# A Manual for Dungeness Crab Surveys in British Columbia

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# A MANUAL FOR DUNGENESS CRAB SURVEYS IN BRITISH COLUMBIA

by

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**Abstract**

Dunham, J.S., Phillips, A., Morrison, J., and Jorgensen, G. 2011. A manual for Dungeness crab surveys in British Columbia. Can. Tech. Rep. Fish. Aquat. Sci. 2964: viii + 68 p.

This manual describes a protocol for Dungeness crab (*Metacarcinus magister*) trap surveys. In British Columbia (BC) Dungeness crab is a valuable marine fishery resource for First Nation, commercial, and recreational sectors, and there is increasing interest in conducting stock assessment surveys of this species. Over several decades, biologists employed by Fisheries and Oceans Canada (DFO) in the Pacific region have developed Dungeness crab survey protocols. Standardizing crab surveys coast-wide will improve data quality and ensure those data collected at different time intervals and from different areas are comparable. We discuss survey sampling issues and fishing gear. We describe how to collect biological information (sex, shell condition, injuries, mating marks, size, weight, and egg color) from living crabs. Templates and coding instructions are provided for recording fishing gear, crab biological, and bycatch information on data sheets and electronically in a custom designed Microsoft Access database.

**Resumé**

Dunham, J.S., Phillips, A., Morrison, J., and Jorgensen, G. 2011. A manual for Dungeness crab surveys in British Columbia. Can. Tech. Rep. Fish. Aquat. Sci. 2964: viii + 68 p.

Ce manuel traite d'un protocole concernant les relevés au casier du crabe dormeur (*Metacarcinus magister*). En Colombie-Britannique, cette espèce représente une ressource halieutique précieuse pour la Première Nation ainsi que pour les secteurs de la pêche commerciale et récréative, et l'intérêt de mener des études sur l'évaluation des stocks de crabes dormeurs est grandissant. Au cours de plusieurs décennies, des biologistes employés par Pêches et Océans Canada ont élaboré, dans la région du Pacifique, des protocoles de relevés concernant le crabe dormeur. La normalisation de ces relevés pour l'ensemble de la côte permettra d'améliorer la qualité des données et de s'assurer qu'elles sont comparables, même si elles ont été recueillies à des moments ou des endroits différents. Nous traitons des engins de pêche et des problèmes concernant l'échantillonnage lors des relevés. Nous décrivons la façon de recueillir des données biologiques (le sexe, l'état de la carapace, les blessures, les signes d'accouplement, la taille, le poids et la couleur des œufs) à partir de crabes vivants. Des modèles et des directives de codage sont fournis pour consigner les données se rapportant aux engins de pêche, aux renseignements de nature biologique et aux prises accessoires sur des fiches techniques ou par voie électronique dans une base de données Microsoft Access personnalisée.

## 1.0 Introduction

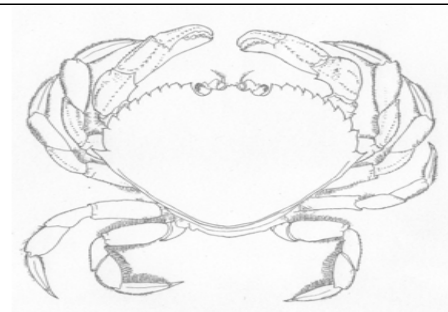
Dungeness crab (*Metacarcinus magister*, Dana 1852) is a significant marine resource in British Columbia (BC). Crabs are important to coastal First Nations, many of whom harvest crab year-round. The first recorded commercial landings in the province occurred in 1885. In 2009 coast-wide commercial catch was 5,081 tonnes and valued at $29.4 million (Canadian). Recreational harvest occurs coast-wide with recreational fishers being most numerous near large population centers. All Dungeness crab fisheries are managed primarily by a minimum size limit and non-retention of females (Fisheries and Oceans Canada 2010). These measures, by conserving the reproductive potential of populations, have sustained viable crab fisheries throughout the 20th century to present.

This manual is designed to aid those who wish to conduct trap surveys to collect biological information on Dungeness crabs. The methodology presented is also broadly applicable to other crab species such as red rock (*Cancer productus*) and the southern tanner crab (*Chionoecetes bairdi*). The purpose of this manual is to educate biologists about field data collection and data management protocols. Having crab biological data collected in a standard manner coast-wide is valuable because data can then be compared between locations and at different time periods. Furthermore, if all crab data are ultimately stored in a central database, then data will not be misplaced or lost, and will be available for broader analyses. We also hope this manual will generally facilitate better communication between the Department of Fisheries and Oceans (DFO) and interested parties.

