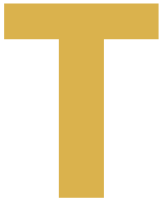




CENTRAL COAST  
ECOSYSTEM-BASED MANAGEMENT  
**INDICATOR MONITORING  
PROGRAM**  
2016-2020



# INTRODUCTION



The Marine Plan Partnership for the North Pacific Coast (MaPP) is an initiative of the Province of British Columbia (B.C.) and 17 Coastal First Nations in four sub-regions: Haida Gwaii, the North Coast, Central Coast, and North Vancouver Island. In the Central Coast sub-region, the MaPP Partners are B.C. and the Heiltsuk, Kitasoo Xai'xais, Nuxalk and Wuikinuxv First Nations. Between 2010 and 2015, Provincial and First Nations government partners drew on the best available scientific, local and traditional knowledge to develop sub-regional marine plans. These plans and the MaPP Regional Action Framework (RAF) are based on an ecosystem-based management (EBM) approach, which has four interconnected goals: ecological integrity, human well-being, collaborative governance and improved understanding of marine ecosystems.

To assess the effectiveness of the Central Coast Marine Plan and inform adaptive decision making in the Plan Area (see map), an early priority for the Central Coast MaPP Partners was to put in place a program for EBM monitoring. Beginning in 2013, extensive work was undertaken by all MaPP sub-regions in consultation with monitoring experts and marine stakeholders to identify potential 'indicators' that are representative of key values and ecosystem components. This work culminated in 2016 with a selection of indicators organized under seven monitoring themes: marine species and habitat, climate change and oceanography, water cleanliness, sense of place and well-being, seafood, coastal development and livelihoods, and stewardship and governance. Once fully implemented, the Central Coast monitoring program will involve ongoing collection and analysis of data on 29 indicators (Figure 1).

This indicator suite includes 18 MaPP regional indicators, which will be monitored with common methodologies by all MaPP sub-regions, and 11 sub-regional indicators that reflect specific Central Coast priorities and areas of concern.

To learn more about EBM monitoring and the development of the MaPP Central Coast EBM monitoring program, see the [Program Backgrounder](#).

Over time, EBM indicator monitoring will:

- improve our understanding of ecosystem health and the relationships between ecosystem components in the Central Coast Plan Area,
- provide warning signs about potential or growing threats to marine values, and
- support well-informed, adaptive decision-making.

