



NAMMCO ANNUAL MEETING 28

22-25 March 2021

Online

MEETING OF THE COUNCIL

DOCUMENT 19	REVISED SUPER-TAG PROJECT DESCRIPTION
Submitted by	NAMMCO Scientific Committee (SC)
Action requested	Take a decision regarding the funding of the proposed collaborative “super-tag” project.
Background	The SC has proposed a collaborative project to develop a new satellite tag suited for use on the whales of most interest to NAMMCO and a program of coordinated research using this tag to study movements and changes in occurrence in the North Atlantic. Norway and the Faroe Islands have previously indicated an ability to find funding to support this proposed collaborative “super-tag” project. At its last meeting, the FAC asked the SC to provide an updated description of the super-tag project, including the quantification of expecting in-kind contributions from all four member countries. The project description has now been revised and updated by the SC and includes a description of in-kind funding, which totals over 13 million NOK for the 5 year period of the project.

Satellite Tracking – A Tool for Cetacean Research in the North Atlantic (The ‘Super Tag’ Project)

Project proposal from the NAMMCO SC

Project coordinator Mads-Peter Heide-Jørgensen

Summary

There is an urgent need to develop new tools for studying movement patterns, habitat selection and population discreteness of North Atlantic baleen whales. Tracking of instrumented marine mammals by Argos satellite is a widely used technique for gaining insight into the behavioural ecology of species that spend most of their time in remote and inaccessible marine habitats. There is, however, no standard techniques for instrumentation and tracking of the baleen whale species that are of primary interest to NAMMCO. Logistical and behavioural difficulties have so far precluded long-term tracking of minke whales, fin whales, blue whales and pilot whales in the North Atlantic. These fast moving species pose specific challenges, and a dedicated effort is required to develop tags and instrumentation techniques that can be used routinely in NAMMCO member countries in order to obtain crucial information for improved management. This proposal presents a joint project from the NAMMCO Scientific Committee (SC) that covers: a) development of a new, smaller and lighter, satellite transmitter with optimal ballistic performance for long-distance deployments, b) a schedule and common protocol for a substantial number of test deployments of the transmitter, and c) a common database for archiving and organisation of data and results. The proposal involves all NAMMCO member countries as well as the Secretariat, with a steering group of SC members involved in whale tracking. The proposal seeks support funding that amounts to 7,650,000 NOK but also includes a substantial (>13 million NOK) amount of in-kind financing from research institutes in all four member countries, including salaries for scientists, travel, and field logistics for deploying tags. The project would also be open for participation from non-member countries.

Background

Tracking of marine mammals by satellite has long been recognized as one of the most important and promising techniques available for studies of cetacean movement, migration, behaviour, diving, stock identity and habitat use. In the past two decades, there has been an enormous growth in the use of satellite telemetry on marine mammals in general. However, most of the advances in the research community have been accomplished through studies of seals and small cetaceans, which can be captured and restrained while they are being instrumented. These techniques are, however, not well suited for use on large baleen whales, which are too big to be captured and handled at sea. A number of studies of bowhead and humpback whales have demonstrated the enormous potential satellite tracking studies have for gaining insights into whale biology. However, the costs and failure rates of these tracking experiments have been unacceptably high. It is clear that before satellite telemetry can be used as a routine method for monitoring movements of baleen whales, it is of fundamental importance to develop smaller and more reliable tracking instruments, as well as better methods for deploying the tags. Another challenge with existing tag technologies is the impact on animal welfare. Short-term effects of whale tagging include increased stroking activity for up to several hours after the whales have been approached. Longer chasing of the whales also increases the risk of detrimental physiological conflicts between bradycardia (dive response) and increased stroking (flight response). Potential long-term effects include inflammation of the tagging area with eventual rejection of the tag, although there is evidence of a strong healing ability in cetaceans. Tags deployed on harbour porpoises and narwhals can be embedded in the skin, but

this is unlikely an option for large whales where the permanently open skin lesion and the vibrations of the tag, would eventually cause it to be rejected and lost.

