Environmental sustainability assessment of wild-caught bull and giant kelp (*Nereocystis luetkeana* and *Macrocystis pyrifera*) from British Columbia caught using hand implements.



**Species:** Bull kelp *(Nereocystis luetkeana),* Giant kelp *(Macrocystis pyrifera)*

**Location:** Northeast Pacific

**Gear:** Hand implements

**Type:** Wild Caught

**Author:** Seafood Watch

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# About Monterey Bay Aquarium Seafood Watch

The mission of the Monterey Bay Aquarium is to inspire conservation of the ocean and enable a future where the ocean flourishes and people thrive in a just and equitable world. To do this, the Aquarium is focused on creating extraordinary experiences that inspire awe and wonder, championing science-based solutions, and connecting people across the planet to protect and restore the ocean. We know that healthy ocean ecosystems are critical to enabling life on Earth to exist, and that our very survival depends on them. As such, our conservation objectives are to mobilize climate action, improve the sustainability of global fisheries and aquaculture, reduce sources of plastic pollution, and restore and protect ocean wildlife and ecosystems.

The aquarium is focused on improving the sustainability of fisheries and aquaculture given the role seafood plays in providing essential nutrition for 3 billion people globally, and in supporting hundreds of millions of livelihoods. Approximately 180 million metric tons of wild and farmed seafood is harvested each year (excluding seaweeds). Unfortunately, not all current harvest practices are sustainable and poorly managed fisheries and aquaculture pose the greatest immediate threat to the health of the ocean and the economic survival and food security of billions of people.

The Seafood Watch program was started 25 years ago as a small exhibit in the Monterey Bay Aquarium highlighting better fishing practices and grew into one of the leading sources of information on seafood sustainability, harnessing the power of consumer choice to mobilize change. The program's comprehensive open-source information and public outreach raises awareness about global sustainability issues, identifies areas for improvement, recognizes and rewards best practices and empowers individuals and businesses to make informed decisions when purchasing seafood.

We define sustainable seafood as seafood from sources, whether fished or farmed, that can maintain or increase production without jeopardizing the structure and function of affected ecosystems, minimize harmful environmental impacts, assure good and fair working conditions, and support livelihoods and economic benefits throughout the entire supply chain. As one aspect of this vision, Seafood Watch has developed trusted, rigorous standards for assessing the environmental impacts of fishing and aquaculture practices worldwide. Built on a solid foundation of science and collaboration, our standards reflect our guiding principles for defining environmental sustainability in seafood.

# Seafood Watch Ratings

The Seafood Watch Standard for Fisheries is used to produce assessments for wild-capture fisheries resulting in a Seafood Watch rating of green, yellow, or red. Seafood Watch uses the assessment criteria to determine a final numerical score as well as numerical subscores and colors for each criterion. These scores are translated to a final Seafood Watch color rating according to the methodology described in the table below. The table also describes how Seafood Watch defines each of these categories. The narrative descriptions of each Seafood Watch rating, and the guiding principles listed below, compose the framework on which the criteria are based.

| | | |
|---|---|---|
| **Green** | Final Score >3.2, and either criterion 1 or criterion 3 (or both) is green, and no red criteria, and no critical scores | Wild-caught and farm-raised seafood rated green are environmentally sustainable, well managed and caught or farmed in ways that cause little or no harm to habitats or other wildlife. These operations align with all of our guiding principles. |
| **Yellow** | Final score >2.2, and no more than one red criterion, and no critical scores, and does not meet the criteria for green (above) | Wild-caught and farm-raised seafood rated yellow cannot be considered fully environmentally sustainable at this time. They align with most of our guiding principles, but there is either one conservation concern needing substantial improvement, or there is significant uncertainty associated with the impacts of the fishery or aquaculture operations. |
| **Red** | Final Score ≤2.2, or two or more Red Criteria, or one or more Critical scores. | Wild-caught and farm-raised seafood rated Red are caught or farmed in ways that have a high risk of causing significant harm to the environment. They do not align with our guiding principles and are considered environmentally unsustainable due to either a critical conservation concern, or multiple areas where improvement is needed. |

**Disclaimer:** All Seafood Watch fishery assessments are reviewed for accuracy by external experts in ecology, fisheries science, and aquaculture. Scientific review does not constitute an endorsement of the Seafood Watch program or its ratings on the part of the reviewing scientists. Seafood Watch is solely responsible for the conclusions reached in this assessment.

**Recommended Citation:** Seafood Watch (2025) Environmental sustainability assessment of wild-caught bull and giant kelp (*Nereocystis luetkeana* and *Macrocystis pyrifera*) from British Columbia caught using hand implements. Monterey Bay Aquarium

# Guiding Principles

Monterey Bay Aquarium defines sustainable seafood as seafood from sources, whether fished or farmed, that can maintain or increase production without jeopardizing the structure and function of affected ecosystems, minimize harmful environmental impacts, assure good and fair working conditions, and support livelihoods and economic benefits throughout the entire supply chain.

As one aspect of this vision, Seafood Watch has developed trusted, rigorous standards for assessing the environmental impacts of fishing and aquaculture practices worldwide. Environmentally sustainable wild capture fisheries:

1. **Follow the principles of ecosystem-based fisheries management**

   The fishery is managed to ensure the integrity of the entire ecosystem, rather than solely focusing on maintenance of single species stock productivity. To the extent allowed by the current state of the science, ecological interactions affected by the fishery are understood and protected, and the structure and function of the ecosystem is maintained.

2. **Ensure all affected stocks[1] are healthy and abundant**

   Abundance, size, sex, age and genetic structure of the main species affected by the fishery (not limited to target species) is maintained at levels that do not impair recruitment or long-term productivity of the stocks or fulfillment of their role in the ecosystem and food web.

   Abundance of the main species affected by the fishery should be at, above, or fluctuating around levels that allow for the long-term production of maximum sustainable yield. Higher abundances are necessary in the case of forage species, in order to allow the species to fulfill its ecological role.

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[1]"Affected" stocks include all stocks affected by the fishery, no matter whether target or bycatch, or whether they are ultimately retained or discarded.

3. **Fish all affected stocks at sustainable levels**

   Fishing mortality for the main species affected by the fishery should be appropriate given current abundance and inherent resilience to fishing while accounting for scientific uncertainty, management uncertainty, and non-fishery impacts such as habitat degradation.

   The cumulative fishing mortality experienced by affected species must be at or below the level that produces maximum sustainable yield for single-species fisheries on typical species that are at target levels.

   Fishing mortality may need to be lower than the level that produces maximum sustainable yield in certain cases such as forage species, multispecies fisheries, highly vulnerable species, or fisheries with high uncertainty.

   For species that are depleted below target levels, fishing mortality must be at or below a level that allows the species to recover to its target abundance.

4. **Minimize bycatch**

   Seafood Watch defines bycatch as all fisheries-related mortality or injury other than the retained catch. Examples include discards, endangered or threatened species catch, pre-catch mortality and ghost fishing. All discards, including those released alive, are considered bycatch unless there is valid scientific evidence of high post-release survival and there is no documented evidence of negative impacts at the population level.

   The fishery optimizes the utilization of marine and freshwater resources by minimizing post-harvest loss and by efficiently using marine and freshwater resources as bait.

5. **Have no more than a negligible impact on any threatened, endangered or protected species**

   The fishery avoids catch of any threatened, endangered or protected (ETP) species. If any ETP species are inadvertently caught, the fishery ensures and can demonstrate that it has no more than a negligible impact on these populations.

6. **Are managed to sustain the long-term productivity of all affected species**

   Management should be appropriate for the inherent resilience of affected marine and freshwater life and should incorporate data sufficient to assess the affected species and manage fishing mortality to ensure little risk of depletion. Measures should be implemented and enforced to ensure that fishery mortality does not threaten the long term productivity or ecological role of any species in the future.

The management strategy has a high chance of preventing declines in stock productivity by taking into account the level of uncertainty, other impacts on the stock, and the potential for increased pressure in the future.

The management strategy effectively prevents negative population impacts on bycatch species, particularly species of concern.

7. **Avoid negative impacts on the structure, function or associated biota of aquatic habitats where fishing occurs**

   The fishery does not adversely affect the physical structure of the seafloor or associated biological communities.

   If high-impact gears (e.g. trawls, dredges) are used, vulnerable seafloor habitats (e.g. corals, seamounts) are not fished, and potential damage to the seafloor is mitigated through substantial spatial protection, gear modifications and/or other highly effective methods.

8. **Maintain the trophic role of all aquatic life**

   All stocks are maintained at levels that allow them to fulfill their ecological role and to maintain a functioning ecosystem and food web, as informed by the best available science.

9. **Do not result in harmful ecological changes such as reduction of dependent predator populations, trophic cascades, or phase shifts**

   Fishing activities must not result in harmful changes such as depletion of dependent predators, trophic cascades, or phase shifts.

   This may require fishing certain species (e.g., forage species) well below maximum sustainable yield and maintaining populations of these species well above the biomass that produces maximum sustainable yield.

10. **Ensure that any enhancement activities and fishing activities on enhanced stocks do not negatively affect the diversity, abundance, productivity, or genetic integrity of wild stocks**

Any enhancement activities are conducted at levels that do not negatively affect wild stocks by reducing diversity, abundance or genetic integrity.

Management of fisheries targeting enhanced stocks ensures that there are no negative impacts on the wild stocks, in line with the guiding principles described above, as a result of the fisheries.

Enhancement activities do not negatively affect the ecosystem through density dependent competition or any other means, as informed by the best available science.

# Summary

This report assesses the sustainability of the giant kelp (*Macrocystis pyrifera*) and bull kelp (*Nereocystis luetkeana*) fisheries in British Columbia, Canada. Harvesting occurs along the entire coast and is by hand, using a cutting tool to trim fronds and blades.

Both species of kelp form expansive beds with floating canopies along the coastline, known as kelp forests, which are among the most productive ecosystems in the world. *Macrocystis* is the largest marine plant, capable of growing 30 cm/day in peak season and up to 45–60 cm/day in peak growing conditions (pers comm. Ocean Wise Seaforestation Team, 2024). In British Columbia, it is found in depths to 10 m. *Nereocystis* is found as deep as 20 m and extends a single stipe toward the surface, ending in a float from which 30–60 blades can grow, reaching to 4 m. Both species are affected by the dynamic environment of the BC coast: *Macrocystis*, which lives 4–8 years in other parts of the world, rarely lives beyond 1–2 years, while *Nereocystis* has an effectively annual life cycle, with most of its population decimated each winter by storms.

Harvesting of kelp in BC has been ongoing since the mid-20th century, and commercial operations occur along the BC coastline. Management of the fishery is the responsibility of the provincial ministry of Water, Land and Resource Stewardship, which manages all aquatic plant harvesting in the province, including issuing individual annual licenses to harvest kelp in one or more Fisheries and Oceans Canada (DFO) Pacific Fisheries Management Area (PFMA) subareas. Applicants request a harvest quota for one or both of the species, which is assessed by the ministry on a case-by-case basis, based on historical inventories. There were 32 license applications in 2017, requesting a total of 900 t. *Macrocystis* is used in the herring spawn-on-kelp (SOK) fishery, while other products of both species include dried edibles, fertilizer, and cosmetics.

