Technology for Stewardship and Sovereignty

Kitasoo Xai'xais Guardians on patrol.

How the Regional Monitoring System from Coastal First Nations-Great Bear Initiative Supports Indigenous Territorial Governance on British Columbia's North Pacific Coast

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Introduction

Globally, Indigenous communities are asserting their rights to territorial sovereignty and resource management, which includes control over data about their territories and communities. The ability to collect, manage, and analyze environmental data represents not just a technical capability but a fundamental expression of self-determination.

The Coastal First Nations-Great Bear Initiative's (CFN-GBI) Regional Monitoring System (RMS) was developed to support this form of self-determination. Born from a desire among CFN-GBI member nations to better understand and protect their territories and resources, the RMS has evolved from simple paper field cards into a multi-pronged digital platform that serves as the technological backbone for Indigenous Guardian programs of CFN-GBI member nations in the North Pacific Coast of what is today known as British Columbia (BC).

Here, we examine how the RMS supports Indigenous sovereignty as well as marine, terrestrial, and cultural stewardship by tracing its evolution from a collaborative initiative to a sophisticated monitoring platform. By exploring its history and use, we see how technology can bridge Traditional Knowledge systems and contemporary governance needs.

Background: Coastal First Nations-Great Bear Initiative, the Coastal Stewardship Network, and the Coastal Guardians

Coastal First Nations-Great Bear Initiative (CFN-GBI)

CFN-GBI is an alliance of eight First Nations on BC's North Pacific Coast: the Gitga'at, Gitxaała, Haida, Heiltsuk, Kitasoo Xai'xais, Metlakatla, Nuxalk, and Wuikinuxv Nations. United by a historic relationship, shared waters, common challenges, and a collective vision for the future, these nations came together in the 1990s in response to rapid resource extraction in the Great Bear Rainforest – the largest intact coastal temperate rainforest on Earth, which encompasses their collective territories.

The purpose of this alliance was to assert First Nations leadership in building a sustainable, conservation-based economy in the North Pacific Coast. Today, CFN-GBI supports multiple programs to preserve the cultural and natural resources of its member nations, promote economic self-sufficiency and sustainable development, and protect coastal ecosystems.

Coastal Guardian Programs and the Coastal Stewardship Network

The Coastal Stewardship Network (CSN) is a program of CFN-GBI, serving as the organizational home for the RMS. Each member nation has its own Stewardship Office that employs Guardians and other staff to undertake stewardship projects based on their nation's priorities. The CSN provides essential tools, training, networking, and regional collaboration opportunities to the Guardian and stewardship programs of member nations, including the technical tools, such as RMS, to monitor and steward from a regional perspective.

The Coastal Guardians stem from a shared tradition among First Nations communities of BC's North Pacific Coast for protecting and sustainably managing coastal territories. These shared stewardship traditions, along with shared goals and priorities, led to the creation of the Coastal Guardian Watchmen Network (CGWN) in 2005 to support Guardian programs of CFN-GBI member nations. In 2012, the program evolved into the "Coastal Stewardship Network" to reflect the growing complexity and ambition of Indigenous stewardship efforts. Its purpose was to support a coordinated regional network that maintains individual nation autonomy while facilitating collaboration on regional issues.

Today's Guardians serve as the eyes and ears of their nation on the land and water. They

Coastal Guardian Watchmen Network

PATROL REPORT – COMBINED SIGHTINGS — Regional Monitoring Strategy

Nation:	Patrol start time:	Sky: ☐Clear ☐Partly cloudy ☐Overcast
Patrol vessel/vehicle:	Patrol end time:	Prec: ☐None ☐Light Rain ☐Rain ☐Snow
GW on patrol:	Air temp: (°C)	Seas: ☐Calm ☐Choppy ☐Rough ☐Swell
		Wave height:_____ft (wind wave + swell)
Date:	Wind speed: (knots or desc)	Visibility: ☐<0.5 ☐0.5-1 ☐1-2 ☐2-5 ☐>5 (nm)
		Note: ☐Fog ☐Glare ☐Other:_____

Area Patrolled: _____

No. of Sheets: Wildlife, Boat and Trap Sightings _____   Approached Tourist Boats _____   Lodge Visits _____

