adoption leave, paternal leave, parental leave granted in compliance with the Employment Code, or periods of sickness benefit or rehabilitation benefit granted on account of unfitness for work, including any caused by a health condition requiring therapeutic rehabilitation? (*If so, specify the number of months*)
   no

4. Name and affiliation of the Lithuanian Principal Investigator
   Name, title: prof. habil. dr. Sergej Olenin
   Implementing institution: Klaipėda University
   Legal code:
   Address: H. Manto 84, 92294, Klaipeda, Lithuania
   Email address: sergej.olenin@jmtc.ku.lt
   Tel: +370 46 398847
   Account No:
   Has the principal investigator within 10 years of submitting the proposal benefited from maternity leave, adoption leave, additional maternity leave, additional adoption leave,

paternal leave, parental leave granted in compliance with the Employment Code, or periods of sickness benefit or rehabilitation benefit granted on account of unfitness for work, including any caused by a health condition requiring therapeutic rehabilitation? (*If so, specify the number of months*)

No

5. Subject classification (as in the OSF system, with the name of the Panel; in case of an interdisciplinary project, please indicate the main discipline)

Ecology

6. Keywords (please submit at least one and at most six keywords separated by a semicolon)

Arctic; global change; deglaciation; coastal habitats; macroplastic; invasion

Project duration for which funding is requested

In months (24 or 36): 36

Project Planned Start Date (01.09.2018, 01.10.2018, 01.11.2018, 01.12.2018 or 01.01.2019): 01.09.2018

7. Summary (*research project objectives/research hypothesis; research project methodology; expected impact of the research project on the development of science, civilization and society; up to 1 page in each language*). The summary in English must be identical to the one in the OSF system.

In English:

The aim of planned research is to describe the mechanism and patterns of the colonization of the deglaciated arctic coasts.

The melting and retreat of Arctic tidal glaciers and ice disappearance from the coast (fast ice, ice foot) are the two most conspicuous effects of climate warming on Spitsbergen, the European Arctic (ACIA 2005). The expances of seabed are free from glacial ice at the rate of 500m per year, and the coastal ice that use to cover shores for 7-9 months, is now reduced to the late winter 2- 3 months. The deglaciation of Spitsbergen cause formation of new habitats, not available before. The observed changes are increase of biomass and biodiversity and emergence of sublittoral communities to shallower waters, where ice scouring was a controlling factor (Włodarska-Kowalczuk, Pearson 2004; Węsławski et al. 2010). The boreal flora and fauna comes to Spitsbergen with Atlantic waters from the Western Europe- UK area. The distance of over 1000km that separates Spitsbergen from the Europe is a challenge for the larvae of benthic organisms, that use to live in the water column few weeks only (Milejkowskij 1968). The new way of migration emerged with the macroplastic litter, that drifts massively on ocean currents (Barnes, Millner 2005; Węsławski, Kotwicki 2017). The large plastic boxes, barrels, nets are easily colonised by adult organisms, that may travel for years on the sea surface, before stranding on the new coast. The aim of the project is to describe the processes of arctic coast colonisation by boreal organisms. Does it follow the principle of island biogeography theory – with random colonisation of the islands, where the species richness, stability of population and structure of communities depends on the island size and distance to the continent? Or we have the scenario of the boreal biogeographical province shift North? In the second case the populations would be similar to source area, communities are rich and stable, and structure similar to those from the boreal sites. In the first case scenario, drift on the macroplastic litter is very important for the islands colonisation, in the second scenario is of no importance, as the whole province shifts anyway. The way to understand which scenario most likely happens, is the comparison of recently ice free areas, those that are still partly iced and the same habitats still frozen. The most suitable area of study is the Isfjorden complex on the

West Spitsbergen, where the sequence from boreal to arctic conditions can be observed on relatively short distance. The area is feasible for study due to the best available logistics, and opportunity to work in adverse weather conditions, that reduce the risk of field work substantially. In addition we will study the most likely source areas – coastal habitats of Fareo- Shetland islands, to compare the genetics of species that are found on Spitsbergen as well. Such study will give us the answer if the Svalbard populations are in contact with the source areas on the continent, or colonization is irregular and random. Planned research will enrich the knowledge on the pace and direction of Arctic change – specifically to the dispute about "tipping point" or "regime shift". As the planned natural science studies are associated with ecosystem goods and services analysis – that covers the field of socio economy and natural economy, the outcome of the project will expand beyond the natural sciences domain. Cooperation between Lithuanian and Polish researchers will enrich both sides, as the Lithuanian partners have great potential in invasive species issue and GIS methodology in mapping seabed communities. Cooperation with Polish researchers will introduce Lithuania to the Arctic research, where nearly all European countries are already present on Svalbard. Polish partners have long tradition and experience in Svalbard research, as well as the infrastructure (polar station and research vessel). Both research teams were working in cooperative projects before in the Baltic research and in European projects on marine biodiversity (BIOMARE, MARBENA, MARBEF, ELME).

In Polish:

Celem planowanych badań jest poznanie mechanizmu zasiedlania przez faunę obszarów arktycznych, z których znika lód.

Topienie i wycofywanie się na ląd lodowców arktycznych oraz zanik lodu w strefie brzegowej (lód zimowy przybrzeżny oraz stopa lodowa) to dwa najbardziej widoczne efekty ocieplania klimatu w Arktyce Europejskiej na Spitsbergenie (ACIA 2005). Obszary dna morskiego, które do niedawna pokrywały lodowce pływowe odsłaniają się w tempie do 500m na rok, a lód brzegowy dawniej zalegający przez 7-9 miesięcy na plażach, teraz występuje tylko w końcowej fazie zimy przez 2-3 miesiące. Ta deglacjacja Spitsbergenu powoduje powstawanie nowych siedlisk, dotychczas niedostępnych dla organizmów. Obserwowane zmiany obejmują wzrost bogactwa gatunkowego, wzrost biomasy fauny dennej oraz wynurzanie się zbiorowisk sublitoralnych w strefę pływową, gdzie do niedawna ścierał je lód (Włodarska-Kowalczuk i Pearson 2004, Węsławski i inni 2010). Kolonizująca odlodzone obszary arktyczne, borealna fauna i flora dociera na Spitsbergen z prądami morskimi z południa, z obszarów Zachodniej Europy i Wielkiej Brytanii. Dystans ponad tysiąca kilometrów dzielących Spitsbergen od Europy jest bardzo trudny do przebycia przez larwy zwierząt żyjących na dnie, zwykle żyjące nie dłużej niż kilka tygodni (Milejkowskij 1968). Nowy sposób transportu fauny i flory morskiej na duże dystanse pojawił się wraz z masowym dryfem dużych plastikowych odpadów (Barnes i Millner 2005, Węsławski i Kotwicki 2017). Organizmy dorosłe mogą zasiedlać tego typu podłoża (zwykle beczki, skrzynki i fragmenty sieci) i następnie nawet przez wiele lat dryfować aż do osiągnięcia nowego wybrzeża. Hipoteza badawcza projektu opiera się na pytaniu: Czy dzisiejsza kolonizacja wybrzeży Arktyki odbywa się to w sposób losowy, zgodnie z teorią biogeografii wysp – gdzie bogactwo gatunkowe, struktura zbiorowisk, trwałość populacji zależy głównie od wielkości wyspy i odległości od obszaru zasilającego ? Czy też mamy do czynienia z przesunięciem się całej strefy biogeograficznej (borealnej) na Północ i w związku z tym zasiedlanie będzie miało charakter bardziej stabilny, z wyraźnym połączeniem z populacjami macierzystymi, zbiorowiska i ich struktura są odpowiednikiem

tych z obszaru borealnego ? W pierwszym wypadku, dryf na plastikowych odpadkach ma duże znaczenie, jako bardzo efektywny sposób pokonywania odległości, w drugim wypadku, nie ma większego znaczenia, ponieważ cała prowincja biogeograficzna przesuwa się i tak. Zastosowana metoda badawcza opiera się na analizie porównywalnych siedlisk podlegających odlodzeniu (miękkie dno sublitoralu fjordów oraz wybrzeża pływowe) w trzech stadiach zaniku lodu – miejsca pozbawione lodu ponad 10 lat temu, miejsca wciąż częściowo zlodzone oraz miejsca gdzie pokrywa lodowa występuje w dawnej postaci. Najbardziej prawdopodobnym obszarem badawczym będzie kompleks fjordów - Isfjorden na zachodnim Spitsbergenie, gdzie sekwencję od borealnych warunków w części zewnętrznej do arktycznych można obserwować na stosunkowo niewielkim obszarze. Logistycznie jest to jedno z najbardziej dostępnych miejsc badawczych, a rozbudowany system fjordów zapewnia możliwość pracy nawet w umiarkowanie złą pogodę, stąd ryzyko niepowodzenia w pracy terenowej jest niewielkie. Zasadniczym elementem badań są obserwacje w najbardziej prawdopodobnym obszarze zasilania Spitsbergenu w faunę borealną – Wyspy Owcze-Szetlandy, gdzie porównamy skład gatunkowy oraz charakterystykę genetyczną najważniejszych gatunków z ich odpowiednikami na Spitsbergenie. Da to odpowiedź na pytanie czy populacje na Spitsbergenie pozostają w kontakcie (zasilaniu) przez populacje z kontynentu, czy kolonizacja odbywała się losowo. Planowane badania przyczynią się do rozwoju wiedzy o skutkach zmiany klimatu w Arktyce – szczególnie do toczącej się dziś dyskusji o tym czy zachodzące w Arktyce zmiany mają charakter „tipping point" czy też „regime shift". Ponieważ wraz z badaniami przyrodniczymi będziemy prowadzili prace dla oceny dóbr i usług ekosystemowych – z zakresu socjo-ekonomii przyrody, oddziaływanie planowanych prac będzie wykraczało poza środowisko nauk ścisłych. Współpraca z badaczami z Litwy pozwoli na wykorzystanie odmiennego potencjału badawczego obu stron – zespół litewski ma ogromne doświadczenie w badaniach gatunków inwazyjnych oraz w zastosowaniu techniki GIS do mapowania dna morskiego i jego zbiorowisk. Współpraca z ekipą polską pozwoli im na wejście w międzynarodowe badania arktyczne na Svalbardzie, gdzie obecna jest niemal cała reprezentacja nauki europejskiej. Zespół polski ma długą tradycję i doświadczenie w badaniach Spitsbergenu oraz odpowiednią infrastrukturę (stacja polarna IGF PAN w Hornsundzie, statek badawczy r/v OCEANIA). Obydwa zespoły badawcze współpracowały już skutecznie zarówno w badaniach Bałtyku jak i szerszych europejskich projektach badań bioróżnorodności morskiej (projekty EU BIOMARE, MARBENA, MARBEF, ELME).