In this manual we provide an overview of the life history of Dungeness crabs. Types of assessments, sampling issues, and how to effectively fish trap gear are discussed, including how DFO conducts standardized crab surveys. We describe crab biological characteristics such as sex, shell condition, injuries, mating marks, and size, and how to record such information on data sheets and in a custom designed Microsoft Access database. Appendices include field-ready printable data form templates, contact information for DFO staff, and a list of helpful species identification guides to use when crab sampling.

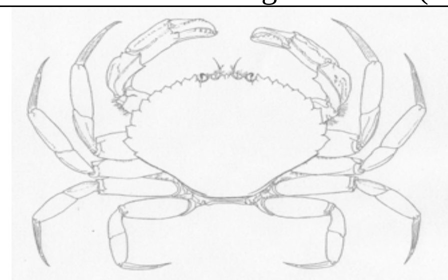
## 2.0 Dungeness Crab Life History

Dungeness crabs are described in Figure 1. They are distributed along the west coast of North America from Mexico to Alaska and occur from the low intertidal to depths of at least 230 meters (Pauley et al. 1989). Early instars have high tolerance to low salinities and, because of this, may be able to avoid certain predators including adult crabs. Juvenile crabs less than 70 millimetres carapace width remain in lower intertidal or shallow subtidal waters and overwinter there. Young crabs tend to move into deeper waters as they grow, although sub-adults require littoral habitats as important foraging areas (Armstrong et al. 2003, Holsman et al. 2006). Adult Dungeness crabs inhabit substrates comprised of sand, mud or silt, and are frequently found near eelgrass beds. During spring months, adult males and females generally move inshore into shallower water and then back into deeper water in late summer or early winter (Stone and O'Clair



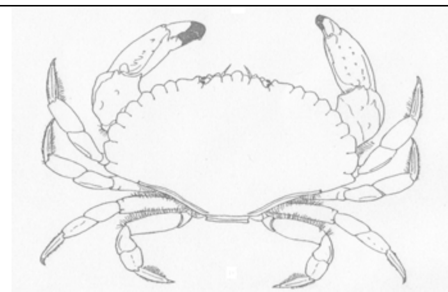
**Description:** Surface of carapace uneven, finely granular and slightly convex, with sharp teeth on antero-lateral margin, no teeth on postero-lateral margin. Carapace widest at 10th antero-lateral spine. Chelipeds with numerous teeth on upper margins of hand. Walking legs broad and flat, last pair with propodus and dactyl particularly so. Tip of telson of male rounded (see also Fig. 7, p. 20).
**Colour:** Carapace brownish with pink or tan granules on ridges and ivory in grooved depressions. Fingers of chelipeds light coloured.
**Habitat:** Sand and eelgrass.
**Legal Size:** Carapace width 165 mm point-to-point.

Dungeness crab (*Metacarcinus magister*)



**Description:** Carapace surface more convex than Dungeness and finely granulated; front with 5 teeth, the central smallest; has sharp antero-lateral teeth and one small postero-lateral tooth on margins. Carapace widest at 9th antero-lateral spine. Chelipeds with few teeth on upper margin of hand. Walking legs slender; dactyls slender and pointed; claw sharp. Tip of telson of male pointed.
**Color:** Carapace light purplish or red-brown with some cream-colored granules. Fingers of chelipeds light coloured.
**Habitat:** Mud.

Graceful crab (*Cancer gracilis*)



**Description:** Front with 5 subequal teeth. Carapace surface uneven and slightly convex; antero-lateral teeth shallow, rounded and become more acute posteriorly with only one obscure postero-lateral tooth. Chelipeds stout, rugose. Walking legs with dactyls fringed with short stiff setae.
**Color:** Carapace dark red with white or red granules on yellow spots on elevations; front dark brown with white or pink granules. Fingers of chelipeds with tips dark coloured.
**Habitat:** Rock.
**Legal Size:** Carapace width 115 mm point-to-point.

Red rock crab (*Cancer productus*)

Figure 1. Common crab species caught in traps in British Columbia. Sketches and descriptions are from Hart 1982.

