

Communication

Knowledge Translation Supports Community Conservation Efforts to Protect and Restore a Local Marine Environment: A Case Study of Átl'ka7tsem/Txwnéwu7ts/Howe Sound, British Columbia, Canada

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Abstract: Individuals, communities, organizations, and governments are the building blocks of economies. All require awareness, information, and achievable actions to contribute to moving towards healthy oceans, the base of a robust blue economy. Ocean Watch, a program run by Ocean Wise Conservation Association, was created to translate scientific understanding, combined with community and traditional knowledge, to empower local action for improved marine health. Clear improvements have been made in the Átl'ka7tsem/Txwnéwu7ts/Howe Sound marine environment, which have been captured in an updated report following from the original 2017 publication. Information within the reports illustrates the connection of communities and the marine environment through articles describing seven themes, which are: (1) Species and Habitat; (2) Clean Water; (3) Sense of Place; (4) Coastal Development and Livelihoods; (5) Stewardship and Governance; (6) Oceanography and Climate Change; and (7) Seafood. Articles such as the 2017 article: “Sea Stars: wasting disease taking its toll” gave background, rationale for importance, current status, current actions, and recommended actions to improve the health status (healthy, caution, critical, limited/no data). The health status for 10 of 28 reassessed articles improved largely due to actions taken by local communities, as recommended in the 2017 report. However, more work is needed, especially for areas of marine health that were not improving and to address threats from climate change. Establishing a sustainable socio-ecological relationship with the ocean is necessary if we are to protect and restore the health of all components of the ecosystem. Empowering communities to take action improves ocean health, which is inherently linked to the health of individuals, communities, and economies.

Keywords: blue economy; ocean pollution; sustainable development goals (SDGs); marine biodiversity

1. Introduction

The United Nations (UN) has internationally recognized the need to improve “Life Below Water” by including it in the UN sustainable development goals (SDG 14) [1]. Achieving this goal is critical for maintaining healthy ecosystems while deriving benefits from the oceans (e.g., seafood, recreation). Ongoing unsustainable use of resources has led to overfishing and an increasing number of collapsed fisheries [2,3]. Additionally, shifts in ocean conditions due to climate change pose substantial risks to human populations (e.g., sea level rise, extreme weather events) [4]. There is growing recognition of the dependence of human health on ocean health. For example, in 2019 researchers began a discussion of a joint Oceans and Human Health agenda for research and governance in Europe [5]. Understanding

the current state of the oceans is important for ocean and human health and supplying resources to a sustainable blue economy.

Anthropogenic activities have degraded ocean health (e.g., unsustainable fishing methods [6], plastic pollution [7], greenhouse gas emissions driving climate change [4]). However, informed, evidence-based actions can reverse deteriorating trends and help to restore ocean resources [8]. Given definitive knowledge of a problem, a lack of action to address the issue is considered an action gap. Such action gaps have long been a challenge in conserving natural systems and resources [9]. To close this gap and progress towards healthy oceans, knowledge (i.e., scientific, traditional) must be communicated to the public and decision makers, including evidence-based, achievable actions that can be taken by the community.

2. Background

2.1. Ocean Watch

Ocean Watch, a program run by Ocean Wise Conservation Association, translates scientific, community, and Indigenous knowledge about many topics related to coastal ocean health, into engaging, non-technical articles suitable for a general audience. Community contributions to article creation engages scientists, community members, and Indigenous groups; creates a sense of ownership; and motivates stewardship. Articles for specific geographical areas (i.e., Átl'ka7tsem/Txwnéwu7ts/Howe Sound and British Columbia) have been combined into comprehensive reports on the state of coastal ocean health. A holistic approach to ocean health has been achieved by presenting information on both ecosystems and the human activities connected to them (e.g., tourism and recreation, coastal development).

Reports feature articles within seven themes: (1) Species and Habitat; (2) Clean Water; (3) Sense of Place; (4) Coastal Development and Livelihoods; (5) Stewardship and Governance; (6) Oceanography and Climate Change; and (7) Seafood. Article information was organized under headings phrased as questions about the topic, specifically: (1) "What's happening with [topic]"; (2) "Why is [topic] important?"; (3) "What is the current state?"; (4) "What is being done?"; and, (5) "What can you do?". Some variability in headings was applied depending on the article, and where information was available, sections were added to draw on Indigenous knowledge. Importantly, the final section (i.e., "What can you do?") contains a list of recommended actions to improve marine health actionable at an individual and organization level, and at a government and policy level. Based on the presented information, a health rating (i.e., healthy, caution, critical, or limited data/not rated) was applied to indicate the status and motivate actions to improve the overall health status (Figure 1). Additionally, the health ratings have provided a framework for tracking status changes over time.