In Lithuanian

Planuojamų tyrimų tikslas - apibūdinti deglacijuotų arktinių pakrančių kolonizavimo mechanizmą ir dėsningumus.

Arkties potvynių-atoslūgių zonos ledynų tirpsmas ir atsitraukimas nuo kranto yra du ryškausi klimato atšilimo padariniai Europos Arktyje, Špicbergene (ACIA 2005). Jūros dugno erdvės atsilaisvina nuo ledyno 500 m per metus greičiu ir pakrantės ledas, kuris ankščiau dengdavo krantus 7-9 mėnesius, dabar laikosi vos 2-3 mėnesius žiemos pabaigoje. Špicbergeno ledo tirpsmas sukelia naujų, ankščiau neprieinamų, buveinių atsiradimą. Stebimi pokyčiai apima biomasės ir biologinės įvairovės didėjimą bei sublitoralinių bendrijų prasiskverbimą į seklesnius vandenis, kur ankščiau ledo gremžimo poveikis buvo jas limituojantis veiksnys (Włodarska-Kowalczuk, Pearson 2004; Węsławski et al. 2010). Borealinė flora ir fauna patenka į Špicbergeną su Atlanto vandenimis iš Vakarų Europos – Jungtinės Karalystės regiono. Bentosinių organizmų pelaginėms lervutėms, vandens stulpe gyvenančioms vos

kelias savaites, virš 1000 km atstumas, skiriantis Špicbergeną nuo Europos, yra geografinis barjeras, neleidžiantis borealiniams organizmams įsikurti Arktyje (Milejkowskij 1968). Tačiau vis didėjantis makroplastiko šiukšlių srautas, dreifuojantis su vandenyno srovėmis, sukuria naują boeralinių rūšių migracijos būdą (Barnes, Millner 2005; Węsławski, Kotwicki 2017). Didelės plastikinės dėžės, statinės ar tinklai yra lengvai kolonizuojami suaugusių organizmų, kurie gali keliauti daugelį metų jūros paviršiumi, prieš atplukdami į naują pakrantę. Projekto tikslas – apibūdinti Arkties pakrančių kolonizacijos procesą borealinėmis rūšimis. Ar šis procesas atitinka salų biogeografijos teorijos principą – su atsitiktine salų kolonizacija, kur rūšinė įvairovė, populiacijų stabilumas ir bendrijų struktūra priklauso nuo salos dydžio ir atstumo iki žemyno? Ar mes turime borealinės biogeografinės provincijos perėjimo į Šiaurę scenarijų? Antruoju atveju populiacijos būtų panašios į šaltinio regioną, bendrijos turtingos ir stabilios, o jų struktūra būtų kaip borealinėse vietovėse. Pirmame scenarijuje organizmų pernaša su makroplastiko šiukšlėmis yra labai svarbus salų kolonizacijos veiksnys, tuo tarpu antrame scenarijuje šis veiksnys yra nesvarbus, nes bet kokiu atveju savo ribas keičia visa biogeografinė provincija. Siekdami išaiškinti, kuris scenarijus yra labiausiai tikėtinas, mes tyrinėsime neseniai nuo ledo atsilaisvinusias buveines ir lyginsime jas su dar iš dalies arba visiškai padengtomis ledu. Tinkamiausias tyrimų rajonas yra Isfjordeno kompleksas Vakarų Špicbergene, kuriame perėjimas nuo borealinių iki arktinių sąlygų gali būti stebimas pakankamai nedideliu atstumu. Ši teritorija yra tinkamiausia studijoms dėl geros logistikos ir galimybės dirbti nepalankiomis oro sąlygomis, siekiant iš esmės sumažinti lauko darbų riziką. Papildomai mes tyrinėsime labiausiai tikėtinus borelinių rūšių šaltinių regionus – Farerų ir Šetlando salų pakrančių buveines, lyginsime borealinių rūšių populiacijų genetinę struktūrą jų gimtajame areale ir arktiniame Špicbergene. Toks tyrimas leis atsakyti į klausimą, ar Svalbardo populiacijos kontaktuoja su šaltiniais žemyne, ar kolonizacija yra netaisyklinga ir atsitiktinė. Planuojami moksliniai tyrimai praturtins žinias apie Arkties regiono pokyčių tempą ir kryptį, ypač apie diskutuojamus "persvėrimo tašką" bei "staigų režimo pokytį". Kadangi planuojami gamtos mokslų tyrimai yra susiję su ekosistemų paslaugų analize, kas apima ir socialinę bei gamtos ekonomiką, todėl projekto rezultatai išsiplės už gamtos mokslų srities ribų. Dvišalis bendradarbiavimas bus naudingas abejoms šalims: Lietuvos mokslininkai turi didelį įdirbį biologinių invazijų tyrimuose, GIS ir statistinio modeliavimo metodų taikyme bei dugno buveinių kartografavime, tuo tarpu Lenkijos mokslininkai įtrauks Lietuvą į Arkties tyrimus. Lenkijos partneriai turi ilgametes tradicijas ir patirtį Svalbardo tyrinėjimuose, taip pat atitinkamą infrastruktūrą (poliarinę stotį ir mokslinių tyrimų laivą). Abi tyrimų grupės ir ankščiau bendradarbiavo jūrų biologinės įvairovės tyrimuose, kartu dalyvaudamos Baltijos moksliniuose tyrimuose ir Europiniuose projektuose (BIOMARE, MARBENA, MARBEF, ELME).

II. RESEARCH TEAM

1. Research Team – Principal Investigators (both PI's need to provide their CVs as an attachment in the appropriate section of the OSF system)

First name and last name; academic degree or research position	Host /Implementing Institution (implementing the project)	Scope of work within individual project tasks
1. Jan Marcin Węsławski, prof., habil. dr.	Institute of Oceanology, Polish Academy of	WP1: scientific management, data synthesis and support work in ecosystem services changes; WP2: rafting of the boreal organisms; WP3: intertidal

	Sciences	biota, WP4 and WP5: species identification, data interpretation
2. Sergej Olenin, prof., habil. dr.	Marine Research Institute, Klaipėda University	WP1: scientific management; WP2: rafting of the boreal organisms, data interpretation; WP3: intertidal biota; data interpretation; W4: mapping of sublittoral habitats, research logistics; WP5: expansion process of boreal marine organisms, data synthesis, BPL method application

2. Research Team – Co-investigators and others (*all research team members listed in this section should have a significant role in the research and their presence as members of the research team should be justified; members can be listed as Co-investigators, Post-docs, PhD students or technical staff; please note that there is no optimum number of researchers taking part in the project, but the research team composition will be evaluated*)

Nature of contribution in the project, type and character of position in the project (**no personal data included**)	Host/Implementing Institution (implementing the project)	Scope of work within individual project tasks
Co-investigator 1	Institute of Oceanology PAS	WP2 and field work coordinator, intertidal fauna ecology; WP 4 and WP5: data identification
Co-investigator 2	Institute of Oceanology PAS	WP3 and field work coordinator, drifters and macroplastic issues; WP 4 and WP5: data identification
Co-investigator 3	Institute of Oceanology PAS	WP 1 Analysis of changes in the levels of delivery of ecosystem good and services; analysis of socioeconomic aspects of the observed changes and required policy reply
Co-investigator 4	Institute of Oceanology PAS	WP 1 Collecting and collating all data gathered during the project to form a unified system of data storage and access; securing -- in cooperation with other data systems like OBIS (Ocean Biogeographic Data Base) and local Svalbard data collecting system (Research on Svalbard portal) -- a wide use of the collected information
Post doc 1	Institute of Oceanology PAS	WP2 GIS analyses of intertidal biota
Post doc 2	Institute of Oceanology PAS	WP3 field work, photography, data processing
PhD student 1	Institute of Oceanology PAS	WP2 Genetic analyses of intertidal fauna
Co- investigator 5	UNIS	Cooperation with data base at SAON
Principal co-investigator 1	Klaipeda University	Species distribution modelling (WP3 and WP4), macro algae taxonomic identification (WP3), analysis of ecological scenarios (WP4)
Principal co-investigator 2	Klaipeda University	WP4 coordination, habitat quality assessment and benthic habitat distribution (WP4)
Co- investigator 1	Klaipeda University	Mapping of sublittoral benthic habitats and video surveys (WP4)
Co- investigator 2	Klaipeda University	Coordination of acoustic surveys, interpretation of acoustic data, analysis of video data (WP3 and WP4)
Co- investigator 3	Klaipeda University	Epigenome analysis of invasive boreal species

		(WP5)
Co- investigator 4	Klaipeda University	Analysis of surface water optical properties (e.g. turbidity) using Earth Observation data (WP3 and WP4)
Co- investigator 5	Klaipeda University	Taxonomic identification of invasive boreal species (WP2 and WP5)
PhD student 1	Klaipeda University	Taxonomic identification of benthic macroalgae and macrofauna (WP4)
PhD student 2	Klaipeda University	Analysis of video and acoustic data (WP3 and WP4)

III. DESCRIPTION OF THE RESEARCH PROJECT (*up to 15 pages for this section*)

1. Objectives and tasks (*describe the idea of the project, the scientific problem aimed to be solved/hypothesis; scientific objectives with particular attention to the innovative nature of the research project and its importance for the development of science should be listed; each objective or task should be described separately*)

The project idea is based on the recent knowledge that the Arctic coastal ecosystems undergo fast transformation due to global climate change and habitat alteration caused by anthropogenic activity. The combined effect of extreme natural conditions and increasing anthropogenic stressors determines the vulnerability of Arctic coastal ecosystems making the quest and identification of natural and anthropogenic changes in polar environment a topical scientific problem. The role of different driving forces in that process yet is poorly studied. The main objective of our project is to study two factors playing an increasing role in the change of Arctic coastal ecosystem: deglaciation as a process, causing emergence of new seabed habitats and marine litter, particularly macroplastic, carrying new species of boreal origin to the polar environments. The study of both processes and their synergetic effects requires the use of innovative research methodologies and involvement of interdisciplinary experience in underwater remote sensing, satellite imagery, sediment chemistry, environmental genetics, invasion biology, application of signal detection theory and empirical modelling.