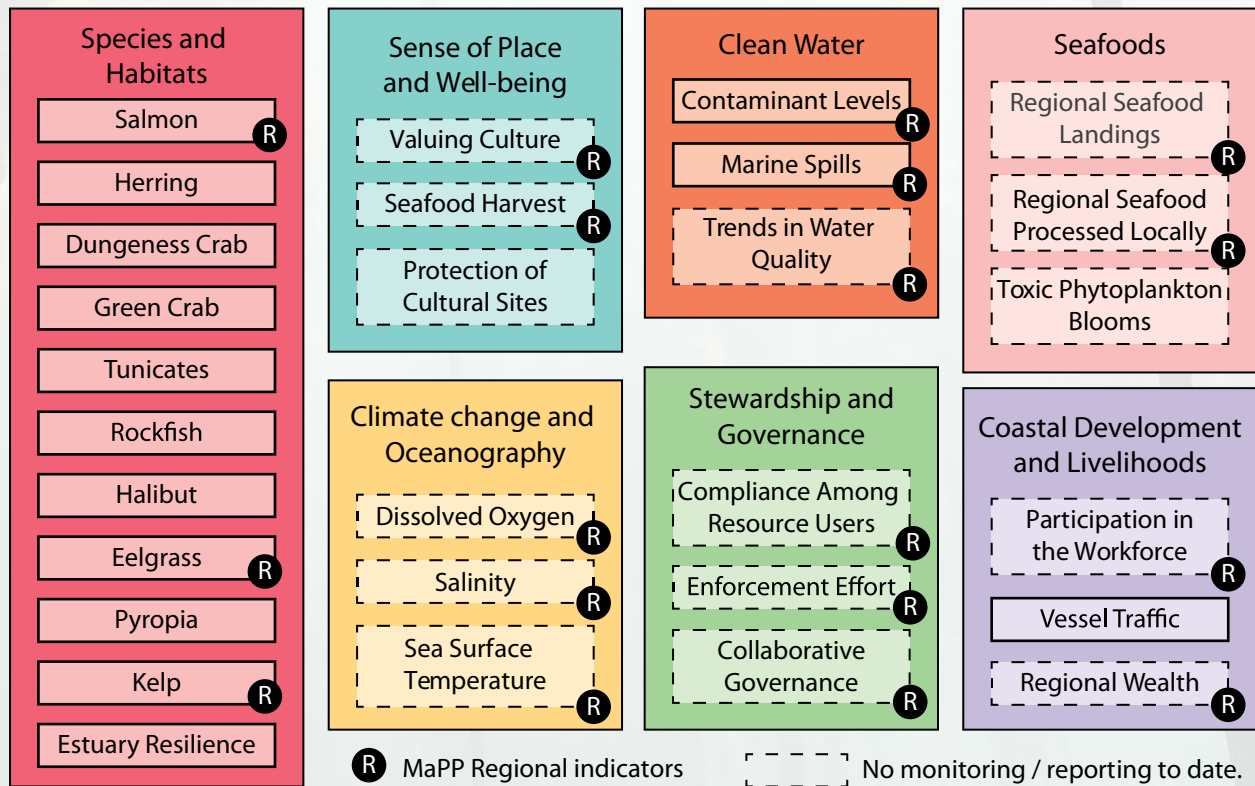
Presented here is a summary of results from the first five years of the monitoring program, during which data were collected and analyzed for the first half (14 of 29) of our indicators (see Table 1). More detailed indicator reports will be used to inform management decisions with respect to a range of issues and activities in the Central Coast Marine Plan Area, and will be updated as new data and analyses become available. Over the coming five years (2021-26) monitoring and reporting on the remaining indicators will also be initiated.





## Figure 1. Central Coast EBM Monitoring Program

Monitoring themes and indicators



## IMPLEMENTATION 2016-2020

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The driving force behind the Central Coast Monitoring Program is the Heiltsuk, Kitasoo Xai'xais, Nuxalk and Wuikinuxv Coastal Guardian Watchmen (CGW). Through dive surveys, on-the-water monitoring, and other primary research, Guardians have collected EBM indicator data on kelp, Dungeness crabs, invasive species (green crab and invasive tunicates), groundfish (rockfish and halibut), estuary health, marine spills and pollution, vessel traffic, and oceanographic conditions. Each year, MaPP has provided funding to employ two Guardians in each Nation and support annual training in data collection and research methodologies. Building research partnerships with other organizations, as well as collaborating with Nations and technical teams in other MaPP sub-regions has also been essential to the successful implementation of the monitoring program. For example, Guardians monitor estuaries with partners through the West Coast Conservation Land Management Program (WCCLMP) and are involved in a long-term annual *Pyropia* survey initiated by the Hakai Institute and Heiltsuk Integrated Resource Management Department (HIRMD) in the Admiral Group. Across all four MaPP sub-regions, kelp monitoring is coordinated through a [MaPP Regional Kelp Monitoring](#) project. These partnerships have been crucial to the progress made thus far in EBM monitoring on the Central Coast.

In addition to data collected through primary research by Coastal Guardian Watchmen and their partners, data from many other sources, including government databases and academic journals, were analyzed for a number of the EBM indicators (Table 1).



