Seafood Assessment

SeaChoice
healthy choices, healthy oceans

Dungeness Crab
Cancer magister

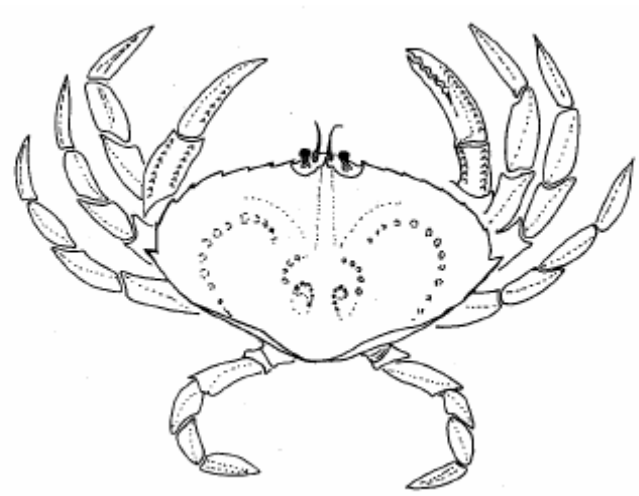

Image courtesy of Fisheries and Oceans Canada

British Columbia

February 2006

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Blue Planet Research and Education

About SeaChoice ® and Seafood Assessments

The SeaChoice® program evaluates the ecological sustainability of wild-caught and farmed seafood commonly found in the Canadian marketplace. SeaChoice® defines sustainable seafood as originating from sources, whether wild-caught or farmed, which can maintain or increase production in the long-term without jeopardizing the structure or function of affected ecosystems. SeaChoice® makes its science-based recommendations available to the public in the form of a pocket guide, Canada's Seafood Guide, that can be downloaded from the Internet (www.seachoice.org) or obtained from the SeaChoice® program directly by emailing a request to us. The program's goals are to raise awareness of important ocean conservation issues and empower Canadian seafood consumers and businesses to make choices for healthy oceans.

Each sustainability recommendation on Canada's Seafood Guide is supported by a Seafood Assessment by SeaChoice or a Seafood Report by Monterey Bay Aquarium; both groups use the same assessment criteria. Each assessment synthesizes and analyzes the most current ecological, fisheries and ecosystem science on a species, then evaluates this information against the program's conservation ethic/sustainability criteria to arrive at a recommendation of "Best Choice", "Some Concerns" or "Avoid". The detailed evaluation methodology is available on our website at www.seachoice.org. In producing Seafood Assessments, SeaChoice® seeks out research published in academic, peer-reviewed journals whenever possible. Other sources of information include government technical publications, fishery management plans and supporting documents, and scientific reviews of ecological sustainability. Information used to evaluate fisheries and aquaculture practices for assessments regularly comes from ecologists, fisheries and aquaculture scientists, members of industry and conservation organizations. Capture fisheries and aquaculture practices are highly dynamic; as the scientific information on each species changes, SeaChoice's sustainability recommendations and the underlying Seafood Assessments will be updated to reflect these changes.

Parties interested in capture fisheries, aquaculture practices and the sustainability of ocean ecosystems are welcome to use Seafood Assessments in any way they find useful, with acknowledgement. For more information about SeaChoice® and Seafood Assessments, please contact the SeaChoice® program via e-mail and telephone information available at www.seachoice.org

SeaChoice® and Seafood Assessments are made possible through a grant from the David and Lucile Packard Foundation.

Executive Summary

The fishery for Dungeness crab in British Columbia is given an overall seafood recommendation of 'best choice'. This species has a low inherent vulnerability to fishing pressure due to a low age of first maturity, relatively fast growth, high fecundity and low maximum age. The status of the stocks is only known through fisheries landings. Stock assessments to determine abundance is not practical or necessary for this species due to their biology. Dungeness crab populations are fully fished in British Columbia. The intensive nature of the fishery is cause for some conservation concerns particularly around handling of undersized, females, and soft-shelled crabs. Bycatch of other species is very low in this fishery. Habitat impacts of the traps themselves has not been studied but is likely having some impact in the form of scour through wave action and hauling of the traps. The habitat most commonly fished (i.e., shallow sandy bottoms) is considered to be resilient to gear disturbance relative to other habitat types. It is unknown if the bait is adding a food subsidy to the surrounding ecological community. Overall the management for this species has proven to be effective. There is no indication that current harvest is impacting the long term abundance of Dungeness crab in British Columbia's waters. Ongoing management improvements, including 100% onboard monitoring in the form of electronic surveillance or at-sea observer coverage will further improve the management.