The first activity focuses on the retreat of ice from the coastal ecosystem - the tidewater glaciers melt and the fast ice disappearance. The change in those two types of ice reshape the coastline and adjacent benthic ecosystems. The process results in the emergence of newly exposed seabed (freed from glacial cover) and ice free shores (no fast ice in winter). There are hard bottoms swept by the massive glacial meltwater outflow, areas covered by glaciomarine muds with high organic carbon content in the sediment and intense sedimentation of organic and mineral particles. We will study the different stages of glacial retreat in order to find out whether it follows the predictable succession chain of events. The main hypothesis is that each stadium of the fast ice and glacial retreat has its characteristic features reflected in seabed habitat and benthic community. We will test this hypothesis performing the comparative research in a variety of iced and de- iced areas that represent the continuum from active tidewater glacier to the dry post- glacial valley with no glacial remains, and from the long lasting fast ice cover to the ice free shore. We will use hydroacoustic and remote underwater video methods to investigate seabed habitats, combined with sediment chemistry and selection of dominant benthic species, assessment of their functional role and position in the food web. We will assess the role of main benthos size compartments – microbenthos, meiobenthos, macro and megafauna to analyze structural changes in these groups along the deglaciation gradient. We also plan to test the satellite imagery methods for tracing glaciers' caused plumes of suspended materials, which have direct impact on the seabed quality.

The arrival of species to deglaciated areas on Svalbard is due to the strong advection of organisms and debris with Atlantic waters from the Northern Europe. The area between Faroe Islands and northern UK, seems to be the key donor region, with lesser importance of Northern Norway (due to the strong coastal current that carries the waters to the Barents Sea). Recently it was shown that Arctic is a dead end of plastic export from Europe due to the sea currents system. Plastic causes threat for the Arctic pelagic food web (Reiser et al. 2014); it was found in stomachs of sea birds and mammals (Trevail et al. 2015), in benthic habitats from littoral to the greater depths on the continental shelf (Bergmann and Klages 2012, Tekman et al 2017). In our project, we will address another, yet little studied aspect of the marine litter problem: the role of plastic in dispersal of non-indigenous, mostly boreal species. Preliminary investigations (Barnes et al. 2015, Weslawski and Kotwicki 2017) have shown that due to increasing amount of macroplastic on the shores of Arctic islands it begins to play an important role in transfer of marine organisms such as macroalgae, epibenthic

bryozoans, barnacles, mussels, etc. Our main hypothesis is that the process of species dispersal by macroplastic follows typical phases of a biological invasion: transportation, arrival, establishment and expansion. In order to access quantitatively the scale of the propagule pressure we will perform littoral surveys at shores characterized by different exposure to ocean currents and wave action. We will establish species composition and size structure of newly arrived organisms in both littoral and sublittoral habitats as well as the genetic makeup of selected populations. The field studies will be completed by GIS analysis and empirical modelling of key-stone species distribution and food web studies. In addition, observation of marine litter will be included in the surveys of seabed habitats in glacial and post-glacial bays. We will investigate whether or not the deglaciation of bays promotes the establishment of the boreal species in Arctic.

2. Current knowledge in this field and preliminary work (*present the analysis of the problem, describe the current state of knowledge in your field and its direct relationship to your project, the impact of the project results on the development of the research field and scientific discipline; disclose novelty, originality and degree of innovation of proposed research*)

Deglaciation of the Arctic and in particular the Svalbard archipelago was subject of numerous studies (see the review in Błaszczyk et al 2009). The effects of sedimentation on the benthic biota were described by Gorlich et al (1989) and Włodarska-Kowalczuk et al. (1998), demonstrating diminishing biomass towards the glacier. The important pattern observed was, that benthos within the transect from the glacier towards the sea follows the Pearson-Rosenberg model of benthic organisms reacting to the stress (Włodarska – Kowalczuk and Pearson 2004). The review of deglaciation effects on the fjordic biota is presented in Lydersen et al (2014) paper, where the food web effects were demonstrated (e.g. accumulation of predators close to the glaciers). While the small-scale (hundreds of meters, years time span) effects of deglaciation have been largely described, the larger scale pattern (kilometers and tens of years) was not assessed – and the large-scale is more appropriate to understand the environmental change ongoing in the Arctic. The tidal glaciers and their retreat was studied to some extent, but the fast ice and its disappearance received much less attention. The littoral – intertidal zone was for a long time regarded as desert in the Arctic due to the fast ice presence and ice scouring effect. The warmer Arctic areas with reduced fast ice cover turned out to be rich in diverse marine life (Weslawski et al. 1993), and the process of recent colonization of de-iced coasts is being observed (Weslawski et al 2010). Colonisation of the Svalbard coast is supported with the advection of Atlantic water and organisms carried North with the North Atlantic - West Spitsbergen Current.

The new reports claim, that Arctic is a dead end of plastic export from Europe due to the sea currents system (Cozar et a. 2017). The role of plastic as a new form of species dispersal was highlighted by Barnes et al. (2002, 2005). Duris and Weslawski (1995) showed an interesting observation of drifting fishing net NW of Bjornoya (74ºN) containing rafters - both boreal *Mytilus* sp. and sympagic, arctic species *Gammarus wilkitzki*. Barnes and Milner (2005) reported about 5% of plastic items on Spitsbergen colonized with encrusting fauna. The reappearance of *Mytilus* on Svalbard after over 1000 years of absence was discovered by Borge et al. (2005) and presented as an effect of increased warm water inflow that allowed the efficient drift of larvae from Norwegian mainland. Earlier, Milejkovski (1968) estimated such transport of larvae between Norway and Svalbard as unlikely due to short larval survival and long, indirect water flow; that opinion was recently confirmed by model simulations showing that most of the benthic larvae are retained in coastal Norwegian waters (Silbergerger et al. 2016). The possibility of rafting the adult organisms on plastic debris offers a more realistic opportunity to survive long distance travels, e.g. from UK or Shetlands to Svalbard, and is regarded as new phenomenon on the ocean scale (Winston et al. 1997, Barnes et al. 2002, 2005). Svalbard hosts less than 100 species of plants and animals on its shores (intertidal), while the North European costs are inhabited with over 500 species that

are physiologically able to colonise the island. Process of expansion of the boreal fauna to the warming Arctic already started, and deglaciation is one of its prerequisites.

Biological invasions, both natural and human-mediated, follow the same universal pattern: transportation of propagules, arrival, establishment and expansion (Davis 2009, Olenin et al. 2011). According to the "10s rule" hypothesis, roughly 10% of species that arrive will establish in a new (invaded) area and of these only 10% will spread (Davis 2009). However, this hypothesis has been rarely tasted due to lack of quantitative data for all subsequent invasion phases. Recent advance in molecular technologies provides new tools to study the species expansion process in Arctic waters. The metabarcoding approach improves detection of eukaryotes from early biofouling communities (Zaiko et al. 2016) and gives an opportunity to assess the propagules pressure quantitatively. The RNA approach allows testing the vitality of organisms arrived to a new area, what is especially important for the early development stages. In addition, freshly arrived propagules have lower genetic variation than populations in the source area (the phenomenon called the "bottle-neck" or "founder" effect). However, Ardura et al. (2017) recently discovered, for the first time in marine invertebrate species, a mechanism that compensates for relatively lower genetic variation of a founder population while it enters the expansion phase. That mechanism, causing significant reduction of global methylation levels, affects gene expression and enables rapid reaction of an organism to environmental changes. Such epigenetic signature may help to establish populations of newly arrived boreal species which are entering the expansion phase.

3. Work Programme including proposed research methods (*indicate the research methodology or methods, data management, type and degree of access to the equipment to be used in the proposed research project, state of pre-existing research indicating the feasibility of research objectives; draw up a milestone project implementation plan dividing the plan of work into stages*[1]*; identify possible risks, critical paths and provide for its management plan)*

The Work Programme comprises five interrelated work packages (WP).

WP 1. Scientific management and synthesis

This WP will provide effective and efficient scientific project management, taking care of the smooth communication between all the WP's, coordinating the implementation of the project tasks according to the project plan, organizing meetings, data acquisition and storage, web page and dissemination activities as well as the reporting. The goal of this WP is to have mixed teams of research papers authors from both countries, as well as exchange of senior students and PhD' between the Lithuanian and Polish side. The issue of ecosystem goods and services as well socioeconomic aspects of the observed changes will be presented in the planned synthesis paper, according to the methodology that is appropriate for the specialised journals in this field (e.g. based on millennium Assessment approach). This WP will be also responsible for the logistic arrangements of the field studies and constant communication between the Polish, Lithuanian and Norwegian teams.

WP 2. Rafting of the boreal organisms: the comparative analysis of anthropogenic and natural substrates.