Enforcement Incidents _____   Cultural and Ecological Sites _____   Eulachon Survey _____

Other Data Collected on Trip: _____

_____

Figure 1: Image of the field cards used for data gathering in the first iteration of the Regional Monitoring System (RMS).

monitor and protect culturally and ecologically important resources while upholding Indigenous laws and implementing land and marine use agreements. Their work encompasses wildlife surveys, fisheries monitoring, cultural site protection, environmental emergency response, visitor education, scientific research support, and more – all while maintaining a presence that asserts Indigenous authority over traditional territories.

Evolution of the Regional Monitoring System

Origins and Development
The RMS was developed in response to a growing recognition among CFN-GBI member nations that effective stewardship required more than Traditional Knowledge alone. It demanded standardized data collection that could support evidence-based decision-making in resource management, negotiations with other governments, and establishing an undeniable presence on the lands and waters supported by data that was beyond reproach.

The RMS began as paper field cards (Figure 1) in 2009 designed for basic data collection under the CGWN. These standardized forms allowed Guardians to record patrol observations consistently across different nations, creating the foundation for regional data sharing.

As the CGWN evolved into the CSN, the RMS underwent its first digital transformation (Figure 2). The first digital version of the RMS was built on CyberTracker forms in specialized handheld devices (Figure 2), which launched in 2011. This system was adopted by the CSN through a knowledge exchange with the Australian Indigenous Rangers programs, which already used CyberTracker for its work.

While the CyberTracker was a valuable tool over the following seven years, it had several limitations, including the dependence on specialized data gathering devices, an outdated user interface, and difficulty in creating data collection forms and maintaining the data in a Drupal database. These limitations prompted a more ambitious redevelopment of the RMS as an Android application backed by a PostgreSQL database, led by the nations and implemented by CSN team members.

Modern RMS: CoastTracker and CoastViewer
The latest iteration of the RMS, launched in 2018, is a custom solution built entirely in-house by the CSN. It consists of a self-hosted relational database, a native Android application for data collection, called CoastTracker, and a browser-based data portal for data visualization and management, called CoastViewer. The secure backbone of the entire