2002). Females are relatively inactive during the winter; they seldom feed and remain buried in the bottom sediment much of the time. When incubating their eggs, females prefer sandy substrate where there is moderate current. Mating is generally synchronous coast-wide in BC occurring during the spring and summer when female crabs moult. Males can only breed newly moulted (soft) females and will carry them around in a mating embrace when they are about to moult (Butler 1960). Where there is high competition for females, a male might carry a female for several days to ensure no other males mate with her. Females store sperm so they can fertilize the eggs at a later date. In October and November, after the female's carapace has hardened, eggs are fertilized as they are extruded. Since females can fertilize at least two successive batches of eggs from one breeding event, they can skip-moult (only need to breed every second year). Females can produce 200,000 to two million eggs depending on their size (Wild 1980). The eggs adhere to the abdomen and are protected and aerated by the female throughout the winter (Fig. 2). The eggs hatch late winter/early spring depending on the area and water temperature.

Dungeness crab larvae emerge first into the water as prezoeae, but moult quickly (within one hour) to the first zoea stage (Fig. 2). The spined zoeae are distributed by ocean currents for up to four months and move offshore and alongshore during late winter and the winter-to-spring transition period. After five zoea stages, megalopae appear in large near- and offshore concentrations between May and September depending on geographical area. Megalopae look like little crabs, are strong swimmers, and seek out appropriate habitats for settlement such as inshore intertidal and subtidal areas, which are often estuaries with freshwater input. Settlement occurs progressively later with latitude except in the Strait of Georgia. After settlement megalopae metamorphose into the first post-larval instar (Pauley et al. 1989).

Dungeness crabs grow by moulting, a process whereby the old shell is shed (Fig. 3). At some point in the moult cycle the crab swallows water which is absorbed through the gut wall into the hemolymph and the crab swells in volume 15-30%. The crab withdraws backward out of the old shell. The soft, new shell that has formed underneath the old shell hardens over a period of two to three months at this new, larger size. Juvenile crabs moult many times throughout the year; it takes about two years—and more than 10 moults—for a juvenile crab to reach sexual maturity (120 millimetres carapace width point-to-point) after which males moult annually. Males do not effectively breed below about 140 millimetres, and breeding success improves with size. It takes 12 to 14 moults and three to four years from time of settlement for a crab to reach legal size (165 millimetres) after which crabs usually moult only once more. Larger males frequently "skip-moult"; that is, not moult for two years. In general, the adult male moult occurs in the winter/spring in BC, but there is considerable variation in timing, even between adjacent areas, and often a significant part of the population moults during other times of the year. Females generally moult between April and August. They grow more slowly than males because most of their energy is devoted to egg-production rather than growth and often skip-moult once they become sexually mature (100 millimetres). Crabs usually live five to eight years, but in intensive fisheries nearly all legal width crabs are