The effects of harvesting on *Macrocystis* and *Nereocystis* communities in BC are not well understood. *Nereocystis* specifically has received limited study, and there are concerns that it is more vulnerable, because of an inability to regrow after damage to its stipe and the possible reduction of reproductive potential when blades are removed. Bull kelp is harvested by many First Nations communities because its serves various functions. Most commonly, bull kelp is eaten fresh, dried, or pickled, while the stipes and floats are useful for weaving materials and as floats, lines, or containers (MaPP 2023).

Abundance in BC is a moderate concern: although inventories conducted by the

provincial government identified large potential yields for both *Macrocystis* and *Nereocystis*, they were conducted many years ago, between 1967 and 2007; and with limited updated information available, the current stock status is unknown. Mortality is a low concern because license conditions do not allow cutting that would result in the death of the plant. Fronds or blades must only be trimmed, and harvest is limited to targeting only 20% of the kelp plants in the bed. Although there may be some mortality from recreational harvesting, the impact is likely to be negligible compared to the high natural mortality that already occurs in the dynamic environment. There is no concern for impacts on other species, because incidental capture is mitigated by the hand-harvesting methods.

Management is precautionary by assessing license applications individually and employing license conditions that restrict harvesters to a conservative harvest rate and a harvest method that limits the impacts to the plant. Inventories have not been updated for more than 20 years and, though there are proposals to conduct new stock assessments in collaboration with First Nations in the coming years, there is no postharvest analysis of fishery impacts. Stakeholder consultation with First Nations in whose territory the activity is occurring is a legislated requirement from the province and is undertaken for every license. First Nations engagement is supported in the Northern Shelf Bioregion by the Marine Plan Partnership for the North Pacific Coast (MaPP) Regional Kelp Monitoring Program. At more regional and local levels, efforts to encourage kelp forest growth have included the reintroduction of sea otters and/or the removal of sea urchin: both strategies intend to slow the loss of kelp via urchin predation (Hamilton et al. 2022). Some of these strategies have been developed alongside First Nations communities, to target the needs of their local environments, such as the need for healthy kelp forests along the coast of Gwaii Haanas National Park, where the Haida Nation has implemented an urchin cull experimental program to preserve habitat for significant rockfish and abalone species (Hamilton et al. 2022).

No ecosystem assessments have been conducted, nor is there any robust spatial management currently employed with specific regard for either species. Although both *Macrocystis* and *Nereocystis* are foundational species in kelp forest ecosystems and are important as food and shelter, studies have shown that small-scale harvesting of kelp canopy has a minimal impact on other kelp forest species, compared to natural dynamics. Therefore, it is unlikely that negative ecosystem effects will occur as a result of small-scale harvest activities, compared to natural dynamics, and it is unlikely that negative ecosystem effects will occur for either species as a result of the current level of harvest activities. As a result of all these findings, the harvests of both bull and giant kelp are rated green.

# Introduction

## Scope of the analysis and ensuing rating

This report assesses the sustainability of harvesting two kelp species, giant kelp (*Macrocystis pyrifera* spp.) and bull kelp (*Nereocystis luetkeana*), along the entire coast of British Columbia, Canada. The recommendation covers harvesting by hand, using a cutting implement to trim fronds and blades.

## Species Overview

The two largest marine plants, *Macrocystis* and *Nereocystis*, are brown algae in the order Laminariales. These species are often known as “floating” or “canopy” kelps because, although they anchor to rock or gravel on the seafloor through their holdfast, much of their stipe and blades float at the surface, forming a dense canopy (Wheeler 1990)(Steneck et al. 2002). Both species tend to grow in expansive kelp beds or forests along the coastline, often together in mixed assemblages, forming one of the most productive ecosystems in the world (Wheeler 1990)(Lucas et al. 2007). In British Columbia, kelp forests are extremely dynamic ecosystems that are heavily affected by environmental conditions. *Nereocystis* is an annual plant that dies each fall, while *Macrocystis*, which can typically live 4–8 years (North 1987), generally survives only 1–2 years on the BC coast (Druehl and Wheeler 1986).

Both *Macrocystis* and *Nereocystis* are vulnerable to grazing by a variety of herbivores, including sea urchins, fish, crustaceans, and molluscs. Sea urchin grazing is a particularly powerful driver: when urchin predators such as sea otters are absent, urchins have the ability to clear-cut whole kelp forests, leaving “barrens” in their place (North 1987)(Tegner and Dayton 2000)(Steneck et al. 2002). A 23-year study along the west coast of Vancouver Island found a highly predictable relationship between sea otters and the rocky reef community phase state. When sea otters are present, algae dominate and urchins are rare, with the opposite true if otters are continuously absent (Watson and Estes 2011). Kelp ecosystems are strengthened when there is top-down control on urchins, thus reinforcing the resilience of kelp forests and reducing the persistence of urchin barrens (Burt et al. 2018).

***Macrocystis***

*Macrocystis* has a broad geographic range with a high degree of variability in physiology and life history, depending on its local environment (Graham et al. 2007). In the Northern Hemisphere, it is distributed along the Pacific coast of North America, and in the Southern Hemisphere, it is found around every continent except Antarctica

(North 1987)(Guiry 2017). Though maximum depth can be as much as 55 m in southern Argentina, *Macrocystis* in British Columbia occurs only in depths to 10 m and in areas with low seasonal variations in temperature or salinity (Druehl 1978)(Graham et al. 2007). Fronds grow out of the holdfast and are buoyed by gas-filled pneumatocysts that join blades to the frond, allowing a canopy to form when they reach the surface, with the largest plants having 40–60 fronds (North 1987)(Graham et al. 2007). Growth occurs through the apical meristem at the frond tip: if the frond is cut, the meristem is removed, thus preventing regrowth (Figure 1); however, the plant can recover through the growth of new fronds from the holdfast to form a new surface canopy (North 1987). Production is high, with growth shown to reach 30 cm/day during the peak growing season {Krumhansl *et al.* 2017). Although considered a perennial plant that usually lives 4–8 years (Druehl and Wheeler 1986)(Wheeler 1990)(Guiry 2017), the dynamic coastal environment of BC means that few plants live more than 2 years (Druehl and Wheeler 1986).

Adult *Macrocystis* plants (known as sporophytes) mature between 6 and 12 months of age, growing reproductive blades (sporophylls) near the base of the frond just above the holdfast (Figure 2) (Wheeler 1990). Sporophylls can number more than 100 on an individual plant and are extremely fecund, producing spores year-round (North 1987)(Wheeler 1990)(Graham et al. 2007). The zoospores contain a single set of chromosomes, which disperse and form microscopic male and female plants if they successfully settle. Provided they settle close enough together, the male plants will fertilize the female and a new sporophyte will grow from the female plant (Wheeler 1990). Fertilization requires the settled zoospores to be within a few millimetres of each other, so dispersal is typically spatially limited to within a few hundred meters from the kelp bed (North 1987). Nonetheless, detached sporophytes can remain reproductively viable for over 125 days as they drift, which aids long-distance colonization (Graham et al. 2007). Recruitment in BC kelp forests is continuous, with recruits making up 20-80% of the population (Druehl and Wheeler 1986).

