NAMMCO

30 Years: 1992 - 2022

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JOINT MEETING OF THE MANAGEMENT COMMITTEES

DOCUMENT 08	**USER KNOWLEDGE : « FOOD FOR THOUGHT » FOR NAMMCO**
Submitted by	Secretariat
Action requested	Take note Make suggestions for progressing with this issue in NAMMCO
Background	The inclusion of user knowledge is required to ensure that resource management decisions are based on the best available knowledge. The MCJ agreed, at its last meeting, that further work should be done to advance on this topic. The secretariat tasked Martin Binachon, NAMMCO intern during 2021, to look into examples of how user knowledge has been collected in a structured and systematic way, and examples of research projects where user knowledge has been an integrated part. This document contains the information gathered on this topic.

TABLE OF CONTENTS

1. INTRODUCTION

By sharing examples from other places where user knowledge is being collected in a structured and systematic way, this document seeks to develop an initial framework that NAMMCO members could draw on to collect user knowledge in their respective countries. This document also seeks to share examples from other places where user knowledge is integrated into research projects, hoping to raise the interest of NAMMCO in doing so in the research it supports.

1.1 WHY COLLECT USER KNOWLEDGE?

The value of Indigenous and local knowledge (or traditional knowledge) and its relevance in conservation efforts have been recognised internationally. For instance, the Convention on Biological Diversity, in its article 8(j), encourages its Parties to respect, preserve and maintain Indigenous and local knowledge, and to promote its wider application for the conservation and sustainable use of biological diversity.[1] Similarly, the 2005 UNESCO Convention (Preamble),[2] the United Nations Declaration on the Rights of Indigenous Peoples (Article 31(1))[3] and the World Intellectual Property Organisation's Intergovernmental Committee on Traditional Knowledge, Folklore and Genetic Resources have all emphasised the relevance of traditional knowledge for the conservation of nature.[4]

At the regional level, the Ottawa Declaration (1996), which established the Arctic Council, recognised the role of traditional knowledge "in the conservation and sustainable use of Arctic biological resources".[5] This acknowledgement was reiterated in 2013 with the Kiruna Declaration, which recognised "that the use of traditional and local knowledge is essential to a sustainable future in the Arctic".[6]

Consequently, a growing number of states and international organisations, as well as local authorities and NGOs, have taken steps to implement these formal recognitions.[7] While there are numerous ways to respect, preserve, maintain, and use traditional knowledge, this document will focus on a specific process: the structured and systematic collection of traditional knowledge. Three reasons motivated that choice. First, multiple examples of such projects are available today, allowing one to draw on from these instances to develop a project fitted to its expectations and needs. Secondly, NORDECO recently recommended that the Secretariat prepare a document focused on the collection of user knowledge.[8] Finally, a valuable aspect of these collections of traditional knowledge is that they can serve diverse purposes. For instance, collections can seek to protect traditional knowledge from disappearing, or from being used by biopirates, but can also be used to document biological changes, to help exchange information between set groups of peoples, to inform scientists, to guide management decisions, etc.[9] As an easily adjustable tool that is capable of serving different interests simultaneously, these collections would seem particularly relevant to fit with the work of NAMMCO and its member countries.

1.2. WHY INCLUDE USER KNOWLEDGE IN RESEARCH?

The value of Indigenous and local knowledge (or traditional knowledge) and its relevance in conservation efforts have been recognised internationally. For instance, the Convention on Biological

[1] Convention on Biological Diversity (adopted 5 June 1992, entered into force 29 December 1993)
[2] Convention on the Protection and Promotion of the Diversity of Cultural Expressions (adopted 20 October 2005, entered into force 18 March 2007)
[3] United Nations Declaration on the Rights of Indigenous Peoples 207, UN Doc A/RES/61/295
[4] More information on WIPO's Intergovernmental Committee is available here: www.wipo.int/tk/en/igc/
[5] Declaration on the Establishment of the Arctic Council, 19 September 1996
[6] Kiruna Declaration On the occasion of the Eighth Ministerial Meeting of the Arctic Council, 15 May 2013
[7] Preston Hardison, 'The Report on Traditional Knowledge Registers (TKRs) and Related Traditional Knowledge Databases (TKDBs)' *Convention on Biological Diversity* (2006), UNEP/CBD/WG8J/4/INF/9
[8] Document MC/07 'Strengthening User Knowledge in NAMMCO', NAMMCO/28/MC/07
[9] Nonyelum Okpokwasili, 'Developing Database for Indigenous Knowledge: Prospects and Challenges' 5(1) Research Journal of Mass Communication and Information Technology 1

Diversity, in its article 8(j), encourages its Parties to respect, preserve and maintain Indigenous and local knowledge, and to promote its wider application for the conservation and sustainable use of biological diversity.[10] Similarly, the 2005 UNESCO Convention (Preamble),[11] the United Nations Declaration on the Rights of Indigenous Peoples (Article 31(1))[12] and the World Intellectual Property Organisation's Intergovernmental Committee on Traditional Knowledge, Folklore and Genetic Resources have all emphasised the relevance of traditional knowledge for the conservation of nature.[13]

At the regional level, the Ottawa Declaration (1996), which established the Arctic Council, recognised the role of traditional knowledge "in the conservation and sustainable use of Arctic biological resources".[14] This acknowledgement was reiterated in 2013 with the Kiruna Declaration, which recognised "that the use of traditional and local knowledge is essential to a sustainable future in the Arctic".[15]

On a more practical aspect, historical examples have concretely demonstrated the value of traditional knowledge. One of the most renowned examples is the 1977 Bowhead Crisis. In 1977, the IWC put a moratorium on the hunt of the bowhead whale in the Beaufort Sea (Alaska/Canada) because scientific surveys estimated a small, endangered, population. Local Inuit hunters, on the other hand, thought the whales were numerous, and their hunt sustainable. The hunters argued that the scientific knowledge of the whales was incorrect and that their surveys were ill-adapted to the species. For instance, contrary to scientists, the hunters contended that the whales could swim under offshore ice and that they did not feed during migration. To answer these critiques, scientists developed a new survey method that incorporated the users' knowledge of the bowhead whales' behaviour. In 1991, the new survey estimated that the bowhead whale population in the Beaufort Sea was 8 times larger than previously estimated and confirmed what the users had argued since 1977.[16]

In response to these concrete examples and formal recognitions, a growing number of states and international organisations, as well as local authorities and NGOs, have taken steps to respect traditional knowledge and promote its application.[17] While there are numerous ways to preserve, maintain, and use traditional knowledge, this document will focus on a specific process: the inclusion of user knowledge within research projects. Four reasons motivated that choice: first, NORDECO recently recommended that the Secretariat prepare a document showcasing user knowledge contributions to scientific research.[18] Secondly, while there are many examples of inclusive research projects today, the academic literature often remains theoretical, thus failing to materialise the concepts it develops. The inclusion of user knowledge within scientific research has also led to successful projects, and sometimes to a significant reduction of the tension between users and responsible authorities.[19] Drawing on these examples may be of interest to NAMMCO members given current tensions between users and the organisation (e.g., narwhals in East Greenland, bycatch, etc). By reflecting on examples of user knowledge inclusion in research projects that support management advice, this document seeks to materialise this issue and provide food for thoughts to NAMMCO

[10] Convention on Biological Diversity (adopted 5 June 1992, entered into force 29 December 1993)

[11] Convention on the Protection and Promotion of the Diversity of Cultural Expressions (adopted 20 October 2005, entered into force 18 March 2007)

[12] United Nations Declaration on the Rights of Indigenous Peoples 207, UN Doc A/RES/61/295

[13] More information on WIPO's Intergovernmental Committee is available here: www.wipo.int/tk/en/igc/

[14] Declaration on the Establishment of the Arctic Council, 19 September 1996

[15] Kiruna Declaration On the occasion of the Eighth Ministerial Meeting of the Arctic Council, 15 May 2013

[16] Paige M. Schmidt and Heather K. Stricker, 'What Tradition Teaches, Indigenous Knowledge Complements Western Wildlife Science' (2010) *USDA National Wildlife Research Center – Staff Publications* 1283

[17] Preston Hardison, 'The Report on Traditional Knowledge Registers (TKRs) and Related Traditional Knowledge Databases (TKDBs)' *Convention on Biological Diversity* (2006), UNEP/CBD/WG8J/4/INF/9

[18] Document MC/07 'Strengthening User Knowledge in NAMMCO', NAMMCO/28/MC/07

[19] Maria E. Fernandez-Gimenez et al., 'Integration or co-optation? Traditional knowledge and science in the Aslaka Beluga Whale Committee '(2006) 33(4) Environmental Conservation 1

members. Finally, one must also recognise that marine mammals are complex to study and scientific knowledge on these species is fragmentary:[20] it remains complex to understand their position and role in the marine ecosystems and to grasp the challenges they face. The experiential, daily gained, knowledge from hunters and fishers can provide insightful data that can inform, complement or support science.[21] Collaborating with users is therefore a cost-effective solution to better our scientific knowledge.