Large plastic items like fishing boxes, liquid containers, construction elements are commonly found on Svalbard shores and are commonly covered with encrusting organisms – algae, colonial and solitary attached animals. The natural rafts carrying coastal organisms through

[1] Interim reports are required only by the RCL for the Lithuanian project part in the middle of the project, i.e. after 12 or 18 months. The approval of the interim report is a condition under which the Lithuanian part of the research project can be continued.

the sea, are wood, sea weeds or land plants. Those natural rafts are also recorded on Svalbard coasts every year, however much less frequently than man-made. We will perform an extensive survey along the coast of Isfjorden, collecting man-made and natural debris for the presence of transported organisms. We will identify species, where possible genetic profile to link the rafters with home populations. Since pilot study indicates that Faore-Shetland region is most likely the donor area for Svalbard coastal organisms we will collect there the intertidal organisms from species found on Svalbard, as well as the control sample from the western Norway. The citizen science action will be organized among numerous sport yachts that go for Spitsbergen every summer from Europe, and that were already willing to take part in environmentaly friendly activity. WP2 will be working closely with WP3 (field and laboratory work) and on the level of data processing with all the other WP's, specifically on the issue of non indigenous species arrivals and establishment.

WP 3. Intertidal biocenose de-icing: tracing structural and functional ecosystem changes

Fast ice and ice foot were the two types of seasonal ice of key importance for the Svalbard shores. Both types of coastal ice are retreating (shorter time of occurrence and less thickness). Isfjorden represents the area, where three stages of coastal de-icing might be compared – from ice free open, west coast, through medium ice in the central fjord part, to the inner basins with long lasting and thick winter ice cover. In three different regimes of the coastal ice we will study the effect of the wave action (loggers detecting the movement of stones in the intertidal), the deposition and decomposition of marine detritus on the shore (kelp deposits, its decomposition with a litter bag method), export of suspensions and nutrients from land to the sea (chemical examination of outflow water from the beach). The intertidal biocenose will be studied for the presence of macroorganisms (algae and fauna) and microbiota (microbial films, meiofauna). We will focus on three types of the shore – rocky/skjerra, gravel beach and soft tidal flats. Species identification, biomass, population structure, productivity and genetics of the selected key genera (*Gammarus, Littorina, Fucus*) at each of the three shore types will be studied in three ice regimes. Field work will be performed in late spring (May) and in late summer (August) with a focus on Isfjorden area. Field work will be supplemented with aerial photography (drones) and satellite imagery. In the adjacent shallow areas (depths less than 10 m, unreachable for the ocean-going vessel Oceania) we will apply a simple hydroacoustic system for the mapping of macrophytes. Such system is easily transportable and may be used from a rubber boat, the method proved to be useful in conditions of extremely shallow and turbid lagoon waters in Lithuania (Bučas et al. 2016).

The effect of this WP will be the assessment of environmental and biocenotic changes that are associated with ice disappearance form the Svalbard shores. Most of the findings shall be valid for other Arctic regions as well, however Svalbard and its position in Atlantic – European Arctic is not representative for the Siberian or American coasts. WP2 will be working closely with WP3 (field and laboratory work) and on the level of data processing with all the other WP's.

WP 4. The assessment of sublittoral benthic habitats within deglaciation gradient

The WP4 will focus on the assessment of changes in sublittoral benthic habitats caused by the retreat of the tidewater glaciers. Opening of ice-free space initiates formation of the new sublittoral habitats, while the melting process of glaciers causes alteration of crucial environmental characteristics (changes in turbidity, temperature, salinity, organic matter, etc.), thus impacting the surrounding habitats. The study will be carried out in a variety of glacial and post-glacial bays that represent the continuum from active tidewater glacier to the

dry post- glacial valley with no glacial remains (variety of well dated seabed habitats can be found in Isfjorden complex on Spitsbergen).

Data collection will include grab sampling to examine the structure of macrozoobenthic communities, diversity of meiofauna and microbiota; remote video surveys using drop-down and ROV mounted cameras for visual assessment of dominant biological and physical features, and collection of physico-chemical properties of the seabed and water column. The study will also include modelling of spatial distribution of key species and habitat maps for selected bays in Svalbard. Based on empirical relations provided by the model, the mechanisms of impacts by the retreat of the tidewater glaciers on biological and physical features of benthic habitats will be clarified, scenarios of future deglaciation will be analyzed. For the habitat quality assessment, the applicability of benthic quality index (BQI) will be tested along the gradient from the retreating glaciers. The study of sublittoral habitats will provide the information for WP5 on distribution of non-indigenous and newly arrived boreal species along the deglaciation gradient: from early-succession habitats to pristine arctic biotopes.

Benthic sampling will be performed during two expeditions in 2019 and 2020 from the research vessel “Oceania”. Biological samples will be sampled with Van-Veen type grab sampler and fixed onboard, samples will be processed according HELCOM recommendations in the IO PAS. Collection of physico-chemical properties will include: substratum (granulometry, CHN, chlorophyll content), near-bottom water temperature and salinity. Video data will be collected by using either drop-down type video system or ROV (or a combination of both). Video footage will be converted into mosaics (still images) from which visual biological (presence/absence, abundance and coverage of selected species) a physical (substrate type and coverage) features will be extracted (Olenin, Šaškov, 2012; Šaškov, 2014).

Spatial distribution of the key benthic species and habitats will be modelled by statistical techniques that cope with nonlinear empirical relationships between responses and environmental factors, such as Maximum entropy or Random forest (Bučas et al., 2013). For modelling, the open-source software will be used: R (R core team, 2017) and Maxent (Steven et al., 2017). Potentially important environmental factors (Drewnik et al., 2017) will include bottom topography (e.g. depth, bottom slope), substrate (e.g. grain size, soft/hard bottoms), hydrodynamic (e.g. wave exposure index), and hydrological parameters (e.g. water temperature, salinity). Ecological scenarios of future deglaciation impact (Onarheim et al., 2017 and references therein) on biological and physical features of benthic habitats will be analyzed based on empirical relations provided by the models.

For the benthic quality assessment, we will use BQI based on the abundance and sensitivity of macrozoobenthos species (Rosenberg et al., 2004), the approach was recently applied by to examine robustness of mathematically defined species sensitivity along the disturbance gradient in the central Baltic Sea (Chuševė, Daunys, 2017).

All methodology has been developed and intensively used by KU in the Baltic Sea in the framework of previous projects: a) spatial distribution modelling - BONUS PREHAB (Šiaulys and Bučas, 2012; Bučas et al., 2013; Lindegarth et al., 2014); b) video and acoustic mapping of sublittoral benthic habitats - EU LIFE Nature BALTIC MPA's and DENOFLIT (Daunys et al., 2015; Šaškov et al., 2014; Bučas et al., 2016); c) benthic quality assessment – EU FP7 DEVOTES and implementation of the Marine Strategy Framework Directive (MSFD) in Lithuania (Chuševė et al., 2016; Chuševė and Daunys, 2017).

IOPAS team took part in number of studies devoted to glaciated fjords on Svalbard and benthic ecology – see e.g. the project GAME (national Research Council of Poland - http://www.iopan.gda.pl/projects/Game/index-pl.html) results and project GLAERE (Norwegian Funding mechanism grant - http://www.iopan.gda.pl/projects/GLAERE/index.html, resulting in over 30 peer reviewed

papers. Expertise includes taxonomy, functional ecology and benthic mapping as well as the logistics of Arctic operations.

WP 5. Assessing the expansion process of boreal marine organisms

The transportation of boreal marine organisms by macroplastic is the first phase of the expansion to the Arctic environments (studied in WP2); while the subsequent phases of this process, the arrival and establishment, take place in intertidal (WP3) and/or sublittoral (WP4) habitats. We hypothesize that there is a fundamental difference in susceptibility of these two types of habitats to the establishment of new arrivals. The intertidal habitats are subject to annual icing effect which can preclude the formation of permanent populations, while the sublittoral ones, less effected by ice, should be more susceptible. In turn, the susceptibility of the sublittoral habitats may also vary in glacial and post-glacial bays. Such conditions present an exceptional opportunity to study the peculiarities of the expansion process of boreal marine organisms to the Arctic. The successful invaders are expected to exhibit higher epigenetic than genetic diversity and epigenetic variation can encompass higher phenotypic plasticity. The maximum alteration at epigenomic level is likely to occur at the arrival through early expansion phase, when the species needs to boost its adaptive capacity to overcome the existing environmental constraints and establish a successful population.

We will use methodology which has been applied to study human mediated biological invasions in boreal coastal lagoons, marinas and ports worldwide (Olenin et al., 2007; Minchin et al. 2016). The sampling will be based on the abundance and distribution range (ADR) of the BPL (biopollution level) method (Olenin et al., 2007; 2011), where the abundance is ranked as “low”, “moderate” or “high” and the distribution scales for each assessment unit (a bay or a defined intertidal area) ranges from “local” to “several”, “many” and “all localities”. Combinations of abundance and distribution provide five levels of ADR, representing the different phases of an invasion. Based on ADR analysis we will: a) assess the susceptibility of different habitats to the new arrivals, and b) select target species for further biological traits analysis (BTA) of successful arrivals. The latter method is based on the systematic review of life form, sociability, reproductive type, feeding method, mobility and other biological traits of marine benthic organisms (Bremner et al. 2006). Finally, in order to evaluate the invasion success of selected target species and establish phases of their expansion we will use the traditional population size structure assessment along with the novel method of epigenome analysis (Ardura et al. 2017). The latter method is based on the detection of polymorphism in DNA methylation patterns using the methylation-sensitive amplified polymorphism approach. We will apply epigenome analysis of potential donor (Faroe Islands, northern Scotland) and introduced (Svalbard) populations in order to test whether the successful invaders exhibit higher epigenetic diversity in an expansion area versus their native areas.

The BPL method including ADR analysis, was developed at KU (Olenin et al., 2007) and has been used by different researchers in Europe and elsewhere; it is also recommended for marine environmental status assessments under the MSFD. The BTA method proved to be successful for the examination of the most widespread non-indigenous species in the boreal European Seas (Cardeccia et al. 2016) in a study performed in EU FP7 DEVOTES project. The epigenome analysis is a novel method, recently applied for the marine invertebrates (Ardura et al. 2017); one of the co-authors is employed by KU (part time) and will provide methodological advice for the current project. Polish team taxonomical experience, both in classical and molecular approach as well as the experience in local marine coastal ecology will be of great importance (see review in Weslawski et al. 2010).