Despite the limitations discussed above, there is an urgent need for more cetacean studies using tracking and datalogging devices. There are many questions that can only be addressed through satellite tracking. These include, for example: Where do North Atlantic baleen whales spend the winter? Are there separate stocks of baleen whales that need to be managed separately? What is the habitat use of the whales and how do they react to oceanographic changes? What is the overlap between key cetacean habitats and maritime activities? Satellite tracking of baleen whales can also be used to identify changes in distribution of cetacean prey, including important fish resources (e.g. capelin migration and herring schools) and (if equipped with depth sensors) provide data on the proportion of time spent at the surface, which is crucial for converting survey estimates into total abundance estimates.

In the North Atlantic, baleen whales are often found in rough seas, and in some areas and seasons, in dispersed pack ice. Tagging of whales is often done in offshore operations from large vessels and sometimes even from helicopter. Furthermore, several of the whale species in the North Atlantic are very elusive compared to populations in other regions, perhaps as a consequence of past and present history with human activities. These circumstances make tagging of whales particularly difficult and only remote instrumentation techniques that are refined for long distance deployments will provide reliable tagging results.

Different satellite tracking systems are currently used in the four NAMMCO member countries for studying the movement of several species of baleen whales, including bowhead, minke, fin and blue whales in Svalbard and mainland Norway, minke, blue, fin and humpback whales in Iceland, minke, fin, humpback and bowhead whales in Greenland and fin whales in the Faroe Islands. A high level of investment in terms of both effort and funding has been spent on scattered attempts to acquire data on these whales. However, success has been limited (especially for minke and fin whales) and what is really needed to make significant progress is a joint effort to refine the methods in a way that will eventually benefit cetacean research, primarily in all four member countries but also more broadly. Reliable and well-performing satellite transmitter systems are currently available for birds, seals, terrestrial mammals small cetaceans and relatively slow-swimming baleen whales such as humpbacks and sperm whales. There is, however, an urgent need to develop effective satellite tracking systems especially for fast swimming and more elusive baleen whale species such as North Atlantic minke and fin whales.

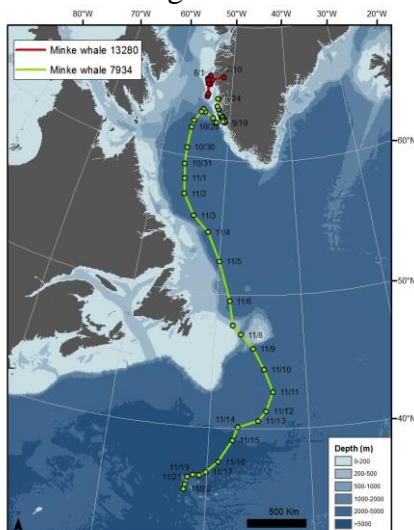


Figure 1. One of very few examples of a successful track of a North Atlantic minke whale.

In all four NAMMCO member countries, it would be extremely valuable to have a reliable, cheap and well-tested satellite tracking system in the toolbox for cetacean studies. It would also be particularly valuable to develop a NAMMCO program in which scientists from all four countries collaborate in their use of satellite tracking methods to solve major management issues that cannot be addressed with other techniques. It cannot be expected that research groups outside NAMMCO will focus on developing the new satellite tracking techniques and technologies necessary to advance the research used to inform the ongoing NAMMCO assessment process. One example of where an effective satellite tracking system for large baleen whales would be of particular importance to all NAMMCO member countries, is to better understand the

seasonal movements and long-term distributional changes of minke and fin whales. Figure 1 provides the best example of a successful but short-term tracking of a minke whale.

This proposal describes how a joint NAMMCO satellite-tracking program could be developed and what would be required to reach a point where the technique can be used as an efficient and reliable field technique. Fin and minke whales are selected as the primary target species for this effort as they are both harvested in NAMMCO countries, little is known about their migrations, and no other organisations are expected to focus on tracking these two species. Pilot whales are also an important species for NAMMCO for which the proposed improvements in tag technology to be developed in this project would also be of value.