1.3. WHAT IS NAMMCO 'USER KNOWLEDGE'?

"User knowledge" is not a common terminology on the international scene. NAMMCO's situation is singular: instead of following the common denominations (e.g., "traditional and local knowledge", "traditional ecological knowledge", "indigenous knowledge", etc), NAMMCO created its own category: "user knowledge". This term, used within the organisation since 1999,[22] makes NAMMCO a uniquely inclusive organisation because it seeks to consider the knowledge of anyone affected by its work. "User knowledge" thus includes not only the experiential knowledge from marine mammals hunters (i.e., knowledge derived from their observations of, and interaction with, the natural resources), but also encompasses, *inter alia*, fishers' knowledge (e.g., regarding bycatch), traditional culinary knowledge of North Atlantic communities, or knowledge of marine mammal 'watchers'.

It is important to acknowledge that user knowledge is *not "*citizen science". Citizen science involves the observation and monitoring of interested citizens, user knowledge cannot be reduced to mere observation. Although Indigenous and local communities do not follow scientific research methods, they have their own methods and validation processes.[23] Besides, Indigenous and local communities have continuously transmitted their knowledge throughout time and generations. This transmission process is key. This is why what is referred to today is called *knowledge*, and not simply *observation* or *monitoring*.

It must also be clarified that user knowledge is, in essence, local knowledge. As an experiential knowledge gained from interacting with one's surroundings and transmitted throughout the generations, user knowledge is set in a precise context and should not be exported to other contexts. For instance, Inughuit hunters in Qaanaaq have a specific knowledge regarding the interactions of killer whales with narwhals. In this region of Greenland, hunters appreciate the coming of killer whales because it drives the narwhals closer to the shore, where it is easier to hunt them. On the contrary, hunters in West Greenland view the killer whale as a competitor that drives the preys away from their hunting grounds. One of these two groups is not more correct than the other, they simply do not have the same interaction with killer whales in their respective hunting grounds. Killer whales may also exhibit different behaviour in different areas.

NAMMCO's uniqueness – as an organisation that provides advice on the management of marine mammals and that seeks to include user knowledge in doing so - makes it difficult to find examples of user knowledge inclusion in research projects that would already befit its work. Through this paper, the phrase "user knowledge" thus refers to any non-scientific knowledge (whether called "Indigenous", "local" or "traditional"). The examples developed hereunder are usually based on a more restrictive comprehension of which "knowledge" should be included. Nevertheless, they are still relevant considerations for NAMMCO, as reflected upon in a second part.

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[20] Timothy J Ragen, Henry P Huntington and Grete K Hovelsrud, 'Conservation of Arctic Marine Mammals Faced with Climate Change '(2008) 18 Ecological Applications S166

[21] See, for example, Henry P Huntington, Lori T Quakenbush and Mark Nelson, 'Effects of Changing Sea Ice on Marine Mammals and Subsistence Hunters in Northern Alaska from Traditional Knowledge Interviews '(2016) 12 Biology Letters 20160198

[22] NAMMCO, *Report of the Ninth Meeting of the Council,* 1999

[23] Maria Tengö et al., 'Connecting Diverse Knowledge Systems for Enhanced Ecosystem Governance: The Multiple Evidence Base Approach '(2014) 43 AMBIO 579

2. EXAMPLES OF USER KNOWLEDGE COLLECTIONS

Rather than presenting an exhaustive list of examples, this document focuses on two instances (a third one is included in Appendix 1). As these examples are related to the framework and work of NAMMCO, it was thought more relevant to present them thoroughly rather than presenting a list of all the examples found during the drafting of this document (of which the list is available in Appendix 2).

For instance, these examples' settings (international; non-Indigenous; Arctic), purposes (monitoring; preservation; scientific collaboration), and the knowledge they collect (experiential; culinary; ecological) are pertinent to NAMMCO's work. They, therefore, offer relevant information as to which type of knowledge NAMMCO could collect, how it could be collected, and what must be considered in doing so.

The World Intellectual Property Organisation's (WIPO) compilation of an extensive set of databases documenting traditional knowledge has been an important source in writing up this document.[24] However, most examples were found thanks to keyword research on the internet and academic search engines ('collection', 'local knowledge', 'database', 'registry', 'traditional knowledge', etc.).

2.1 THE TRADITIONAL FOOD REGISTER - AUSTRIA[25]

Date of creation: 2012

Actors involved: Ministry for Agriculture, Regions and Tourism

Type of knowledge collected: Traditional Culinary Knowledge

Type of platform: Web-based

Accessibility: Open access

Figure 1 Homepage of the Register

In cooperation with the Committee for the Preservation of the Culinary Heritage of Austria, the Austrian Ministry of Agriculture, Regions and Tourism has developed a register of Austrian traditional food.

The register seeks to thoroughly document traditional culinary knowledge, "to preserve the roots of Austrian eating and drinking culture, recipes and typical Austrian agricultural raw products from disappearing and extinction", and to renew interest in local food systems.[26] Traditional food is defined by the register as dishes that have lasted for at least 3 generations, and that contain local Austrian products.

In this register the state authorities are primarily in charge: they are tasked with pooling, categorising and uploading local Austrian knowledge about agricultural products, foodstuffs, meals and drinks. The entries in the register usually include:

[24] WIPO, *Online Databases and Registries of Traditional Knowledge and Genetic Resources* (WIPO 2016). Available here: https://www.wipo.int/export/sites/www/tk/en/resources/pdf/gr_table.pdf

[25] Database accessible here: info.bmlrt.gv.at/themen/lebensmittel/trad-lebensmittel.html

[26] Kuratorium Kulinarisches Erbe Österreich, 'Präambel', available here: www.kulinarisches-erbe.at/ueber-uns/leitbild/

- A historical overview of the dish
- The folklore surrounding it
- A linguistic study of the dish's name
- A description of where and how the raw material is produced
- Detailed recipes

A fair number of academic and non-academic references are listed for every entry. Once ready, the knowledge is uploaded on the website of the Ministry and made available to the public. Moreover, the entries in the register are transmitted to the World Intellectual Property Organisation. The traditional Austrian cuisine is therefore protected by the intellectual property framework. This is thought to protect registered breeds, manufacturing methods and traditional products from being exploited and copied by third parties.

The Traditional Food Register initiative aims to preserve, protect and promote traditional, local, Austrian cuisine. This project is particularly interesting because it concerns a European country and has an inclusive comprehension of traditional (user) knowledge. As the consumption of traditional food is fading in the North Atlantic countries,[27] the Austrian example suggests that such user knowledge is preservable and promotable in a simple manner.

2.2 THE LOCAL OBSERVATIONS DATABASE - ALASKA[28]

Date of creation: 2005

Actors involved: Iñupiat and Yupik sea-ice experts & the University of Alaska Fairbanks' Alaska Arctic Observatory & Knowledge Hub

Type of knowledge collected: Local observations of the ecosystem and climatic conditions

Type of platform: Web-based

Accessibility: Open access

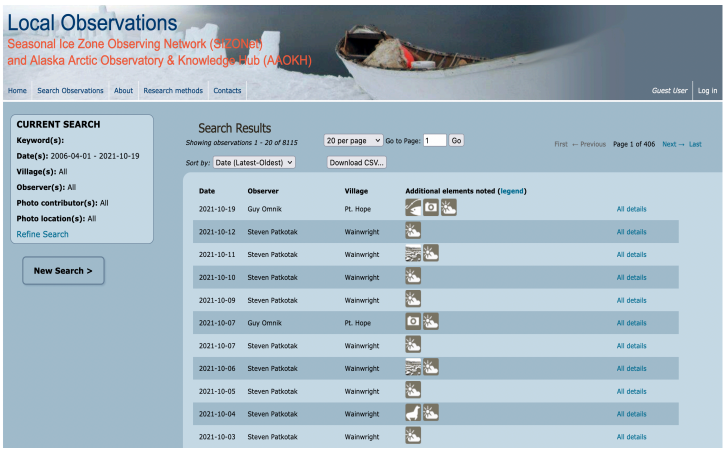

Figure 2 Example of a research for the most recent data on the Local Observations Database

This project was initiated in 2005 as a collaboration between Iñupiat and Yupik communities and scientific researchers in North and West Alaska. The database was created as Arctic coastal communities and scientists observed long-term changes in sea-ice conditions. Indeed, although these changes were documented orally in Arctic coastal communities, the observations of the communities were not available to scientists and policy-makers. The database was therefore thought of as an interface between the two knowledge systems. It serves primarily two purposes:

- Preserve and pass on local and traditional knowledge of sea ice and its use

[27] See, for example, Ingvar Svanberg, 'The Importance of Animal and Marine Fat in the Faroese Cuisine: The Past, Present and Future of Local Food Knowledge in an Island Society" (2021) 5 Frontiers in Sustainable Food Systems DOI: <doi.org/10.3389/fsufs.2021.599476>

[28] Database accessible here: eloka-arctic.org/sizonet/

- Present this knowledge in a manner that is accessible to science- and policy-makers.