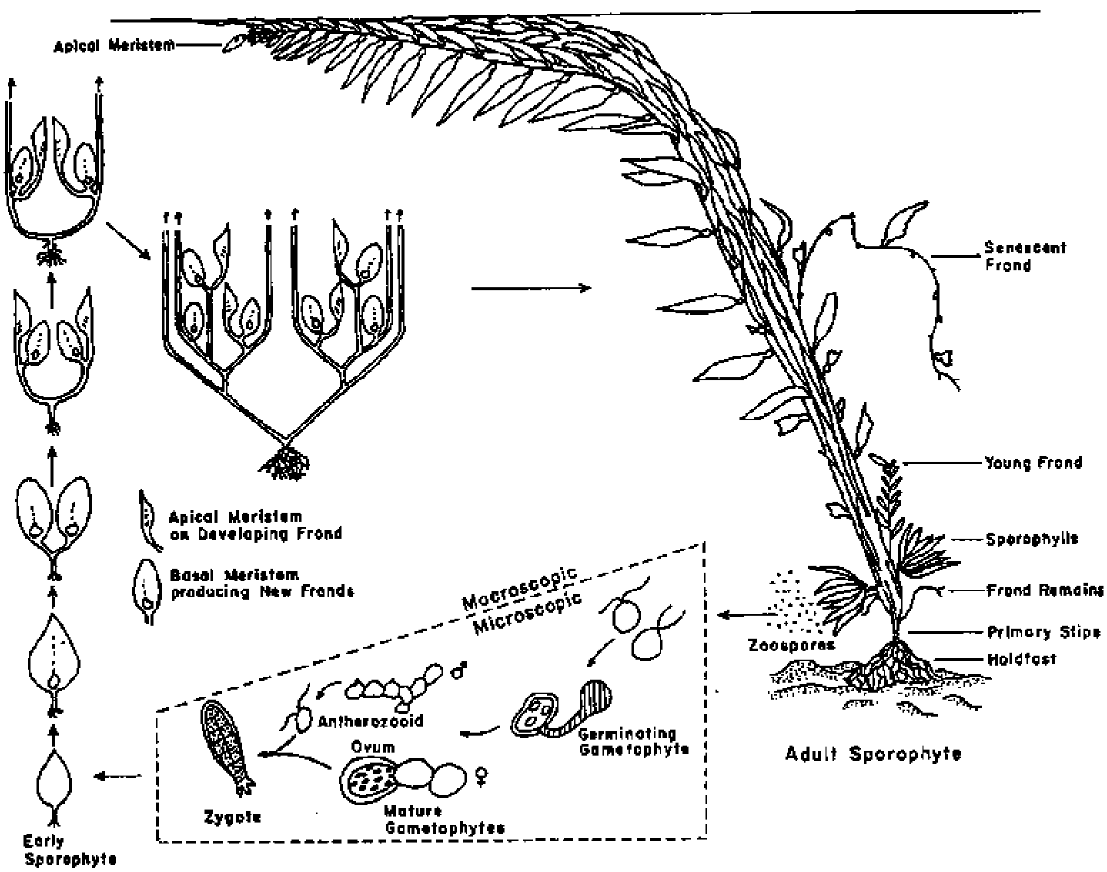


**Figure 1:** *Macrocystis* growth (North 1987).

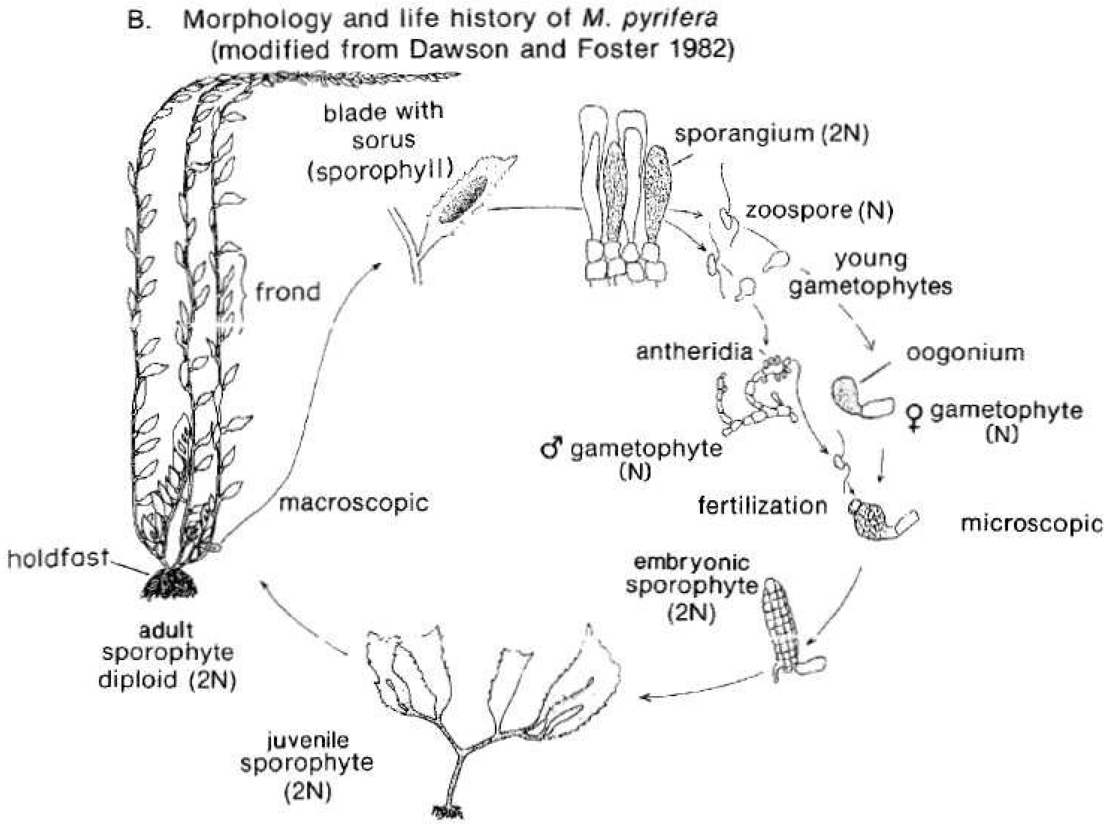


**Figure 2:** The morphology and life history of kelp, using *Macrocystis* as an example (Foster and Schiel 1985).

### *Nereocystis*

*Nereocystis* is distributed from Unmak Island, Alaska, to Point Conception, California and is found in rocky habitat 3 to 20 m deep, in areas of high water movement {Vadas, R.L. 1972}(Wheeler 1990)(Carney et al. 2005)(Springer et al. 2010). Also known as bull kelp, this is the only species of kelp in the Salish Sea that forms canopies (Dobkowski and Crofts 2021). The sporophyte grows a bladeless stipe from the holdfast, ending in a surface float from which tens of blades ultimately grow (Figure 3) (Wheeler 1990). Bull kelp has an annual growing season starting in January and February, and grows more quickly throughout the year as it moves from a more proportional juvenile growth phase at a maxium rate of 14 cm per day (Dobkowski and Crofts 2021)(British Columbia Marine Conservation Analysis 2013). But by October and November, most of the adult plants are lost as the stipe breaks under the force of winter storms, resulting in the eventual destruction of the bed (Foreman, R.E 1984)(Wheeler 1990)(Springer et al. 2010)(Foreman, R.E 1984)(Wheeler 1990)(Springer et al. 2010). Unlike *Macrocystis,* the *Nereocystis* plant has a single pneumatocyst attached to the end of a long slim stipe, which holds several blades near the surface of the water (Springer et al. 2007). An adult sporophyte may hold 30–60 blades, which grow up to 4 m long (Springer et al. 2010).

Reproduction occurs through the broadcasting of spores (see Figure 2), which are produced in visible dark patches (“sori”; singular “sorus”) on the blades, and peaks in September and early October (Foreman, R.E 1984). *Nereocystis* is one of the most reproductively productive species in the world, producing approximately 3.7 × $10^{12}$ spores per plant in a single season (Scagel 1961)(Joska and Bolton 1987).

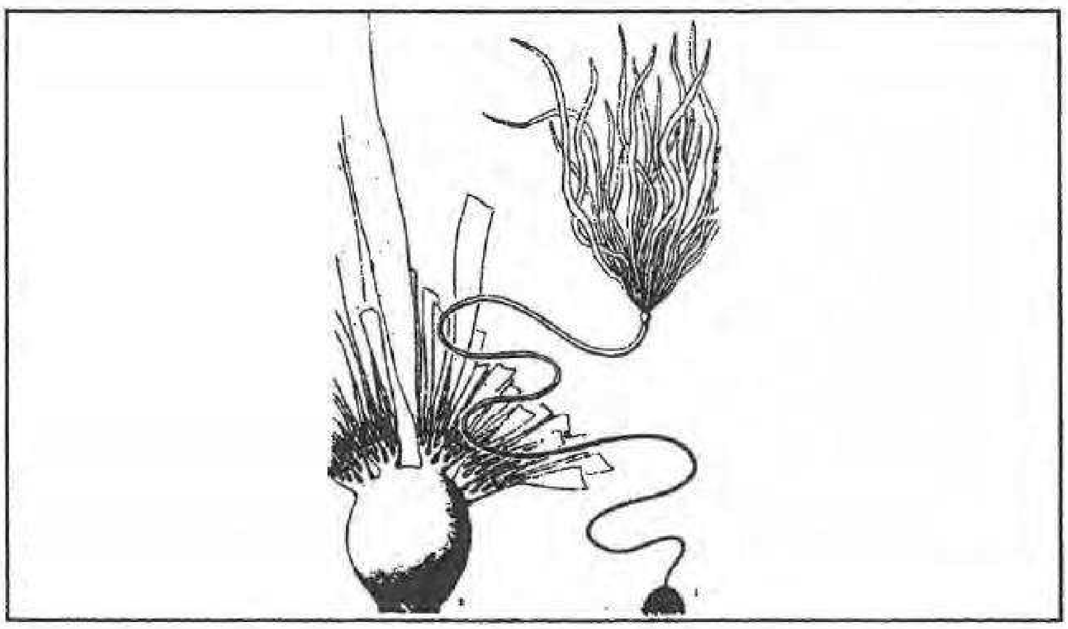

**Figure 3:** *Nereocystis*. Close up of pneumatocyst (left) and whole plant (right) (Smith 1944).

## Kelp in British Columbia

Between 1967 and 2007, the provincial government conducted a series of inventories of kelp beds (specifically for *Macrocystis* and *Nereocystis*) in British Columbia that had the potential for commercial harvest (Figure 4). These inventories were created using a method known as KIM-I (Kelp Inventory Method-I) developed by Foreman (Foreman, R.E 1984) that uses aerial infrared photographs to determine the surface cover, combined with ground-truthed data from surveys (Wheeler 1990).

Resource limitations restricted the number of surveys, with only 13 taking place during 30 years, and most places were surveyed only once (Lucas et al. 2007). But wherever repeat surveys have given the opportunity to observe changes over time, differences in both species composition and stock biomass have been noted (Field, E.J. and Clark, E.A.C. 1978)(Sutherland 1990)(Sutherland 1998)(Sutherland 1999)(Sutherland et al. 2008). The provincial government supports kelp monitoring in collaboration with First Nations Partners through the Marine Plan Partnership for the North Pacific Coast (MaPP) Regional Kelp Monitoring Program, which began in 2018. “This regionally-coordinated program utilizes existing institutions, such as First Nations Guardian Watchmen programs, to conduct a tiered program of information gathering using different survey types, including drone, kayak, and SCUBA surveys, to collect kelp forest data based on the needs and logistic capacity in each area” (Hamilton et al. 2022). In 2022, the BC government began investing in the monitoring and sustainability of wild giant kelp harvest on Haida Gwaii, using various data collection methods (sensors, digital imagery, remote operated vehicles, etc.) to gather environmental data and to evaluate stressors on kelp forests (DFO 2022).

Several local-scale monitoring programs of kelp beds have been conducted by other institutions around the coast, which have also tracked changes in abundance over time, including in the Georgia Strait, where losses of *Nereocystis* in the central Strait region (Lamb et al. 2011) and the west coast of Vancouver Island (Watson and Estes 2011) were noted. Specific reasons for the changes over time are largely unknown, although environmental factors in dynamic systems can have a significant effect (Sutherland et al. 2008). A strong link between the presence of sea otters and an algae-dominated community has been demonstrated on the west coast of Vancouver Island, because otters prey on urchin (Watson and Estes 2011). Sea temperature changes, as well as El Nino, have been suggested as possible reasons for changes in *Nereocystis* extent (Sutherland 1990)(Lucas et al. 2007)(Heath et al. 2015). Preliminary genetic studies have suggested that *Nereocystis* along the Pacific coast belong to four “clusters.” Current speed, temperature, and substrate type have been shown to affect kelp canopy resilience and growth in places where studies have found that colder, more exposed areas were favorable for growth; whereas periods of intense warming, such as the 2014–19 marine heatwave, caused considerable decline in some parts of BC (Starko et al. 2022)(Starko et al. 2024)(Mora-Soto et al. 2024). This means that, although kelp have shown resilience to warming and are among the most abundant coastal marine habitats, they are vulnerable to climate change and may require targeted conservation efforts in the future (Starko et al. 2024).

*Nereocystis* in the Georgia Strait and Puget Sound, where kelp bed declines have also been observed (Mumford, T.F. 2007)(Schroeder et al. 2020), are part of the same “cluster,” which has fewer alleles. Potentially, this cluster is less adaptive to environmental changes, such as temperature or pollution, than populations in other clusters like those in the Juan de Fuca Strait, where the kelp canopy area has increased over time (Berry et al. 2005).

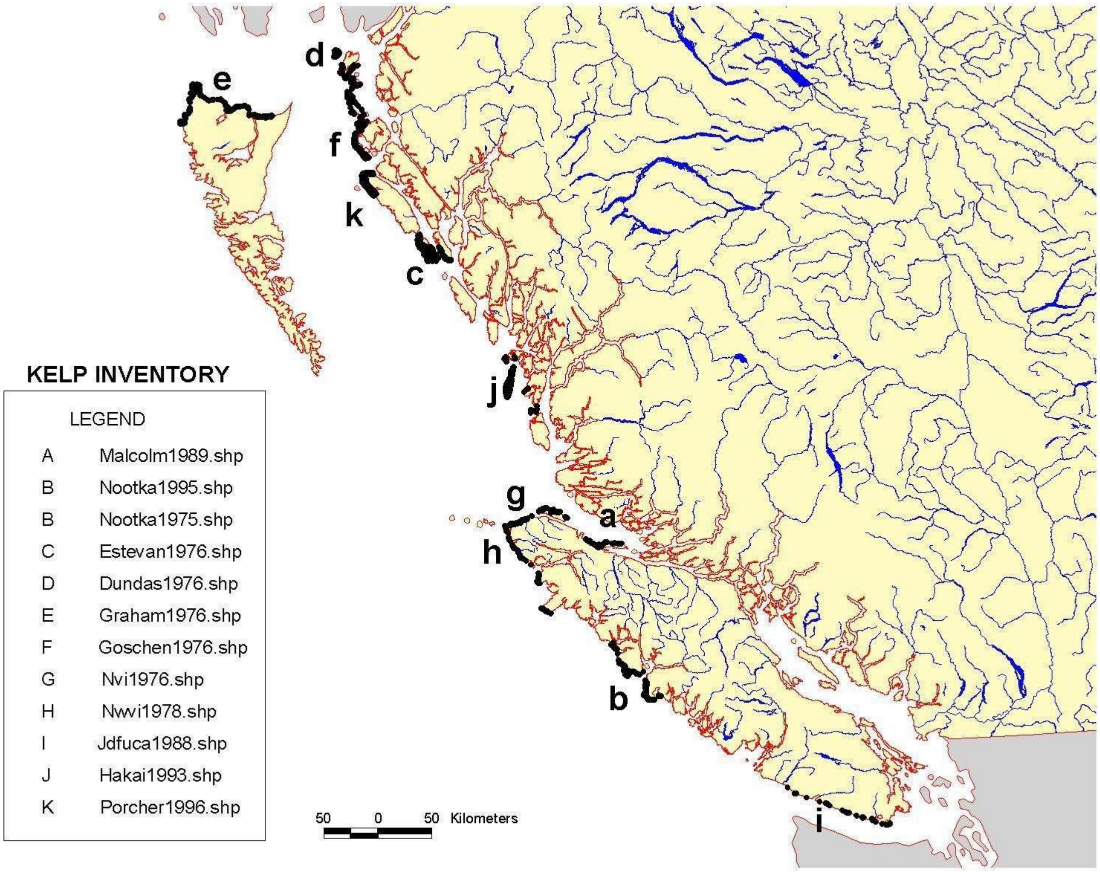


**Figure 4:** Map of kelp bed inventories in British Columbia, 1976–1996. The legend indicates the survey year. A 2007 inventory is not shown, but took place in the same area as the “j” survey (Sutherland et al. 2008).