# TABLE 1. MAPP CENTRAL COAST EBM INDICATORS MONITORED TO DATE (2016-2020)

Indicator	Monitoring theme	Research and data sources
Contaminant levels in sediment	Clean Water	OceanWise (Pollution Tracker)
Dungeness crab relative abundance	Species & Habitats	Coastal Guardian Watchmen (CGW) Central Coast Indigenous Resource Alliance (CCIRA)
Eelgrass distribution	Species & Habitats	Hakai Institute
Estuary resilience to climate change	Species & Habitats	CGW West Coast Conservation Land Management Program
Green crab presence and distribution	Species & Habitats	CGW CCIRA Fisheries and Oceans Canada (DFO)
Halibut population status	Species & Habitats	International Pacific Halibut Commission (IPHC)
Herring spawn timing and magnitude	Species & Habitats	DFO
Kelp distribution and abundance	Species & Habitats	CGW (Kitasoo/Xai'xais) Hakai Institute Province of B.C.
Size and location of marine spills	Clean Water	CGW (Regional Monitoring System - RMS) Canadian Coast Guard (Transport Canada)
Pyropia abundance	Species & Habitats	Hakai Institute CGW (Heiltsuk, Wuikinuxv)
Rockfish length and age	Species & Habitats	DFO CCIRA British Columbia Marine Conservation Atlas
Pacific salmon abundance	Species & Habitats	Pacific Salmon Foundation (Pacific Salmon Explorer)
Invasive tunicate distribution	Species & Habitats	CCIRA DFO Gartner et al. (2013)
Vessel traffic magnitude and type	Coastal Development & Livelihoods	CGW (RMS) Canadian Coast Guard Atlas of the Pacific North Coast Integrated Management Area Noise Exposure to the Marine Environment from Ships (NEMES)

# KEY FINDINGS

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Following is a brief summary of preliminary findings from our first five years of data collection and analysis. These findings, as well as descriptions of the indicators and associated methodologies, are presented in much more detail in individual indicator reports that will be published soon.

## 1 Contaminant levels in sediment

Metric(s): Levels and trends of contaminants of concern.

This indicator was selected by the Central Coast partners because it is known to be associated with a range of impacts on marine plants and animals, including the bioaccumulation of chemicals in upper levels of the food chain. Based on data from one site on the Central Coast, [none of the known contaminants](#) measured by the OceanWise PollutionTracker program were above levels at which adverse biological effects could become a concern.

## 2 Dungeness crab relative abundance

Metric(s): catch per unit effort (CPUE); crab size.

A healthy Dungeness crab population is extremely important to the First Nations and communities of the Central Coast, as it has implications for food security, employment, cultural identity and other aspects of human wellbeing. The factors that influence Dungeness crab abundance are difficult to determine given the different depths, geographic ranges and distinct life phases of this species. The Central Coast Nations have observed an increased fishing pressure on Dungeness crab over the past 15 years. This does not necessarily imply a threat to the health of crab populations overall, and our findings to date do not show any trends (up or down) in crab abundance. However, some areas facing increased pressure from commercial and recreational fishermen are also accessed by the Central Coast Nations for food, social and ceremonial (FSC) harvesting. Given crab's importance to the Nations, ongoing monitoring is a priority.

## 3 Eelgrass distribution

Metric(s): Linear distance; aerial extent.

The current distribution of eelgrass beds across the Central Coast Plan Area remains unclear due to the limited amount of field data that have been collected to ground truth aerial surveys. Further research is a priority, therefore. Eelgrass health is closely linked with the health of species that hold high cultural, commercial and recreational value, such as salmon, Pacific herring and Dungeness crab. Field observations of eelgrass wasting disease, which interferes with photosynthesis and can eventually kill a plant, are a possible indication of climate change impacts (wasting disease is more severe in warmer waters). With increases in vessel traffic on the Central Coast, there is also growing concern about the potential impacts of anchoring on eelgrass beds.



*Invasive European Green Crab*

## 4 Estuary resilience to climate change

Metric(s): change in soil level; sea sfc temp (SST); change in sea level.

Healthy estuaries are highly productive habitats, but sea-level changes can have dramatic impacts on the structure and function of estuarine systems. Improving our understanding of how resilient Central Coast estuaries are to climate change, and what factors affect that resilience, will help the Central Coast partners to understand and mitigate impacts of climate change. Preliminary findings from the Asseek River estuary show a build-up of sediment between March 2017 and July 2018, which can be a good sign for resilience (it suggests that the estuary will maintain its position relative to a rising sea). More data and analyses are required to determine long-term trends in accretion / erosion, changes in sea surface temperature, and tidal range.