Concretely, the database consists of daily reports of ice and weather conditions. Community-designated sea-ice experts send to the University of Alaska Fairbanks daily reports of their observations and explanations of local sea-ice features. These can be sent by mail, email, or even phone conversations, thus allowing the experts to use the most cost-effective and user-friendly means available to them.

Although a few key weather variables must be reported, the experts are "encouraged to report any local details they deem important or interesting having to do with the ice environment, subsistence activities and wildlife seen, sea ice travel, and community events".[29] Likewise, not only textual reports but other means of documentation such as pictures are allowed, to ensure that what needs to be documented can be documented.

Once they receive these reports, University staff is then charged with classifying and uploading these reports online. The data is available online to anyone, with or without personal credentials. However, prior to accessing the database, guest users are asked to recognise that this data has been produced in a specific context by recognised experts. In case the guest user wants to use the database, s/he must acknowledge and cite by name the person(s) whose observations are being discussed or analysed.

While respecting and recognising the rights of the knowledge holders, this database allows western scientists to improve the data used in their studies and to provide relevant scientific information products back to the communities. For instance, this project has allowed the development of the "Sea Ice for Walrus Outlook",[30] a resource that aggregates observations made by experts and scientists to issue a weekly report (in the summer months) providing information about the sea ice conditions for walrus in Alaska. Alaska Native and coastal communities use these precise outlooks to analyse the current sea ice conditions and better plan their subsistence hunting.

3. EXAMPLES OF RESEARCH COLLABORATIONS

Bibliographic research was mostly conducted thanks to keyword research on the internet and academic search engines ('collaboration', 'local knowledge', 'marine mammals', 'bycatch', 'fisher knowledge',' traditional knowledge', etc.). Such research provided numerous examples. Rather than presenting an exhaustive list of examples, (a well-furnished list of Arctic examples is available here[31]; a list of further references is also available in Appendix 3) this document only focuses on two instances (a third one is provided as supplementary information in Appendix 4).

These instances were chosen because they feature some characteristics that are relevant to the NAMMCO community. For instance, their foci (marine mammals; Arctic; non-Indigenous) and purposes (estimate abundance; reduce bycatch; co-management) are pertinent to NAMMCO's work. These examples thus offer relevant information as to how NAMMCO could collaborate with users in the North Atlantic and what must be considered in doing so.

[29] Ibid

[30] The project is accessible here: www.arcus.org/siwo

[31] Marjo Vierros, 'Traditional knowledge relating to Arctic marine species and habitats' *Convention on Biological Diversity Arctic Regional Workshop to Facilitate the Description of Ecologically or Biologically Significant Marine Areas* (CBD 2014)

3.1 COLLABORATIVE RESEARCH ON THE NORTHERN HUDSON BAY NARWHAL POPULATION[32]

Date: 2006-2007

Purposes: in response to hunters' disagreement, re-examine the survey range used for abundance estimates and study the seasonal range of the Northern Hudson Bay Narwhal

Method: combining satellite-tracking data with interviews of local hunters

Results: improved knowledge on the seasonal range of the Northern Hudson Bay Narwhal and improved survey range. Estimated abundance changed from 5,600 to 19,200

This collaborative research was conducted by Westdal et al. in the summers of 2006 and 2007. The Northern Hudson Bay narwhal population gathers around Naujaat (Repulse Bay) in summer and is hunted by the local community there. The objectives of the research were to clarify the size of the population's summer range and to improve the understanding of its seasonal migration. Such research was particularly important for the co-managers of this population, the Nunavut Wildlife Management Board and the Department of Fisheries and Ocean. Indeed, strong uncertainties regarding the size and migration of this narwhal population were of concerns to the managers, as they feared that the population was hunted by other communities on its route to its wintering range. On the other hand, hunters in Naujaat had expressed their disagreement as to the current population estimates and argued that the Northern Hudson Bay narwhals were abundant and spread over a greater area than what the scientists believed.

To better understand the hunters' criticisms, and with the free, prior and informed consent of the Nunavut Research Institute and the local Hunters and Trapper Organisation, Westdal conducted seventeen semi-structured interviews with the local users. The interviews were seen as a first source of information that could provide qualitative data on the Northern Hudson Bay narwhal population such as: the number of animals, their summer range, their migration route, etc. In addition, nine narwhals were tagged with satellite-tracking devices. The animals were tracked for up to 305 days and the satellite telemetry provided key additional data on the narwhal population.

In this instance, the satellite tracks confirmed that the information gathered in the interviews was representative of the general population movements in and out of the Hudson Bay and offered additional details on the population's range. Combining user knowledge with satellite telemetry led to several important conclusions:

- The Northern Hudson Bay narwhal population has its wintering range east of the Hudson Strait, and its migration route does not come across other Inuit communities. This confirmed the hunters' assessment that the narwhals were not hunted by other communities. It also confirmed the hypothesis that this narwhal population was distinct from the Baffin Bay population.
- The population's spring, summer and fall ranges were clarified. Again, the hunters' assessments corroborated the information provided by satellite telemetry and offered additional details (e.g., regarding narwhal density and distribution within the summer range).
- The summer range of the Northern Hudson Bay narwhal population was greater than what previous population surveys had covered. Covering the summer range of the narwhal population as described

[32] K.H. Westdal et al., 'Migration Route and Seasonal Home Range of the Northern Hudson Bay Narwhal (Monodon monoceros)' in Ferguson et al. (eds) *A Little Less Arctic* (Springer Netherlands 2010)

by the hunters instead of limiting the survey to the assumed range would have generated more sightings.

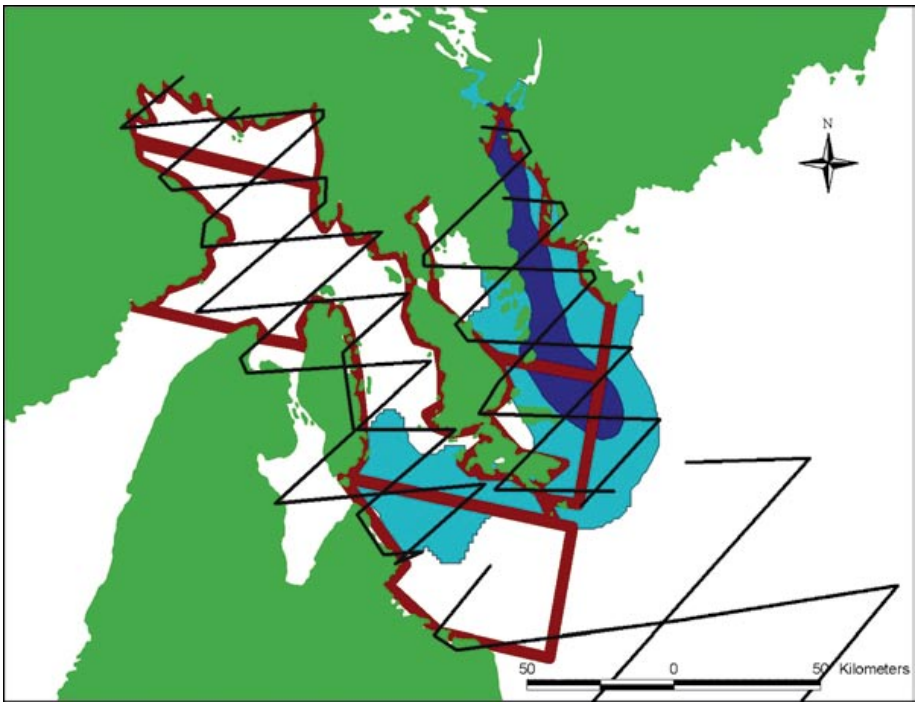

Figure 3. August 2006 NHB narwhal summer home range (outer ring (light blue) 95% kernel probability and inner ring (dark blue) displaying the 50% kernel probability) overlayed with photographic aerial survey coverage boundaries in red and visual survey flight lines in black (Bourassa 2002). The 2007 aerial photo survey (red boundaries) left approximately 2,700 km2 (34%) of the 2006 home range uncovered. © Westdal et al.