All georeferenced ADR data on species findings in littoral and sublittoral habitats will be transferred to an information system on aquatic non-indigenous and cryptogenic species (AquaNIS, www.corpi.ku.lt/databases). This open access system was developed as a product of the EU FP7 project VECTORS and is being maintained by Klaipėda University; it

contains thousands of new species arrival records in various Large Marine Ecosystems, including Canadian Arctic and Nordic European Seas (Olenin et al., 2014; 2016).

PROJECT IMPLEMENTATION PLAN: MILESTONES

ADAMANT requires intensive co-operation among partners through workshops, field research, laboratory work and publication of results. At the first stage the opening workshop will be arranged at IOPAN in Sopot (2018) for presentation of the partners' experience, harmonization of the detailed research plan and development of the project logistics. Preparation for the field campaigns will be performed using telecommunication means and, if necessary, by personal visits to partner institutions. The second stage of the project is devoted to collection of field data during two expeditions in 2019 and 2020 from the research vessel "Oceania" and by intertidal surveys. Polish and Lithuanian teams will work together in the field surveys both at Svalbard and Fareo-Shetland islands. Two project meetings will be organized in autumn 2019 (KU, Klaipėda) and 2020 (IOPAN, Sopot) to discuss the ongoing results of the project, to refine research activities and to plan publishing strategy. The milestone of the third stage is the final workshop (spring 2021, Klaipėda) to finalize publication of the project results and develop ideas for the next joint research projects in Arctic. In connection to this meeting, a public event will be arranged in Klaipėda in cooperation with the Lithuanian Sea Museum to to present the results of the first joint Lithuanian-Polish research project in Arctic.

POSSIBLE RISKS, CRITICAL PATHS AND RISK MANAGEMENT PLAN

Long-term experience of field studies in Arctic conditions tells that the most posible risk is related to unsuitable hydrometeorological conditions for field sampling (floating ice, storms, fog, etc). This risk can be managed by detailed planning of alternative sampling locations in relatively sheltered fjords and bays. Also, two field campaigns (in 2019 and 2020) will help to minimize this risk. All field studies (both onboard of the R/V "Oceania" and intertidal excursions) will be performed strictly according to safety requirements.

During the field studies malfunction of an underwater video system may happen. To minimize this risk, we will prepare alternate video systems, which are available both at KU and IO PAS, including drop-down cameras, towed cameras and ROV mounted cameras. Also, electronic engineers (crew of the R/V "Oceania") can help to repair equipment.

A problem may arise in selection of the target species for the epigenome analysis, because finding of populations of the same species in different phases of expansion may require additional field time, which is rather limited in specific conditions of Arctic research. In that case we will use the species which currently are known to spread in Svalbard. The potential candidates are: the blue mussels of *Mytilus edulis* group (*M. trossulus* and *M. galloprovincialis*), expanding their range since 2005 from variable sources in the North Atlantic; the gammarid *Gammarus oceanicus*, known since 1957 on Spitsbergen, now spreading fast North and East; the gooseneck barnacle *Lepas anatifera* and bladderwrack *Ascophyllum nodosum*, recently transported with plastic litter.

4. Added value of international cooperation, the importance of Lithuanian-Polish cooperation (*description of the value of the proposed international cooperation with project partners from Poland/Lithuania [and other countries if applicable, and if such partners are funded from their respective national sources], how the project partners from Lithuania and Poland are capable of collectively achieving project objectives, and how they are suited and committed to the tasks assigned to them; show the complementarity between the partners; explain how the partners are balanced in relation to the objectives of the project; describe the planned continuation of collaboration after the end of the project*)

Polish researchers have a long-term experience in polar research. They recently completed several projects, such as GAME, MAESTRO and GLAERE, which substantially advanced

our knowledge on ecosystem processes in the warming environments of European Arctic. The entire issue of a peer-reviewed journal OCEANOLOGIA (2017, v. 59) currently is devoted to present presenting findings of GAME project in physical oceanography, marine chemistry, marine biology and modelling of the coastal waters of Svalbard archipelago.

In the present cooperation project, ADAMANT, the core of the Polish team will be formed of IOPAN researchers completed with invited specialists from University of Łódź and University of Gdańsk. Following their experience from the GLAERE project ("Glacial bays as Arctic fauna refugia") they will focus on the hydrology, marine optics, sediment chemistry, water column studies and benthic fauna assessment (WP2 and WP3). Polish research vessel OCEANIA will take part in the project, providing ship time needed to perform field studies both in Svalbard archipelago and in potential donor areas of marine boreal species, such as Faroe Islands and northern Scotland.

The Lithuanian team involved in the project ADAMANT consists of benthic ecologists and specialists in remote sensing methods, invasion biology and environmental genetics (Klaipėda University). In the project, they will be responsible for the seabed photography, sublittoral habitat mapping, GIS analyses and empirical modeling of key-stone species distribution (WP4) based on their long-term experience in development of the theoretical background and methodology of benthic research (e.g. Olenin, Ducrotoy 2006; Šaškov, Olenin 2012; Šiaulys et al 2012; Šiaulys, Bučas 2016; Bučas et al. 2016; Chuševė et al. 2016). Invasion biologists will use methodology which they developed and applied (e.g. Olenin et al., 2007; Minchin et al. 2016) to study human mediated biological invasions in different coastal environments worldwide. They will also apply a novel method of epigenome analysis (Ardura et al. 2017) to assess the expansion phases of boreal marine organisms (WP5).

Both Polish and Lithuanian researchers and PhD students will participate in all research activities, from field surveys and laboratory analyses to systematic literature reviews and presentation of results at scientific forums and in peer-reviewed publications. The synergetic effect will be achieved by teaming of the long-term experience in polar studies of the Polish scientists with the knowledge and skills of the Lithuanian researchers in seabed mapping, satellite image analysis, invasion biology and epigenome analysis. The project will be implemented in close cooperation with Norwegian partners – Norsk Polarinstitutt and University Center of Svalbard (UNIS). The experience of Lithuanian team in polar and sub-Arctic research so far is limited to few pilot studies (SCUBA diving and underwater surveys) performed in Svalbard (2005) and the White Sea (2004). Therefore, one of the important goals of ADAMANT is to create an opportunity for closer involvement of the Lithuanian scientists into polar research programmes, which is vitally important for further development of marine science in the country.

5. Planned results (*dissemination of project results: scientific publications and presentations at conferences; joint Polish-Lithuanian publications are mandatory; scholarly monographs, doctoral and habilitation dissertations, new methods and research facilities, economic and societal impact, impact of the research results on the development of science, scientific discoveries)*

Data collected during field surveys, biological traits and epigenome analyses will be used for joint Polish-Lithuanian publications in peer-reviewed journals, such as Polar Biology, Biological Invasions, Marine Pollution Bulletin, Oceanologia, Journal of Sea Research and others. We plan to publish 8-10 papers on various project related topics, including: Typology of seabed habitats along the deglaciation gradient in Svalbard; Functional ecosystem changes associated with the ice disappearance from the shore; Ecosystem goods and services change following deglaciation and boreal species advance to Svalbard coasts; Empirical models of alteration in distribution of key species on Svalbard in conditions of the

ice retreat; Peculiarities of the biological invasion pattern in Arctic coastal conditions; The role of anthropogenic and natural substrates in rafting of boreal organisms to Svalbard; Biological traits of the boreal species expanding their range to Svalbard; Epigenetic diversity of new arrivals: the case of boreal species in Svalbard.

A project web page will be developed in English, Polish and Lithuanian to present the project objectives, tasks and results at IOPAN and KU. Open data base from all project findings and measurements will be made available for the OBIS, SAON and EMODNET ocean data management systems. Georeferenced data on newly arrived species will be transferred tor the information system on aquatic non-indigenous and cryptogenic species (AquaNIS).

Data obtained in the course of the project will be used for preparation of at least two PhD thesis (on benthic habitats, epigenetic research of boreal species). Also, the materials (specimens of benthic animals and macroalgae, underwater and hydro-acoustic imagery data, etc) will be transferred as study material to universities involved in the project. Finally, underwater photographs, video records will be used for popularization of marine polar research at schools.

The knowledge received in the project will be useful for development of invasive species management strategy in Arctic in relation to the increasing availability of the Northwest and Northeast Passages for ship traffic.

6. References (a list of all publications cited in sections III.1 – III.5 of the Joint Project Description)

Ardura, A., Zaiko, A., Morán, P., Planes, S. and Garcia-Vazquez, E., 2017. Epigenetic signatures of invasive status in populations of marine invertebrates. *Scientific Reports*, *7*, p.42193.

BARNES D.K.A. 2002. Invasions by marine life on plastic debris. *Nature* 416: 808–809.

BARNES D.K.A., MILNER P. 2005. Drifting plastic and its consequences for sessile organism dispersal in the Atlantic Ocean. *Marine Biology* 146: 815–825.

BERGE J., JOHNSEN G., NILSEN F., GULLIKSEN B. and SLAGSTAD D. 2005. Ocean temperature oscillations enable reappearance of blue mussels *Mytilus edulis* in Svalbard after a 1000 year absence. *Marine Ecology Progress Ser.* 303: 167–175.

BERGMANN M., KLAGES M. 2012. Increase of litter at the Arctic deep-sea observatory HAUSGARTEN. *Mar Pollut Bull.* 64: 2734–1741, doi: 10.1016/j.marpolbul.2012.09.018.

BERGMANN M., SANDHOP N., SCHEWE I., D'HERT D., 2016. Observations of floating anthropogenic litter in the Barents Sea and Fram Strait, Arctic. *Polar Biol*ogy 39: 553–560.

BERGMANN, M., LUTZ, B., TEKMAN, M.B., GUTOW, L. 2017. Citizen scientists reveal: Marine litter pollutes Arctic beaches and affects wild life. *Marine Pollution Bulletin in press:*

Błaszczyk, M., Jania, J.A., Hagen, J.O., 2009. Tidewater glaciers of Svalbard: recent changes and estimates of calving fluxes. Pol. Polar Res. 30, 85–142.