## 5 Green crab presence and distribution

Metric(s): location; abundance.

European Green crabs are invasive to British Columbia. Aggressive and hardy predators, they can outcompete native species and are known to damage eelgrass beds and negatively impact a variety of culturally and economically important prey species. There appears to be an established population of green crabs at one of the monitoring sites on the Central Coast, Gale Creek. However, this cannot yet be determined conclusively, and the data also suggest that crabs may be spreading through the Central Coast more slowly than expected – a promising sign.

## 6 Halibut population status

Metric(s): weight per unit effort; number per unit effort.

Pacific halibut is one of the most important groundfish species for First Nations', commercial and recreational fisheries. The Central Coast Nations have observed that it is both increasingly difficult to catch halibut, and that the size of fish that are caught is decreasing. Our monitoring has found that the population structure of halibut could be shifting towards a higher proportion of smaller individuals. Since halibut fecundity increases with size this could have implications for population status over time.

## 7 Herring spawn timing and magnitude

Metric(s): spawn index / spawn biomass; spawn habitat index.

As the dominant forage fish species in the Canadian Pacific, herring are culturally, ecologically and commercially important. Since a closure of the commercial roe herring fishery in 2007 (until 2013), the Spawn Index (a measure of the weight of mature spawners) appears to be increasing, whereas the Spawn Habitat Index (representing the frequency and magnitude of spawns) has been declining or remaining constant since 1990. Data also show a decreasing number of large herring spawns in some parts of the Central Coast, which is concerning.

## 8 Kelp distribution and abundance

Metric(s): linear distance; aerial extent; annual variation.

Canopy kelp species contribute to the productivity of shallow coastal ecosystems and act as habitat for a diversity of marine life. Bull kelp and giant kelp are the dominant canopy species on the Central Coast, and the predominant species exploited commercially in the region. The Kitsoo Fisheries annual kelp monitoring program shows canopy cover appears to be lower overall in sampled plots, and local harvesters have noted an apparent weakening of holdfasts, increased bryozoan loads, and declines in availability of kelp in areas that have been regularly harvested. There are significant concerns about the potential impacts of climate change on kelp, including impacts of warmer sea temperatures and decreased salinity. Due to a lack of up-to-date field data to ground truth aerial and satellite data, however, there remains uncertainty about the current extent of bull kelp and giant kelp across the Central Coast Plan Area.

## 9 Size and location of marine spills

Metric(s): location; size; pollutant type.

Marine spills caused by vessel collisions, accidents on board, or the loss of cargo or fuel after a grounding or sinking present a hazard to the environment and human health. In recent years there have been spills and near misses in B.C.'s coastal waters that have illustrated the risks to the marine environment associated with vessel traffic. Four years after a spill caused by the grounding of the Nathan E. Stewart, Nations have concerns over impacts to FSC and commercial harvesting of many marine species, including manila clams, red sea urchin, sea cucumber, salmon, and herring spawn on kelp. Monitoring data also shows a high number of events that could have resulted in spills (but fortunately did not). This underlines the risk of future spills in the region, especially in light of planned port expansions and industrial marine development proposals across the B.C. coast (mostly outside the Central Coast sub-region). Petroleum products make up the majority of pollutants spilled in the Central Coast.



## 10 **Pyropia abundance**

Metric(s): percent cover; biomass; sea surface temperature.

*Pyropia* (also known as Black seaweed, black gold, or nori) is a nutritionally and culturally important food along the Pacific Coast that has been harvested by First Nations since time immemorial. *Pyropia* abundance seems to have stabilized in the four years following catastrophic declines reported in 2016, although 2020 saw the lowest abundance since monitoring surveys began in 2017. Local harvesters also continue to observe declines in the quality and quantity of this important marine plant. Data on *Pyropia* only span 2017-2020 and therefore miss longer term trends. Notably, there are no data from years with reportedly low pyropia abundance.