This research by Westdal et al. led to several conclusions relevant for management. Most importantly, it showed that a previous aerial survey had not covered the full summer range of the narwhal population. Accordingly, the Department of Fisheries and Ocean corrected the survey coverage, which lead to substantial changes in the abundance estimates. Prior to Westdal's research, the population was estimated at 5,600 narwhals but new aerial surveys, which covered a wider area, generated an abundance estimate of 19,200 narwhals.

This research also shows that user knowledge can be effectively used to question and better scientific data. Indeed, the re-examination of the survey coverage was motivated by the hunters' arguments against the previous surveys. By using the hunters' knowledge in conjunction with scientific knowledge, the present research obtained clear information on the migration and seasonal ranges of the Northern Hudson Bay narwhal population. User knowledge thus provided additional, clarifying, information to the satellite telemetry and survey coverage: it allowed the researcher to redefine the population's summer range, provided further information on the population's distribution and density within this summer range and supported the migration pattern identified by the tracking devices.

3.2 THE ALASKA BELUGA WHALE COMMITTEE[33]

Date: 1988 -

Purposes: study the beluga populations in Alaska and manage the hunt of the animal at the local level

Method: inclusion of users in design, conduct and interpretation of all research supported by the Committee

Results: improved knowledge on beluga abundance, migration and stocks in Alaska (and agreement to decrease catches for an endangered stock)

Unlike the two previous examples, this instance does not focus on research collaboration but on the functioning of an organisation: the Alaska Beluga Whale Committee. This instance was chosen because it offers a more holistic approach to the inclusion of user knowledge in research. Indeed, the local communities are integrated into the whole framework, from the design of scientific research to the management advice. Most information presented here does not come directly from the Committee but is the result of research on co-management by social scientists.

The Alaska Beluga Whale Committee (ABWC) is a co-management group created in 1988 following the bowhead whaling moratorium crisis of 1977. It consists of hunters, scientists and agency managers. The idea behind the creation of the ABWC was to create a local structure that could manage beluga hunting to avoid being regulated by external authorities, such as the International Whaling Commission. Within this organisation, hunters are highly represented and have voting rights on most matters. Additionally, they are the only ones able to vote on hunting-related issues. This type of structure presents a unique management advice framework which largely differs from NAMMCO's and a comparison would likely be interesting. The focus will here, however, be put on the research collaboration rather than on the decision-making process.

The ABWC is a classic management organisation that mostly focuses its research on stocks and catch levels. What distinguishes it from others is its strong inclusion of the local communities within this research (Table 1).

[33] Maria E. Fernandez-Gimenez et al., 'Integration or co-optation? Traditional knowledge and science in the Aslaka Beluga Whale Committee' (2006) 33(4) Environmental Conservation 1 and Kathryn J. Frost et al., 'Alaska Beluga Whale Committee - a unique model of co-management' (2021) 40 Polar Research 5611

Table 1. Summary of ABWC research and the roles played by hunters and scientists in these projects. In addition to the roles specified here, all ABWC members participate in making decisions on research priorities and funding. (Note: TEK = Traditional Ecological Knowledge)

	Aerial surveys	*Harvest reports*	*Satellite telemetry*	*Genetic research*	*TEK studies*
Purpose	Population estimates. Stock assessments	Document harvest levels, struck and lost. Document other observations. Stock assessments	Identify which stocks go where. Seasonal distribution of stocks. Document dive duration	Distinguish stocks and populations	Document traditional knowledge about belugas
Hunter roles	Direct surveyors to areas where belugas likely to be found. Accompany flights. Data interpretation. Report results to communities	Report harvest levels, struck and lost, conditions, observations, hunting methods. Report results to communities	Hypothesis generation. Tagging. Data interpretation. Report results to communities	Hypothesis generation. Sample collection. Data interpretation. Report results to communities	Provide knowledge. Review and validate draft report
Scientist roles	Conduct aerial surveys. Analyse data. Report results	Use harvest reports to develop stock assessments. Report results	Hypothesis generation. Tagging. Data analysis and interpretation. Report results	Hypothesis generation. Data analysis and interpretation. Report results	Document knowledge on tapes and maps. Report results. Compare TEK with existing literature
TEK contri-bution	Where and when belugas are seen	Observations on hunting practices and beluga health and behaviour	Knowledge of how to capture belugas. Observations on distribution	Observations of different groups of belugas	All types of observations about belugas and related species and ecosystem functions
Learning	Current population size	Current rates of harvest appear sustainable. Rates of struck and lost declining	Belugas go far north	Five distinct stocks in Alaska	Insights into beluga ecology and relation to other species and terrestrial ecosystems

From this table, one can notice that the hunters are advising scientists regarding the location and time of the aerial surveys. Although such an initiative is likely to avoid the mistake illustrated in the first example cited, the hunters still expressed some frustration towards the surveys as logistical, financial and statistical requirements often constrained the scientists and lead to the modification of the survey plans advised by the hunters.

Secondly, one can note that hunters from the ABWC have not only assisted scientists in tagging beluga whales but that some have been certified as taggers. This certification allows the research to be continued without the automatic presence of scientists and formally acknowledges the participation of the hunters in the studies. Besides, the scientists often share the results of the satellite telemetry with the hunters (i.e., sending weekly updates of the tracking maps). This practice has been very appreciated by the local communities, who are eager to see where “their” animals go off in the winter. Sharing the knowledge to and involving the users greatly supports the assimilation and dissemination of the data, and results, to the local communities. This reinforces the trust, and cohesion, between the different stakeholders and ensures commitment to the ABWC. At the annual meeting of the ABWC, telemetry results are discussed both by the hunters and the scientists, and both participate in the interpretation of the data.

Thirdly, an interesting point concerns stock identification. Thanks to the numerous tissue samples provided by the hunters (over 2,000 samples), genetic studies have identified five distinct beluga stocks in Alaska. The identification of one of these stocks, the Cook Inlet beluga population, led to the conclusion that the harvest of this population was unsustainable. Managers and hunters discussed this finding together and agreed to substantially reduce the catch of this population. The fact that the hunters had actively participated in the identification of this population is likely to have helped reach that decision.

Finally, the ABWC not only uses user knowledge in its scientific studies, it also has two research programmes focused on the knowledge of the local communities in Alaska. Here, user knowledge is documented and shared with the scientists, providing yet another source of information on belugas in Alaska.

In sum, the ABWC co-management organisation involves the users in the different steps of any research project: design, conduct and interpretation. While there are still conflicts between user knowledge and science within the ABWC, there is a general sense that the co-management system works well and both scientists and users adhere to it.

Although the structure of the ABWC, which largely differs from NAMMCO's, facilitates the inclusion of users, the organisation's framework still provides relevant information for NAMMCO. Indeed, it shows that the active collaboration between users and scientists, throughout the different research phases, has led to improved knowledge and management of the beluga whales in Alaska. The ABWC example shows that users' contributions throughout the research process are valuable and that such cooperation usually leads to greater adherence to the scientific results: "Because hunters as well as scientists are involved in the design, conduct and interpretation of studies, the results and conclusions become 'ours', not 'theirs'."[34] On the other hand, by intensely working with the users and their knowledge, scientists bettered their understanding of the impacts of their work on the local communities.

4. DEVELOPING USER KNOWLEDGE COLLECTION(S) WITHIN NAMMCO: QUESTIONS AND CONSIDERATIONS

Reflecting upon the previous examples, as well as academic papers focusing on such collections, the second part of this document seeks to raise some of the questions NAMMCO Members will have to ask themselves when considering the development of user knowledge collections.

These questions do not exhaust the topic, yet they present a good overview of the considerations one must take into account when creating a user knowledge collection.

4.1 WHAT TYPE OF KNOWLEDGE SHOULD BE RECORDED?

As the previous examples have shown, the possibilities are multifarious. Within NAMMCO, such collections can be focused on marine mammals' hunters' observations, but also on their experiential knowledge (i.e., not only record what they currently observe, but collect their knowledge on marine mammals such as usual migration routes, feeding habits, etc). However, collections can go further as to include culinary knowledge or fishers' observations of bycatch.