Development of a Satellite Transmitter for Remote Instrumentation of Cetaceans

A major obstacle to tagging large whales is that the instruments need to be remotely deployed from a distance, with the use of an airgun, crossbow or pole system. Currently there are two types of pneumatic guns that can be used for launching satellite transmitters: the ARTS and the DanInject rifles. Crossbows are not sufficiently powerful for launching the tags available today and pole systems can only be used reliably for slow moving whales such as humpback, sperm and bowhead whales. Therefore, a large majority of the worldwide tagging efforts (and technological developments) in recent decades have been directed towards these more easily accessible species.

The main issue with the tag launching system is that the shape and mass of satellite transmitters works against an optimal ballistic performance. The large size and high mass requires launching forces that are prohibitive in field situations when trying to achieve remote tagging at distances beyond 10m. The result is that many deployments are at best of short duration and at worst result in failed instrumentation of the whales.

The way to improve the success rate and duration of the tags is to develop smaller and lighter tags with better ballistic performance. This is only technically and commercially feasible if the quantity of tags to be manufactured is sufficiently large. That is why joint effort and collaboration between all the NAMMCO countries is needed. Programs and efforts in whale tagging within the individual NAMMCO countries are too small to generate sufficient commercial incentive for developing an optimal transmitter configuration for large cetaceans.

For long-term tracking of baleen whales in the North Atlantic, a tag with better ballistic performance that can be deployed remotely from distances up to 25 m is required. It is suggested that a thinner and lighter tag should be developed for remote deployment with the ARTS. The tag needs to have a smaller volume and generate a smaller footprint in the whale to improve the retention time. The following specifications are therefore required:

- a smaller diameter (<17mm) and a shorter length (<200mm) than the current tags
- a retention time and transmission duration comparable to existing designs of similar size for at least a 12 month period so that information on the complete annual migration cycles can be obtained
- a level of robustness similar to existing designs
- the provision of positions 4 times per day, with additional behavioral data (dive and accelerometer) data also desirable.
- ability to function with the Argos DCLS system, potentially also with GPS positioning

A new tag should be rigorously examined for mechanical robustness before field trials. For this, a large number of tags should be deployed in 2–3 configurations in a coordinated effort among

researchers on selected whale species. This would be to ensure consistency in the evaluation of tag performance.

The development of a new implantable transmitter design with a prototype that will meet these requirements demands an initial investment in engineering costs estimated to be in the order of 1.6 million NOK, based on an offer from one tag manufacturer (Wildlife Computers, USA). This would cover the costs associated with developing a tag that is <17mm in diameter (instead of 22–24 mm for the present tags) with a reduction in weight and volume of 30% to 50% compared to existing designs. The diameter of the tag is determined by the availability of the smallest cylindrical lithium ion battery that is commercially available (the AAA cell). The tag should be produced with a new manufacturing process called Direct Metal Laser Sintering (DMLS) that should make the tag more robust to the impact of hitting the whale, as well as less likely to be broken by whales during social interactions. A new tag developed according to these requirements would not be available for field deployments until 2023 at the earliest as several tests to ensure performance would be needed before it could be commercially available.

Research on Movements & Changes in Occurrence of Baleen Whales in the North Atlantic

Common minke whales are the most abundant of the large cetaceans in the North Atlantic. They are hunted by three of the four NAMMCO member countries and are also hunted in Japan. However, we currently know very little about their wintering grounds, migratory routes and changes in distribution in relation to biotic and climatic factors. Other species of large whales that are easier to study have been subject to various tracking studies in the North Atlantic (e.g. humpback), while only sporadic and opportunistic attempts to track minke whales have been conducted. This is despite their significant ecological and economic importance for NAMMCO countries. Fin whales are at least equally important for Iceland (and Greenland), but tagging efforts have so far been limited and unsuccessful around Iceland and Greenland.

Here we propose a joint and coordinated effort to study the detailed movements of baleen whales in all four NAMMCO countries. Based on the development of a smaller and more efficient satellite transmitter design (as described above), we propose to purchase a large number of tags that can be allocated to the four NAMMCO countries and used for a coordinated research effort. A test procedure will be developed that will involve interested scientists from the member countries and a deployment scheme that will allow for comparison of instrumentation as part of the field programs.

The field effort to deploy tags will be conducted by the national institutes, which will also cover the costs associated with tagging field work and data analysis. The launching gear will also be provided by each national research institute.