An executive summary for each report synthesizes information to identify reoccurring issues and priorities. Key issues, an action plan, and leadership suggestions are made based on comprehensive area-specific information. There has been notable community action guided by the Ocean Watch report in Átl'ka7tsem/Txwnéwu7ts/Howe Sound.

2.2. Átl'ka7tsem/Txwnéwu7ts/Howe Sound

Located within the unceded territory of Skwxwú7mesh Úxwumixw/Squamish Nation, Átl'ka7tsem/Txwnéwu7ts/Howe Sound is a quintessential Pacific Northwest fjord with a large diversity of marine life, temperate rainforest, and coastal communities. It is adjacent to the major Canadian city of Vancouver (Figure 2).

Within the area there are ten local governing bodies (i.e., Bowen Island Municipality, Town of Gibsons, Village of Lions Bay, District of Squamish, District of West Vancouver, Resort Municipality of Whistler, Gambier Island Local Trust Committee, Sunshine Coast Regional District, Squamish-Lillooet Regional District, Metro Vancouver) and First Nations (i.e., Skwxwú7mesh Úxwumixw/Squamish Nation). All connect to and impact the local marine environment; therefore, collaboration is necessary

for ocean health. However, cohesive action across diverse groups is challenging. At the local government level, the Howe Sound Community Forum (HSCF) was established in 2000, comprising representatives of local governments, to “provide a forum for local governments, Regional Districts and First Nations discussion to maintain and enhance the economic, environmental, cultural and social well being of the Howe Sound for the benefit of present and future generations” [10]. The Ocean Watch Howe Sound (OWHS) 2017 report supported this vision by providing a single source of evidence-based information regarding the health of the local marine environment [11].





Healthy 1) The status is healthy according to available data, 2) the trend is positive if known, 3) some data are available, and/or 4) actions to address or mitigate are well underway and are known to be effective. Actions should be taken to maintain positive status and/or trend.	
Caution Status, trend, data, and/or actions provide contradictory or inconclusive information. Actions are needed to move into positive status and trend and avoid negative status and trend.	
Critical 1) Impacts or issues are high risk or have resulted in a low or vulnerable status, 2) improvements are uncertain, minor, or slow, and/or 3) actions to address or mitigate are non-existent, vague, or have low effectiveness. Actions are needed to move into positive status and trend.	
Limited Data/Not Rated Not rated due to the nature of the article, or there are not enough data to produce an assessment.	

Figure 1. Health ratings symbols and criteria.

Historically, marine health in Átl'ka7sem/Txwnéwu7ts/Howe Sound was degraded through anthropogenic activities; however, improvements to marine health were already evident in the OWHS 2017 report [11]. Throughout the 20th century, the area was heavily impacted by industrial pollution from Britannia Mine (i.e., predominantly copper mining) and two pulp and paper mills. By 2017, Britannia Mine had been closed for approximately 40 years. Beginning in 2000, remediation work was undertaken by the provincial government (e.g., installment of a water treatment plant). Consequently, conditions have improved for shoreline species and fish. However, some contaminants remained above provincial water quality guidelines [12]. The impacts from the pulp and paper industry included fishery closures (e.g., shrimp, prawn, crab) to protect human health [13]. By 2017, improvements were apparent after the implementation of effluent regulations, mill process changes, and the closure of one mill in 2006 [13]. Citizens in the area recorded more cetacean sightings, including killer whales, which are top trophic level predators, supporting data showing that marine recovery was occurring [14].

After the release of the OWHS 2017, the Ocean Watch Task Force (OWTF), a sub-committee of the HSCF, was created. The OWTF comprised representatives from each of the local governments, First Nations, community group members, and environmental NGOs, specifically the David Suzuki Foundation, as well as a representative of the Átl'ka7sem/Howe Sound UNESCO Biosphere Region

designation application. The role of the OWTF was to take a leadership role in addressing key issues identified in the 2017 report, and create a strategic plan for collaborative movement on local government actions [15]. The 2017 report created a sense of ownership within local communities, and increased interest at both the individual, organization, and local government level in making progress. Subsequently, the Ocean Watch team at Ocean Wise was tasked with producing an updated report to investigate progress made since 2017.