In addition, NAMMCO members may not all seek to collect the same knowledge. Like the Traditional Knowledge Database, it thus seems pertinent to build one general system which can then be adapted to each countries' necessities.

4.2 WHO SHOULD BE IN CHARGE OF MANAGING THE COLLECTION?

Multiple possibilities are available: national authorities, designated universities, local authorities, knowledge holders and the NAMMCO Secretariat could all be included in the process one way or another. For clarity, efficiency and cost-effectiveness, it is necessary to designate clear roles for each potential actor.

For instance, knowledge holders can be tasked to report their knowledge to the local authorities, which will send it to the Secretariat. The Secretariat would then have to classify and upload the information

[34] Kathryn J. Frost et al., 'Alaska Beluga Whale Committee - a unique model of co-management' (2021) 40 Polar Research 5611

on the countries' databases. However, it could also be that researchers are tasked with collecting a certain form of user knowledge (with the consent of the knowledge holders) and that they transmit the data collected to the national authorities directly, which will classify and upload it on national databases.

This question is therefore also a question of inclusivity and collaboration: does one want the knowledge holders to actively participate (that may lead to lesser efficiency or a more complex process, but also more detailed and accurate data); or does one want to have national authorities overview and manage the whole collection (deciding which data will be collected, how, and manage the collection)? There are no correct answers, and this consideration is very much dependent on the previous one; as one way to collect knowledge may befit more from one type of knowledge.

4.3 HOW TO CONVINCE USER KNOWLEDGE HOLDERS TO PARTICIPATE IN SUCH A PROCESS?

This question is one of the most crucial ones. Indeed, without good incentives, the knowledge holders have absolutely no interest in sharing their knowledge with external authorities.

For instance, fishers have no interest in reporting their by-catch data to national authorities if that leads to lesser fishing quotas or financial sanctions. Likewise, hunters may not want to share their knowledge with external authorities if it does not bring them anything back: why would they share their struck and lost data, or their knowledge of the whales' migration routes if that leads to lesser quotas or the coming of other hunters in previously secret hunting grounds?

There are multiple, complementary, solutions to address this challenge:

- Ensure that the knowledge holders remain the holders of their knowledge: the knowledge holders should decide who will be able to access the collected knowledge; the national authorities must recognise that the knowledge collected is the property of the knowledge holders; etc.
- Ensure that the knowledge holders will have the appropriate tools to share their knowledge (allow the database to store oral records, videos, photos, etc).
- Financial incentives may also be a way to incite knowledge holders to participate, yet this may not guarantee the full participation of the users in the collection.
- Collect knowledge that is relevant for the users, and not only for NAMMCO. For instance, by collecting knowledge that may disappear otherwise, even if that knowledge is not directly pertinent to NAMMCO, authorities may incite users to participate actively in the programme.

This question is therefore also inextricably linked to the previous questions: if the users feel comfortable with sharing the knowledge collected, and with the way with which it is collected, they are likely to actively participate in the process. On the contrary, if the users perceive this collection as extraction of their knowledge over which they have little to say, they may not participate at all, thus jeopardising the whole project.

4.4 ETHICS AND LIMITS

- Free, Prior and Informed Consent: whether the database will be made public or not, the users must have given their free and informed consent prior to the collection of their knowledge. Explicit policies should be developed to ensure this is done appropriately.[35]
- The intellectual property of the knowledge holders must, again, be recognised by the competent authorities (whether or not this knowledge is registered).[36] Besides, if the database

[35] Merle Alexander et al., *The Role of Registers and Databases in the Protection of Traditional Knowledge - A Comparative Analysis* (UNU-IAS 2004)
[36] WIPO, *Documenting Traditional Knowledge – A Toolkit* (WIPO 2017)

is public a "user agreement" should be created. This user agreement asks any guest to acknowledge the data is the intellectual property of the knowledge holders. This helps ensure property rights are not infringed upon by third parties.

- Content, design and development should be - at least partially - controlled at the local level. As traditional knowledge is a continuing process, transferring it to other contexts is difficult and limiting. Knowledge holders should therefore be able to control the content and development of the database to make sure their knowledge is not misunderstood.[37]
- One of the greatest limits of databases is that they decontextualise knowledge. Since knowledge is situated (i.e., embedded in a specific social, cultural and historical context), the collections should try to reflect this context as much as possible. For instance, they can clearly explain where, when and how the knowledge collected is used by the knowledge holders.[38]
- Another limit is that database can 'fix' knowledge. Authorities must recognise that collecting user knowledge is a process rather than an event, and that it should be subject to reviews, updates and/or modifications regularly.
- Finally, a user knowledge collection should not be seen as an end in itself but should be part of an integrated strategy that seeks to protect and integrate such knowledge where appropriate. Political and legal measures should support this process.[39] For instance, the relevant authorities can develop political strategies seeking to promote the use of this knowledge in management decisions, or legal measures that would require scientists to include such collections of knowledge in their research.

5. INCLUDING USER KNOWLEDGE IN RESEARCH: CONSIDERATIONS

5.1 USER KNOWLEDGE *IS* RELEVANT

The two instances have demonstrated that user knowledge can inform science at all levels of research and that it can complement scientific data in a cost-effective manner. Power imbalances have tended to delegitimate user knowledge to support only western science,[40] yet worldwide examples have demonstrated that user knowledge can inform scientists on marine mammals' distribution, abundance, migration patterns, behaviours, populations, catches, bycatch occurrences, etc. As Appendices 3 and 4 further highlight, these two examples are far from unique.

Secondly, it must be recognised that user knowledge cannot only be viewed as a *supplementary* body of information. User knowledge cannot only be used when it supports scientific evidence. In fact, it is even more useful when it challenges science, as it allows the scientists to formulate new hypotheses, maybe introduce different methods and lead to different conclusions. Without hunters arguing that the summer range of the Northern Hudson Bay narwhal population was greater than what scientists had thought, Westdal would not have re-calculated this summer range. In Liu's et al. example (Appendix 4), users provided data that scientists could not produce, thus giving to both researchers and managers new information on bycatch.

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[37] Bjørg Pettersen, 'Mind the digital gap: Questions and possible solutions for design of databases and information systems for Sami traditional knowledge', in Jelena Porsanger and Gunvor Guttorm (eds) *Working with Traditional Knowledge: Communities, Institutions, Information Systems, Law and Ethics* (Sámi University College 2011)

[38] Idem

[39] Preston Hardison, 'The Report on Traditional Knowledge Registers (TKRs) and Related Traditional Knowledge Databases (TKDBs)' *Convention on Biological Diversity* (2006), UNEP/CBD/WG8J/4/INF/9

[40] Evgeniia (Jen) Sidorova, 'The Incorporation of Traditional Ecological Knowledge in the Arctic Council: Lip Service? '(2020) 56 Polar Record e28

5.2 USER KNOWLEDGE SHOULD BE MOBILISED IN ALL STEPS OF A RESEARCH PROJECT

It is essential to include users in all steps of any research project: design, conduct and interpretation. By excluding user knowledge from one or several of these steps, the risk of misusing or disrespecting it is amplified.

Research at the Beverly and Qamanirjuaq Caribou Management Board (BQCMB) can exemplify this issue. The BQCMB has tried to survey caribou populations movements in collaboration with local communities. However, although the locals were included in the overall survey, only scientists were included in the design of the research. The issue, then, is that scientists decided to collar some animals with tracking devices, yet this practice is thought to be extremely disrespectful towards the animals for local users. In fact, they view it as such a disrespect that they fear it will threaten the availability of the resource in the future. By not consulting with the local populations in the design of the project, but imposing them a ready-made research methodology, the scientists created conflicts and mistrust that could have been avoided.[41]

The same comment can be made regarding the interpretation of the data. If users cannot comment and interpret data at least partly coming from their knowledge, the risk of misinterpretation is substantial.

5.3 USER'S OWNERSHIP OF THEIR KNOWLEDGE MUST BE RECOGNISED AND RESPECTED[42]

Users' ownership of their knowledge must be recognised and respected. As such, it is necessary to ask prior to any solicitation their free and informed consent to participate in a research project. If the users refuse, this choice must be respected. Including users as authors in scientific papers is an additional tool to strengthen and formalise this recognition.

5.4 MEANINGFUL COLLABORATION TAKES TIME[43]

Collaboration between scientists and users is a long process with its share of frustration and disagreements. In that sense, negotiation between scientific and user knowledge is usually necessary. Indeed, the two knowledge systems do not function on the same level. User knowledge often includes values and beliefs whereas Western scientific knowledge seeks to separate knowledge from values. These differences must be recognised and dealt with, for instance by using a variety of modes of communication and interaction.