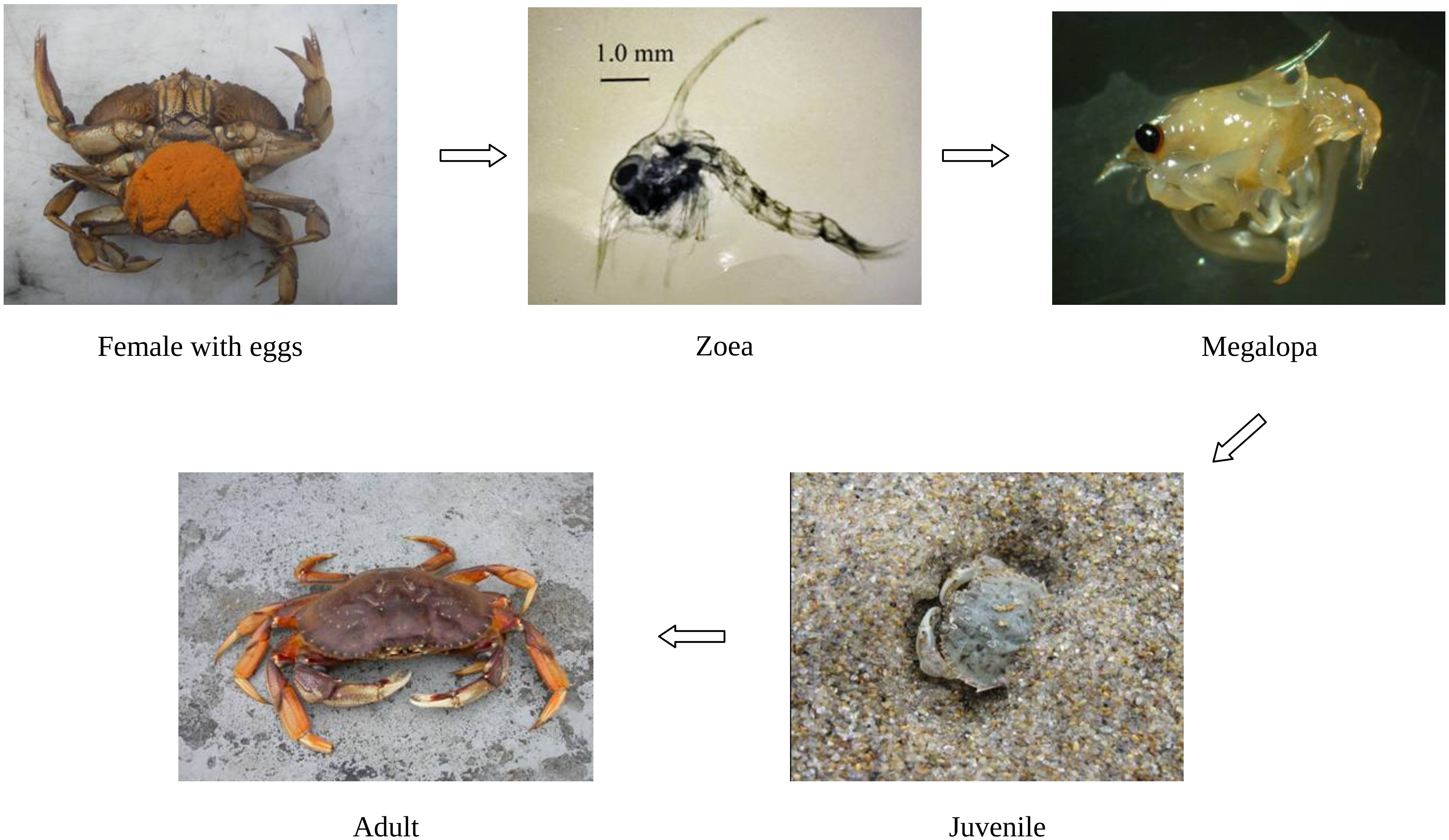



Figure 2: Dungeness crab life cycle.

Newly moulted crab (left) and discarded carapace (exuvia) (right)

Crab exuvia. Note the absence of muscle tissue (meat) inside. Often mistaken by beachcombers as a dead crab.

Figure 3. Growth and moulting in Dungeness crabs.

removed during a fishing season. Males rarely grow larger than 215 millimetres, females 170 millimetres carapace width (Butler 1960, 1961, in prep).

Like many marine invertebrate species, Dungeness crabs comprise a metapopulation whereby local populations of relatively sedentary juveniles and adults are interconnected by dispersing larvae. This means individual crab populations are sustained either by larvae originating from the parent stock and/or from other populations over a broader large geographical area. Thus, a stock/recruitment relationship can be difficult to demonstrate considering the wide range of potential donors to the larval pool. Variations in recruitment are generally believed to be environmentally determined (McConnaughey et al. 1992, Shanks and Roegner 2007).

Dungeness crabs occupy ecological niches in both marine and estuarine waters and the species is ecologically important as both prey and predator at all life stages. Eggs are consumed by the worm, *Carcinonemertes errans* (Wickham 1979). The planktonic zoea and megalopa larval stages are preyed upon by many fish, including coho and chinook salmon, whales, and other fish predators. Juvenile crabs are consumed by demersal fish such as flatfish like the starry flounder, English sole, and rock sole, and skates and sculpins. Crabs and birds also eat juvenile Dungeness crabs. Adult crabs are consumed by octopi, lingcod, cabezon, wolf-eels, rockfish, halibut, dogfish, sculpins, sturgeon, crabs, sea otters, and scoters (Stevens et al. 1982, Reilly 1983, Butler in prep).

Dungeness crabs are opportunistic feeders. Larvae feed offshore in the water column on zooplankton and phytoplankton. Juvenile crabs actively forage in littoral habitats where they consume bivalves (clams and mussels), molluscs, shrimp, other crabs, and small fish. Adult crabs are often found in sandy/silty substrates in bays and estuaries where they prey on fish, bivalves, crustaceans including other Dungeness crabs, worms, mysids, amphipods, isopods, and algae (Gotshall 1977, Stevens et al. 1982, Butler in prep).