Table of Sustainability Ranks

	Conservation Concern			
Sustainability Criteria	**Low**	**Moderate**	**High**	**Critical**
Inherent Vulnerability	√			
Status of Stocks		√		
Nature of Bycatch	√			
Habitat Effects		√		
Management Effectiveness	√			

About the Overall Seafood Recommendation:

- A seafood product is ranked **Avoid** if two or more criteria are of High Conservation Concern (red) OR if one or more criteria are of Critical Conservation Concern (black) in the table above.
- A seafood product is ranked **Good Alternative** if the five criteria "average" to yellow (Moderate Conservation Concern) OR if the "Status of Stocks" and "Management Effectiveness" criteria are both of Moderate Conservation Concern.

- A seafood product is ranked **Best Choice** if three or more criteria are of Low Conservation Concern (green) and the remaining criteria are not of High or Critical Conservation Concern.

Overall Seafood Recommendation:

Best Choice Good Alternative Avoid

Introduction

Biology (Primary source: FOC 2002)

The Dungeness crab is distributed from the Aleutian Islands, Alaska, to Monterey Bay, California. They can be found as shallow as the intertidal zone to depths of 180 m. They are widespread and most abundant on sandy bottoms and in shallow waters associated with eelgrass.

During mating the male crab embraces the female for several hours prior to, during and for several days after breeding to ensure he is the only one that mates with her. Mating occurs within a few hours after the female has moulted and her shell is soft. During the soft-shell stage the female's carapace is soft enough for the male to penetrate and deposit his sperm. The sperm deposited from a single mating event can be retained by the female for several years and be used to fertilize a number of separate egg extrusions. After fertilization, typically in the fall, the female will carry up to 2.5 million eggs attached to her abdomen for a period of three to five months until they hatch. While females are bearing eggs they often bury themselves to protect and incubate the eggs. After hatching the larval crab remain in the water column for about four months and are transported by currents. Successful year classes of Dungeness crab are largely dependent on the survival during these first few critical months and the transport by currents to favourable rearing areas.

Crabs must moult in order to grow. Young crabs grow quickly and moult frequently until they reach reproductive size. Larger crabs moult less often as most of their energy is expended towards producing gametes not growth. The process of moulting requires the crab to absorb water into its tissues which increases their size causing the hard carapace split. After moulting the crabs are particularly susceptible to predation and therefore tend to seek shelter until the shell hardens--approximately six weeks. Adult males and females tend to moult at different times, so that the males will be hard-shelled and able to mate when the females moult. A crab will moult 10 to 12 times before reaching maturity at about two years. Females become mature at a shell-width of about 90 millimetres, while males reach maturity at a shell-width of about 150 mm (legal size 165 mm). Males can grow to a carapace width of 230 mm and weigh about two kilograms. In heavily fished areas, however, few crabs wider than 190 mm are found.

Fishery Overview (Sources of information: FOC 1999, FOC 2000, FOC 2006)

Dungeness crab has been harvested commercially in British Columbia since the late 1800s. The fishery first started in waters around Vancouver than progressed northwards to other major crab fishing areas. By the 1960s all areas were being fished. From 1960 to 1990 the landings were relatively stable ranging between 1000 and 2000 t annually (Figure 1). Starting in 1990 increased value combined with less opportunity in other fisheries resulted in an intensification of the crab fishery.

All commercial fishing for Dungeness crabs in British Columbia uses baited traps to capture the crabs. The traps are required to have an escape port to allow undersized crabs to escape, as well as have biodegradable escape mechanisms in the event of the trap being lost. Traps are either fished singly or on long lines with multiple traps.