Figure 2: (top) Image of the first digital version of the Regional Monitoring System (RMS), which used CyberTracker forms. (bottom) Haida Guardians using the original RMS devices that ran CyberTracker before the Android-based CoastTracker was developed.
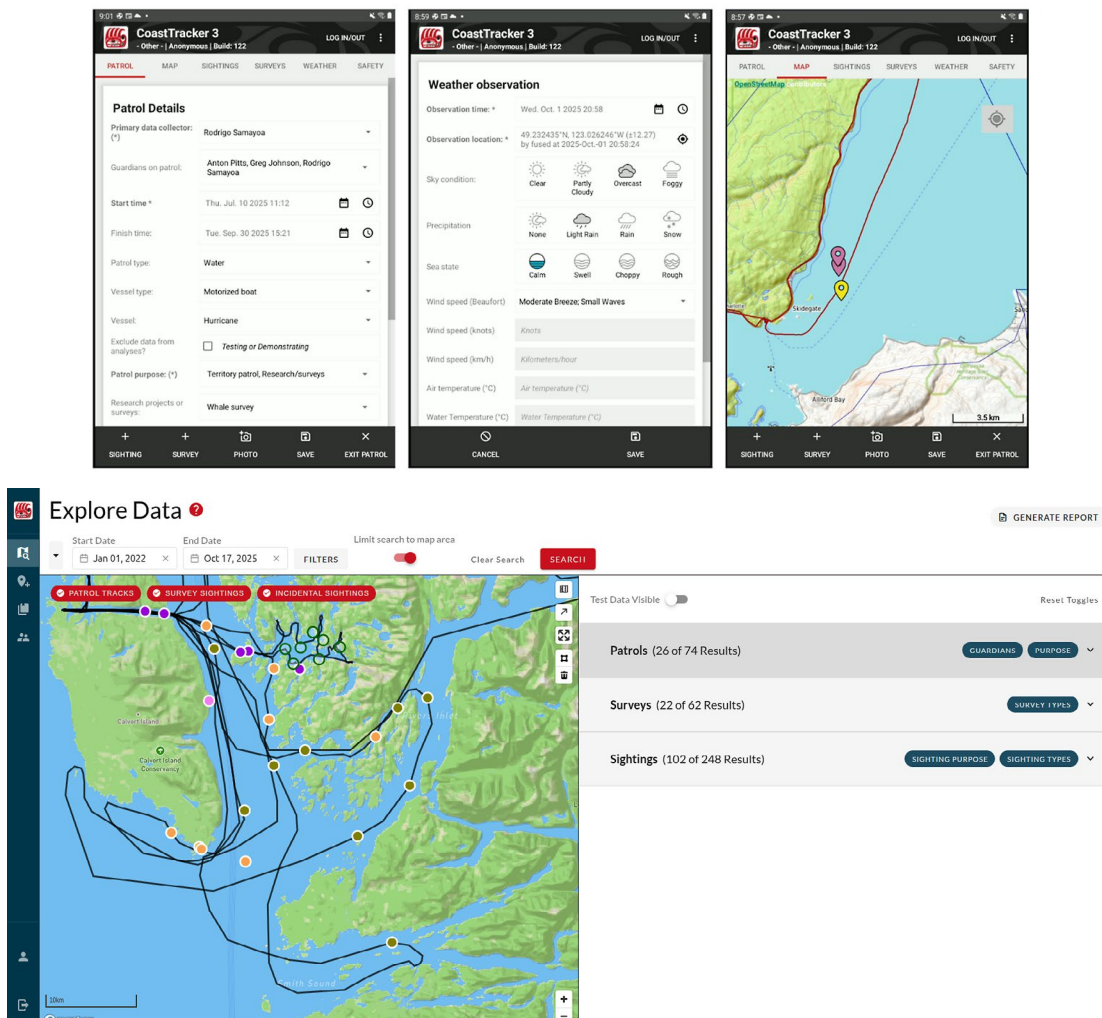
Figure 3: (top) Screenshots of the CoastTracker Android application displaying test data used for demonstration purposes. (bottom) Screenshots of the search interface of the CoastViewer data portal displaying test data used for demonstration purposes.

system is a relational database that can handle the complex relationships between different types of data. All information is securely stored on BC-based servers and stewarded by trusted partners on behalf of the nations. Fine-grained role management ensures that only authorized individuals can access specific data, maintaining both security and nation-specific control over sensitive information.

CoastTracker, the Android data collection app (Figure 3), serves as the primary data collection interface for Guardians in the field. It tracks Guardian patrols, creating a detailed record of territorial presence while enabling data gathering through various forms.

CoastViewer, a browser-based data portal (Figure 3), gives nations tools to access, manage, and analyze their data in a user-friendly interface that does not require technical skills. It features a powerful multi-filter search tool that allows authorized users to search, filter, access, and manage collected data. The portal makes it possible to edit data, generate reports for community meetings and publications, and identify trends that inform resource management decisions.

Data Collection Capabilities
To ensure data quality and regional consistency, the RMS implements standardized data collection protocols while still allowing

Table 1: List of forms available in the Regional Monitoring System (RMS). The number of sightings and surveys supported by the RMS changes as the nations' needs evolve.

RMS Data Forms	
Survey Types	
• Trap Survey • Boat Survey • Kelp Survey • Cultural Features Inventory • RCA Survey	• Crab Survey • Salmon Spawning Stream Walk • Catch Monitoring • Shoreline Debris Cleanup • Crown Tenure Monitoring
Sighting Types	
• Bear Den • Bird Sighting • Boat Sighting • Cultural Feature • Cultural and Ecological Sites • Fuel fill-up record • Geotagged Note • Marine Debris Sighting • Other Observations • Patrol Log Entry • Rockfish Conservation Area Boat Sighting	• Sample Collection • Spill Sighting • Stream Water Quality • Suspicious Activity/Enforcement Incident • Tenure activity record • Trap Sighting • Water Test • Whale Observation • Wildlife Sighting
Other Forms	
• Basic Patrol Details • Weather Observations • Safety Checklist	

flexibility for nation-specific needs. The RMS is designed to allow Guardians to conduct environmental and cultural surveys during their patrols and log sightings and incidents they encounter (Figure 4). The system currently supports 20 sighting types and 10 distinct survey types, ranging from whale surveys to cultural features inventories. A full list of sighting and survey types available can be found in Table 1.