### History of the fishery and its management

Historically, kelp have been harvested primarily for their alginates—components that have a variety of industrial uses, including food processing, fertilizer, and construction (Scagel 1961)(Lewis 1985)(Wheeler 1990). While a significant industry developed in some parts of the world (for example, in California for *Macrocystis*), several attempts to harvest on an industrial scale in British Columbia have failed. The first project was initiated in 1946 and activities peaked in the late 1960s and early 1970s, with 44 harvesting licenses held by 6 companies for the BC coast (Wheeler 1990)(Malloch 2000). But these occasions, as well as initiatives in the 1980s, either failed to launch completely or operated only briefly due to a combination of financial and political complications (Malloch 2000). Since then, harvesting has been confined to small-scale operations that mostly yield less than 100 MT annually (Malloch 2000). A large portion of the kelp harvested in BC is *Macrocystis*, and much of it is gathered specifically by the herring spawn-on-kelp (SOK) fishery. This fishery involves either attaching kelp fronds to ropes and introducing them to herring that have been captured and contained in a pond or depositing the fronds in wild spawning areas. The fish lay eggs on the fronds (the fish in ponds are then released unharmed), with the herring roe gathered together with the kelp and brined before being shipped to market (Malloch 2000). Other small-scale operations harvest both *Macrocystis* and *Nereocystis* and dry them for consumption or process them into cosmetics and fertilizers, or as feed in mariculture (Valdez et al. 2003)(Springer et al. 2007).

Until 2017, management of the kelp fishery in British Columbia has been the remit of the Ministry of Agriculture. But after a provincial strategic review in light of the Fish and Seafood Act (Fish and Seafood Act 2022), it was determined that management of aquatic plants better fit the mandate of the Ministry of Forests, Lands and Natural Resource Operations, and recently responsibility was transferred to the Ministry of Water, Land and Resource Stewardship. There is currently no specific management plan for kelp harvesting in British Columbia.

Kelp harvesting licenses are awarded every year between February and June for particular areas of the coast, based on applications received the previous year and depending on a number of factors such as technical review and consultation. Harvest areas are defined by the management areas within Fisheries and Oceans Canada (DFO) Pacific Fishery Management Areas (PFMAs) and may be modified based on a number of factors, including from First Nations consultation. There are 555 subareas that contain shoreline and possible kelp habitat (DFO 2007), although many of these areas may be without kelp, such as those in the Georgia Strait (DFO 2017).

Harvesters request quotas for one or more subareas, and the applications are assessed on a case-by-case basis by the Ministry. In 2017, there were 32 applications for *Macrocystis* and *Nereocystis* harvesting (Table 1). Harvesters who use *Macrocystis* for the SOK fishery also need a separate fishing license, issued by Fisheries and Oceans Canada (DFO), known as a J-License. *Macrocystis* and *Nereocystis* license conditions require that all kelp harvesting be done by hand with a cutting tool. In addition, the kelp must only be trimmed; removal of the holdfast is prohibited (Fish and Seafood Act 2022).

Recreational fishing of kelp is unlicensed and the extent is unknown. In BC, harvesting less than 100 kg (wet weight) of kelp for personal use does not require a wild aquatic plant license and must be carried out in accordance with license conditions (Fish and Seafood Act 2022). But because both species are subtidal (Lucas et al. 2007), they are hard to access without boats, and opportunistic harvesters may lack incentive.

Therefore, recreational harvests are likely to be highly localized and a minor component of the fishery.

**Table 1**

| Species | Number of Applications | Quota Requested (MT) |
|---|---|---|
| *Nereocystis luetkeana* | 6 | 45.0 |
| *Macrocystis pyrifera* | 20 | 836.0 |
| Both species | 6 | 22.5 |
| Total | 32 | 903.5 |

Applications in 2017 for *Macrocystis* and *Nereocystis* harvest. Note: 700 MT of the *Macrocystis* quota requested were from a single application (MFLNRO unpublished data).

# Production Statistics

Production increased 43% between 2014 and 2016, from 281 MT to 400 MT, respectively (Table 2). The 2016 harvest represents almost double the production from the early 2000s, which totaled approximately 200 MT per year (Figure 5). The actual harvest did not meet the quota requested in any year between 2014 and 2016.

**Table 2**

| Year | Approved quota (MT) | Actual harvest (MT) |
|---|---|---|
| 2016 | 676.00 | 402.75 |

| | | |
|---|---|---|
| 2015 | 649.00 | 329.00 |
| 2014 | 887.00 | 281.00 |

Combined *Macrocystis* and *Nereocystis* harvest in British Columbia, 2014–16. Source: MFLNRO (unpublished data).

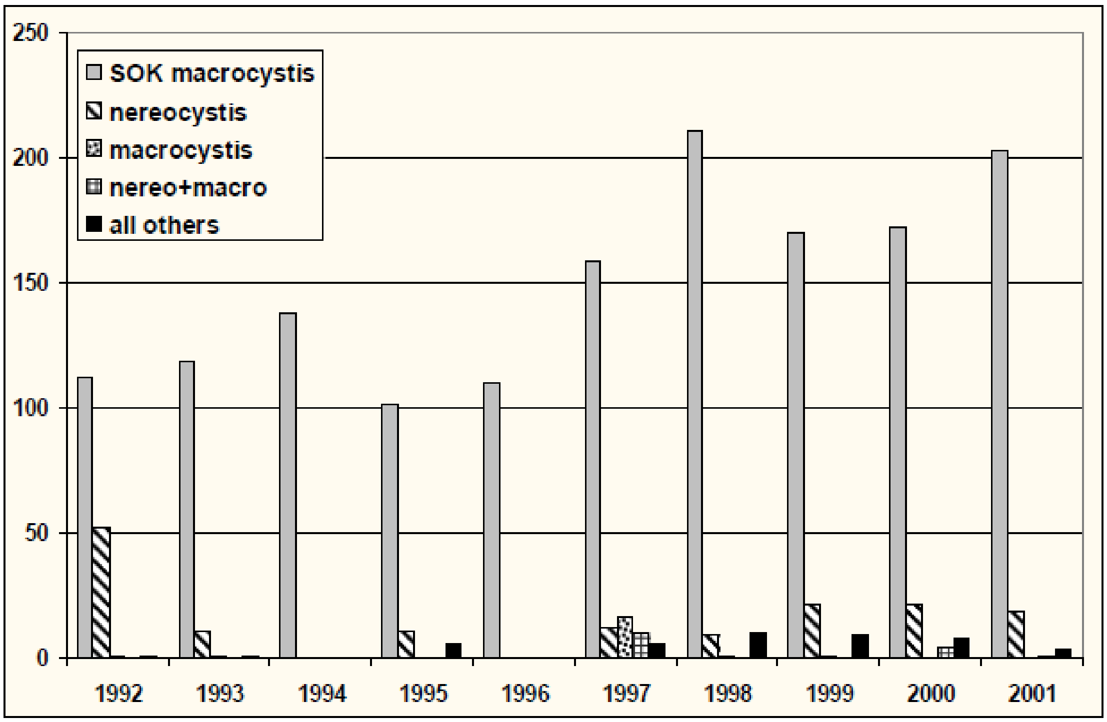


**Figure 5:** Kelp harvest (mt) in British Columbia 1992–2001 (Lucas et al. 2007).

## Importance to the US/North American market.

No data are available for small-scale kelp harvesting operations in terms of trade; their product is largely sold directly online or in local markets (A. Swinimer personal communications 2024). *Macrocystis* used in the SOK fishery is almost entirely exported to Japan, with virtually all processing done on arrival; only about 2% is consumed in North American Japanese restaurants (Edwin Blewett & Associates Inc 2001). The addition of herring spawn to kelp increases the value of both the roe and the kelp significantly (Malloch 2000)(Edwin Blewett & Associates Inc 2001); however, weak demand in Japan has seen both landings and the landed value decline in recent years (Nelson, S. 2014), dropping from $29–44/kg in 2013 to $15–26/kg in 2016.

## Common and market names.

Until recently, the *Macrocystis* genus was thought to contain four species because of their morphological differences; however, molecular analyses conducted in the 2000s suggested that the genus should contain only one species: *M. pyrifera* (Demes et al. 2009)(Macaya and Zuccarello 2010). Although most historical literature refers to giant kelp in BC in its *M. integrifolia* form, this report follows the current scientific consensus and recognizes *M. pyrifera* (formerly *integrifolia*) as the giant kelp species in BC, and refers to the algae as *Macrocystis* throughout {Lindstrom 2023}. More recently, it has been recommended that all northeastern Pacific Ocean specimens north of Point Conception, California, which were previously recognized as *M. integrifolia* and *M. pyrifera*, now be called *M. tenuifolia* (Sandra C. Lindstrom 2023). But this designation is pending further molecular work and is not widely implemented at the time of this assessment. Likewise, as the only species in the genus, *N. luetkeana* is referred to as *Nereocystis* in this report.

**Other common names:**
*Macrocystis pyrifera*: giant kelp (Scagel 1961), bladder kelp (NZMPI 2017).

*Nereocystis luetkeana*: bull kelp, ribbon kelp, bullwhip kelp, sea whip, bladder kelp (Guiry 2017).

## Primary product forms

Both kelp species are primarily sold directly to chefs or individuals online or through local markets. Wild harvested kelp is most often sold fresh (whole), dried, pickled, or flaked.

# Final Ratings

| Ratings Details | C 1 Target Species | C 2 Other Species | C 3 Management | C 4 Habitat | Rating |
|---|---|---|---|---|---|
| **Bull kelp**<br>Canada \| British Columbia \| Northeast Pacific Ocean \| Hand implements | 3.413 | 5.000 | 3.000 | 3.873 | Green (3.752) |
| **Giant kelp**<br>Canada \| British Columbia \| Northeast Pacific Ocean \| Hand implements | 3.413 | 5.000 | 3.000 | 3.873 | Green (3.752) |

## Summary

Both bull kelp and giant kelp harvested in British Columbia using hand implements are rated green, based on the species' low vulnerability and unknown density, the minimal impact on other species, moderately effective management, and minimal concerns regarding impacts to the ecosystem.