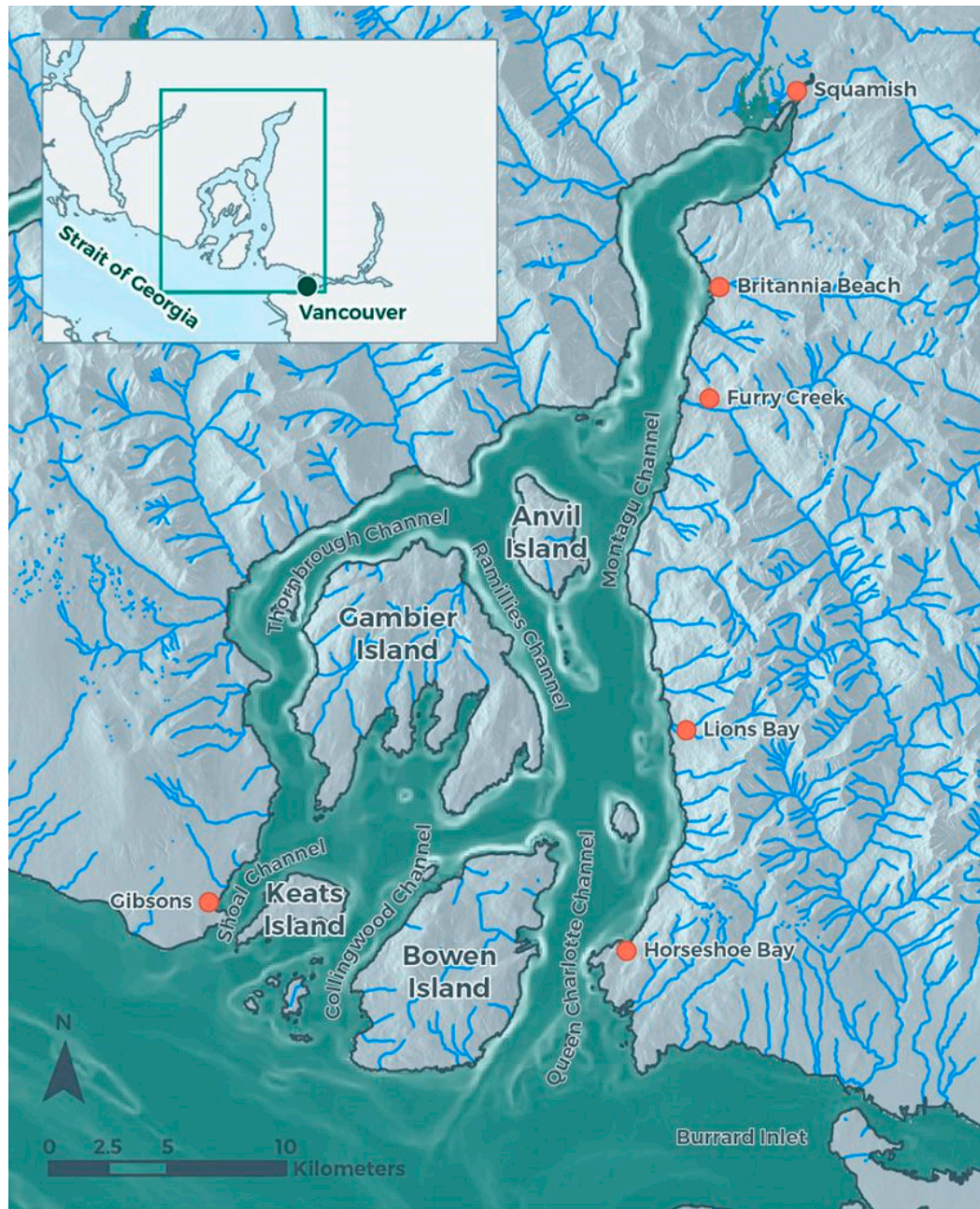


Figure 2. Map of Átl'ka7tsem/Txwnéwu7ts/Howe Sound.

3. Ocean Watch Átl'ka7tsem/Txwnéwu7ts/Howe Sound 2020

Work on an updated report (see Supplementary Materials) began in early 2019, only two years after the original report was released. To further engage the communities and gather knowledge for the 2020 update, a workshop was held mid-2019. Key stakeholders participated including government representatives, First Nations, community members, and environmental NGO groups. Discussion

focused on climate change and included breakout groups tasked with identifying and prioritizing themes for the key mitigation actions to support marine health in the Sound. Prioritized themes were applied within the 2020 report to classify key issues and structure the updated action plan.