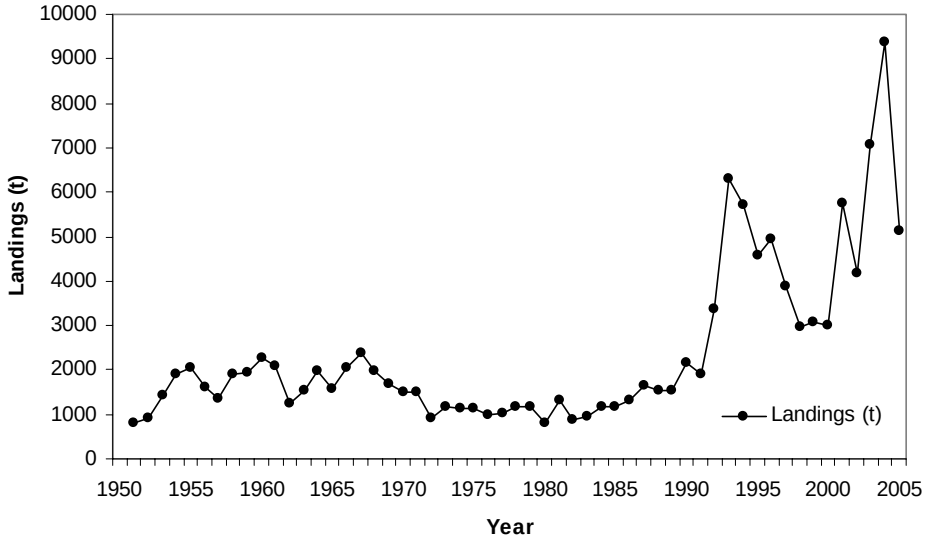

Figure 1. Coastwide landings (t) of Dungeness crab from Canada's Pacific waters. Source: FOC catch statistics.

Management of Dungeness crab is primarily by the three 'S's—size, sex, and season. Size limits are used as the primary conservation measure. In British Columbia the size limit is 165 mm across the maximum breadth of the carapace. The size limit is designed to protect sexually mature male Dungeness crab for at least one year prior to harvest. Female Dungeness crabs rarely exceed the 165 mm size limit but are further protected from the commercial fishery through non-retention of females. Undersized and female crabs must not be retained by the commercial fishery. The protection of females and a portion of the mature males in Dungeness crab populations ensures that conservation goals are maintained. The fishery is closed during certain times of the year depending on the region in order to protect the 'soft shelled' stages of the crabs as they moult. Effort directed towards the capture of Dungeness crab is also managed by limiting the number of traps a licensee can fish. The fishery has been limited entry since 1991 with only 222 eligible licenses coastwide. For management purposes the coast is divided into seven crab areas. Licensed vessel owners select an area to fish for a three year period.

Unlike other commercial fisheries there is no attempt to estimate the biomass and allocate a total allowable catch to the fleet or individual licensees. The size, sex, and seasonal restrictions are considered sufficient to protect the spawning stock of Dungeness crabs. In addition to the three S's, there are also restrictions in soak time, trap limits, and soft-shell restrictions. Landings can vary considerably year by year depending on the abundance of crabs which in turn is influenced by environmental conditions that affect the survival of larval crabs and subsequent recruitment to the fishery. The landings in 2003 and 2004 were the two largest in history at ~7000 and 9000 t respectively (Figure 1).

Scope of the analysis and the ensuing recommendation:

The recommendation based on this analysis is limited to Dungeness crab captured from Canada's Pacific waters.

Availability of Science

Compared to more intensively managed finfish species, Dungeness crab has relatively little science associated with its management. As explained in earlier sections the management does not require detailed stock status information to properly manage the fishery.

Market Availability

Common and market names: Dungeness crab

Seasonal availability: Year round. In British Columbia the season varies by crab management area.

Product forms: Dungeness crab is commonly sold live, or as fresh or frozen whole, cooked crab. Other products include sections, single legs and picked meat. Early crab fisheries tended to can the meat.