## 11 **Rockfish length and age**

Metric(s): length and age series; ocean sub regions.

There are more than 38 species of rockfish in B.C., many of which are of conservation concern due to their low growth rates and rates of reproduction. Two species of rockfish – Yelloweye and Quillback – are included in the Central Coast EBM indicator monitoring program. Declines in the size and age of Yelloweye rockfish are relatively drastic in one of five upper ocean sub-regions of the Central Coast. This could have implications for population resilience over the long term and negative consequences for human wellbeing, including with respect to access to traditional food, cultural identity, and regional wealth. In other ocean sub-regions, on the other hand, rockfish length and age have increased. More data are needed, including from within Rockfish Conservation Areas (RCAs), for a clearer understanding of trends.

## 12 **Pacific salmon abundance**

Metric(s): relative abundance and biological status of 5 salmon species.

For over 11,000 years the cultures, social structures and economies of the Central Coast First Nations have been based on the abundance of salmon, and these Nations' territories were once home to some of the largest salmon runs in North America. Although the status of most populations of Pacific salmon for which there are data on the Central Coast is 'good' to 'fair', according to the [Pacific Salmon Foundation](#), many populations are also experiencing lower abundance and more synchronicity. This latter finding, in which populations with relatively high abundances in different years are now experiencing similar abundance levels from year to year, is a coastwide phenomenon and could imply that salmon populations are becoming less resilient in the face of climate change and fishing pressure. Ongoing monitoring of this indicator will remain a priority due to salmon's ecological, social, and cultural importance, and because salmon abundance may be linked to changes in marine and freshwater marine systems as well as effective stewardship.

Continued monitoring and reporting will improve our understanding of the status of individual indicators and the relationships between ecosystem components and provide warning signs of potential or growing threats to ecological integrity and human wellbeing.

## 13 Invasive tunicate distribution

Metric(s): presence / absence.

Tunicates are small filter feeders that colonize natural or artificial surfaces including boats and marine infrastructure. They are disruptive to habitats and trophic structures and pose a risk to the aquaculture industry, with potential impacts to employment and regional wealth. Three species of invasive tunicates (Transparent, Violet and Golden star) have been documented in the Central Coast, concentrated in the inner coast. Current data are not yet sufficient to draw any conclusions about trends. If invasive tunicates become prolific in the Central Coast, they could threaten the viability of aquaculture as an emerging industry.

## 14 Vessel traffic magnitude and type

Metric(s): vessel density & distribution; # boats by type; patrol effort.

Residents of the Central Coast rely on marine transportation, and a great variety of vessels are used to transport goods, services, and people in the region. Vessel traffic has the potential to impact marine ecosystems through underwater noise, marine mammal strikes, shoreline erosion, introduction of aquatic invasive species, and pollution. Guardian Watchmen patrol efforts are focused on the nearshore areas of the Central Coast Plan Area, where vessel densities are highest. Available data are not yet adequate to show clear trends in overall vessel traffic but indicate an increase in tourist and sport fishing vessel traffic in the summer season, especially in the inside passage. Port expansions and a number of industrial marine development proposals along the BC coast could lead to a significant increase in large vessel traffic transiting the Plan Area. Continued monitoring is necessary to understand the magnitude, type, and potential risks from vessels in the area.



# INFORMING MANAGEMENT PLANNING AND DECISION MAKING

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Although the Central Coast EBM monitoring program is not yet fully implemented, the information in the indicator reports has begun to fill critical knowledge gaps and is already being used by the Central Coast Partners to inform discussions with stakeholders and other levels of government with respect to the implementation of the Marine Plan and related management issues. For example:

- Estuary monitoring is providing critical information to a Pacific coast dataset related to the impacts of climate change on estuary health and how resilient these estuaries are in the face of climate change.
- Central Coast kelp monitoring contributes to a [Regional MaPP Kelp Monitoring](#) project and will help to inform new harvest policies for wild marine plants in the Plan area if/as they are developed.
- Observations of vessel traffic provide data for marine park management and use permits, infrastructure planning and risk management. MaPP Guardians have also identified areas where oil spill mitigation and response management are needed.
- With the support of the monitoring program the Nations have developed the only multi-year nearshore dataset of rockfish in the Northern Shelf Bioregion. This has been used by the Nations in their work with DFO to identify important rockfish habitat and support the case for enlarging Rockfish Conservation Areas in the sub-region.
- Monitoring data on rockfish, glass sponges, and habitat types are important inputs to the design of a [Marine Protected Area network in the Northern Shelf bioregion](#). The network will include a variety of legal or other effective mechanisms for marine protection. With data from the MaPP Guardians, Central Coast Nations have been able to document and bring forward their interests in protecting important nearshore habitats through the MPA network planning process.
- The data from the Dungeness crab surveys have informed the Central Coast Nations' collaborative management discussions with the federal department of Fisheries and Oceans (DFO) and led to commercial fishery closures intended to restore and preserve First Nations' access to traditional foods. These closures are part of a broader network of commercial and recreational crab fishery closures negotiated for implementation in 2020.
- Over the past four years MaPP Guardians have created one of the largest, most detailed databases of sea stars on the coast. Due to [sea star wasting disease](#) these animals have recently experienced a major die-off from Mexico to Alaska. However, the Central Coast Nations have discovered that in deep fjords sea stars appear to be relatively healthy. The Nations are developing partnerships with research organizations to better understand these findings and their management implications.

## NEXT STEPS

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The purpose of the EBM monitoring program is to better understand our marine environment and the threats to the ecological, cultural and economic values we care about in order to effectively manage the Central Coast for current and future generations. The Central Coast MaPP Partners will use this first installment of indicator reports to inform future management decisions, including with respect to future monitoring efforts. The findings point to a number of areas where the attention of managers and decision makers is needed, and these will be further defined through ongoing analysis and discussions within the Central Coast partner organizations and with our monitoring partners, stakeholders, and other organizations. For example:

- Spatial inventories of kelp species require updating, and other methods of assessing kelp distribution and abundance could be explored.
- Updated field data ('ground truthing') are needed to address uncertainty about the current distribution of eelgrass across the Central Coast Plan Area.
- The findings on Pacific salmon abundance could be used to identify conservation units and indicator streams where additional monitoring efforts and/or restoration activities should be prioritized, as well as to inform reviews of marine-based tenures that could impact corresponding salmon populations.
- The report on invasive tunicates concludes that discussions are needed to determine whether more targeted monitoring should be undertaken to better understand current distribution and track future rates of dispersion.
- Discussions with government agencies and industry may be needed to improve strategies for responding to marine spills and implementing restoration work where necessary.
- Discussions on Rockfish Conservation Areas (RCAs) for species that are valuable both commercially and for FSC, and any spillover effects that RCAs have for fisheries occurring outside their boundaries, could be supported by MaPP's EBM monitoring work.



A key priority for the Central Coast MaPP partners, furthermore, is to develop the methodologies and begin collecting data on all 29 of the indicators selected for EBM monitoring. Whereas monitoring and reporting to date has largely focused on ecological indicators under the Species and Habitat theme, the success of the EBM management approach will come from understanding and strengthening all three pillars of this approach: together with **ecological integrity**, that includes **human wellbeing** and **collaborative governance**, which are equally important elements of the EBM framework. Our next step, therefore, is to work with our partners in the other MaPP sub-regions (Haida Gwaii, North Coast, and North Vancouver Island) to develop and implement indicators for monitoring these components. Monitoring and reporting on these and all of our indicators will continue to be focused on providing decision makers with the best possible information to advance shared objectives within the Central Coast Plan Area.

Finally, we have learned a great deal in the first five years of EBM monitoring about monitoring itself and the capacity requirements of a program such as this. These requirements are considerable and will only become more so as we expand the program. To ensure long-term success, therefore, we will continue to develop and grow partnerships and work to secure stable funding for the program moving forward.