# Assessments

This section assesses the sustainability of the fishery(s) relative to the Seafood Watch Standard for Fisheries, available at www.seafoodwatch.org. The specific standard used is referenced on the title page of all Seafood Watch assessments.

# Criterion 1: Impacts on the Species Under Assessment

*This criterion evaluates the impact of fishing mortality on the species, given its current abundance. When abundance is unknown, abundance is scored based on the species' inherent vulnerability, which is calculated using a Productivity-Susceptibility Analysis. The final Criterion 1 score is determined by taking the geometric mean of the abundance and fishing mortality scores. The Criterion 1 rating is determined as follows:*

- Score >3.2 = **Green** or Low Concern
- Score >2.2 and ≤3.2 = **Yellow** or Moderate Concern
- Score ≤2.2 = **Red** or High Concern

*Rating is Critical if Factor 1.3 (Fishing Mortality) is Critical.*

### Guiding principles

- *Ensure all affected stocks are healthy and abundant.*
- *Fish all affected stocks at sustainable level*

## Criterion 1 Summary

| Bull kelp | | | |
|---|---|---|---|
| **Region / Method** | **Abundance** | **Fishing Mortality** | **Score** |
| Canada \| British Columbia \| Northeast Pacific Ocean \| Hand implements | 2.330 Moderate Concern | 5.000 Low Concern | **Green (3.413)** |

| Giant kelp | | | |
|---|---|---|---|
| **Region / Method** | **Abundance** | **Fishing Mortality** | **Score** |
| Canada \| British Columbia \| Northeast Pacific Ocean \| Hand implements | 2.330 Moderate Concern | 5.000 Low Concern | **Green (3.413)** |

**Key relevant information:**
Stock assessments for kelp have been undertaken by the provincial government intermittently across British Columbia since 1967; however, most beds have been surveyed only once (Lucas et al. 2007). The most recent survey was in 2007. Other monitoring studies have indicated that kelp beds exhibit high variation in abundance over time (Berry et al. 2005)(Watson and Estes 2011). Because of the lack of stock assessments for both kelp species, a productivity-susceptibility analysis (PSA) was conducted and it determined that both *Macrocystis* and *Nereocystis* have low vulnerability.

Recent studies on kelp throughout BC suggest that, while canopy kelp forests have experienced variable patterns of change across coastal BC, with some areas experiencing persistence or even increases in canopy kelp, there have also been recent and substantial declines in some focal areas. The concurrent evidence of declines suggests that kelp forest ecosystems in several parts of BC may be threatened, which warrants conservation concern. Combined with the fact that actual abundance for both species is unknown because stock assessments are more than 10 years old, abundance is a “moderate concern.”

# Criterion 1 Assessment

# Scoring Guidelines

## Factor 1.1 - Abundance

Goal: Stock abundance and size structure of native species is maintained at a level that does not impair recruitment or productivity.

- *5 (Very Low Concern) — Strong evidence exists that the population is above an appropriate target abundance level (given the species’ ecological role), or near virgin biomass.*
- *3.67 (Low Concern) — Population may be below target abundance level, but is at least 75% of the target level, OR data-limited assessments suggest population is healthy and species is not highly vulnerable.*
- *2.33 (Moderate Concern) — Population is not overfished but may be below 75% of the target abundance level, OR abundance is unknown and the species is not highly vulnerable.*
- *1 (High Concern) — Population is considered overfished/depleted, a species of concern, threatened or endangered, OR abundance is unknown and species is highly vulnerable.*

## Factor 1.2 - Fishing Mortality

Goal: Fishing mortality is appropriate for current state of the stock.

- *5 (Low Concern) — Probable (>50%) that fishing mortality from all sources is at or below a sustainable level, given the species ecological role, OR fishery does not target species and fishing mortality is low enough to not adversely affect its population.*
- *3 (Moderate Concern) — Fishing mortality is fluctuating around sustainable levels, OR fishing mortality relative to a sustainable level is uncertain.*
- *1 (High Concern) — Probable that fishing mortality from all source is above a sustainable level.*

# Bull kelp *(Nereocystis luetkeana)*

## 1.1 Abundance

## Northeast Pacific | Canada | British Columbia | Hand implements

## Moderate Concern

*Nereocystis* has diminished from the Strait of Georgia and Puget Sound over the last two decades {Mumford 2007}(Lamb et al. 2011), and though there is evidence of bull kelp decline from 2005 to 2017, the impacts on total population growth are unknown, and more evidence is required to distinguish trends from natural variability (Schroeder et al. 2020). Therefore, a productivity-susceptibility analysis was used, which showed low vulnerability. Because of the unknown status of bull kelp beds throughout BC and the use of a PSA, abundance received a "moderate concern" score.

## Supplementary Information

Productivity-Susceptibility Analysis for bull kelp (*Nereocystic luetkeana*)

**Table 3**

| Productivity Attribute | Relevant Information | Score (1 = low risk, 2 = medium risk, 3 = high risk) |
|---|---|---|
| **Average age at maturity** | One year. *Nereocystis* is an annual plant (Wheeler 1990). | 1 |
| **Average maximum age** | As an annual, *Nereocystis* dies at the end of each season. | 1 |
| **Fecundity** | The most fecund kelp species. Produces $3.7 \times 10^{12}$ spores per plant, three orders of magnitude larger than other kelps, except *Macrocystis* (Scagel 1961)(Joska and Bolton 1987). | 1 |
| **Reproductive strategy** | Broadcast spawner (Wheeler 1990) | 1 |
| **Trophic level** | Kelps are foundational species, photosynthesizing to produce energy at the base of food webs. | 1 |

| Productivity score | | 1 |
|---|---|---|

## Table 4

| Susceptibility Attribute | Relevant Information | Score (1 = low risk, 2 = medium risk, 3 = high risk) |
|---|---|---|
| **Areal overlap** (Considers all fisheries) | Plant harvest is limited to 20% of the available biomass (Ministry of Agriculture 2017). But harvest intensity along the coast is so low on an entire-coast scale that the majority (> 90%) of the species concentration is unharvested. Other harvesting in the habitat, such as urchin fishing, is unlikely to have direct impact on the kelp bed or individual plant. | 1 |
| **Vertical overlap** (Considers all fisheries) | Although harvesting only targets the part of the plant at the surface, representing a small part of the depth range, this is where the primary productivity and reproductive areas are (Springer et al. 2010), therefore putting *Nereocystis* at high risk. | 3 |
| **Seasonal availability** | Plants are harvested in a manner that allows regrowth throughout the season, where only 5–10% of the total seasonal production is harvested (Wheeler 1990). But seasonal trends in the fishery are unknown. | 3 |
| **Selectivity of fishery** (Specific to fishery under assessment) | Fishery is highly selective, targeting *Nereocystis* individually. | 3 |
| **Post-capture mortality** (Specific to fishery under assessment) | Properly harvested, blades are trimmed so that mortality does not occur (Ministry of Agriculture 2017). | 1 |
| **Susceptibility score** | | **2.200** |

**Inherent Vulnerability:** 2.417—Low Vulnerability

## 1.2 Fishing Mortality

## Northeast Pacific | Canada | British Columbia | Hand implements

## Low Concern

Neither *Macrocystis* nor *Nereocystis* suffer mortality when harvested according to BC license regulations. Instead, harvesters cut the blades or stipe at limited lengths or depths, allowing for regrowth across the season (Wheeler 1990)(Ministry of Agriculture 2017). Although the extent of recreational fishing is unknown and may involve mortality by incorrect harvesting techniques, the impact is likely to be negligible relative to the high natural mortality in a dynamic environment. Therefore, it is highly likely that mortality from all sources is at a sustainable level, and this criterion is rated a "low concern."

## Supplementary Information

Kelp harvesting performed in accordance with the license conditions does not result in mortality of the algae. Instead, in the case of *Macrocystis*, only 25% of the fronds are removed, or for *Nereocystis*, the blades are trimmed (Ministry of Agriculture 2017). In both cases, regrowth occurs. Because kelp plants are continually growing and losing material during the summer, the allowed harvest of 20% of the standing stock represents only approximately 5–10% of the total seasonal production (Wheeler 1990). In a study of small-scale *Macrocystis* harvesting, canopies fully recovered in most cases within 4 weeks of harvest (Krumhansl et al. 2017).

There are some concerns over the impacts of harvesting on kelp populations, particularly *Nereocystis*; however, these generally focus on methods involving mortality (e.g., harvesting the whole plant) (Springer et al. 2010). Even if *Nereocystis* mortality were to occur, studies suggest that the kelp community is relatively robust, with Foreman (Foreman, R.E 1984) reporting that 100 m strips could be clear-cut in *Nereocystis* assemblages without risk to the resource. Similarly, regular harvesting by hand of *Macrocystis* in California at 1.2 m below the waterline had no impact on local stocks (Dayton et al. 1998), nor did similar harvesting in Alaska (van Tamelen and Woodby 2001).

Province-wide, harvesting pressure is quite small, with historically few individuals harvesting wild kelp (A. Swinimer personal communications 2024), making harvest impacts highly localized; however, the harvest limitation to 20% of plants in any bed should spread effort enough to minimize such impacts. Some kelp mortality may occur through recreational harvesting because of a lack of regulation and education, though it is likely to be concentrated around coastal communities where kelp beds are accessible. But both *Macrocystis* and *Nereocystis* have short life-cycles and high recruitment, with highly dynamic populations as a result of susceptibility to natural disturbances (Tegner and Dayton 2000). Because there is no evidence to suggest that harvesting greatly contributes to mortality, it is likely that mortality from unlicensed commercial methods or small recreational harvests will have a negligible effect.

It is also important to consider the scale of harvest. A particular *Macrocystis* bed in California is estimated to produce 33,000 MT/year of drift kelp (i.e., broken fronds and plants that drift on the current). Hand-harvesting from the same bed produces 600 MT/yr, which represents an equivalent of only around 2% of the biomass lost as drift kelp (Donnellan and Foster 1999). Given that the total kelp gathered in BC is less than 500 MT as of 2017 (MFLNRO, unpublished data), harvest impacts on mortality are likely to be small in comparison to natural environmental drivers.

# Giant kelp *(Macrocystis pyrifera)*

## 1.1 Abundance

## Northeast Pacific | Canada | British Columbia | Hand implements

## Moderate Concern

Although evidence suggests that giant kelp forests have been declining, it is largely due to environmental changes and not likely a result of overexploitation from harvest (Sutherland et al. 2008). The impact on giant kelp abundance from harvesting activities is largely unknown. Therefore, a productivity-susceptibility analysis was used, which showed low vulnerability. Considering the unknown abundance, the distribution of giant kelp beds throughout BC, and the use of a PSA, abundance receives a "moderate concern" rating.