Import and export sources and statistics: In 2005 3785 t was exported primarily to U.S. markets and 154 t was imported from the U.S.[1]

Analysis of Seafood Watch® Sustainability Criteria for Wild-caught Species

Criterion 1: Inherent Vulnerability to Fishing Pressure

Dungeness crabs have a low inherent vulnerability to fishing pressure. First maturity is reached by 2 years and females are very fecund producing up to 2.5 million eggs. These two factors alone result in a green ranking for this criterion. During the soft-shell stage after moulting Dungeness crabs have increased vulnerability of injury through handling by commercial fisheries. Because fishing effort is very intense in some areas, undersized, female, or soft-shelled crabs may be captured and released several times. Each handling poses a risk of injury or mortality. The Department of Fisheries and Oceans (DFO) is working towards minimizing handling of soft-shelled crabs by researching soft-shell periods (FOC 2006). The quality of Dungeness crab habitat on a coastwide basis is not considered to be degraded however the loss of estuarine eelgrass habitat has been observed in the Strait of Georgia (BCWMSP 1994) and is threatened in other areas by upstream land-based practices such as logging and nutrient loading (Wright 2002).

Table 1. Life history characteristics of Dungeness crab

Max Size	Age at Maturity	Maximum Age	Fecundity	Species Range	Special Behaviors	Population Variability	Sources
230 mm	2 years	8-13 years	~up to 2.5 million eggs	North Pacific	Moulting/ soft-shell	High	FOC 2002

Synthesis

Criterion 1: Inherent Vulnerability to Fishing Pressure	
Primary Factors to Evaluate	**Ranking**
Age at first maturity	
von Bertalanfy growth coefficient ‘k’	NA
Maximum Age	
Reproductive potential (fecundity)	
Secondary Factors to Evaluate	
Species range	
Special behaviours or requirements	
Quality of habitat	
Overall Inherent Vulnerability to Fishing Pressure Rank	

Criterion 2: Status of Wild Stocks

Unlike most managed commercially fished species, there is no need for fisheries managers to know the overall abundance of Dungeness crab. The management strategy allows for a conservative harvest while protecting the spawning population. The abundance fluctuates based on environmental conditions and there is not attempt to manage for abundance.

Factor 1: Management classification status

Dungeness crab populations are fully exploited (FOC 2002) but are not considered overfished due to safeguards in the management strategy. Generally Dungeness crab stocks appear healthy based on landings. This factor receives a green ranking.

Factor 2: Abundance thresholds

There are no abundance thresholds set for this fishery. Instead size and sex restrictions ensure that the spawning biomass is maintained. This factor receives a green ranking.

Factor 3: Occurrence of overfishing

Similar to Factor 2, under current management this species cannot be 'overfished'. This factor receives a green ranking.

Factor 4: Overall degree of uncertainty in status of stock

There is a high degree of uncertainty surrounding the actual size of the stock as the population is highly variable based on environmental conditions. However the management structure does not require stock size information as it does not manage towards a total allowable catch. This factor is not applicable

Factor 5: Long-term trend

There are no long-term indicators of stock abundance. Prior to 1990 landings were quite stable and likely reflected the market demand. Beginning in 1990 overall effort increased to the point where all areas became fully fished. In fully fished areas, essentially all legal sized males are removed from the population on an annual basis. The landings in any given year therefore reflect the abundance. Because recruitment is variable, landings from a fully fished area will reflect this variability. Overall, this factor is *not applicable* for ranking.

Factor 6: Short term trend

As with Factor 5, this factor is *not applicable* for ranking

Factor 7: Current age, size, or sex distribution

All Dungeness crab populations are considered ‘fully fished’. A fully fished population results in the removal of essentially all legal-sized males which is not a natural condition. This factor is given a red ranking.

Synthesis

This criterion is difficult to evaluate for Dungeness crab. Concepts such as ‘unfished’ biomass that are widely applied to other commercial fisheries cannot be applied to Dungeness crab. However there is little doubt that this species is ‘fully fished’ and that the size and sex distributions are skewed from natural conditions. Overall this criterion is given a yellow ranking.