Data Sovereignty
The development of the RMS was guided by principles of data sovereignty. Unlike other monitoring systems, where data flows to crown governments, non-profits, academic institutions, or commercial vendors, all RMS data remains under Indigenous control. The servers are physically located in BC and are operated by trusted partners who act as custodians rather than owners of the information.

Each nation maintains complete control over access to their information. They can choose to share specific datasets with other nations for regional analysis, provide limited access to research partners under strict agreements, or keep sensitive information completely private. This granular control ensures that nations can collaborate when beneficial, while maintaining autonomy over their data.

Today, all members of the RMS development team are trained in the First Nations principles of OCAP® – Ownership, Control, Access, and Possession – an information governance standard that sets how data should be collected, protected, used, or shared.

Practical Applications
The practical applications of RMS data extend across multiple aspects of territorial governance and stewardship. In marine and land use plan implementation, the data provides the empirical foundation for resource management, demonstrating whether conservation measures are achieving their goals. For government-to-government

Figure 4: Kitasoo Xai'xais Guardians on patrol.

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agreements, RMS data offers evidence that supports nation positions in negotiations and collaborative management arrangements.

In fisheries and wildlife management, systematic data collection enables nations to identify population trends, document the impacts of various harvesting pressures, track invasive species, and advocate for conservation measures based on evidence. The system also serves crucial functions in community reporting and transparency, allowing Guardians to share monitoring results with community members and demonstrate the tangible outcomes of Guardian programs.

Perhaps most fundamentally, the constant collection of monitoring data demonstrates ongoing territorial presence, a critical element

in asserting Aboriginal title and rights. Every patrol logged, every observation recorded, becomes part of a comprehensive record of Indigenous stewardship that has both legal and political significance.

To better understand the transformative impact the RMS has had on CFN-GBI member nations, we present the following two case studies.

Case Study: Crab Closures in Central Coast
For years, the Kitasoo Xai'xais, Heiltsuk, Nuxalk, and Wuikinuxv Nations watched as commercial and recreational fishers descended on their territories during Dungeness crab season. Unsustainable harvesting over many years left populations depleted, limiting what communities could

Figure 5: Nuxalk Guardians measuring crabs during a crab survey in their territory.

COASTAL FIRST NATIONS

harvest for Food, Social, and Ceremonial (FSC) purposes – a protected right for First Nations within Canada's Constitution.

When the nations first raised concerns with Fisheries and Oceans Canada (DFO) in 2007, their observations and Traditional Knowledge were dismissed. DFO demanded scientific proof before considering any management actions. This response, while frustrating, catalyzed one of the most successful examples of Indigenous-led research and collaborative management in recent history.

The nations took matters into their own hands, declaring fishery closures under their own Indigenous laws at ten sites, while leaving ten sites open to compare results. The RMS was used by the Guardians to systematically document crab populations (Figure 5) in both the open and closed sites, including requesting non-compliant fishers to remove their traps and documenting violations in closed sites.

The data revealed exactly what the nations had been observing: significant increases in both crab size and abundance at closed compared to open sites. These peer-reviewed published findings provided the scientific credibility that DFO demanded.

The combination of rigorous data collection using the RMS and sustained political pressure finally prompted DFO to act. In 2021, after 14 years of Indigenous advocacy backed by Guardian collected data, DFO agreed to a collaborative governance framework. This landmark decision closed 17 sites to commercial and recreational fishing while preserving Indigenous FSC harvesting rights.

Critically, Guardians continue to monitor the closures using the RMS, ensuring compliance, and tracking recovery of crab populations.

Case Study: Whale Protection and Conservation

Since 2010, Gitga'at Nation Guardians have systematically identified and catalogued humpback (Figure 6), orca, and fin whale sightings in their territory using the RMS, building one of the most comprehensive datasets on cetacean populations in the North Pacific Coast.