## Supplementary Information

Productivity-Susceptibility Analysis for giant kelp (*Macrocystis pyrifera*)

**Table 5**

| Productivity Attribute | Relevant Information | Score (1 = low risk, 2 = medium risk, 3 = high risk) |
|---|---|---|
| **Average age at maturity** | Zoospore production beings at 6–12 months age (North 1987). | 1 |
| **Average maximum age** | Approximately 2 years. *Macrocystis* is a perennial plant, but the high dynamics of the BC coast mean that it rarely lives beyond 2 years (Druehl and Wheeler 1986)(Wheeler 1990). But giant kelp has been known to live as long as 7 years (National Parks Service 2022). | 1 |
| **Fecundity** | Extremely high fecundity, estimated at 10,000 sporangia/$cm^2$ (North 1987), or $3.15 \times 10^{12}$ spores per plant (Joska and Bolton 1987). | 1 |
| **Reproductive strategy** | Broadcast spawner (Wheeler 1990) | 1 |
| **Trophic level** | Kelps are foundational species, photosynthesizing to produce energy at the base of food webs. | 1 |
| **Productivity Score** | | **1** |

## Table 6

| Susceptibility Attribute | Relevant Information | Score (1 = low risk, 2 = medium risk, 3 = high risk) |
|---|---|---|
| **Areal overlap** (Considers all fisheries) | Plant harvest is limited to 20% of the available biomass (Ministry of Agriculture 2017). But the harvest intensity along the coast is so low on an entire-coast scale that the majority (> 90%) of the species concentration is unharvested. Other harvesting in the habitat, such as urchin fishing, is unlikely to have direct impact on the kelp bed or individual plant. | 1 |

| | | |
|---|---|---|
| **Vertical overlap** (Considers all fisheries) | Only 25% of the plant is taken (Ministry of Agriculture 2017), so harvest overlap represents > 66% of the plant unfished. Other fisheries in the same space, such as diver-caught urchin, are unlikely to have direct impact on the plant. | 1 |
| **Seasonal Availability** (Considers all fisheries) | Plants are harvested in a manner that allows regrowth throughout the season, where only 5–10% of the total seasonal production is harvested (Wheeler 1990). But seasonal trends in the fishery are unknown. | 3 |
| **Selectivity of fishery** (Specific to fishery under assessment) | Fishery is highly selective, targeting *Macrocystis* individually. | 3 |
| **Post-capture mortality** (Specific to fishery under assessment) | Properly harvested, blades are trimmed so that mortality does not occur (Ministry of Agriculture 2017). In a study of small-scale *Macrocystis* harvesting, canopies fully recovered in most cases within 4 weeks of harvest (Krumhansl et al. 2017). | 1 |
| **Susceptibility score** | | **1.80** |

**Inherent Vulnerability:** 2.059—Low Vulnerability

## 1.2 Fishing Mortality

## Northeast Pacific | Canada | British Columbia | Hand implements

## Low Concern

Neither *Macrocystis* nor *Nereocystis* suffer mortality when harvested according to BC license regulations. Instead, harvesters cut the blades or stipe at limited lengths or depths, allowing for regrowth across the season (Wheeler 1990)(Ministry of Agriculture 2017). Although the extent of recreational fishing is unknown and may involve mortality by incorrect harvesting techniques, the impact is likely to be negligible relative to the high natural mortality in a dynamic environment. Therefore, it is highly likely that mortality from all sources is at a sustainable level, and this criterion is rated a “low concern.”

## Supplementary Information

Kelp harvesting performed in accordance with the license conditions does not result in mortality of the algae. Instead, in the case of *Macrocystis*, only 25% of the fronds are removed, or for *Nereocystis*, the blades are trimmed (Ministry of Agriculture 2017). In both cases, regrowth occurs. Because kelp plants are continually growing and losing material during the summer, the allowed harvest of 20% of the standing stock represents only approximately 5–10% of the total seasonal production (Wheeler 1990). In a study of small-scale *Macrocystis* harvesting, canopies fully recovered in most cases within 4 weeks of harvest (Krumhansl et al. 2017).

There are some concerns over the impacts of harvesting on kelp populations, particularly *Nereocystis*; however, these generally focus on methods involving mortality (e.g., harvesting the whole plant) (Springer et al. 2010). Even if *Nereocystis* mortality were to occur, studies suggest that the kelp community is relatively robust, with Foreman (Foreman, R.E 1984) reporting that 100 m strips could be clear-cut in *Nereocystis* assemblages without risk to the resource. Similarly, regular harvesting by hand of *Macrocystis* in California at 1.2 m below the waterline had no impact on local stocks (Dayton et al. 1998), nor did similar harvesting in Alaska (van Tamelen and Woodby 2001).

Province-wide, harvesting pressure is quite small, with historically few individuals harvesting wild kelp (A. Swinimer personal communications 2024), making harvest impacts highly localized; however, the harvest limitation to 20% of plants in any bed should spread effort enough to minimize such impacts. Some kelp mortality may occur through recreational harvesting because of a lack of regulation and education, though it is likely to be concentrated around coastal communities where kelp beds are accessible. But both *Macrocystis* and *Nereocystis* have short life-cycles and high recruitment, with highly dynamic populations as a result of susceptibility to natural disturbances (Tegner and Dayton 2000). Because there is no evidence to suggest that harvesting greatly contributes to mortality, it is likely that mortality from unlicensed commercial methods or small recreational harvests will have a negligible effect.

It is also important to consider the scale of harvest. A particular *Macrocystis* bed in California is estimated to produce 33,000 MT/year of drift kelp (i.e., broken fronds and plants that drift on the current). Hand-harvesting from the same bed produces 600 MT/yr, which represents an equivalent of only around 2% of the biomass lost as drift kelp (Donnellan and Foster 1999). Given that the total kelp gathered in BC is less than 500 MT as of 2017 (MFLNRO, unpublished data), harvest impacts on mortality are likely to be small in comparison to natural environmental drivers.

# Criterion 2: Impacts on Other Species

*All main retained and bycatch species in the fishery are evaluated under Criterion 2. Seafood Watch defines bycatch as all fisheries-related mortality or injury to species other than the retained catch. Examples include discards, endangered or threatened species catch, and ghost fishing. Species are evaluated using the same guidelines as in Criterion 1. When information on other species caught in the fishery is unavailable, the fishery's potential impacts on other species is scored according to the Unknown Bycatch Matrices, which are based on a synthesis of peer-reviewed literature and expert opinion on the bycatch impacts of each gear type. The fishery is also scored for the amount of non-retained catch (discards) and bait use relative to the retained catch. To determine the final Criterion 2 score, the score for the lowest scoring retained/bycatch species is multiplied by the discard/bait score. The Criterion 2 rating is determined as follows:*

- Score >3.2 = **Green** or Low Concern
- Score >2.2 and ≤3.2 = **Yellow** or Moderate Concern
- Score ≤2.2 = **Red** or High Concern

*Rating is Critical if Factor 2.3 (Fishing Mortality) is Crtitical*

## Guiding principles

- *Ensure all affected stocks are healthy and abundant.*
- *Fish all affected stocks at sustainable level.*
- *Minimize bycatch.*

## Criterion 2 Summary

### Criterion 2 score(s) overview

This table(s) provides an overview of the Criterion 2 subscore, discards+bait modifier, and final Criterion 2 score for each fishery. A separate table is provided for each species/stock that we want an overall rating for.

| Bull kelp | | | |
|---|---|---|---|
| Region / Method | Sub Score | Discard Rate/Landings | Score |
| Canada \| British Columbia \| Northeast Pacific Ocean \| Hand implements | 5.000 | 1.000: < 100% | Green (5.000) |

| Giant kelp | | | |
|---|---|---|---|
| Region / Method | Sub Score | Discard Rate/Landings | Score |
| Canada \| British Columbia \| Northeast Pacific Ocean \| Hand implements | 5.000 | 1.000: < 100% | Green (5.000) |

### Criterion 2 main assessed species/stocks table(s)

This table(s) provides a list of all species/stocks included in this assessment for each 'fishery' (as defined by a region/method combination). The text following this table(s) provides an explanation of the reasons the listed species were selected for inclusion in the assessment.

| Northeast Pacific \| Canada \| British Columbia \| Hand implements | | | |
|---|---|---|---|
| Sub Score: 5.000 | Discard Rate: 1.000 | | Score: 5.000 |
| Species | Abundance | Fishing Mortality | Score |
| Bull kelp | 2.330: Moderate Concern | 5.000: Low Concern | Green (3.413) |

| Northeast Pacific \| Canada \| British Columbia \| Hand implements | | | |
|---|---|---|---|
| Sub Score: 5.000 | Discard Rate: 1.000 | | Score: 5.000 |
| Species | Abundance | Fishing Mortality | Score |
| Giant kelp | 2.330: Moderate Concern | 5.000: Low Concern | Green (3.413) |

Bycatch of the kelp fishery is limited to animals and epiphytic algae that are attached to the plant at the time of harvesting and are directly removed with the kelp. Several species of invertebrates, fish, and algae colonize the kelp fronds, with the greatest diversity found near the holdfast (Graham et al. 2007).

There are no studies investigating the bycatch of small-scale kelp harvesting; although some fishers will visually inspect and generally shake off any attached animals, it is not a license requirement and it is likely that virtually all epifauna are removed with the kelp (A. Swinimer personal communications 2024). But harvest conditions for *Macrocystis* only allow removal of 25% of fronds on any plant, and *Nereocystis* harvesters must only trim the blades at the surface, while holdfast removal is explicitly prohibited for both kelps (Ministry of Agriculture 2017), so species utilizing the base of the plants are not affected.

Because there are no significant impacts on any other species, either as a main component of the catch or as a known primary source of mortality for a particularly species, Criterion 2 requires no further assessment for *Macrocystis* or *Nereocystis*, and a full score of 5 is assigned to this criterion.

# Criterion 2 Assessment

## Scoring Guidelines

### Factor 2.1 - Abundance

*(same as Factor 1.1 above)*

### Factor 2.2 - Fishing Mortality

*(same as Factor 1.2 above)*

### Factor 2.3 - Modifying Factor: Discards and Bait Use

Goal: Fishery optimizes the utilization of marine and freshwater resources by minimizing post-harvest loss. For fisheries that use bait, bait is used efficiently.

*Scoring Guidelines: The discard rate is the sum of all dead discards (i.e. non-retained catch) plus bait use divided by the total retained catch.*

| Ratio of bait + discards/landings | Factor 2.3 score |
|---|---|
| <100% | 1 |
| >=100 | 0.75 |

## 2.3 Discard Rate/Landings

### Northeast Pacific | Canada | British Columbia | Hand implements

### < 100%

There are negligible discards from this fishery, and any species attached to kelp fronds are likely removed by harvesters without significant mortality. Because of the hard-harvested nature of kelp, no bait is used. For these reasons, discards and bait use do not exceed 100% of landings.

