

Application for Consent to conduct
Marine Scientific Research

Date: 21.01.2021

1. General Information

1.1 Cruise name and/or number: AutoNaut Extended Ellett Line sea trial
AutoNaut 'Oban'

1.2 Sponsoring Institution(s):	
Name:	AutoNaut Ltd
Address:	Unit J, Heath Place, Bognor Regis, West Sussex, PO22 9SL, United Kingdom
Name of Director:	Mike Poole
UK Partner Institute in this Innovate UK funded sea trial of a new AutoNaut uncrewed surface vessel (USV)	Scottish Association for Marine Science (SAMS),
Address	Scottish Marine Institute, Oban, Argyll, PA37 1QA
Name of Director	Mark Innal

1.3 Scientist in charge of the Project:	
Name:	Mike Poole
Country:	United Kingdom
Affiliation:	
Address:	AutoNaut Ltd, Unit J, Heath Place, Bognor Regis, West Sussex, PO22 9SL, United Kingdom
Telephone:	+44 (0)1243 511 421 During Covid-19 lockdown +44 (0)7970 935938
Fax:	
Email:	mike.poole@autonautusv.com
Website (for CV and photo):	www.autonautusv.com

1.4 Entity(ies)/Participant(s) from coastal State involved in the planning of the project:	
Name:	Sigurður Guðjónsson
Affiliation:	CEO
Address:	Marine and Freshwater Research Institute Fornubúðum 5 220 Hafnarfjörður, Iceland
Telephone:	+ 354 575 2050
Fax:	
Email:	sigurdur.gudjonsson@hafogvatn.is
Website (for CV and photo):	www.hafogvatn.is

2. Description of Project

2.1 Nature and objectives of the project:
This is the first proving sea trial for a new AutoNaut wave-propelled uncrewed surface vessel (USV) that has been hardened and adapted to enable it to carry out long endurance data gathering missions, at high latitude in the Arctic and Antarctic seas, eventually in winter.

The 'AutoNaut for Extreme Environments' project was funded by Innovate UK through its Robotics and AI theme. This 'Extension' project is to verify and validate the technologies developed, and to demonstrate the USV to external stakeholders – in this case the global community of high latitude research scientists, and commercial operators.

New technologies being trialled were developed by the partner universities of East Anglia and Exeter and include anti-icing, the autonomous detection and avoidance of small ice in waves, and provision of hotel electrical power for sensors as well as platform control and satellite communication. In addition, new build materials suitable for extreme cold, and robust design changes are being trialled.

The plan is to partner with SAMS, based in Oban, so that science data can be collected on the extended Ellett Line to Iceland, and if possible to progress some way towards Greenland. SAMS has a long established programme of underwater data collection using gliders. This will be the first time contemporaneous surface and underwater data is gathered autonomously on this research line.

Scientists at SAMS and potentially the National Oceanography Centre in Southampton will analyse the data, with the intention of publishing papers. Such peer reviewed science papers are an important part of the demonstration. The data will be shared with other partners including Iceland's Marine and Freshwater Research Institute, and the Faroe Marine Research Institute.

The deployment will begin at SAMS in Oban and return there. It will last three to four months. It is hoped to launch in June 2021, Covid-19 restrictions permitting.

AutoNaut is controlled via satellite by remote pilots. It conforms with Maritime UK's Code of Practice for autonomous vessels <https://www.maritimeuk.org/media-centre/publications/maritime-autonomous-surface-ships-uk-code-practice/>. The USV is equipped with autonomous collision avoidance and broadcasts AIS.

Sensors will include an ADCP to measure currents to depth, passive acoustic monitor (PAM) to collect data on cetaceans, a weather station, sensors for water properties (temperature, conductivity etc) and cameras below and above the water to monitor wildlife.

A simultaneous application is being made to gather data in the Faroes EEZ as part of contingency planning for the following reasons:

1. Permission to enter Iceland's EEZ may not be granted, or not granted in time for this summer 2021 deployment.
2. It is important this proving trial & demonstration of high latitude USV capability does reach high latitude. The route north from Scotland must enter either Iceland's or the Faroes' EEZs. Passage through the Faroes EEZ would allow the USV to reach high latitude.
3. Covid-19 restrictions may curtail UK research cruises in the area by manned ships, which would normally provide economical contingency recovery if the USV is damaged. Damage could cause the USV to drift into Faroes EEZ. FMRI has research vessels which could assist recovery to the Faroes.