Bremner, J., Rogers, S.I. and Frid, C.L.J., 2006. Methods for describing ecological functioning of marine benthic assemblages using biological traits analysis (BTA). Ecological Indicators, 6(3)Ж 609-622.

Bučas, M., Bergström, U., Downie, A-L., Sundblad, G., Gullström, M., von Numers, M., Šiaulys, A., Lindegarth, M., 2013. Empirical modelling of benthic species distribution, abundance, and diversity in the Baltic Sea: evaluating the scope for predictive mapping using different modelling approaches. ICES J. Mar. Sci. 70(6): 1233-1243.

Bučas, M., Šaškov, A., Šiaulys, A., Sinkevičienė, Z., 2016. Assessment of a simple hydroacoustic system for the mapping of macrophytes in extremely shallow and turbid lagoon. Aquatic Botany 134: 39–46.

Cardeccia, A., Marchini, A., Occhipinti-Ambrogi, A., Galil, B., Gollasch, S., Minchin, D., Narščius, A., Olenin, S. and Ojaveer, H., 2016. Assessing biological invasions in European Seas: biological traits of the most widespread non-indigenous species. Estuarine, Coastal and Shelf Science (article in press).

Chuševė, R. and Daunys, D., 2017. Can benthic quality assessment be impaired by uncertain species sensitivities? Marine pollution bulletin, 116(1), pp.332-339.

Chuševė, R., Nygård, H., Vaičiūtė, D., Daunys, D. and Zaiko, A., 2016. Application of signal detection theory approach for setting thresholds in benthic quality assessments. Ecological indicators, 60, pp.420-427.

CÓZAR A., MARTÍ E., DUARTE C. M., GARCÍA-DE-LOMAS J., VAN SEBILLE E., BALLATORE T.J. and IRIGOIEN X. 2017. The Arctic Ocean as a dead end for floating plastics in the North Atlantic branch of the Thermohaline Circulation. *Science Advances 3*(4): e1600582. http://doi.org/10.1126/sciadv.1600582

Daunys, D., A. Šaškov, A. Šiaulys, I. Bagdanavičiūtė, J. Dainys, L. Ložys, M. Dagys, N. Nika, and R. Žydelis. 2015. Evaluation of diversity and distribution of habitats, fishes and birds in the Lithuanian exclusive economic zone for development of NATURA 2000 network. LIFE+ DENOFLIT Technical Report.

Davis, M.A., 2009. Invasion biology. Oxford University Pressю

Drewnik A., Węsławski J.M., Włodarska-Kowalczuk M. (2017) Benthic Crustacea and Mollusca distribution in Arctic fjord – case study of patterns in Hornsund, Svalbard. Oceanologia 59(4): 565-575.

DURIS Z. and WĘSŁAWSKI J.M. 1995. A preliminary examination of ice floes at Isfjorden, Spitsbergen on a presence of sympagic fauna. *Wyprawy Geograficzne UMCS, Lublin*: 227–231.

Gorlich, K., Węsławski, J.M., Zajączkowski, M., 1987. Suspensions settling effect on macrobenthos biomass distribution in the Hornsund fjord, Spitsbergen. Polar Res. 5, 175–192.

Ingrid H. Onarheim, Lars H. Smedsrud, Randi B. Ingvaldsen & Frank Nilsen (2014) Loss of sea ice during winter north of Svalbard, Tellus A: Dynamic Meteorology and

Lindegarth, M., Bergström, U., Mattila, J., Olenin, S., Ollikainen, M., Downie, A.L., Sundblad, G., Bučas, M., Gullström, M., Snickars, M., von Numers, M., Svensson, J.R., Kosenius, A.K., 2014. Testing the potential for predictive modeling and mapping and extending its use as a tool for evaluating management scenarios and economic valuation in the Baltic Sea (PREHAB). AMBIO, 43(1): 82–93.

Lydersen Christian, Philipp Assmy, Stig Falk-Petersen, Jack Kohler, Kit M. Kovacs, Marit Reigstad, Harald Steen, Hallvard Strøm, Arild Sundfjord, Øystein Varpe, Waldek Walczowski, Jan Marcin Węsławski, Marek Zajączkowski. 2014 The importance of tidewater glaciers for marine mammals and seabirds in Svalbard, Norway. Journal of Marine Systems 129 (2014) 452–471

MILEJKOVSKY S.A. 1968. Distribution of pelagic larvae of bottom invertebrates of the Norwegian and Barents Seas. *Marine Biology* 1: 161-167.

Minchin et al. 2016 Oceanography, 66:1, 23933, DOI: 10.3402/tellusa.v66.23933

Olenin, S., Minchin, D., & Daunys, D. (2007). Assessment of biopollution in aquatic ecosystems. Marine pollution bulletin, 55(7), 379-394.

Olenin, S., Elliott, M., Bysveen, I., Culverhouse, P.F., Daunys, D., Dubelaar, G.B., Gollasch, S., Goulletquer, P., Jelmert, A., Kantor, Y. and Mézeth, K.B., 2011. Recommendations on methods for the detection and control of biological pollution in marine coastal waters. Marine Pollution Bulletin, 62(12): 2598-2604.

Olenin, S., Narščius, A., Minchin, D., David, M., Galil, B., Gollasch, S., Marchini, A., Occhipinti-Ambrogi, A., Ojaveer, H. and Zaiko, A., 2014. Making non-indigenous species information systems practical for management and useful for research: an aquatic perspective. Biological Conservation, 173: 98-107.

Olenin, S., Narščius, A., Gollasch, S., Lehtiniemi, M., Marchini, A., Minchin, D. and Srėbalienė, G., 2016. New arrivals: an indicator for non-indigenous species introductions at different geographical scales. Frontiers in Marine Science, 3, Art-No.

Olenin, S., & Ducrotoy, J. P. (2006). The concept of biotope in marine ecology and coastal management. Marine Pollution Bulletin, 53(1), 20-29.

R Core Team (2017). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/.

REISSER J., SHAW J., HALLEGRAEFF G., PROIETTI M., BARNES D.K.A., ET AL. . 2014. Millimeter-Sized Marine Plastics: A New Pelagic Habitat for Microorganisms and invertebrates. *PLoS ONE* 9: e100289. doi:10.1371/journal.pone.0100289

Rosenberg, R., Blomqvist, M., Nilsson, H.C., Cederwall, H. and Dimming, A., 2004. Marine quality assessment by use of benthic species-abundance distributions: a proposed new protocol within the European Union Water Framework Directive. Marine Pollution Bulletin, 49(9), pp.728-739.

Šaškov A., 2014. Application of underwater remote imagery and acoustic data for quantitative benthic biotope identification, predictive mapping and building of explanatory models. Doctoral dissertation of Biomedical sciences, ecology and environmental sciences (03B). Klaipėda, 140 p.

Šaškov, A.L. and Olenin, S.N., 2012. Applying the remote underwater video recording for quantitative analysis of characters of benthic biotopes and their identification. Tr. Belomorsk. Biol. Stn. Mosk. Gos. Univ, 11, 64-73.

Šiaulys, A., Bučas, M., 2012. Species distribution modelling of benthic invertebrates in the south-eastern Baltic Sea. Baltica, 25 (2), 163-170.

SILBERBERGER M., RENAUD P., ESPINASSE B. and REISS H. 2016. Spatial and temporal structure of meroplankton community in a sub Arctic shelf system. *Marine Ecology Progress Series* 555: 79–93.

Steven J. Phillips, Miroslav Dudík, Robert E. Schapire 2017. Maxent software for modeling species niches and distributions (Version 3.4.1). Available from url: http://biodiversityinformatics.amnh.org/open_source/maxent/. Accessed on 2017-12-4.

TEKMAN M.B., KRUMPEN T. and BERGMANN M. 2017. Marine litter on deep Arctic seafloor continues to increase and spreads to the North at the HAUSGARTEN observatory. *Deep-Sea Research Part I* 120: 88–99.

TREVAIL A. M., GABRIELSEN G. W., KÜHN S. and VAN FRANEKER J. A. 2015. Elevated levels of ingested plastic in a high Arctic seabird, the northern fulmar (*Fulmarus glacialis*). *Polar Biol*ogy 38: 975–981.

WALCZOWSKI W. and PIECHURA J. 2007. Pathways of Greenland Sea warming. *Geoph. Res. Lett.* 34, L10608

Weslawski and Kotwicki 2017 Macroplastic- new vector for boreal species dispersal on Svalbard. Polish Polar Research , submitted

WESLAWSKI J.M., WIKTOR J., ZAJĄCZKOWSKI M. and SWERPEL S. 1993. Intertidal zone of Svalbard 1 Macroorganisms distribution and biomass. *Polar Biology* 13: 73-108.

Węsławski J.M., Wiktor J.jr., Kotwicki L. 2010 Increase in biodiversityin the Arctic rocky littoral, Sorkappland, Svalbard after 20years of climate warming. Marine Biodiversity 40, 123-130_

Włodarska- Kowalczuk, M., Weslawski, J.M., Kotwicki, L., 1998. Spitsbergen glacial bays macrobenthos — a preliminary comparative study. Polar Biol. 20, 66–73.

Wlodarska-Kowalczuk, M., Pearson, T., 2004. Soft-bottommacrobenthic faunal associations and factors affecting species distributions in an Arctic glacial fjord (Kongsfjorden, Spitsbergen). Polar Biol. 27, 155–167.

Zaiko, A., Schimanski, K., Pochon, X., Hopkins, G.A., Goldstien, S., Floerl, O. and Wood, S.A., 2016. Metabarcoding improves detection of eukaryotes from early biofouling communities: implications for pest monitoring and pathway management. *Biofouling*, *32*(6), pp.671-684.