Criterion 2: Status of Wild Stocks	
Primary Factors to Evaluate	**Ranking**
Management classification status	
Abundance threshold	
Occurrence of overfishing	
Overall degree of uncertainty in status of stock	Not applicable
Long term trend in abundance	Not applicable
Short term trend in abundance	Not applicable
Current age, size, or sex distribution	
Overall Status of Wild Stocks Rank	

Criterion 3: Nature and Extent of Bycatch

Seafood Watch® defines sustainable wild-caught seafood as marine life captured using fishing techniques that successfully minimize the catch of unwanted and/or unmarketable species (i.e., bycatch). Bycatch is defined as species that are caught but subsequently discarded (injured or dead) for any reason. Bycatch does not include incidental catch (non-targeted catch) if it is utilized, accounted for and/or managed in some way.

Bycatch of other species is low relative to the weight of Dungeness crab landed. Although the bycatch ratio has not been formally derived it is likely less than 1% (Morrison pers. comm. 2006, Phillips pers. comm. 2006). The main form of bycatch in this fishery is undersized, soft-shell or female crabs. Traps are required to have escape holes that are a minimum of 110 mm in diameter to allow undersized crabs to escape. Females, providing they are handled properly can be released without harm. Soft-shell crabs however are vulnerable to injury or mortality from surface handling as even being dropped into the water from the vessel deck can injure or kill the crab (FOC 2006). Because the fishery is fully fished, non-retained crabs can potentially be captured several times thereby increasing the risk of injury or mortality. Soft-shell crabs are also vulnerable to cannibalism while in the trap. To prevent the capture of soft-shell crabs seasonal closures are in effect in most of the main fishing grounds. The type of bait in the traps also can influence the capture rate of soft-shell crabs. Fish frames or hanging bait increases the catch rate of soft-shell crabs and therefore DFO has requested that this type of bait not be used but it is not currently a license requirement. Avoiding soft-shell periods is the main research emphasis for DFO (FOC 2006). This criterion is given a green ranking.

Criterion 3: Bycatch	
Primary Factors to Evaluate	**Ranking**
Quantity of bycatch	
Population consequence of bycatch	
Trends in bycatch rates	NA
Secondary Factors	
Ecosystem Impacts	
Overall Bycatch Rank	

Criterion 4: Effect of Fishing Practices on Habitats and Ecosystems

Dungeness crabs are captured by trap gear on shallow sandy bottoms. This type of gear is thought to have some impact on bottom habitats from scouring by wave action and when the gear is retrieved. Shallow sandy bottoms are considered to be quite resilient to disturbance. The geographic scope of the fishery is moderate in that it is confined to shallow depths and specific areas. The deployment of baited traps has not received much attention from an ecosystem perspective. Recent studies in lobster fishing grounds have found that bait adds a significant food subsidy to the surrounding ecological community thereby having potential to alter the food web (Saila et al. 2002). Capturing Dungeness crabs with traps is not likely to cause a major change in the ecosystem state.

Synthesis

Criterion 4: Effect of Fishing Practices on Habitats and Ecosystems	
Factors to Evaluate	**Ranking**
Impacts of Fishing Gear on Habitat	
Resilience of the Habitat	
Spatial Extent of the Impact	
Disruption of food webs	
Changes in ecosystem state	
Overall Effect of Fishing Practices on Habitats and Ecosystems Rank	

Criterion 5: Effectiveness of the Management Regime

Dungeness crabs have a management structure quite different than most other commercially fished species. The main difference is that the management does not set TACs or allocate quota and therefore there is no need for estimates of stock abundance. Basically it is thought that if the spawning biomass is protected (no retention of females) and the size limit is large enough to let males spawn, then the fishery can be considered conservatively managed. Abundance is then determined by environmental conditions which vary by year and location. Additional protective measures such as limited entry (222 licenses), closed seasons, area closures and trap limits are also used to manage the fishery. The number of traps a licensee is permitted to fish varies by vessel size, area and season (see FOC 2006 for details).