Research programmes developed by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) can exemplify this endeavour. IPBES has created institutional mechanisms to ensure effective communication between local communities and scientists. For instance, it has created dialogue workshops, where local communities and scientists discuss together

[41] Stella Spak, 'The Position of Indigenous Knowledge in Canadian Co-Management Organizations' (2005) 47(2) Anthropologica 233

[42] Nordic Council of Ministers (ed), *Local Knowledge and Resource Management: On the Use of Indigenous and Local Knowledge to Document and Manage Natural Resources in the Arctic* (Nordic Council of Ministers 2015)

[43] Derek Armitage et al., 'Co-Management and the Co-Production of Knowledge: Learning to Adapt in Canada's Arctic '(2011) 21 Global Environmental Change 995

the assessments conducted by IPBES. The organisation has also created a web-based platform that connects the different local communities and scientists through, for instance, online forums.[44]

5.5 CONCLUSION

The examples taken in this document demonstrate that user knowledge can be integrated in many (all) different research projects, and that its meaningful inclusion can bring interesting results for both scientists and managers. But NAMMCO itself is no stranger to considering user knowledge today. For instance, the East Greenlandic hunters' contention that there are distinct genetic narwhal populations in East Greenland has triggered genetic analyses on the putative spring and summer stocks in Scoresby Sound. Preliminary genetic analyses seem to at least partly corroborate the users' assertion, thus confirming the value of their knowledge on this still poorly-known species. In East Greenland, users have also contended that the survey coverage was not optimal. The planning of new surveys will take into account this argumentation. As the Northern Hudson Bay example demonstrated, user knowledge can substantially improve survey quality.

In conclusion, including user knowledge in research projects appears to be a complex yet beneficial process. Such an endeavour does require financial and timely investments. However, the benefits are incommensurable in the long-term. Indeed, the participation of users to research projects modifies the way research and their management consequences are perceived. By directly participating in the research, users can claim partial ownership of that research and directly influence management decisions. This ownership of, or at least influence over, the research' conclusions and advice inevitably leads to a greater acceptance and respect of the management decisions. The inclusion of user knowledge thus not only improves the scientific understanding of marine mammals, it also decreases tensions between managers and users. NAMMCO's work engages with tens of thousands of users. This invaluable source of knowledge must be solicited to improve science and better our management advice.

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[44] Rosemary Hill and others, 'Working with Indigenous, Local and Scientific Knowledge in Assessments of Nature and Nature's Linkages with People '(2020) 43 Current Opinion in Environmental Sustainability 8

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Kuratorium Kulinarisches Erbe Österreich, 'Präambel' <www.kulinarisches-erbe.at/ueber-uns/leitbild>

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Rosemary Hill and others, 'Working with Indigenous, Local and Scientific Knowledge in Assessments of Nature and Nature's Linkages with People' (2020) 43 Current Opinion in Environmental Sustainability 8

Stella Spak, 'The Position of Indigenous Knowledge in Canadian Co-Management Organizations' (2005) 47(2) Anthropologica 233

Timothy J Ragen, Henry P Huntington and Grete K Hovelsrud, 'Conservation of Arctic Marine Mammals Faced with Climate Change' (2008) 18 Ecological Applications S166

United Nations Declaration on the Rights of Indigenous Peoples 207, UN Doc A/RES/61/295

WIPO, *Documenting Traditional Knowledge – A Toolkit* (WIPO 2017)

WIPO, *Online Databases and Registries of Traditional Knowledge and Genetic Resources* (WIPO 2016)

The databases are available on the following websites:

1. The Traditional Knowledge Database: http://cosppac.bom.gov.au/traditional-knowledge/
2. The Traditional Food Register: info.bmlrt.gv.at/themen/lebensmittel/trad-lebensmittel.html
3. The Local Observations Database: eloka-arctic.org/sizonet/

APPENDIX 1

THE TRADITIONAL KNOWLEDGE DATABASE - SOUTH PACIFIC[45]

Date of creation: 2012

Actors involved: Four South Pacific Countries: Solomon Islands, Niue, Vanuatu, Samoa

Type of knowledge collected: Weather & Biodiversity (Stories and Monitoring)

Type of platform: Web-based

Accessibility: Flexible, from open access to restricted to project managers

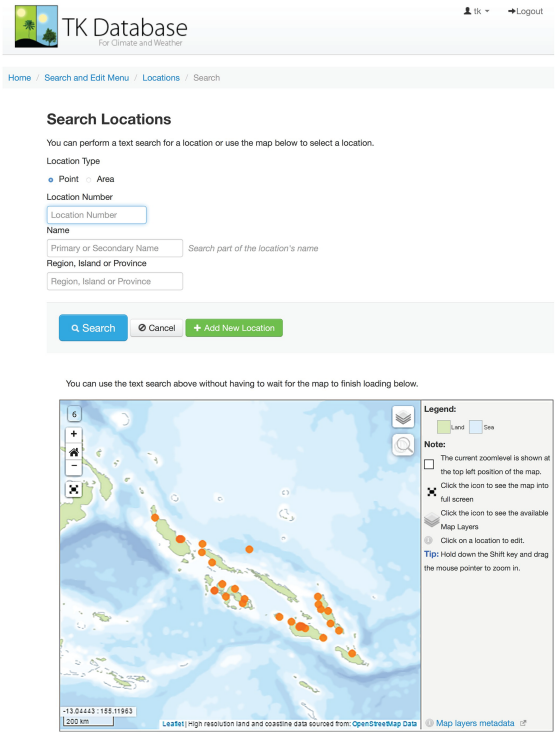

Fig. 1. Location search and mapping function © L.E. Chambers et al., 2017 Royal Meteorological Society

The Traditional Knowledge Database (TKD) is an international project led by the National Meteorological Services of four countries in the Southern Pacific Ocean. In these four countries, concerns had been expressed regarding the disappearance of the traditional knowledge held by Indigenous and Local Communities. As part of a project aimed at increasing the resilience of local communities in face of extreme climatic events, the National Meteorological Services thus created a Traditional Knowledge Database. The TKD both seeks to store and preserve traditional narratives related to weather and climate forecasting, as well as to monitor weather dynamics by documenting, in the long term, traditional indicators of weather and climate events.

The project was elaborated following key principles that were agreed upon by the different stakeholders:

- The Free, Prior and Informed Consent of the knowledge holders must be obtained before documenting anything
- The Intellectual Property Rights of the knowledge holders must be recognised and respected. As such, the knowledge holder should be able to decide on its accessibility (open access; public with permission; project managers only - possible additional restrictions based on other criteria such as gender, religion, etc).
- The software that will hold the database must be free, and open source
- The database must be easy to use, and usable in environments with limited technical expertise and/or without internet access

[45] Lynda E. Chambers et al., 'A database for traditional knowledge of weather and climate in the Pacific', (2017) Meteorological Applications 491. DOI: <10.1002/met.1648>

- The database must be able to store multiple media formats to make room for cultural contextualisation
- The costs associated with the maintenance of the system must be minimal
- The design framework must be the same for all countries, but the databases should be separate and custom features should be deployed for each country (e.g., maps, language)

To answer these principles, the TK Database was designed as a web application, accessible only to the project managers and the knowledge holders (others have to request access). The traditional narratives on climate are to be mostly collected in interviews conducted on-site by trained staff from the National Meteorological Services. In addition, local communities can edit and upload new information. They are also invited to monitor weather following traditional indicators, and to report their observations in the database. It was decided that the restriction groups in the database should be flexible, to allow the users to set restrictions appropriate to their individual needs.

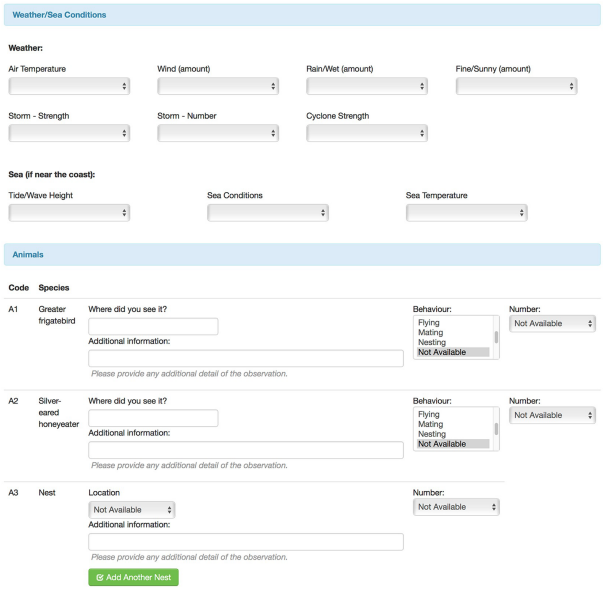

Fig. 2 Extract from the Monitoring Form © L.E. Chambers et al., 2017 Royal Meteorological Society

Following the development of the database, trials were conducted with different stakeholders to ensure everyone's compliance with the project. Once ready, in-country training was provided to authorities 'staff and local partners (on the functioning of the database; on free, prior and informed consent; etc).