## 3.0 Directed Assessments

Crab stock assessment in BC, while not necessary to determine harvest quotas, is presently focussed on improving access to the resource for all users and improving the value of fisheries overall. This requires the collection, analysis, and interpretation of crab biological data from directed assessment surveys. Synoptic and exploratory surveys normally involve traps, either commercial, recreational, or research varieties, and provide answers to specific questions about crab populations or the fishery in a particular area. Surveys help us to better understand fishing and environmental impacts, allocation related issues, and provide training opportunities.

### 3.1 Synoptic Surveys

A synoptic survey assesses a fished area for which the characteristics of the fishery are known. Attempt is made to representatively sample the entire area fished in order to establish the relative abundance and other biological characteristics of the crabs such as moult timing. A valuable aspect of synoptic surveys is the ability, over successive seasons, to verify biological information collected and relate it to other crab assessments elsewhere or from past years. This has enabled DFO to develop accurate estimates of the time required for a crab to harden after the moult, to verify shell age based on claw wear and other indicators, and to determine growth rates.

DFO has been conducting synoptic surveys on the Fraser River delta since 1988. This program originally began as an evaluation of crab populations to determine if shells were hard enough to permit a commercial fishery. Annual surveys are conducted prior to the scheduled opening in June, and in late October at the end of most commercial activity. This provides a historic record of Catch Per Unit Effort (CPUE; the average number of crabs per trap) and population structure between years, a measure of the variability in moult times, breeding times, egg extrusion and release, mortality rates, and an accurate record of trap bycatch. These surveys have been used to investigate the effects of soak duration, bait and trap type, escape port efficiency, as well as provide samples for toxicological and genetic analyses. Additionally, they provide an excellent training opportunity in crab assessment for fisheries guardians, enforcement officers, resource managers, university students, and biologists.

DFO also routinely surveyed the Tofino area on the west coast of Vancouver Island from 1984 to the late 1990s. This program documented changes in the intensity of the fishery, the magnitude of annual recruitment, growth and mortality rates, the range in crab movements, moult times, and larval settlement over that time period.

### 3.2 Exploratory Surveys

Exploratory surveys are conducted when little is known of the crab population in a given area, either because there is no reliable record from any fisheries or because it is remote or isolated. Exploratory surveys can be used to determine the presence or absence of a crab population, and a relative abundance estimate from CPUE analysis will indicate the magnitude of the population. Furthermore, examination of the width frequency of crabs and their age structure can often indicate the current level of impact from other fisheries. Generally a population (width-frequency) structure with a sharp truncation at or just below legal width indicates major removals by a crab fishery. In contrast, no obvious truncation and the presence of a high proportion of old shell crabs above legal width indicate the population has not been heavily impacted. More detailed knowledge may require other types of surveys or landings records.

## 4.0 Survey Sampling

### 4.1 Survey Objectives

The objective of sampling is normally a general, periodic assessment of abundance. If sampling is done consistently over time, it will provide an index of relative abundance of sex and size, information about moulting patterns, injury rates, upcoming recruitment, and longer term population trends. Sampling will not provide any estimate of population size or information about migration patterns. Data can either be collected using standardized fishing gear or commercial gear depending on the objectives of the sampling program.

## 4.2 Standardized Fishing

Standardized crab fishing means the trap type, bait, and soak time are kept constant throughout the sampling program. This is why DFO surveys differ from other sources of fishing information—they use standardized research gear fished in a standard fashion, and in some areas particular sites are fished repeatedly over time. Thus catch per trap as a measure of crab abundance is directly comparable between years and areas for which standardized gear was used. Use of a standardized methodology also permits comparison with other gear types and variables such as soak times, bait types, bait loads, trap spacing, etc.

If all crab surveys in BC are standardized in the same manner, then catch data can be compared between survey groups at different locations and times, and this will be desirable for certain types of analyses. In contrast, if different trap types are sometimes used, with various amounts and kinds of bait, and the soak time altered between sets, then it becomes impossible to compare crab relative abundance between sites and at different time periods. This is the challenge when analyzing commercial catch data—the variety of trap types, kinds of bait, and soak times makes any comparison of crab relative abundance less meaningful.