2.2 If designated as part of a larger scale project, then provide the name of the project and the Organisation responsible for coordinating the project:

N/A

2.3 Relevant previous or future research projects:

<https://mars.noc.ac.uk/projects/extended-ellett-line> "The Extended Ellett Line (EEL) is a full-depth hydrographic section between Scotland, Rockall, and Iceland. It is designed to capture the shallow, warm inflow into the subpolar gyre and the Nordic Seas and the deep, cold return flow that contributes to the lower branch of the Atlantic Meridional Overturning Circulation.

The objective is to make an annual occupation of the EEL section and create a time series of the evolution of the Northeast Atlantic. The Ellett Line has been occupied since 1975 and its extension since 1996, making it one of the longest-running deep-ocean annual repeat hydrographic sections.”

SAMS

The Scottish Association for Marine Science (SAMS) is a multidisciplinary research institute founded in 1884. Located in Oban on the west coast of Scotland, it is a collaborative centre of the UKRI NERC employing about 150 staff with a graduate school of approximately 45 PhD students. SAMS has over 100 research projects and an established record of participating in and managing large projects. The Marine Physics Group at SAMS has a long history of deploying moored, drifting and autonomous instruments in shelf seas and the deep ocean to study the north-east Atlantic. SAMS began regular monitoring of the Rockall Trough along the Ellett Line in 1975, and continues to this day. This work has led to recognition of the persistence of the slope current and variability of the offshore waters, and has made a significant contribution to our understanding of the shifting balance between the Subpolar and Subtropical Gyres in the North Atlantic.

Research team

Prof. Mark Inall is leader of Physical Oceanography at SAMS and Director of the Scottish Alliance for Geoscience, Environment and Society (SAGES). Inall is a research scientist with authorship of 88 ISI listed research papers and two book chapters. His research focuses on studies designed to elucidate marine mixing processes. Inall has been at the forefront of using technological innovation in physical oceanography: as part of the first UK team to make in situ marine turbulence measurements, initially from ships, and now from AUVs and Gliders; and as leader of the first UK team to use Gliders for standard ocean sections.

Prof. Stuart Cunningham is a lead scientist in SAMS' Ocean Systems group. Cunningham is a physical oceanographer with twenty five years of experience in making observations of the physical properties and circulation of the ocean using ships and arrays of moored instruments. From 2003-2012 he was the lead principal investigator of the NERC's Rapid Climate Change programme to monitor the Atlantic overturning circulation at 26.5°N. He is a PI in the EU Atlas programme and has been a PI in EU Framework 7 projects: North Atlantic Climate: Predictability of the climate in the North Atlantic/European sector related to North Atlantic/Arctic Ocean sea surface temperature and sea ice variability and change (NACLIM) and EU FP7 and Thermohaline Circulation at Risk? (THOR), EU FP7.

Inall and Cunningham are both Principal Investigators on the CLASS and OSNAP programmes.

Dr Sam Jones is employed as PDRA on OSNAP, focussing on ocean-shelf exchange, ocean-atmosphere interaction, boundary currents, data visualisation, basin-scale circulation, and synthesis of large and diverse datasets. Dr Jones will analyse and interpret Autonaut data with reference to concurrent Seaglider, ALR and Slocum data, historical data bases and AMM15 numerical model output and produce animated visualisations, for which he has won an award.

The AutoNaut high latitude USV developed will be relevant to international studies of high latitude oceans including OSNAP (Overturning in the Subpolar North Atlantic Program), Global Ocean Observing System (GOOS), The Southern Ocean Observing System (SOOS), and other international studies.

The PAM data gathered in this deployment on cetaceans, particularly beaked whales, and the ADCP data on currents at depth will form the basis for papers. SAMS are interested in the air/sea interaction phenomenon that the proposed AutoNaut data collection is ideally suited to study (diurnal near-surface jets that influence air/sea gas exchange).

2.4 Previous publications relating to the project:

AutoNaut itself is a commercial early-stage company and has not published scientific papers. A number of research projects have used AutoNauts to gather data resulting in case studies

and other reports, so maintaining a high profile in the trade press and general media.