The data collected is varied and rich: animal behaviours, flowering records, observations on clouds and rainfall, etc. The media with which this data is collected is also diverse: written surveys, audio records, videos, photos, etc.

To this date, the data collected has allowed National Meteorological Services to better their comprehension of the seasonal changes observed by the local communities and facilitates meaningful discussions with communities. On the other hand, the long-term monitoring of climate indicators is expected to provide considerable interest to agencies in the Pacific associated with natural resource management.

The Traditional Knowledge Database is a successful project that has enabled the systematic collection of traditional knowledge in four Pacific countries. As such, the TKD is a cost-effective and adaptable platform that serves purposes on different levels: it preserves disappearing communities' traditional knowledge, while informing National Meteorological Services on weather conditions in remote regions.

Survey/Knowledge List

10 records found

1

Knowledge Number	Narrative	Indicator	Object	Knowledge Location	Expected Outcome			
21	**********	**********	**********	Apia	**********	Edit Interview	Edit Knowledge	Delete Knowledge
22	Excited cows mean weather will change	Other - Mooing, running and jumping	Cattle or Cow/Bull	Kieta	Cooler termperatures	Edit Interview	Edit Knowledge	Delete Knowledge
23	**********	Nesting	Green sea turtle	Gizo	Active cyclone season	Edit Interview	Edit Knowledge	Delete Knowledge
26	**********	**********	**********	Funafuti	**********	Edit Interview	Edit Knowledge	Delete Knowledge
25	**********	**********	**********	Sohano	**********	Edit Interview	Edit Knowledge	Delete Knowledge
27	Eruption of volcano means next 3 months will be co	Other - Large eruption of local volcano	Volcanic eruption	Honiara	Cooler termperatures	Edit Interview	Edit Knowledge	Delete Knowledge
24	The type of clouds above the volcano indicate the	Colour (specify which colour in comments below)	Cumulus cloud	Mount Yasur	Rainfall can be heavy	Edit Interview	Edit Knowledge	Delete Knowledge

Fig. 3. “Illustration of the digital rights management implemented in the TK Database based on fictitious data. Note that this user (a female elder) is not able to view or edit some records due to sensitivity settings”

APPENDIX 2

This table is not an exhaustive list of all the collections that document user knowledge. It only presents the examples found in the drafting of this document.

Name of the collection	Country	Purpose
BioZulua Database	Venezuela	Collect medicinal traditional knowledge of 24 ethnic groups living in the Amazonian jungle
Caracal	Namibia	Collect local users' relevant landmarks and traditional paths
Collective Register for Intellectual Property	Panama	Collect and protect the traditional knowledge of Indigenous Peoples in Panama
eNuk	Nunatsiavut (Canada)	Collect Inuit knowledge and observations on the environmental and climatic changes
eTORO	Malaysia	Collect indigenous plant knowledge
Honey Bee Network	India	Collect and disseminate innovations based on traditional knowledge
Indigenous Foods Knowledges Network	Canada, Russia, Greenland, USA	Collect and share indigenous knowledge to address food sovereignty
Korean Traditional Knowledge Portal	Korea	Collect the traditional knowledge of the country (medicinal, culinary, agricultural)
National Registers for Collective Knowledge	Peru	Collect and protect the traditional knowledge of Indigenous Peoples in Peru
Community Plant Genetic Resource and Traditional Knowledge Registration	Southwest China	Collect and share traditional knowledge on medicinal plants held by Southwest China's farmers
People's Biodiversity Register	India	Document the traditional knowledge of communities on local biological resources, and their use
Pisuna-net	Greenland	Collect user knowledge on natural resources and their use
Snowchange	Finland	Document climate and environmental change in the North
The Indigenous Knowledge and Resource Management in Northern Australia	Australia	Documenting indigenous knowledge and helping its transmission to younger generations
The Potato Park Indigenous Biocultural Heritage Register	Peru	Collect and protect the traditional knowledge (mostly agricultural) of the communities living in the Potato Park
Traditional Knowledge Digital Library	India	Collect and protect (from biopiracy) the Indian medicinal traditional knowledge recorded in written documents
Traditional Knowledge Registers	Kenya	Collect and protect (from biopiracy) the Kenyan traditional knowledge on genetic resources
Yup'ik Environmental Knowledge Project	Alaska (USA)	Document Yup'ik place names

APPENDIX 3

Topic	Country or Region	Reference
Abundance and distribution of marine mammals	Alaska (USA)	George Noongwook et al., 'Traditional Knowledge of the Bowhead Whale (Balaena mysticetus) around St. Lawrence Island, Alaska' (2007) 60(1) *Arctic* 47
Abundance and distribution of marine mammals	Alaska (USA)	Henry Huntington, Lori Quakenbush and Mark Nelson, 'Evaluating the Effects of Climate Change on Indigenous Marine Mammal Hunting in Northern and Western Alaska Using Traditional Knowledge' (2017) 4 *Frontiers in Marine Science* 319
Biodiversity	Worldwide	Rosemary Hill et al., 'Working with Indigenous, local and scientific knowledge in assessments of nature and nature's linkages with people' (2020) 43 *Current opinion on Environmental Sustainability* 8
Biodiversity	Arctic	CAFF, *Traditional Knowledge - Progress Report 2017-2019* (CAFF 2019)
Bycatch	Brazil	Camilah Zappes et al., 'Traditional knowledge identifies causes of bycatch on bottlenose dolphins: An ethnobiological approach' (2016) 120 *Ocean & Coastal Management* 160
Climate Change	Northern Norway and Russia	Elina Herlander and Tero Mustonen (eds) *Snowscapes, Dreamscapes. Snowchange Book on Community Voices of Change* (Tampere Polytechnic Publications 2004)
General considerations	Worldwide	Paige M. Schmidt and Heather K. Stricker, 'What Tradition Teaches, Indigenous Knowledge Complements Western Wildlife Science' (2010) *USDA National Wildlife Research Center – Staff Publications* 1283
General considerations	Worldwide	Jay T. Johnson et al., 'Weaving Indigenous and sustainability sciences to diversify our methods' (2016) 11 *Sustainable Science* 1
General considerations	Worldwide	Maria Tengö et al., 'Connecting Diverse Knowledge Systems for Enhanced Ecosystem Governance: The Multiple Evidence Base Approach' (2014) 43 *Ambio* 579
General considerations (local monitoring)	Worldwide	Finn Danielsen et al., 'The Concept, Practice, Application, and Results of Locally Based Monitoring of the Environment' (2021) *BioScience* 1
Management	Worldwide	Madhav Gadgil, Fikret Berkes and Carl Folke, 'Indigenous Knowledge for Biodiversity Conservation' (1993) 22 *Ambio* 151
Management	Alaska (USA)	Lily Gadamus and Julie Raymond-Yakoubian, 'A Bering Strait Indigenous Framework for Resource Management: Respectful Seal and Walrus Hunting' (2015) 52(2) *Arctic Anthropology* 87
Management	Canada	Derek Armitage et al., 'Co-management and the co-production of knowledge Learning to adapt in Canada's Arctic' (2011) 21(3) *Global Environmental Change* 995
Management	Greenland	Martin Reinhardt Nielsen and Henrik Meilby 'Quotas on Narwhal Hunting in East Greenland: Trends in Narwhal Killed per Hunter and Potential Impacts of Regulations on Inuit Communities' (2013) 41 *Human Ecology* 187

APPENDIX 4

USING FISHERS' KNOWLEDGE TO INVESTIGATE THE BYCATCH OF MARINE MAMMALS IN THE SOUTH CHINA SEA[46]

Date: 2013

Purposes: study the bycatch of marine mammals around Hainan and the interactions between fishers and marine mammals

Method: 510 anonymous interviews with local fishers

Results: improved knowledge on the rate and range of bycatch around Hainan, and the interactions of the fishers with the by-caught animals.