*We strongly suggest any group conducting Dungeness crab surveys in BC standardize their fishing in the same manner as DFO* (for more details, please refer to Section 5.3, DFO Standardized Fishing, on page 17). This will allow crab data collected by various groups in different areas and at different time periods to be comparable. Another option is for a particular group to standardize their crab gear in their own way rather than using DFO standards for surveys (for example, use squid instead of herring for bait or soak traps for three instead of one day). With this option, the benefit is that data can be compared between sites where the survey took place; however, the downside is data cannot be compared to those collected in areas where different baits or soak periods were used. Another option is for a group to conduct crab surveys without standardizing their fishing gear at all. This is not recommended because no comparisons of relative abundance will be possible between sites and over time.

A valid survey objective may be to evaluate catch rates and impacts of the commercial fishery in a particular area. In this case, it may be necessary for survey gear to mimic that used by the commercial fishery, and this could involve using traps with open escape ports, bait other than herring, and a multi-day soak period. A powerful survey design could have standardized fishing and commercial fishing methods occurring simultaneously to answer several research objectives.

## 4.3 Survey Design

The design of a crab survey program will be influenced by the size of the survey area, the number of traps and people, and time available. Wherever possible, we recommend that users determine the geographical extent of the survey area. Commercial fishers generally know where the best places to fish crabs are so their fishing patterns likely indicate areas of greatest abundance of legal size males. However, traps should not only be placed in the middle of known crab habitat, but also extend far enough so habitat boundaries can be identified (some zeros in the data will suggest where this occurs). Local knowledge may indicate some areas are not suitable crab habitat in which case they can be removed from the survey area. In circumstances where data are required about other sizes and/or females, then the survey area may need to be expanded and specialized gear considered.

If very little is known about a particular area, then the survey area can first be delineated by presence of suitable crab habitat which may be roughly determined by studying hydrographic charts, from sounding the area, or from local knowledge. Traps should be fished throughout the entire area of possible habitat excluding only areas of rough, rocky bottom, and at all depths to the limit of the habitat, if possible. We recommend extending the survey to areas where crabs might not be found as their distribution may change seasonally or annually. It is important to determine if the crabs in question are an isolated population or part of a larger population free to move throughout a more extensive area.

Crab sampling can also occur opportunistically during surveys directed at other invertebrate species. Even though with this approach it will not be possible to determine the full range of crab habitat, collecting a number of isolated samples may still contribute valuable biological knowledge. Often records of other crab species, notably tanner (*C. bairdi*), red rock (*C. productus*), and graceful (*C. gracilis*) crabs are obtained in this manner.

Within the survey area, sampling sites where trap gear will be deployed will need to be determined, the number of sites constrained by the number of traps and people, and time available. Ideally traps should be dispersed throughout the survey area. If it is a relatively small area with uniform habitat and constant depth, for example, an estuary at the head of an inlet where crab habitat extends from zero to 15 meters deep, then sampling sites can be chosen randomly. One approach is to divide the estuary into 100 × 100 meter grids and then randomly select those grids where gear will be deployed (Fig. 4a). Similarly, random points can be generated throughout the area in question using spatial mapping software. At each randomly chosen grid/point, fishing gear can either be a string of singles or a ground line. In some cases placing a single trap at many random sampling sites selected throughout an area may suffice.

Another approach is a stratified sampling design which means the survey area is divided into smaller units that share similar characteristics, and the desire would be to deploy traps in each of the units. For more information on statistical sampling design, please

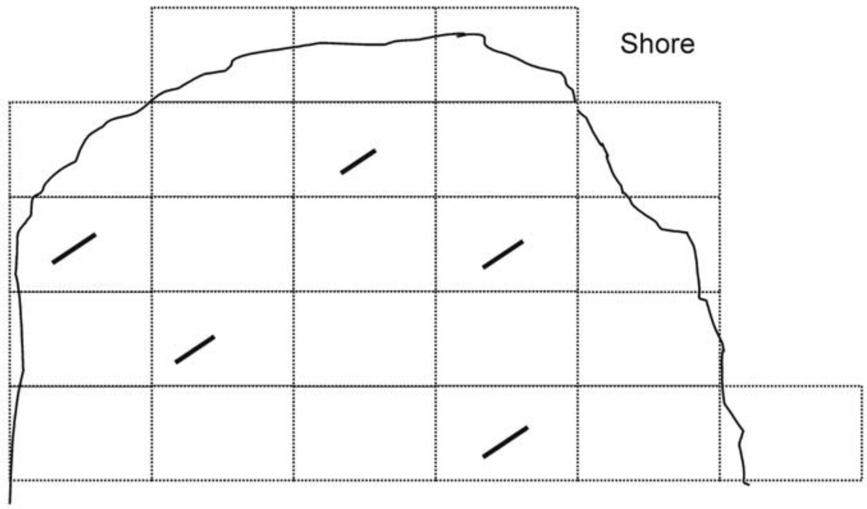



Figure 4a.  Sampling design to cover a small area with uniform habitat and constant depth.  Here, five sampling locations in an estuary divided into 100 × 100 meter grids are illustrated.  The thick, short dark lines represent groups of traps or single traps randomly placed throughout the estuary.