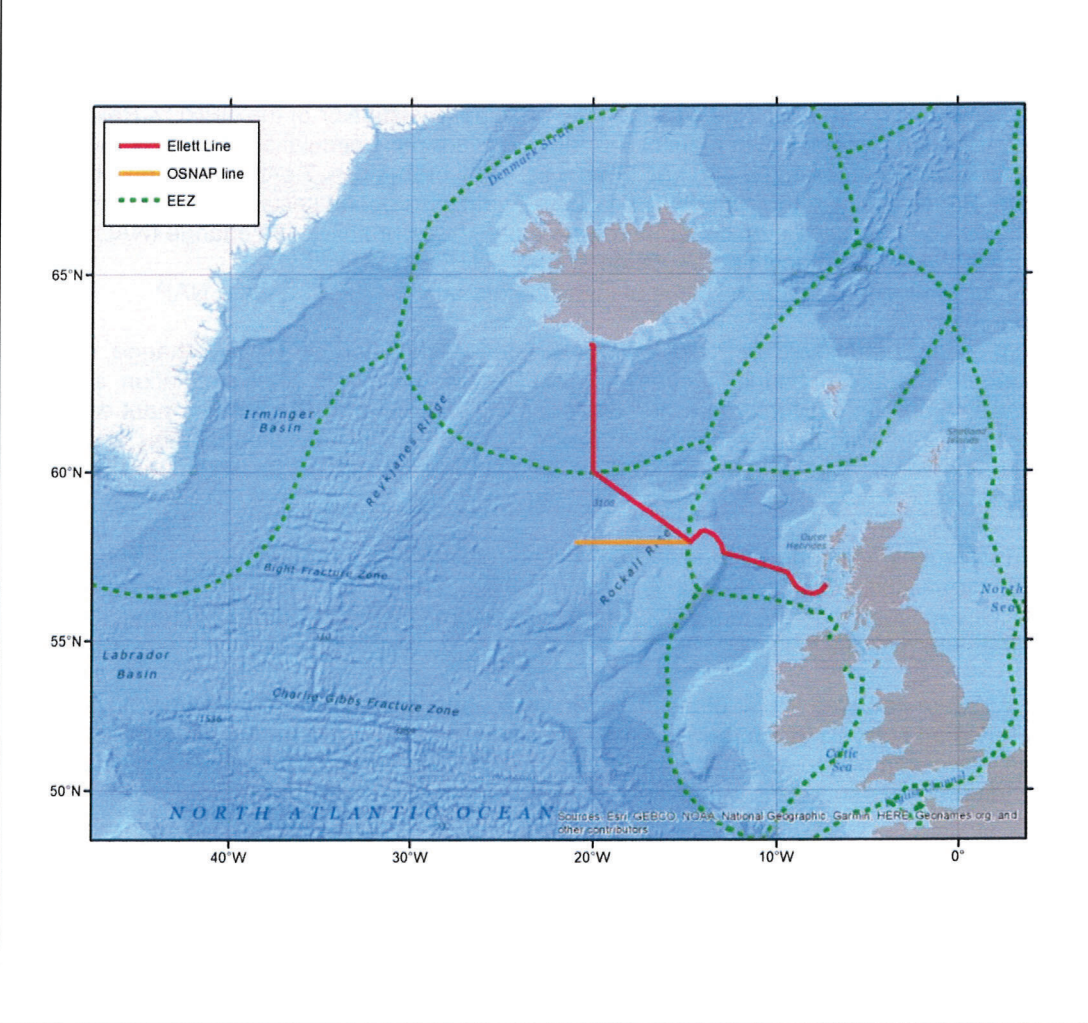
3. Geographical Areas

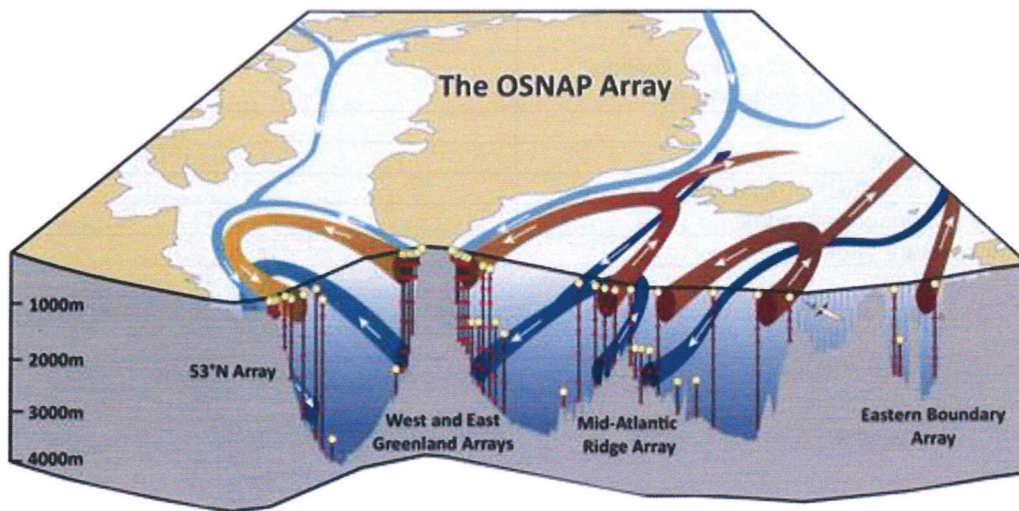
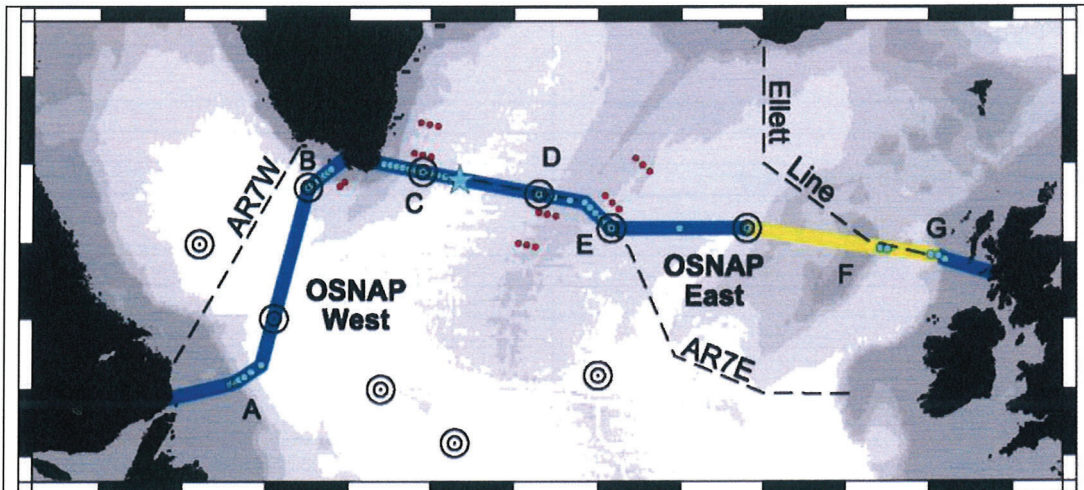
3.1 Indicate geographical areas in which the project is to be conducted (with reference in Latitude and longitude, including coordinates of cruise/track/way points)

The project will launch and return to SAMS at Oban $56^{\circ}24'55.26''N$, $5^{\circ}28'18.62''W$
The Extended Ellett Line runs close to Rockall $32^{\circ} 55' 40.642'' N$ $96^{\circ} 49' 19.632'' W$, and then north to Iceland to approximately $64^{\circ}8'7.73''N$, $21^{\circ}53'43.48''W$
The OSNAP research area extends westward from approximately Rockall to southern Greenland and to Canada.
AutoNaut Oban's route will be configured so as to collect data contemporaneous with that gathered by SAM's underwater glider programme.

As explained at 2.1 entry to the Faroes EEZ is a contingency in case of damage, drift, and the need for recovery. It also offers an alternative route to high latitude.

3.2 Attach chart(s) at an appropriate scale (1 page, high-resolution) showing the geographical Areas of the intended work and, as far as practicable, the location and depth of sampling Stations, the tracks of survey lines, and the locations of installations and equipment.





4. Methods and means to be used

4.1 Particulars of vessel: N/A	
Name:	
Type/Class:	
Nationality (Flag State):	
Identification Number (IMO/Lloyds No.):	
Owner:	
Operator:	
Overall length (meters):	
Maximum draught:	
Displacement/Gross Tonnage:	
Propulsion:	
Cruising & maximum speed:	
Call sign:	
INMARSAT number and method and capability of communication (including emergency	

frequencies):	
Name of Master:	
Number of Crew:	
Number of Scientists on board:	

4.2 Particulars of Aircraft: N/A	
Name:	
Make/Model:	
Nationality (flag State):	
Website for diagram & Specifications:	
Owner:	
Operator:	
Overall Length (meters):	
Propulsion:	
Cruising & Maximum speed:	
Registration No.:	
Call Sign:	
Method and capability of communication (including emergency frequencies):	
Name of Pilot:	
Number of crew:	
Number of scientists on board:	
Details of sensor packages:	
Other relevant information:	