IV. FURTHER INFORMATION

1. The Host /Implementing Institution's premises, scientific infrastructure and services to be used within the project (*describe the Host/Implementing Institution's commitment to the project, i.e. whether it provides access to facilities, scientific equipment, administrative and financial support services and other necessary items; both Polish and Lithuanian applicants should note that the administrative personnel costs have to be covered from overheads. For detailed information please refer to: "Costs incurred in research projects funded by the National Science Centre" – …. and "General rules for the competitive funding of research and dissemination projects of the Research Council of Lithuania"*)(*up to 1 page).*

Poland:
Institute of Oceanology PAS will secure the ship time of r/v Oceania needed to conduct Isfjorden coastal survey in two consecutive summer seasons. Administration of the IOPAS will take part of the project management.

2. Ethical issues: please describe whether there are any ethical issues raised by the proposed research and if so, how they are to be addressed (*please indicate whether the research envisaged, according to the project, requires a permit from one or several authorised bodies.*
For Polish Applicants e.g.: the Bioethics Committee or the ethics committee for testing on animals etc., in accordance with regulations on modified organisms, using protected species or within protected areas. If so – in section G of the application form in the OSF system commit to obtain all such permissions, recommendations and authorisations as may be required or enter the permit's ID number.

This is not applicable, since we are not going to work with the vertebrates, and all studies with marine biota are going to be registred and conducted with local Norwegian environmental regulations (Research on Svalbard registration system and Sysselmannen permits). Also, please note that Polish Applicants have to follow the "NCN Code of ethics on research integrity and application for funding" – Attachment to resolution no 39/2016 of the Council of the NCN of 11th May 2016.

For Lithuanian Applicants e.g.: the Bioethics Committee, the State Food and Veterinary Service, Environmental Protection Agency, etc.).

3. Researchers with whom you have collaborated scientifically (*please list the researchers with whom you have collaborated scientifically throughout the years 2017, 2016, 2015 and 2014 and those with whom you have agreed to cooperate on this proposal. This information will assist the RCL and NCN scientific officers in avoiding potential conflicts of interest during the review process.*)

Norsk Polarinstitutt- Harald Steen, Haakon Hop,Hallvard Stroem
UNIS – Oystein Varpe,
AKVAPLAN NIVA – Paul Renaud, Stig Falk Petersen
University of Oslo – Dag Hessen
University of Tromso – Jorgen Berge
NIVA – Martin Svening
University of Gdansk – Jacek Urbanski, Lech Stempniewicz,
University of Łódź – Michał Grabowski
University of Silesia – Jacek Jania
Sea Fisheries Institute Gdynia – Dariusz Fey, Tomasz Linkowski

4. Other submissions of the proposal (*has the proposal been submitted in response to other calls or to other funding agencies? Please check RCL and NCN rules regarding submission of a project to more than one scheme*.)

No

V. BUDGET

1. Polish project part: Specification and justification of funds requested.
You can apply for the following cost items: personnel, equipment, consumables, outsourcing/subcontracting, travel and subsistence costs, including conference attendance fees of team members of the Polish research team, travel and subsistence costs for participants of project meetings and seminars in Poland, Other costs (including publication costs, excluding review fees), Overheads. **You need to justify all costs requested except the overheads (up to 2 pages).**
(Please see: "*Costs incurred in research projects funded by the National Science Centre" – …."* and all relevant material on the NCN website)

Personnel costs (€132 362) include salaries of the project principal investigator (Jan Marcin Węsławski), 4 part time co-investigators (including 2 WP leaders), two post-doc positions (12 months each) and one PhD student position (30 months).The salaries of the project leader and WP leaders (all holding full time positions as IOPAN) are limited to the minimum time required for the project coordination and supervision of post docs and PhD student (1-2 months each year).

Consumables (€ 13 072) include three major groups: (i) consumables needed for field work (€ 3 735) i.e., fuel for the rubber boats, ammunition, protective clothing, safety equipment, soft and wire ropes, floats and food needed for field campaigns, (ii) chemical reagents, including commercial kits for molecular biology (for example, DNA purification), laboratory glassware and minor laboratory equipment e.g., containers, holders, filters, silver boats, silver circles, syringes, pipettes (€ 9 104), and (iii) office materials (€ 233).

Outsourcing/subcontracting costs (€ 7 236) are related to the genetic analysis (€ 5 836) and hiring local boat transportation during the field campaigns (€ 1 400).

Travel costs (€ 11 672) include field work expenses (€ 7 003) , i.e., air tickets to Spitsbergen and UK (Fareo-Shetland) during two summer seasons and for minimal field team (2 to 4 persons) and participation in international conferences (€ 4 669)., most likely large meetings such as Arctic Frontiers in Tromso, Biodiversity Congress or ASLO conference; these costs include conferences registration fee, air tickets, subsistence and accommodation.

Other costs (€ 2 801) covers publication fees in high quality international journals.

Indirect costs (€ 66 858) are set at 40% a year (excluding equipment costs) according to the National Science Centre regulations.

2. Lithuanian project part: Specification and justification of funds requested.
You can apply for the following cost items: personnel, social insurance, service costs, expenses for copyright works, expenses for goods, business travel costs, expenses for the acquisition of non-current assets, indirect costs, additional indirect costs for the operation of research equipment. (Please see RCL website for further information). **You need to justify all costs requested except the indirect costs** (however, additional indirect costs for the operation of research equipment must be justified) **(up to 2 pages).**
(Please see: *"General rules for the competitive funding of research and dissemination projects of the Research Council of Lithuania"*)

Personnel costs (53329 EUR – wages, 16740 EUR – social insurance and other contributions) are distributed as following: minimal required hours per month (20) during the whole project for the principal investigator and two principal co-investigators, as they lead and coordinate workpackages, are responsible for adequate data collection and analysis,

preparation of reports and scientific publications. Co-investigators, which are responsible for very specific tasks (such as acoustic surveys, video surveys, genetic analysis, etc.) are employed at the same hour per month rate, but for shorter time, depending on effort required (4-12 months). PhD students are employed also at the same hour per month rate, but for the period of 24 months since large share of their work are sample processing what requires more time.
Expenses for goods (13000 EUR) fall under two categories: expenses for epigenetic analysis (DNA sample preservation reagents, DNA extraction kits, reagents for global methylation analysis) – 9000 EUR and five sets of arctic expedition gear (wind and water proof suits, boots, insulated inner clothing, etc.) for fieldwork, including work on research vessel, boat and shore surveys under arctic conditions. Costs for reagents and other laboratory consumables were approximately estimated based on current prices provided by the long-term supplier. Costs for expedition gear sets were approximately estimated based on phone inquiries of several possible providers.
Business travel costs (18000 EUR) fall under three categories: (1) costs for two expeditions for four persons to Svalbard (12000 EUR) which include plane tickets, daily allowance, etc., approximate price per person was estimated based on long term experience of Polish scientists; (2) travel to scientific conferences for dissemination of major research findings for 4 persons to international symposium with long lasting traditions on marine geological and biological habitat mapping GEOHAB (4000 EUR) and an internship for a PhD student to Polish partners for acquisition of knowledge on the taxonomy of arctic species (1000 EUR); (3) two trips for 4 persons to project partners (1000 EUR) for the kick-off meeting and annual meeting for discussions on fieldwork planning, data analysis, reporting and collective publications.
No expenses for services, copyright works and acquisition of non-current assets are intended.
Indirect costs (18920 EUR) are set to 27% each year.

3. **Polish Research Team Budget Table** (For the purpose of this Joint Project Description and its evaluation, please indicate all amounts in Euro)

For Polish Applicants: Please note that the Euro exchange rate should be calculated according to the NCN Council's Resolutions No. 82/2017 (see appendix 2), namely EUR 1 amounts to PLN 4,2837 (please round the numbers down). The budget table available in the OSF system will help you to calculate the amounts according to NCN regulations.

BUDGET TABLE FOR POLISH APPLICANTS (EUR) **Please note that the table must be identical to the budget table available in the OSF system**	
Investigators /Staff costs	**132 362**
Equipment	**0**
Materials and small equipment (expendable goods for direct use in the project)	**13 072**
Outsourced services (services ordered from entities external to the Host Institution)	**7 236**
Conferences and business trips (by members of the research team)	**11 672**

Visits and consultations (*travel expenses /travel expenses by external collaborators and/or consultants and costs of meetings; costs of visits for the Lithuanian team are covered from the RCL budget*)	**0**
Other costs (*such as those which do not fit into other categories, including publication costs, excluding review fees*)	**2 801**
Collective investigators	**0**
Overheads (max. 40%)	**66 858**
Total Poland	**234 001**

4. **Lithuanian Research Team Budget Table**

For Lithuanian Applicants: Please note that the budget table available in the RCL electronic system will help you to calculate the amounts according to RCL regulations

BUDGET TABLE FOR LITHUANIAN APPLICANTS (EUR) **Please note that the table must be identical to the budget table available in the RCL system**		
No.	Cost item	Total, EUR
1.	Wages	53329.0
2.	Social insurance and other contributions	16740.0
3.	Service costs	0
4.	Expenses for copyright works	0
5.	Expenses for goods	13000.0
6.	Business travel costs (*costs of visits for the Polish team are covered from the NCN budget*)	18000.0
7.	Expenses for the acquisition of non-current assets	0
8.	Indirect costs (*up to 30 % of the funds indicated in points 1-4*) and additional indirect costs for the operation of research equipment	18920.0
	Total Lithuania:	119989.0
	Total Lithuania and Poland:	353 990

VI. CVs INCLUDING PUBLICATION LISTS

Please provide CVs for both Principal Investigators, 3 pages max. per person (academic and research career, research projects led, research experience at home and abroad, most important prizes and awards; for each individual, please include a list of a maximum of 10 of the most relevant publications published[2] over the period of 10 years prior to the submission of the proposal[3]; during the evaluation, emphasis will be put on the quality of the publications, i.e. if they are on the list by JCR, or on comparable lists, and the monographs' nationwide or international impact will also be considered; where possible, please indicate the current five-year impact factor of the journal and the number of citations of each publication excluding self-citations).