Between 2010 and 2022, for example, Gitga'at Guardians recorded over 2,900

Figure 6: Humpback whales breaching.

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humpback whale sightings – part of more than 60,000 marine mammal observations and 6,000 patrols across their territory. During patrols and whale surveys, Guardians used CoastTracker to log detailed information about whale encounters, including GPS coordinates, behaviour observations, and group composition.

This systematic monitoring has revealed crucial insights into whale populations and behaviour. The data shows humpback whale sightings increasing at a rate of 8% per year since 2010, consistent with broader population recovery trends along the BC coast. Perhaps more importantly, Gitga'at research has identified seasonal movement patterns and critical habitat areas that have directly informed marine protected area planning and vessel management strategies. With an increase in shipping traffic in the region, this monitoring work has become increasingly important to mitigate the risk of ship strikes.

These are just two examples showing the RMS in use, informing decision-making and government-to-government agreements. In fact, as of 2022, member nations' Guardians were supporting 34 provincial and federal agreements (Figure 7). While not all Guardian programs use the RMS or its data to support and enforce these agreements, the RMS is a critical tool that Guardians have access to when needed.

Challenges and Lessons Learned
The journey of building and maintaining a regional data collection system has revealed numerous technical and operational challenges that continue to shape the RMS evolution.

Regional vs. Local Priorities
Each nation brings different needs and priorities to the system, creating an ongoing tension between developing customized features for a specific nation, and standardizing data collection for regional use.

GUARDIANS ARE ACTIVE IN SUPPORTING 34 PROVINCIAL AND FEDERAL AGREEMENTS

5 Marine Agreements

4 Fisheries Agreements

5 Energy and Climate Agreements

21 Lands Agreements

Turning Point Declaration
General Protocol on Land Use Planning and Interim Measures
Forest Range (Opportunities) Agreement
Gitga'at Interim Measure Agreement Regarding Forestry Development
Metlakatla Interim Measure Agreement Regarding Forestry Development
Heiltsuk Forestry Agreement
Kitasoo Forestry Agreement
Wuikinuxv Forestry Agreement
Wuikinuxv Interim Measures Agreement
Nuxalk First Nation Interim Agreement on Forest & Range Opportunities
Metlakatla Indian Band and Iax Lw'alaams Indian Band Cut-Off Claim Settlement Agreement
Framework Regarding Tenuring for Aquaculture and Commerical Recreation (Tenuring Framework Agreement)
Coast Land Use Agreement
Land and Resource Protocol Agreement
Protected Area Collaborative Management Agreements (CMAs)
Cedar Access And Stewardship Agreement
Reconciliation Protocol Agreement (RPA)
Great Bear Rainforest Land Use Order Objective
Amending Agreement of the Reconciliation Protocol (2016) (Reconciliation 2.0)
MOU CFN/BC Pathway to Reconciliation: Long-term Social, Economic, Governance and Environmental Sustainability
Kunst'aa Guu – Kunst'ayaah Reconciliation Protocol; CHN

Reconciliation Framework Agreement for Bioregional Oceans Management and Protection (Oceans Reconciliation)
Marine Protected Area Network Strategy (known as the MPA Network)
LOI to collaborate on Coastal and Marine Planning in the Pacific Northwest
MaPP Marine Implementation Strategy (2015-2020)
Tourism and Aquaculture Tenuring Framework

Fisheries Resources Reconciliation Agreement (FRRA)
Aboriginal Aquatic Resources and Oceans Management (AAROM)
Pacific Integrated Commercial Fisheries Initiative
Aboriginal Fund for Species at Risk (AFSAR)

Metlakatla FN Limited Partnership Agreement Pacific Trails Pipeline
GBI LNG Framework Agreement
LOU - Environmental Quality and LNG Development on the North Coast, And Skills Training & Employment
Coastal First Nations LNG Benefits Agreement
Agreement on Environmental Monitoring of the Pacific NorthWest LNG Project

COASTAL GUARDIAN WATCHMEN: STEWARDING THE COAST FOR ALL (2022)

Figure 7: List of federal and provincial government-to-government agreements supported by the Guardian programs of the Coastal First Nations-Great Bear Initiative (CFN-GBI) member nations.