It is widely recognised that bycatch is one of the most important threats to marine mammals today.[47] To better monitor and manage this issue, ASCOBANS has recently argued that authorities should install remote electronic monitoring (REM) with CCTV on commercial fishing vessels,[48] a method experimented and used with success in the Netherlands, for example, in the last decade.[49] Collaboration with fishers is seen as desirable, and ASCOBANS argues that ideally, it should be combined with REM to obtain the most efficient tool.

The solution proposed by ASCOBANS' might be effective in monitoring bycatch, but at the same time disregards user (here, fishers) knowledge. Indeed, installing CCTV on commercial fishing vessels shows the low confidence towards the fishers' reporting (as stressed in many scientific reports), and is likely to increase tensions between the fishers and the authorities.

The research presented below does provide a different approach and highlights that fishers' knowledge can be used by scientists to improve knowledge on bycatch and possibly provide relevant advice to the management authorities.

Coordinated by a team of four researchers, the present study examines the bycatch of marine mammals around Hainan Island, in the South China Sea. Bycatch is a growing concern for the 30 species of marine mammals living in the area, especially small cetaceans. The authors pinpoint that it is difficult, costly and time-consuming to survey the population of marine mammals in the Southern China Sea and that the results are quite limited. Considering this, they argue that the knowledge from local fishers can be a useful source of information on bycatch.

To access this source of information, a large-scale survey with local fishers of Hainan Island was conducted. The survey's objectives were:

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[46] M. Liu et al., 'Fishers' knowledge as an information source to investigate bycatch of marine mammals in the South China Sea' (2016) Animal Conservation 1

[47] D.L Alverson et al., 'A global assessment of fisheries bycatch and discards', (1994) FAO Fisheries Technical Paper n°339

[48] Grant P. Course, *Monitoring Cetacean Bycatch: An Analysis of Different Methods Aboard Commercial Fishing Vessels* (ASCOBANS Secretariat 2021)

[49] Meike Scheidat et al., 'Electronic monitoring of incidental bycatch of harbour porpoise in the Dutch bottom set gillnet fishery (September 2013 to March 2017)' (2018) *Wageningen University & Research* report C102/18

- to update baseline data on fishing methods and activities
- to study geographic and seasonal patterns of bycatch
- to study drivers of interactions between marine mammals and fishers

The method employed was a questionnaire-based interview with the different fishing communities of Hainan. In addition to the trained researchers, 42 volunteers from a local university were recruited. This enabled the conduction of 510 interviews with local fishers. The interviewers explained the clear goals of the survey and that the data would be treated anonymously before asking for the explicit consent of the fishers.

The questionnaire focused on:

- commonly used fishing gear
- observed distribution and abundance of marine mammals
- responses towards bycatch of marine mammals
- whether the interviewee had by-caught marine mammals in its gear
    - If s/he had: how often, when, where, what

While acknowledging that under-reporting and false statements are likely in the survey, several conclusions were reached:

The interviewees recalled 150 bycatch events between 2000 and 2013, involving around 600 animals (mostly humpback dolphins, finless porpoises, and other small dolphins).

These events were mostly associated with gill-nets and peaked in the spring (the biggest fishing season). Statistics showed that the bycatch intensity is correlated with the fishing intensity and not with the seasons. The bycatch density for specific species does, however, variate geographically. For instance, Indo-Pacific finless porpoises were mostly by-caught in the western coastal waters of Hainan (see Figure 2).

Finally, while a slight majority perceived that marine mammal populations were decreasing, only half of the fishers reported that they would release live animals. The other half declared that they would capture the animal either to sell it, eat it or use it as bait. Furthermore, only 5% of the fishers said they would inform the fisheries administration following a bycatch.

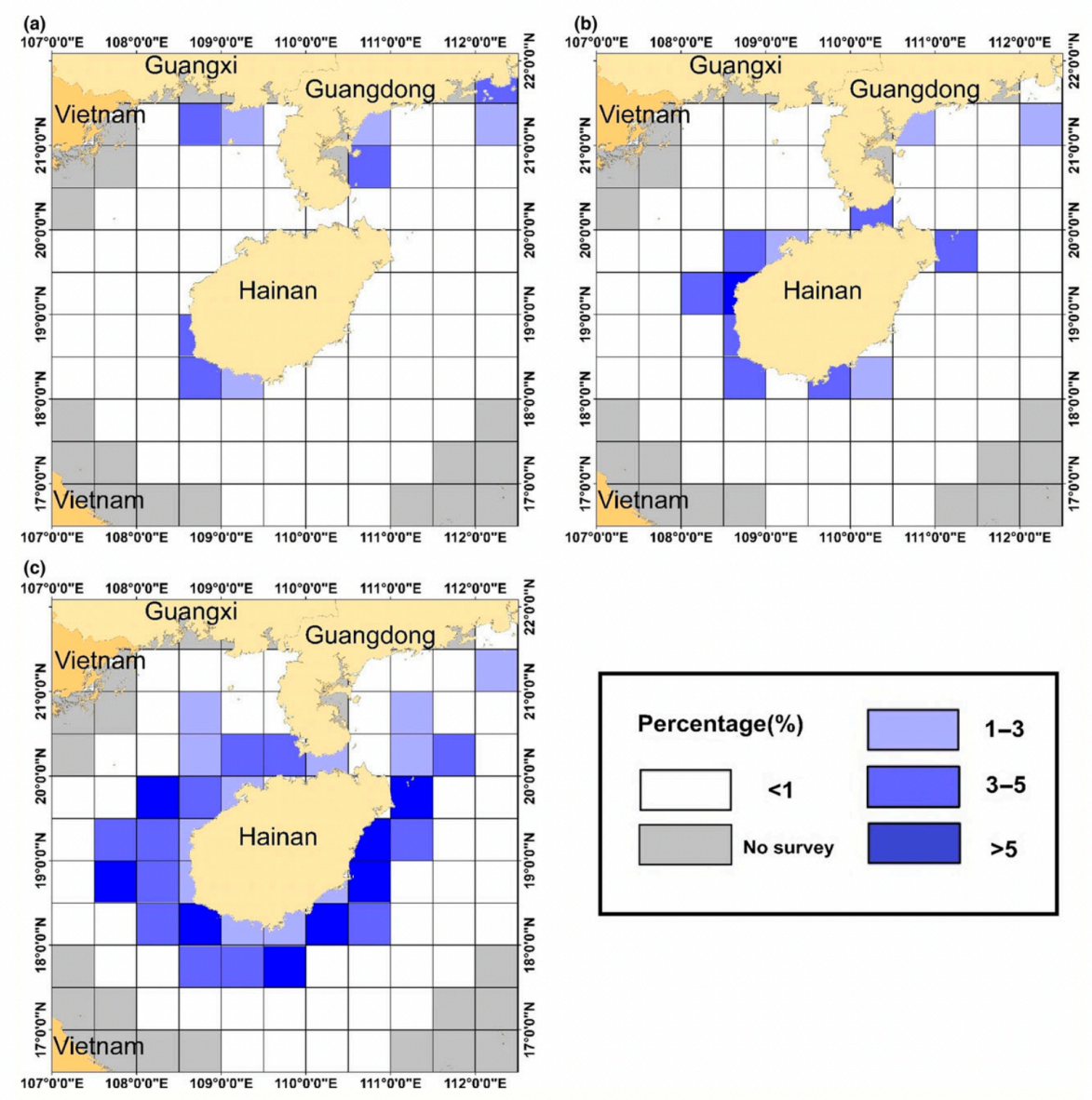

Figure 1. Distribution patterns of relative bycatch density D_{rb} in the investigated waters for (a) Indo-Pacific humpback dolphins (SCH), (b) Indo-Pacific finless porpoises (NPH) and (c) unidentified small dolphins (SMD).

These conclusions have important implications for the management authorities. First, they highlight massive underreporting of bycatch events to the authorities, most likely because of a fear of being punished for killing protected species. Second, to address this problem, the results suggest that spatial regulations and fishing gear regulations could have an impact, at least on some species. Third, given that half of the fishers reported that they would release a live animal, providing education on how to disentangle marine mammals could improve the release of live animals and their subsequent survival.

Finally, this study underlines the value of collaborating with fishers and solicit their knowledge to better study, monitor and tackle bycatch. Indeed, with only 5% of the bycatch events officially reported, the data detained by the fisheries authorities was very incomplete. By conducting anonymous interviews with local fishers, the researchers managed to obtain far more precise information on bycatch around Hainan Island, including spatial distribution and gear issues that are of direct relevance to the management authorities.