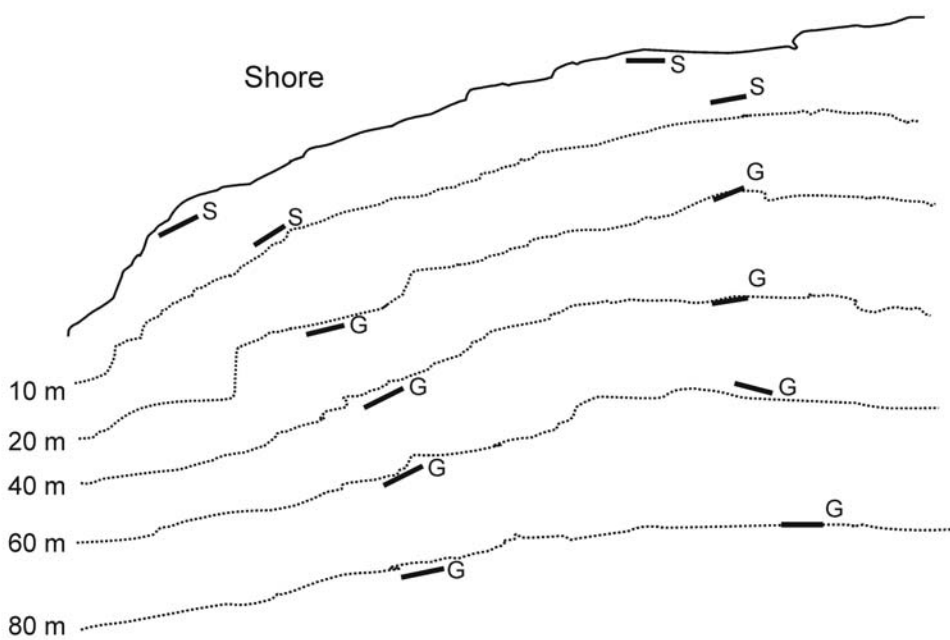



Figure 4b.  Sampling design to cover a large area with a range of depth zones.  Here, two sampling locations along the shore are illustrated.  The thick, short dark lines represent groups of traps (S = singles, G = ground lines) placed at various depth zones: 0-5, 5-10, 20, 40, 60, and 80 meters.

consult Thompson (1992). There may be reasons to further subdivide the survey area based on Pacific Fishery Management Areas (PFMAs), depth, oceanographic features, fished vs. unfished, etc. A benefit of stratification is different strata can be compared to one another. Sometimes the area in question to be surveyed is large and covers a range of depths; for example, a 30 square kilometre inlet where crab habitat extends from zero to 80 meters deep. One approach is to stratify the shoreline so fishing gear will be distributed evenly throughout the inlet. Gear would then be set at random locations along the shore in each stratum. Furthermore, at each location the range of depth zones could be sampled such as in the 0–5 meter zone below local low water (BLLW), the 5–10 meter zone, and then at increasing depth increments of 20 meters (Fig. 4b). DFO uses this type of sampling design on the Fraser River delta. If the survey area does not include such deep water sites, then setting gear at 10 meter depth increments would suffice.

If possible, sampling sites should initially be selected randomly. However, in the field particular sites may not be appropriate for sampling for a variety of reasons, e.g., they are located too close to a traffic lane or an anchorage, and there is the possibility of gear being lost. In these situations sites can be adjusted to accommodate the obstacles or abandoned entirely and other sites selected in their place.

Crab surveys are often done to provide an estimate of crab abundance over time. This means returning to the same areas, normally several times in one year, and often again during subsequent years. We recommend a fixed station design whereby the same sampling sites are reused. Such pair-wise comparisons are useful for tracking temporal changes in crab abundance. There are other benefits to returning to the same sites—logistically it might be easier and it can reduce variability in crab catches over time. On the Fraser River delta stock assessment biologists have returned to the same fixed sampling stations twice a year for two decades.