Maintaining data consistency across nations while accommodating these diverse needs requires careful protocol development and continuous negotiation.

These compromises can sometimes lead to some features required by individual nations to be excluded from the development cycle; and often to scope creep, if nation- or project-specific features are added after initial development. To fill these gaps in the RMS's data collection capabilities, some nations have resorted to using data management tools like Form Connect, Device Magic, or Avenza for specific projects.

Barriers to Adoption
The RMS has also seen slow adoption by some nations or departments within nations. Barriers to adoption have included the lack of required features, specific data collection protocols not met by the RMS, the lack of access to enough Android devices by some nations or departments, or platform lock-in that makes it difficult for some teams to move away from using legacy systems.

Technical and Operational Challenges
The quality of data collected through the RMS depends on multiple factors that require constant attention. Hardware limitations affect GPS accuracy in mountainous terrain or dense forest cover. Human factors – training, motivation, consistency in following protocols – all influence data quality. The CSN team addresses these challenges through regular quality assurance processes, but maintaining high standards across hundreds of patrols per month remains an ongoing challenge.

Infrastructure limitations in remote communities have also significantly influenced system design. Many areas still lack reliable mobile internet access, requiring CoastTracker to function fully offline with data syncing capabilities when connectivity becomes available. The recent introduction of Starlink satellite internet, however, could enable new features that require real-time data transmission.

The Cost of In-house Software
While in-house development of the RMS has been a key strength in customization and data sovereignty, the cost of development has also posed challenges. Cost constraints affect every aspect of the system's development and maintenance. The CSN team must carefully prioritize which features to develop, which bugs to fix, and which training to provide. Unlike government or industry systems with large budgets, the RMS operates primarily on

federal or provincial grant funding that must be continuously secured and justified, limiting the pace of innovation and support that can be provided to users.

Decision-making and Policy Challenges

The decision-making process behind the RMS reflects both its strength as a regional system and the complexity of managing a shared resource among sovereign nations. While the RMS is regional in scope, the data remains owned by each nation, requiring careful attention to data sharing agreements that balance regional collaboration with nation sovereignty and the sensitive nature of some information.

Building and maintaining trust among nations has been integral to RMS development. The CSN has created decision-making processes that respect these realities while enabling collaboration where possible – requiring ongoing dialogue, clear protocols, and accepting that certain data will not be shared. Few statistics and maps are included in this essay to respect the fact that the nations own this data.

Integrating RMS data with existing government systems can also present technical, legal, and political challenges. Legal frameworks may not recognize data collected through the RMS. For example, Kitasoo Xai'xais and Nuxalk Guardians recently gained Park Ranger authorities under BC's Park Act and Ecological Reserve Act. While they track patrols and incidents in the RMS, they must also keep handwritten logs in separate notebooks to comply with legal requirements for enforcement actions, leading to effort duplication.

Conclusion

The RMS serves as a model for Indigenous-led monitoring globally, demonstrating that communities can build and operate sophisticated technological systems to serve their needs. As Indigenous groups worldwide assert territorial rights, monitor environmental changes, and protect cultural resources, the RMS provides both inspiration and practical lessons.

The system's role in establishing presence on land and water has implications beyond environmental monitoring. In Aboriginal title cases and rights assertions, systematic documentation of Indigenous presence and stewardship provides powerful evidence. Every data point collected represents an act of sovereignty, demonstrating that these nations never abandoned their territories and continue exercising their responsibilities as stewards.

The RMS contributes to reconciliation and collaborative governance by providing a mechanism for nation-to-nation dialogue based on empirical evidence. When Indigenous nations present comprehensive territorial data, it transforms negotiations and planning processes – government and industry cannot dismiss such Indigenous concerns as anecdotal.

Most significantly, the RMS demonstrates that advancing Indigenous rights and stewardship are complementary aspects of holistic territorial governance. The same data supporting Aboriginal title identifies conservation needs; the same Guardians monitoring whale populations protect cultural sites; the same technology facilitating collaboration enables sovereignty. ⁓

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