Please upload CVs and the Joint Project Description as attachments in the appropriate sections in the OSF submission system.

CV of Jan Marcin Węsławski

Jan Marcin Węsławski, born 1955 in Gdańsk, is a marine ecologist, specialized in marine food webs, Arctic coastal waters ecology and biodiversity assessment. His special interests include crustaceans identification. He has spent more than 50 months in polar and marine expeditions to Svalbard, Greenland, Arctic Canada and Russia. His publication record include more than 100 publications published in peer-reviewed journals. Cited over 2500 times, Hirche index 32 (SCOPUS data base, October 2017). PhD degree in 1984, habilitation in 1993. In 2000 he was appointed professorship by the President of Poland. Since 1985 he has been employed at the Institute of Oceanology Polish Academy of Sciences in Sopot (Poland) as a research scientist. Between 1996 and 2006 he has been the head of the Research Council of Sea Fisheries Institute in Gdynia and in 2006-2007 vice-director for Research at IOPAS. Leadership of recent projects: GAME (Growing of Arctic Ecosystem) Polish National Research Center MAESTRO project (1 mln euro); 2013-2016, GLAERE (Glacial bays as arctic ecosystem refugia) Norwegian Funding Mechanism 2014-2017 (1 mln euro). Supervision of PhD students: 13 PhD thesis completed, 1 project running.

Relevant, recent publications in peer-reviewed journals:

Urbański J, Stempniewicz L., Węsławski JM., Dragańska-Deja K, Wochna A, Goc M., Iliszko L. 2017. Subglacial discharges create fluctuating foraging hotspots for sea birds in tidewater glacier bays", Nature Scientific reports, March 2017

Wiktor J, Agnieszka Tatarek, Jan Marcin Wesławski, Lech Kotwicki, Michel Poulin (2016) Colonies of Gyrosigma eximium: a new phenomenon in Arctic tidal flats, Oceanologia 58 (3)

Grzelak K, Marta Głuchowska, Klaudia Gregorczyk, Aleksandra Winogradow, Jan Marcin Wesławski 2016. Nematode biomass and morphometric attributes as biologicalindicators of local environmental conditions in Arctic fjords. Ecological Indicators, 69 2016, pages 368-380

Drewnik A., Jan Marcin Węsławski, Maria Włodarska-Kowalczuk, Magdalena Łącka, Agnieszka Promińska, Agata Zaborska, Marta Głuchowska.(2016) From the worm's point of view. I: Environmental settings of benthic ecosystems in Arctic fjord (Hornsund, Spitsbergen). Polar Biology, January 2016, pages 1-14

[2] In the case of unpublished manuscripts please submit the acceptance letters from the editor as the attachments to the proposal in the OSF system.

[3] Breaks in research career shall not be counted as part of this period. Older publications can be cited only if the applicant has taken significant career breaks within the last 10 years. The career break is understood as maternity leave, adoption leave, additional maternity leave, additional adoption leave, paternal leave, parental leave granted in compliance with the Employment Code, periods of sickness benefit or rehabilitation benefit granted on account of unfitness for work, including any caused by a health condition requiring rehabilitation.

Berge J., Daase M., Renaud P.E., Ambrose W.A., Jr., Darnis G., Last K.S., Leu E., Cohen J.H., Johnsen G., Moline M.A., Cottier F., Varpe Ø.,Shunatova N., Bałazy P., Morata N., Massabuau J-Ch., Falk-Petersen S., Kosobokova K.,Hoppe C.J.M., Węsławski J.M., Kukliński P., Legeżyńska J., Nikishina D., Cusa M., KędraM., Włodarska_Kowalczuk M., Vogedes D., Camus L., Tran D., Michaud E., GabrielsenT.M., Granovitch A., Gonchar A., Krapp R. and Callesen T.A. (2015) Unexpected Levels of Biological Activity during the Polar Night Offer New Perspectives on a Warming Arctic, Current Biology, 2015, 25, 1–7

Berge, Paul E. Renaud, Gerald Darnis, Finlo Cottier, Kim Last, Tove M. Gabrielsen, Geir Johnsen, Lena Seuthe,Jan Marcin Węsławski, Eva Leu,Mark Moline, Jasmine Nahrgang, Janne E. Søreide, Øystein Varpe, Ole Jørgen Lønne,Malin Daase, Stig Falk-Petersen. In the dark: 2015, A review of ecosystem processes during the Arctic polar Night. Progress in Oceanography, Volume 139, Pages258–271

Bremner, J., Rogers, S.I., Frid, C.L.J., 2006. Methods for describing ecological functioning of marine benthic assemblages using biological traits analysis (BTA). Ecol. Indic. 6, 609e622. http://dx.doi.org/10.1016/j.ecolind.2005.08.026.

Lydersen Christian, Philipp Assmy, Stig Falk-Petersen, Jack Kohler, Kit M. Kovacs, Marit Reigstad, Harald Steen, Hallvard Strøm, Arild Sundfjord, Øystein Varpe, Waldek Walczowski, Jan Marcin Węsławski, Marek Zajączkowski. 2014 The importance of tidewater glaciers for marine mammals and seabirds in Svalbard, Norway. Journal of Marine Systems 129 (2014) 452–471

Kedra M, Wlodarska-Kowalczuk M and Weslawski JM. 2009. Decadal change in macrobenthic soft-bottom community structure in a high Arctic fjord (Kongsfjorden, Svalbard) Polar Biology 10.1007/s00300-009-0679-1

Weslawski, J. M.; Kwasniewski, S.; Stempniewicz, L. 2009. Warming in the Arctic May Result in the Negative Effects of Increased Biodiversity. Polarforschung, 78, 3, 105-108

CV of Sergej Olenin

Sergej Olenin, born 1958 in Klaipėda, is a marine ecologist, specialized in benthic ecology, biological invasion studies and environmental impact assessment. Since 1980s he participated in research cruises in the Baltic and North Seas, Pacific and Atlantic Oceans; he conducted SCUBA diving and underwater video research expeditions at different seas incl. the White Sea (Northern Russia) and Svalbard. His publication record includes more than 100 peer-reviewed papers. Cited over 2000 times, Hirche index 28 (SCOPUS data base, November 2017). PhD degree in 1990, habilitation in 2006. Since 1992 he has been employed at the Marine Science and Technology Centre of Klaipėda University; in 2008-2009 he worked at UniFob Environmental Research, affiliated to the University of Bergen (Norway). He is a member of the Editorial Board of the international journals, "Biological invasions" (Springer), “Oceanologia” (Elsevier), „Estuarine, coastal and shelf sciences“ (Elsevier), "Oceanological and Hydrobiological Studies" (De Gruyter Open publ.). In 2009-2010 he chaired the Joint Research Center / International Council for the Exploration of the Sea Task Group “Non-indigenous species” developing Good Environmental Status Descriptor for the EU Marine Strategy Framework Directive. Leadership of recent projects: BINARC (Biological invasions in Arctic and Sub-Arctic marine ecosystems under the climate change: causes, impacts and projections) Research Council of Norway (30.000 EUR); JSPD1 and JSPD2 (Implementation of the EU Marine Strategy Framework Directive in Lithuania) European Economic Area Grants (1 mln EUR). Participation in the recent EU

funded projects: DEVOTES (Development of innovative tools for understanding marine biodiversity and assessing good Environmental Status), VECTORS (Vectors of Change in Oceans and Seas Marine Life, Impact on Economic Sectors), MEECE (Marine Ecosystem Evolution in a Changing Environment). Supervision of PhD students: 7 PhD thesis completed, 3 PhD projects running.
Relevant, recent publications in peer-reviewed journals:

1. Olenin S, Narščius A, Gollasch S, Lehtiniemi M, Marchini A, Minchin D, and Srėbalienė G 2016. An Indicator for Non-indigenous Species Introductions at Different Geographical Scales. Frontiers in Marine Sciences, 3: 208. doi: 10.3389/fmars.2016.00208
2. Minchin, D., Olenin, S., Liu, T. K., Cheng, M., & Huang, S. C. 2016. Rapid assessment of target species: Byssate bivalves in a large tropical port. Marine Pollution Bulletin, 112(1), 177-182.
3. Ojaveer H, Galil BS, Campbell ML, Carlton JT, Canning-Clode J, Cook EJ, Davidson AD, Hewitt CL, Jelmert A, Marchini A, McKenzie CH, Minchin D, Occipinti-Ambrogi A, Olenin S, Ruiz G. 2015. Classification of Non-Indigenous Species Based on Their Impacts: Considerations for Application in Marine Management. PLoS Biology 13(4): e1002130. doi:10.1371/journal.pbio.1002130
4. Olenin S., Elliott M., Bysveen I., Culverhouse P., Daunys D., Dubelaar G.B.J., Gollasch S., Goulletquer P., Jelmert A., Kantor Y., Mézeth K.B., Minchin D., Occhipinti Ambrogi A., Olenina I., Vandekerkhove J., 2011. Recommendations on methods for the detection and control of biological pollution in marine coastal waters. Marine Pollution Bulletin. doi:10.1016/j.marpolbul.2011.08.011
5. Olenin S., Narščius A., Minchin D., David M., Galil B., Gollasch S., Marchini A., Occhipinti-Ambrogi A., Ojaveer H., Zaiko A. 2014. Making non-indigenous species information systems practical for management and useful for research: an aquatic perspective. Biological Conservation (173); 98-107 https://doi.org/10.1016/j.biocon.2013.07.040
6. Bučas M., Daunys D., Olenin S. 2009. Recent distribution and stock assessment of the red alga Furcellaria lumbricalis on an exposed Baltic Sea coast: combined use of field survey and modelling methods. Oceanologia. Vol. 51 (3), p. 341-359, ISSN 0078-3234.
7. Olenin S., Ducrotoy J. P. The concept of biotope in marine ecology and coastal management. 2006. Marine Pollution Bulletin, 53, p. 20-29, ISSN 0025-326X. doi.org/10.1016/j.marpolbul.2006.01.003