# Criterion 3: Management Effectiveness

*Five factors are evaluated in Criterion 3: Management Strategy and Implementation, Bycatch Strategy, Scientific Research/Monitoring, Enforcement of Regulations, and Inclusion of Stakeholders. Each is scored as either 'highly effective', 'moderately effective', 'ineffective,' or 'critical'. The final Criterion 3 score is determined as follows:*

- *5 (Very Low Concern) — Meets the standards of 'highly effective' for all five factors considered.*
- *4 (Low Concern) — Meets the standards of 'highly effective' for 'management strategy and implementation' and at least 'moderately effective' for all other factors.*
- *3 (Moderate Concern) — Meets the standards for at least 'moderately effective' for all five factors.*
- *2 (High Concern) — At a minimum, meets standards for 'moderately effective' for Management Strategy and Implementation and Bycatch Strategy, but at least one other factor is rated 'ineffective.'*
- *1 (Very High Concern) — Management Strategy and Implementation and/or Bycatch Management are 'ineffective.'*
- *0 (Critical) — Management Strategy and Implementation is 'critical'.*

The Criterion 3 rating is determined as follows:

- Score >3.2 = **Green** or Low Concern
- Score >2.2 and ≤3.2 = **Yellow** or Moderate Concern
- Score ≤2.2 = **Red** or High Concern

*Rating is Critical if Management Strategy and Implementation is Critical.*

## Guiding principle

- The fishery is managed to sustain the long-term productivity of all impacted species.

*Five factors are evaluated in Criterion 3: Management Strategy and Implementation, Bycatch Strategy, Scientific Research/Monitoring, Enforcement of Regulations, and Inclusion of Stakeholders. Each is scored as either 'highly effective', 'moderately effective', 'ineffective,' or 'critical'. The final Criterion 3 score is determined as follows:*

# Criterion 3 Summary

| Fishery | Management Strategy And Implementation | Bycatch Strategy | Scientific Data Collection and Analysis | Enforcement of and Compliance with Management Regulations | Stakeholder Inclusion | Score |
|---|---|---|---|---|---|---|
| Northeast Pacific \| Canada \| British Columbia \| Hand implements | Moderately Effective | Highly effective | Moderately Effective | Moderately Effective | Moderately Effective | Yellow (3.000) |
| Northeast Pacific \| Canada \| British Columbia \| Hand implements | Moderately Effective | Highly effective | Moderately Effective | Moderately Effective | Moderately Effective | Yellow (3.000) |

# Criterion 3 Assessment

## Scoring Guidelines

### Factor 3.1 - Management Strategy and Implementation

*Considerations: What type of management measures are in place? Are there appropriate management goals, and is there evidence that management goals are being met? Do manages follow scientific advice? To achieve a highly effective rating, there must be appropriately defined management goals, precautionary policies that are based on scientific advice, and evidence that the measures in place have been successful at maintaining/rebuilding species.*

### Factor 3.2 - Bycatch Strategy

*Considerations: What type of management strategy/measures are in place to reduce the impacts of the fishery on bycatch species and when applicable, to minimize ghost fishing? How successful are these management measures? To achieve a Highly Effective rating, the fishery must have no or low bycatch, or if there are bycatch or ghost fishing concerns, there must be effective measures in place to minimize impacts.*

### Factor 3.3 - Scientific Research and Monitoring

*Considerations: How much and what types of data are collected to evaluate the fishery's impact on the species? Is there adequate monitoring of bycatch? To achieve a Highly Effective rating, regular, robust population assessments must be* *conducted for target or retained species, and an adequate bycatch data collection program must be in place to ensure bycatch management goals are met.*

## Factor 3.4 - Enforcement of Management Regulations

*Considerations: Do fishermen comply with regulations, and how is this monitored? To achieve a Highly Effective rating, there must be regular enforcement of regulations and verification of compliance.*

## Factor 3.5 - Stakeholder Inclusion

*Considerations: Are stakeholders involved/included in the decision-making process? Stakeholders are individuals/groups/organizations that have an interest in the fishery or that may be affected by the management of the fishery (e.g., fishermen, conservation groups, etc.). A Highly Effective rating is given if the management process is transparent, if high participation by all stakeholders is encouraged, and if there a mechanism to effectively address user conflicts.*

## 3.1 Management Strategy And Implementation

## Northeast Pacific | Canada | British Columbia | Hand implements

## Moderately Effective

Management measures include a conservative harvest rate and restrictions on harvest method, which protect the plant (Ministry of Agriculture 2017). Each harvest area has a limit of one license per species, and harvesters are granted a maximum harvest quota with their license and must record the weight of harvest each day (A. Swinimer personal communications 2024). To obtain a license, harvesters are required to submit a comprehensive harvest plan outlining the area of harvest (for example, map and GPS locations), the density of kelp in that area, and any potential effects that harvesting may have on the ecosystem (A. Swinimer personal communications 2024). Because these species exhibit such marked spatial and temporal variability in canopy kelp abundance over time, management should be conducted at biologically relevant scales (e.g., that reflect spatial patterns in canopy kelp resilience) appropriate for sustainably managing kelp harvest. The lack of any stock monitoring means that the effectiveness of management measures is unknown; however, their precautionary nature and the small scale of the fishery indicate that harvesting is unlikely to have significant negative impacts on either the *Macrocystis* or *Nereocystis* populations.

Measures do not meet all the standards of “highly effective” management, but exceed those for “ineffective” or “critical.” Therefore, this factor receives “moderately effective.”

## Supplementary Information

There is no comprehensive management plan for the harvesting of aquatic plants; however, the provincial government manages the kelp fishery with a strategy similar to DFO’s precautionary harvest approach for data-limited fisheries, allowing only small harvests relative to the estimated biomasses (Edwin Blewett & Associates Inc 2001).

Harvest areas are defined by DFO’s 48 Pacific Fishery Management Areas (PFMAs), which cover the entire BC coast and are divided into a variable number of subareas (DFO 2017). Applications are submitted before October to harvest either kelp in one or several subareas the following year and are coupled with a quota request. Each application is assessed on a case-by-case basis, and licenses are administered each year (A. Swinimer personal communications 2024). If approved, a license grants the holder the exclusive use of a harvest area and a nontransferable quota for a specific species over a calendar year (A. Swinimer personal communications 2024). Harvesting takes place year-round, although *Macrocystis* harvesting for the SOK fishery will occur between mid-February and the end of May, during the fishery openings (DFO 2023). As of this report in 2024, "... 10 licences are allocated for Haida Gwaii including 4 held by Haida individuals, 3 by Haida organizations, and 3 by non-Haida individuals or companies. Commercial SOK fishery operators are also required to obtain kelp harvesting permits from the Province of BC. With the signing of the Kunst'aa guu–Kunts'aayah Reconciliation Protocol between the Haida Nation and Province of BC in 2009, the Haida Gwaii Solutions Table began to advise on and jointly approve annual kelp harvesting permits" (Haida Marine Planning 2022).

License conditions place specific restrictions on the harvest method, which is designed to protect the individual plants from mortality as well as limit the harvest impacts on the kelp bed. In addition, harvesting is not permitted within a BC provincial park, an ecological reserve, or a protected area (Province of British Columbia 2024). The harvest rate for both *Macrocystis* and *Nereocystis* is limited to 20% of the plants in the bed, although repeat harvesting of individual plants is permitted and must not include harvest from protected areas or leased land. *Macrocystis* harvesting must be done using a sharp cutting tool and only fronds may be cut, with no more than 25% of the fronds on a single plant taken. *Nereocystis* license conditions require that only blades are cut and are cut no closer than 20 cm from the bulb (Ministry of Agriculture 2017).

## 3.2 Bycatch Strategy

### Northeast Pacific | Canada | British Columbia | Hand implements

## Highly effective

This fishery has no or very low (> 5% total catch) bycatch, with no bycatch of species of concern during kelp harvest. Therefore, this factor receives "highly effective."

## 3.3 Scientific Data Collection and Analysis

### Northeast Pacific | Canada | British Columbia | Hand implements

## Moderately Effective

Since 2017, the Marine Plan Partnership (MaPP) has developed a Regional Kelp Monitoring Program that involves First Nation Guardian Watchmen, universities, and nonprofit institutions to help monitor kelp beds at biologically relevant temporal and spatial scales (Hamilton et al. 2022). The quantity of kelp harvested by each license holder is monitored annually through a royalty program, where harvesters pay a fee depending on the quantity of kelp they gather; however, no analysis of the data is performed. The MFLNRO has had intentions to update the kelp bed inventories since 2017, but progress has been limited and no updated inventories are currently available.

Therefore, although few recent studies have been published related to the abundance and distribution of kelp throughout BC, several efforts are underway to fill knowledge gaps and restore locations where kelp forests have been depleted (MaPP 2023). Improvements to data-limited assessment and management methods have been made since 2017, so this factor receives “moderately effective.”

## Supplementary Information

Monitoring of the kelp fishery is limited to the requirement for harvesters to pay royalties on their yield. Because harvesters are responsible for recording how much they remove, this functions similarly to a fisher’s logbook and is used by managers to determine how much kelp has been harvested in each area. Management does not have the resources for more detailed monitoring, because only two officers oversee kelp harvest throughout BC (A. Swinimer personal communications 2024). Given the scale of the fishery along the entire provincial coast and the relatively small harvest of only a few hundred tons, this may be an appropriate strategy, but the lack of direct oversight may lead to underreporting.

The MFLNROF has expressed the intent to conduct further monitoring and begin updating the kelp bed inventories through the MaPP. This partnership closely collaborates with First Nation stakeholders along the central and north coasts, as well as the north of Vancouver Island. As of 2023, several projects are underway, including the monitoring of kelp on the North Pacific Coast (MaPP 2023).

## 3.4 Enforcement of and Compliance with Management Regulations

## Northeast Pacific | Canada | British Columbia | Hand implements

## Moderately Effective

The Ministry of Agriculture has previously had full-time enforcement officers for aquatic plants, including the kelp fisheries; however, the current level of monitoring and enforcement is unclear. With relatively few license holders, it is unclear how regularly monitoring of harvesters occurs, although historically, compliance has been considered good. Therefore, this factor is a “moderate concern.”

### Supplementary Information

Two full-time enforcement officers from the Ministry of Agriculture monitor compliance of aquatic plant harvesting in BC (A. Swinimer personal communications 2024). There is no official reporting of enforcement/monitoring activity, so it is unclear how regularly harvesters are inspected. Overall, there are no significant compliance issues (A. Swinimer personal communications 2024).

## 3.5 Stakeholder Inclusion

### Northeast Pacific | Canada | British Columbia | Hand implements

### Moderately Effective

Stakeholder engagement is limited to consultation with First Nations when harvesting applications are made within their territory. Although user conflicts are effectively addressed through this mechanism, there is a historical absence of engagement with other stakeholders, including kelp harvesters. But through initiatives like the MaPP, First Nations have been more broadly involved in management of kelp resources (MaPP 2023). Despite the lack of clarity regarding decision-making, improvements in stakeholder and rights-holder consultations have improved since 2017. Therefore, management is “moderately effective.”

### Supplementary Information

With the signing of the Kunst'aa guu–Kunts'aayah Reconciliation Protocol between the Haida Nation and the Province of BC in 2009, the Haida Gwaii Solutions Table began to advise on and jointly approve annual kelp harvesting permits in their territory (Haida Marine Planning 2022). Managers in other areas in BC have also recently begun to engage with First Nations through the MaPP (MaPP 2023). But engagement between managers and harvesters is limited to license applications and royalty payment. There is no clear mechanism for communicating management decisions.