Monitoring and enforcement of this fishery is currently in transition. By April 1, 2006 all vessels participating in the fishery are required to have 100% electronic monitoring or at-sea observer coverage. Electronic monitoring will collect information on vessel location, date, time, speed while the vessel is fishing, individual traps (e.g. electronic trap tags and a scanner) and fishing activity through sensors in the hydraulic system. The 100% coverage monitoring program is anticipated to give detailed catch reporting information. In addition, vessels will be subjected to dockside and at-sea inspections.

Overall the management technique applied has maintained stock productivity over time. This criterion is given a green ranking.

Ongoing Management Concerns

Soft-shell stage: The intensive nature of the fishery may be causing incidental mortality on undersized, female and soft-shell crabs. Research into the moult timing by region is being undertaken.

Illegal harvest: Fishing in closed areas, retention of soft-shell, undersized, and females crabs, and fishing during closed seasons is reported to be occurring. The extent of this practice is unknown. The move towards 100% observer coverage may limit some of this activity.

Poor catch reporting: Reporting of catch is a major concern of management as the catch is the only indictor of abundance. To address these concerns electronic or 100% at-sea monitoring will be required on all commercial crab vessels commencing April 1, 2006.

Sea otters: Sea otters are expanding into their former habitats. Because sea otters are predators of crabs they will have an effect on the abundance.

Table 2. Commercial harvest management measures for the Dungeness crab fishery.

Management Measure	Comments
Management Jurisdictions & Agencies	DFO
Total Allowable Catch	None
Retention restrictions	>165 mm, males only, no soft-shell
Gear Restrictions	Trap with escape rings and rot cords to prevent 'ghost fishing' in the event of a lost trap. Lost traps must be reported.
Gear Limit	Varies by vessel size, season, and area.
Area Closures	Several
Monitoring	100% electronic or at-sea monitoring, random inspections either dockside or at sea.
Licensing	Limited entry since 1991 (222)
Management plans	Annually prepared by DFO.

Synthesis

Criterion 5: Effectiveness of the Management Regime	
Factors to Evaluate	**Ranking**
Scientific Monitoring	NA
Stock Status	NA
Scientific Advice	
Bycatch	NA
Fishing Practices	NA
Catch Monitoring and Enforcement	
Management Track Record	
Overall Effectiveness of the Management Regime	

Overall Evaluation and Seafood Recommendation

The fishery for Dungeness crab in British Columbia is given an overall seafood recommendation of 'best choice'. This species has a low inherent vulnerability to fishing pressure due to a low age of first maturity, relatively fast growth, high fecundity and low maximum age. The status of the stocks is only known through fisheries landings. Stock assessments to determine abundance is not practical or necessary for this species. Dungeness crab populations are fully fished in British Columbia. The intensive nature of the fishery is cause for some conservation concerns particularly around handling of undersized, females, and soft-shelled crabs. Bycatch of other species is very low in this fishery. Habitat impacts of the traps themselves has not been studied but is likely having some impact in the form of scour through wave action and hauling of the traps. The habitat most commonly fished (i.e., shallow sandy bottoms) is considered to be resilient to gear disturbance relative to other habitat types. It is unknown as to whether the bait is adding a food subsidy to the surrounding ecological community. Overall the management for this species has proven to be effective. There is no indication that current harvest is impacting the long term abundance of Dungeness crab in British Columbia's waters. Ongoing management improvements, including 100% onboard monitoring in the form of electronic surveillance or at-sea observer coverage will further improve the management.

Table of Sustainability Ranks

	Conservation Concern			
Sustainability Criteria	**Low**	**Moderate**	**High**	**Critical**
Inherent Vulnerability	√			
Status of Stocks		√		
Nature of Bycatch	√			
Habitat Effects		√		
Management Effectiveness	√			

Overall Seafood Recommendation:

Best Choice Good Alternative Avoid

References

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Endnotes

[1] http://www.dfo-mpo.gc.ca/communic/statistics/trade/canadian_trade/export_data/xsps05_e.htm