The update was released in August 2020 [16]. The 2020 edition features articles by previous and new authors. A climate change lens was applied throughout the report, both as a theme and within all articles. The order of the seven themes was changed. The report now begins with Climate Change and Oceanography, which includes the addition of three new articles in this theme alone. The new articles provide: (1) an introduction to climate change; (2) an overview of the need to reduce greenhouse gas emissions and how to shift to zero carbon municipalities; and (3) a description of ocean acidification data for the area. Additionally, every article in the report now includes a high-level look at the impact of climate change in a new section: “What are the potential impacts of climate change on [topic]”.

The report includes three additional new articles: Pinnipeds (theme: Species and Habitat); Plastics (theme: Clean Water); and, PollutionTracker (theme: Clean Water). Unfortunately, at the time of publication, no updates were available for two previous articles (i.e., Cultural Continuity, theme: Sense of Place; and Squamish Nation Stewardship, theme: Stewardship and Governance). The Ocean Health Index, included in the 2017 report, was removed in the 2020 update because community feedback indicated its inclusion was confusing, given a health status was also indicated via the Ocean Watch Health ratings (Figure 1).

For the 2020 update, a committee comprising local community members and researchers was convened to assign a health status to each article. Articles were assigned to committee members and the criteria from 2017 was applied (Figure 1). In some cases, although forward movement on past recommended actions was identified, not enough had occurred to warrant an increase in health status. Thus, arrows were applied to the 2020 health ratings—an upward arrow indicated positive forward movement had occurred, while a downward arrow indicated a move away from recommended actions. Final health ratings were decided by consensus through discussion of rationales within the committee. Committee members provided additional feedback on content, further enhancing the engagement and sense of ownership of this important work.

4. Átl'ka7tsem/Txwnéwu7ts/Howe Sound from 2017 to 2020

Community and local government action was evident during the reassessment of health statuses between 2017 and 2020. In each article, tables of actions taken give specific details about what occurred; however, these were subject to limitations based on data availability (e.g., the ability to determine whether individual actions were being taken).

An overview of improvements is presented as a comparison of the 2017 and 2020 health ratings. For ten articles across four themes, improvements in health statuses were observed (i.e., the rating improved, or an upwards arrow was applied to indicate progress taken on actions) (Figure 3).

The emphasis on climate change also affected health ratings. The re-assignment of statuses gave two articles in the Climate Change and Oceanography theme an added critical rating, in addition to the caution rating they already carried. However, these articles still reported positive movement of recommended actions [17,18]. Additionally, the article on marine birds moved from caution, to critical/data limited. In this case, progress was made because of the expansion of an Important Bird Area (IBA) into the Sound; however, an IBA offers no legal protection and bird populations continue to decline [19]. For tourism and recreation, caution was assigned for 2020, a decline from the previous healthy/caution health status. Despite positive actions being taken in the last three years, this rating reflects a need for a more collaborative, sustainable management of growth in this industry [20].

Finally, only a single article recorded actions contrary to earlier recommendations. In this case, the article sport fishing, within the Seafood theme, was marked as declining because long-term monitoring programs for salmon were discontinued and increased pressure on sport fishing is being felt as this activity grows in popularity [21].
























Climate Change and Oceanography	2017	2020
SQUAMISH FLOOD PLANNING Significant progress has been made on the recommended actions from the 2017 report; however, there is still considerable work to be done, and that relies on funding and implementation continuing.	 	  ↑
Species and Habitat	2017	2020
PLANKTON No data is presented in this update; however, a pilot plankton study using the same sites as Stockner et al. (1977) was undertaken in summer/fall of 2019, as per recommendations from the 2017 report.		 ↑
CETACEANS An increase in large whale numbers and a decrease in small cetacean numbers has been reported. Much forward movement on actions has been taken.	 	  ↑
EELGRASS Efforts to restore and transplant eelgrass are ongoing; however, more work is needed as not all transplants are successful.		
GLASS SPONGES Considerable advances in knowledge have been made; however, glass sponges remain vulnerable to mechanical damage and climate change.		 ↑
SQUAMISH ESTUARY Many positive actions are being taken to repair this critically important habitat; however, monitoring of these efforts is needed to measure their impacts.	 	  ↑
Clean Water		
PULP MILL MARINE EFFLUENT Dioxin and furan contamination in sediment and benthic life is decreasing following regulations but is still detected.		 ↑
WRECKED, ABANDONED, AND PROBLEM VESSELS The passage of Bill C-64 has increased resources available for removal of vessels; however, this is a complex issue and further refining of legislation is necessary.		 ↑
Stewardship and Governance	2017	2020
MARINE PROTECTED AREAS Positive actions have been taken, with the creation of new marine refugia to protect glass sponge reefs and the expansion of the important bird area (IBA). However, the IBA offers no legal protection.		
COMPREHENSIVE PLANNING Recent accomplishments suggest positive improvements, but a need for continued collaboration and communication is essential.		 