# Criterion 4: Impacts on the Habitat and Ecosystem

*This Criterion assesses the impact of the fishery on seafloor habitats, and increases that base score if there are measures in place to mitigate any impacts. The fishery's overall impact on the ecosystem and food web and the use of ecosystem-based fisheries management (EBFM) principles is also evaluated. Ecosystem Based Fisheries Management aims to consider the interconnections among species and all natural and human stressors on the environment. The final score is the geometric mean of the impact of fishing gear on habitat score (factor 4.1 + factor 4.2) and the Ecosystem Based Fishery Management score. The Criterion 4 rating is determined as follows:*

- Score >3.2 = **Green** or Low Concern
- Score >2.2 and ≤3.2 = **Yellow** or Moderate Concern
- Score ≤2.2 = **Red** or High Concern

## Guiding principles

- Avoid negative impacts on the structure, function or associated biota of marine habitats where fishing occurs.
- Maintain the trophic role of all aquatic life.
- Do not result in harmful ecological changes such as reduction of dependent predator populations, trophic cascades, or phase shifts.
- Ensure that any enhancement activities and fishing activities on enhanced stocks do not negatively affect the diversity, abundance, productivity, or genetic integrity of wild stocks.
- Follow the principles of ecosystem-based fisheries management.

*Rating cannot be Critical for Criterion 4.*

## Criterion 4 Summary

| Fishery | Physical Impact of Fishing Gear on the Habitat/Substrate | Modifying Factor: Mitigation of Gear Impacts | Ecosystem-based Fisheries Management | Forage Species? | Score |
|---|---|---|---|---|---|
| Northeast Pacific \| Canada \| British Columbia \| Hand implements | Score: 5 | Score: 0 | Moderate Concern | No | Green (3.873) |
| Northeast Pacific \| Canada \| British Columbia \| Hand implements | Score: 5 | Score: 0 | Moderate Concern | No | Green (3.873) |

## Criterion 4 Assessment

### Scoring Guidelines

#### Factor 4.1 - Physical Impact of Fishing Gear on the Habitat/Substrate

Goal: The fishery does not adversely impact the physical structure of the ocean habitat, seafloor or associated biological communities.

- *5 - Fishing gear does not contact the bottom*
- *4 - Vertical line gear*
- *3 - Gears that contacts the bottom, but is not dragged along the bottom (e.g. gillnet, bottom longline, trap) and is not fished on sensitive habitats. Or bottom seine on resilient mud/sand habitats. Or midwater trawl that is known to contact bottom occasionally. Or purse seine known to commonly contact the bottom.*
- *2 - Bottom dragging gears (dredge, trawl) fished on resilient mud/sand habitats. Or gillnet, trap, or bottom longline fished on sensitive boulder or coral reef habitat. Or bottom seine except on mud/sand. Or there is known trampling of coral reef habitat.*
- *1 - Hydraulic clam dredge. Or dredge or trawl gear fished on moderately sensitive habitats (e.g., cobble or boulder)*
- *0 - Dredge or trawl fished on biogenic habitat, (e.g., deep-sea corals, eelgrass and maerl)*
  *Note: When multiple habitat types are commonly encountered, and/or the habitat classification is uncertain, the score will be based on the most sensitive, plausible habitat type.*

## Factor 4.2 - Modifying Factor: Mitigation of Gear Impacts

Goal: Damage to the seafloor is mitigated through protection of sensitive or vulnerable seafloor habitats, and limits on the spatial footprint of fishing on fishing effort.

- *+1 —>50% of the habitat is protected from fishing with the gear type. Or fishing intensity is very low/limited and for trawled fisheries, expansion of fishery's footprint is prohibited. Or gear is specifically modified to reduce damage to seafloor and modifications have been shown to be effective at reducing damage. Or there is an effective combination of 'moderate' mitigation measures.*
- *+0.5 —At least 20% of all representative habitats are protected from fishing with the gear type and for trawl fisheries, expansion of the fishery's footprint is prohibited. Or gear modification measures or other measures are in place to limit fishing effort, fishing intensity, and spatial footprint of damage caused from fishing that are expected to be effective.*
- *0 —No effective measures are in place to limit gear impacts on habitats or not applicable because gear used is benign and received a score of 5 in factor 4.1*

## Factor 4.3 - Ecosystem-Based Fisheries Management

Goal: All stocks are maintained at levels that allow them to fulfill their ecological role and to maintain a functioning ecosystem and food web. Fishing activities should not seriously reduce ecosystem services provided by any retained species or result in harmful changes such as trophic cascades, phase shifts or reduction of genetic diversity. Even non-native species should be considered with respect to ecosystem impacts. If a fishery is managed in order to eradicate a non-native, the potential impacts of that strategy on native species in the ecosystem should be considered and rated below.

- *5 — Policies that have been shown to be effective are in place to protect species' ecological roles and ecosystem functioning (e.g. catch limits that ensure species' abundance is maintained at sufficient levels to provide food to predators) and effective spatial management is used to protect spawning and foraging areas, and prevent localized depletion. Or it has been scientifically demonstrated that fishing practices do not have negative ecological effects.*
- *4 — Policies are in place to protect species' ecological roles and ecosystem functioning but have not proven to be effective and at least*

*some spatial management is used.*

- *3 — Policies are not in place to protect species' ecological roles and ecosystem functioning but detrimental food web impacts are not likely or policies in place may not be sufficient to protect species' ecological roles and ecosystem functioning.*
- *2 — Policies are not in place to protect species' ecological roles and ecosystem functioning and the likelihood of detrimental food impacts are likely (e.g. trophic cascades, alternate stable states, etc.), but conclusive scientific evidence is not available for this fishery.*
- *1 — Scientifically demonstrated trophic cascades, alternate stable states or other detrimental food web impact are resulting from this fishery.*

## 4.1 Physical Impact of Fishing Gear on the Habitat/Substrate

### Northeast Pacific | Canada | British Columbia | Hand implements

### Score: 5

Harvesting is by hand and limited to cutting blades far from the holdfast, so there is no physical impact of the gear on the kelp habitat or substrate. Thus, gear does not contact the bottom and receives a "5."

## 4.2 Modifying Factor: Mitigation of Gear Impacts

### Northeast Pacific | Canada | British Columbia | Hand implements

### Score: 0

Not applicable because the gear used is benign and the fishery received a score of "5."

## 4.3 Ecosystem-based Fisheries Management

### Northeast Pacific | Canada | British Columbia | Hand implements

### Moderate Concern

Kelp beds are important to the ecosystem both as a structural foundation species, by providing the structure for a whole ecosystem, and as the base of food webs, by putting energy into the system. There are no ecosystem assessments for either species and no spatial management is employed. But studies on *Macrocystis* fisheries show that small-scale harvesting has a minimal impact on the kelp forest ecosystem. Investigations into *Nereocystis* harvesting indicate that the impact on canopy coverage depends on the time of harvest, but the limited harvest rate is likely to minimize impacts.

Given the small scale of harvesting relative to the geographic scale of the fishery, and that harvesting does not cause mortality, it is unlikely that significant negative ecosystem effects will occur. Therefore, this criterion is a "moderate concern."

### Supplementary Information

Kelps provide important ecosystem functions as foundation species in the kelp forest habitat, and by providing structure, shelter, and a food source, kelps can enhance species diversity and productivity locally and across broad spatial scales (Krumhansl et al. 2017). As a food source, kelps provide the initial source of the carbon upon which almost all the kelp forest species depend, while also providing a physical structure and shelter to protect juvenile fishes and invertebrates (Graham et al. 2007)(Springer et al. 2010). Kelp forests are also important nutrient recyclers and stores of atmospheric carbon (Springer et al. 2010)(Krumhansl et al. 2017).

Kelp harvesting has been shown to affect *Macrocystis* ecology and, by extension, could potentially have some effect on population dynamics in the wider ecosystem. Some studies have suggested that partial canopy harvesting increases kelp recruitment, due to an increased availability of limiting resources, such as light and space (Kimura, R.S. 1980)(Kimura and Foster, 1984)(Reed 1987). Conversely, a study of harvesting at higher rates observed a decline in the density of juvenile *Macrocystis,* which are likely to have been outcompeted by understory kelp species benefiting from the canopy reduction (Krumhansl et al. 2017). Harvesting may also affect reproductive potential. At high rates of canopy removal, where more than 75% of the canopy is removed, drastic decreases in both reproductive blade growth and sporophyll production have been recorded (Reed 1987)(Geange 2014), although declines in reproductive potential have not been observed when harvesting is conducted at smaller scales, such as those required in BC (Krumhansl et al. 2017).

Studies suggest that the direct impacts on the ecosystem from small-scale kelp harvesting are minimal. Canopy removal has little effect on understory algae species other than increasing growth, because the kelp is still taking up most of the substrate space unless mortality occurs (Wheeler 1990). Kelp canopy invertebrate populations appear to be unaffected (Wheeler 1990), and the only recorded impact on benthic grazers is poorer nutrition of urchin populations where harvesting has been severe (Druehl and Breen 1986).

Studies in California and Chile have shown that fish move out of areas where *Macrocystis* canopy is removed, but return when the bed regrows (Miller and Geibel 1973)(Moreno, C.A. and Jara, H.F. 1984), with the overall impact on fish from *Macrocystis* harvesting much less than that of commercial targeting of invertebrates such as lobster, abalone, and sea urchin (Wheeler 1990). Similarly, investigation into small-scale harvesting in BC indicates that there is minimal effect on associated fish assemblages and that climate may be a stronger driver (Krumhansl et al. 2017). Overall, Tegner and Dayton (Tegner and Dayton 2000) suggest that, given the high susceptibility of kelp forests to natural disturbances, well-managed kelp harvesting is a relatively benign disturbance.

*Macrocystis* harvest for the SOK has, by extension, a potential impact on herring populations because the fish are captured in a seine net and placed in ponds in order to lay eggs on the kelp fronds. But the SOK fishery is managed to minimize impacts on the fish, and the fish are released alive after spawning (DFO 2023). There is no evidence that any fluctuations in herring biomass are caused or accentuated by the SOK fishery.

There are no investigations specifically targeting the impact of *Nereocystis* harvest on kelp communities. Still, Roland (Roland 1985) found that partly removed blades do not grow back to their full extent, as well as the proportion bearing reproductive sori. Therefore, harvesting could affect the amount of canopy biomass available for habitat, as well as food availability as detritus (Springer et al. 2010). It could also influence the number of reproductive propagules contributing to recruitment, and it was recommended that, instead of harvesting a whole bed at once, to stagger harvest across different plants throughout the year (Roland 1985). The restriction in the BC fishery that limits harvesting to only 20% of the plants ensures that the whole bed is never taken.

There is no specific spatial management in this fishery; however, fishing is prohibited from protected areas and leased land, which will act as a refuge. In recent years, efforts to increase ecosystem-based management have been driven by many First Nations groups throughout BC, and most notably for kelp in Haida Gwaii. “In November 2018, the Gwaii Haanas Gina 'Waadlux̲an KilG̲uhlG̲a Land-Sea-People Management Plan was signed by representatives from the Government of Canada and the Haida Nation, outlining the shared vision for the future of Gwaii Haanas and the direction for the Archipelago Management Board to manage both the terrestrial and marine areas of Gwaii Haanas". In this plan, a commitment was made by the parties to collaboratively develop a rebuilding strategy and implementation plan by 2020 that preserves ecological integrity and promotes sustainable use of resources such as herring, eelgrass and kelp (Haida Marine Planning 2022). Demonstrated efforts like this, alongside the precautionary harvest conditions (Ministry of Agriculture 2017), mean that any overall ecosystem and food web impacts directly from harvesting are likely to be minimal.

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