Cost Specification

- **Initial engineering costs** for developing a transmitter based on AAA cells with a diameter similar to these batteries. This includes 5 prototype transmitters for test purposes, as well as 10 dummy tags for ballistic testing. The price offer for this work from Wildlife Computers is 1.6 million NOK.
- **Price per tag** (following prototype development) would be approximately 25,000 NOK and it is suggested that NAMMCO purchase 200 tags over a 3 year period for use in all four member countries. Additional project partners would be asked to purchase at least 50 tags.
- **Administrative costs** will be handled by the NAMMCO Secretariat and will include fees for the provision of Argos location services (150,000 NOK per year used), expenses

associated with the establishment and maintenance of an up-to-date website and database for the project (total 300,000 NOK for all years), contract management (including legal advice) (150,000 NOK), and project coordination and annual reporting to national funders (300,000 NOK total for all years).

Table 1. Time schedule for the satellite tag development and the funding required for the technical and administrative components of the project.

Break down of costs per year	Price per unit	NOK
2021		
Part 1 of contract on development costs		900,000
Project administration & legal advice on contract/s		150,000
Sum		1,050,000
2022		
Part 2 of contract on development costs		700,000
Purchase of 80 tags for deployment in the North Atlantic	25,000	2,000,000
Creation of the project's website		100,000
Project administration & coordination		50,000
Sum		2,850,000
2023		
Purchase of 80 tags for deployment in the North Atlantic	25,000	2,000,000
Argos fees		150,000
Establishing a database for files & photos		100,000
Project administration & coordination		75,000
Sum		2,325,000
2024		
Purchase of 40 tags for deployment in the North Atlantic	25,000	1,000,000
Argos fees		150,000
Maintenance of an updated database and website		50,000
Project administration & coordination		75,000
Sum		1,275,000
2025		
Maintenance of an updated database and website		50,000
Project administration, incl. coordinating final reporting		100,000
Sum		150,000
TOTAL		7,650,000

Project Organisation

Project Consortium

The project will be organized by a project coordinator (Prof. M.P. Heide-Jørgensen) and a steering group including representatives from Iceland (Dr. G. Vikingsson), the Faroe Islands

(B. Mikkelsen), Norway (Dr. N. Øien, Dr. C. Lydersen, Dr. M. Biuw) and Greenland (R. Hansen). The steering group will meet twice a year to discuss the progress of the project. Initial meetings between the steering group and the engineers and manufacturer of the satellite tags will be arranged in the fall of 2021. These can take place virtually, which is why no budget for travel is included in this part of the project. The timing of the project is heavily dependent on the manufacturer and may have to be adjusted according to what is realistic, and additional meetings with the manufacturer will be arranged on an *ad hoc* basis.

Although the initial project proposal includes only NAMMCO member countries, it should be noted that additional project partners from non-NAMMCO countries would also be welcome to join. Those accepted as full project partners would participate in the steering group, field testing, and the joint research program in the same way as NAMMCO parties. The NAMMCO Secretariat would be tasked with administering the admission of new project partners, including contracts relating to any financial contributions. The steering group would have responsibility for coordinating the involvement of additional partners in the research planning and program.

When tags are available to be tested in the field, a strict procedure for data collection during the deployment phase will be developed jointly between all partners participating in the project in order to make deployments comparable between countries, and to allow tag performance and longevity to be evaluated in relation to specific tagging characteristics (position on animal, degree of penetration, angle of entry etc.). Tags will be distributed among the participants according to their options for deploying tags.

Data Management

Common data dissemination from the Argos Data Collection and Location service will be hosted by an Argos account at the NAMMCO Secretariat, which will also pay the annual fees for the location services to Argos CLS. The NAMMCO Secretariat will also establish a project webpage with information on the progress of the project. The project steering group will provide information, interactive maps and graphics for this web page (see example at <https://www.hi.no/en/hi/forskning/research-data-1/whale-tracking>), which the Secretariat will keep up to date. The Secretariat will also establish a database to store photos from tagged whales and a place to store a copy of raw data files from Argos.

The project steering group will also arrange a common tagging web-portal to assist with visualization and data access. Such web portals exist at some of the manufacturers of satellite transmitters. The web-portal will primarily be used for exchanging the results from this project among SC members.