4.3 Particulars of Autonomous Underwater Vehicle (AUV): Uncrewed Surface Vessel (USV)	
Name:	Oban
Manufacturer and make/model:	AutoNaut Ltd. 5m, high latitude
Nationality (Flag State):	UK
Website for diagram & Specifications:	www.autonautusv.com
Owner:	AutoNaut Ltd
Operator:	AutoNaut Ltd
Overall length (meters):	5m
Displacement/Gross tonnage:	250kg
Cruising & Maximum speed:	1-3 knots
Range/Endurance:	Six months +
Method and capability of communication (including emergency frequencies):	Iridium Rudics satellite communication – global remote piloting from anywhere with an internet connection. AIS class B collision avoidance GPS tracker (Yellowbrick) Global coverage Joystick local control (~500m)
Details of sensor packages:	ADCP Nortek or Teledyne PAM Seiche Weather station Airmar Water YSI Xylem EX02 Cameras Teledyne
Other relevant information:	

4.4 other craft in the project, including its use:
SAMS will launch and recover using an inshore RHIB or similar. SAMS will use their own vessels for underwater glider operation (a separate project) Research vessels conducting cruises in the area are being identified in case contingency recovery is required due to damage.

4.5 Particulars of methods and scientific instruments:		
Types of samples and Measurements:	Methods to be used:	Instruments to be used:
Sub-surface currents	Currents to depths of ~100m	Nortek or Teledyne ADCP
Passive Acoustic Monitor	Either a thin line towed array, or PAM fitted to hull, depending on availability	Seiche Ltd
Weather	Wind direction and strength, humidity, barometric pressure, pitch and roll, GPS	Airmar
Water	Six sensors are possible measuring temperature, conductivity, pH, backscatter etc.	YSI Xylem EX02
Cameras	Above and below water to monitor wildlife	Teledyne

4.6 Indicate nature and quantity of substances to be released into the marine environment:
none

4.7 Indicate whether drilling will be carried out. If yes, please specify:
N/A

4.8 Indicate whether explosives will be used. If yes, please specify type and trade name, Chemical content, depth of trade class and stowage, size, depth of detonation, frequency of Detonation, and position in latitude and longitude:
N/A

5. Installations and Equipment

Details of installations and equipment (including dates of laying, servicing, method and Anticipated timeframe for recover, as far as possible exact locations and depth, and Measurements):
N/A

6. Dates

6.1 Expected dates of first entry into and final departure from the research area by the research vessel and/or other platforms:
From June 1st to 30th November 2021

6.2 Indicate if multiple entries are expected:
Multiple entries are not expected, but may be required by circumstances

7. Port Calls

7.1 Dates and Names of intended ports of call:
None. Launch and recover to Oban in Scotland

7.2 Any special logistical requirements at ports of call:
None

7.3 Name/Address/Telephone of shipping agent (if available):
N/A

8. Participation of the representative of the coastal State

8.1 Modalities of the participation of the representative of the coastal State in the research Project:
Data sharing.
Availability of contingency research vessel for recovery if damage occurs.

8.2 Proposed dates and ports for embarkation/disembarkation:
None

9. Access to Data, Samples and Research Results

9.1 Expected dates of submission to coastal State of preliminary report, which should include The expected dates of submission of the data and research results:
February 2022

9.2 Anticipated dates of submission to the coastal State of the final report:
February 2022

9.3 Proposed means for access by coastal State to data (including format) and samples:
Free access to data. Format to be determined.

9.4 Proposed means to provide coastal State with assessment of data, samples and Research results:
SAMS report on data analysis

9.5 Proposed means to provide assistance in assessment or interpretation of data, samples And research results:
SAMS report on data analysis

9.6 Proposed means of making results internationally available:
SAMS peer reviewed paper. Abstracts and conference presentations. Media releases.

10. Other permits Submitted

10.1 Indicate other types of coastal state permits anticipated for this research (received or Pending):
Faroes – application is being made to enter Faroes EEZ

11. List of Supporting Documentation

11.1 List of attachments, such as additional forms required by the coastal State, etc.:
N/A

Signature:



(on behalf of the Principal Scientist)

Contact information of the focal point:

Name: AutoNaut Ltd

Country: UK

Affiliation:

Address: AutoNaut Ltd, Unit J, Heath Place, Bognor Regis, West Sussex, PO22 9SL, United Kingdom

Telephone: +44 (0)1243 511 421

During Covid-19 lockdown +44 (0)7970 935938

Fax:

Email: mike.poole@autonautusv.com