Figure 3. Articles arranged by theme showing improved or improving status from 2017 to 2020. The 2020 rationale is given for each article presented.

Marine health is affected by many factors, including global trends. However, the value of local community improvements cannot be underestimated, and steps to scale-up these efforts are needed to move the global community forward.

5. Ocean Watch as a Tool in the Blue Economy

As noted above, community participation is key to the success of the Ocean Watch reports. Similar work includes a lagoon management project in the European Union. The ARCH project (“architecture and roadmap to manage multiple pressures on lagoons”), worked to provide

realistic solutions to manage identified issues, and connect with policy makers, local authorities, and stakeholders [22]. Different examples of successes and challenges were identified, supporting the need for a combined approach of traditional and scientific knowledge together with social learning and political will [23]. Ocean Watch reports have met these conditions (i.e., identified key issues to improve marine health; provided evidence-based actions; and provided a singular, comprehensive resource that facilitated collaborative action between local governments) in Átl'ka7tsem/Txwnéwu7ts/Howe Sound, leading to rapid improvements in the health of the local marine environment.

Locally, the political environmental in Átl'ka7tsem/Txwnéwu7ts/Howe Sound has driven climate change action, including the declaration of a climate emergency in half of the municipalities in the Sound (i.e., five of ten) with climate targets set in all ten communities [24]. Social efforts have also been strong, such as the movement towards designating the area as a UNESCO biosphere region [25]. Externally, motivation to facilitate the creation and uptake of these reports has been and remains strong, including significant local philanthropist funding over a multi-year period. The reports provide information and direction for communities to create local leadership (i.e., the OWTF) and shift their environmental trajectory.

By making science accessible and community actions clear, Ocean Watch has bridged a knowledge-action gap. The 2020 update indicates progress had been made on many previously recommended actions. Consequently, health status improvements have been seen. One of the key actions from 2017 was to consolidate information for decision-makers. Accordingly, the OWTF was formed, and a key outcome was the creation of a strategic plan to guide local governments in addressing recommended actions in a collaborative, cooperative manner [26].

Additionally, work has been ongoing on the Marine Reference Guide (MRG) project, as recommended in the 2017 action plan. When completed, the MRG will map aquatic ecological and human-use information for the region to “support informed decision-making, collaborative management, marine spatial planning, and community education” [27]. The MRG has received support from local governments and groups. Publication is anticipated for the spring of 2021 [27].

A key to the success of the 2020 Ocean Watch report has been the community participation at all stages of its development (i.e., engagement, knowledge gathering, health rating assignment, identifying priority themes, action plan, and leadership structure). The co-creative process has engaged the local communities and created capacity to make rapid progress possible in the short time span between the original report and the update.

The Ocean Watch Átl'ka7tsem/Txwnéwu7ts/Howe Sound 2020 report shows that collaboration between local communities, First Nations, scientists, and local governments can lead to successful knowledge translation, a sense of ownership and increased stewardship, and environmental leadership at a community level. As shown in the update, the themes and the article template are adjustable to adapt to evolving local situations; likewise, application to different regions would be possible due to this flexibility. The Ocean Watch coastal marine health report is a valuable tool for improving ocean health through community engagement and evidence-based decision making. The transfer of this tool to other coastal regions will support improved ocean conditions necessary to establish a blue economy.

Supplementary Materials: Full report: Miller, A.; Chapman, J.; Dearden, A.; Ross, P. (editors). Ocean Watch: Átl'ka7tsem/Txwnéwu7ts/Howe Sound Edition 2020; Ocean Wise Research Institute, Ocean Wise Conservation Association: Vancouver, BC, Canada, 2020. Available online: <http://oceanwatch.ca/howesound>.

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