Long-term archiving of data will be arranged through an existing facility for archiving marine data to be decided by the steering group. This will ensure that the obtained data will be available for future studies of marine mammal movements in the North Atlantic. It is also increasingly a requirement that data from published studies be deposited at sites that are accessible to future generations.

The NAMMCO Secretariat will be the financial administrator of the project and will act as contractor for orders of engineering services, tags and Argos fees. The NAMMCO Secretariat will also be the contracting partner for the countries that contribute funding and will therefore also coordinate the annual reporting to funders.

Estimates of Internal (in-kind) Contributions to the Project

Salaries for the steering group and project coordinator to cover the time spent working on the project, as well as costs associated with travel and field expenses are expected to be covered by national research institutes. The expected in-kind contributions from each NAMMCO member

country are listed in Table 2. The estimates given in this table indicate the intended level of contribution and do not represent a confirmed budget from the participating institutes. Confirmation requires that the initial funding to cover the engineering costs is obtained and that a feasible product is able to be manufactured. The overall sum of the intended in-kind contributions for all five years of the proposed project is 13 million NOK, which reflects the member countries' strong commitment to moving this project forward.

The current time schedule assumes that the project would be able to start in the fall of 2021. 2022 would then be used for developing the new tags. Field work with deployment of tags would take place in 2023 and 2024, while the project would be finalised and reported in 2025.

Table 2. List of estimated internal (in-kind) contributions to the satellite tagging project by NAMMCO member countries.

	Value in NOK (excl. overheads)				
	2021	2022	2023	2024	2025
GREENLAND					
Project Coordinator	83,000	291,000	291,000	291,000	291,000
Scientist	28,000	168,000	168,000	168,000	168,000
Technician			98,000	98,000	
Travels		30,000	80,000	80,000	30,000
Boat time			150,000	150,000	
Sum	111,000	489,000	787,000	787,000	489,000
Total for 5 years	2,663,000				
NORWAY					
Three scientists	102,000	175,000	705,000	705,000	541,000
Technician			452,000	452,000	
Travels		40,000	150,000	150,000	50,000
Boat time			2,200,000	2,200,000	
Sum	102,000	215,000	3,507,000	3,507,000	591,000
Total for 5 years	7,922,000				
ICELAND					
Scientist	40,000	160,000	220,000	220,000	200,000
Technician			145,000	145,000	
Travels		30,000	80,000	80,000	30,000
Boat time			200,000	200,000	
Sum	40,000	190,000	645,000	645,000	230,000
Total for 5 years	1,750,000				
FAROE ISLAND					
Scientist	20,000	120,000	120,000	120,000	120,000
Technician			90,000	90,000	
Travels		30,000	60,000	60,000	30,000
Boat time			100,000	100,000	
Sum	20,000	150,000	370,000	370,000	150,000
Total for 5 years	1,060,000				

Planned Deliverables

In addition to the intention to deliver effective new tag technology, at the end of the project the steering committee will publish at least one academic article describing the tag's development, specifications, application potential, and results from field testing and early use. During the reporting phase, a symposium may also be held to share the experience of the project with a wider audience. No specific budget is allocated to hosting this symposium in this application

as it will be dependent on successful tag development and deployment. The costs associated with a potential future symposium will be considered within the workplan of the SC.

Collaboration with Other Countries

The current proposal is based on participation in the project from all four member countries of NAMMCO. However, if other countries would like to join the project as full project partners, they will be welcome. In doing so, they would become part of the steering group and as such, would be expected to contribute to the design and development of the tags, the field testing of the tags (including covering the costs of purchasing tags for deployment), and the joint research effort to deploy tags in their areas of interest and analyse the information obtained.

Involvement of other countries may increase the costs for administration and coordination of the project, but may reduce the level of investment from NAMMCO member countries for tag development and manufacturing.

Japan has expressed its interest in contributing to improving the use of satellite tracking technologies, particularly for minke whales, and therefore in working collaboratively with NAMMCO on this project. Determining how the collaboration with external partners would be structured in practice would be articulated by the steering group if funding is granted.