Crab survey design can be adaptive as the survey crew gains experience. Initial results from exploratory surveys may indicate areas of abundance that may then be more extensively surveyed. Sometimes it might be useful to combine survey approaches. For example, the first days of the survey can be used to sample those transects which must be surveyed during each sampling period. Any extra days can be used for exploratory fishing.

## 4.4 Sampling Frequency

Sampling frequency will depend on available resources and whatever the sampling objectives are. It is often useful to gather information about when peak abundance may occur and when soft shell periods might be. Peak abundance normally occurs after settlement or a moult (May to July), in late summer or early fall (September to November), and again in winter (January to March). Large males probably moult in winter/early spring, with a potential secondary moult sometime in the summer. A high proportion of females moult during the summer.

If the objective is to identify the start of the winter/early spring male moult, then sampling should occur monthly beginning in January. Monthly sampling will give the best indication of seasonal behaviour, especially if conducted for several years as there are inter-annual differences between years which can be pronounced in certain locations. If monthly sampling cannot be achieved, then sampling should occur at least on a regular periodic basis. A multi-year program should generally be consistent from year to year. Sampling frequency may be greater in the early part of a sampling program and then reduced once some basic information about distribution, abundance, or important life cycle periods has been determined. For example, the first year of a program could include sampling monthly or bimonthly, then be reduced in subsequent years to target important periods for the survey area.

Long-term population evaluation is becoming an increasingly important function of stock assessment. It is necessary to detect changes in crab populations that may be in response to changes in harvest practices or the marine environment such as those related to climate change. Fishing may significantly impact populations in certain areas, particularly given the recent trend away from finfish toward targeted invertebrate stocks (Fisheries and Oceans Canada 2001). Intensive fishing effort may eventually compromise conservation of reproductive potential ensured by size and sex restrictions. Such evaluations depend on long-term data series normally supplied by synoptic surveys.

### 4.5 How Many Crabs Should Be Collected?

A representative number to be measured for shell condition and width during a particular sampling event is 200 crabs; however, the more the better. For example, to deduce moult timing in males, it is best to analyze legal male shell condition data only and not sublegal male data because smaller crabs moult frequently and will mask the timing of the moult for larger crabs. This is one reason why it is important to collect sufficient numbers of crabs in each size/sex category (legal males, sublegal males, and females) in order to answer particular research questions.

The goal of the sampling program is to collect a good representation of the population, but crabs can be segregated at certain times of the year by size and sex. If samples are only returning one size or sex of crabs, then the remainder of the population might be present in other areas, and these crabs should be located by broadening the survey area.

## 5.0 Fishing Gear Information

### 5.1 Traps

The basis for most assessments is the standard crab trap. A popular style of the commercial Dungeness crab trap is the circular variety with opposing tunnels, two escape ports, and a biodegradable escape mechanism under tension in the form of a rot cord or rot panel (Fig. 5).

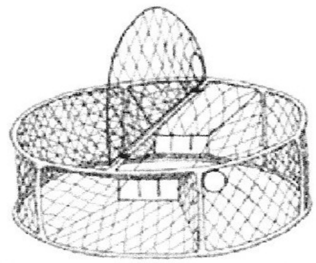


Figure 5. Commercial Dungeness crab trap.

Trap mesh can be stainless steel or synthetic (such as nylon or plastic) with approximately 6 centimetre (2½ inch) squares or diamonds. Maximum trap volume allowed in the commercial fishery is 400 litres. Crab traps are generally designed to capture larger legal size crabs and are less likely to capture smaller crabs. Traps used in surveys should be the same type, size, and be rigged identically. This consistency should be maintained between years so data can be compared.

### *5.1.1 Closed or open escape ports?*

Closing escape ports or keeping them open during a survey will depend on objectives of the sampling program. If the program is intended to provide a broader picture of population structure, including the abundance of undersized crab that may recruit to the future fishery, and the abundance of females, then fishing traps with closed escape ports would be appropriate. If crab data are to be compared to those collected by DFO, then escape ports must be closed, and data collected in the same manner as done by stock assessment biologists. Note that even with escape ports closed, trap mesh generally allows crabs below about 140 millimetres to escape. Escape ports should be closed using rot cord only so if traps are lost the rot cord will eventually disintegrate and open the escape ports allowing small crabs to escape. Rot cord is easy to cut and remove if survey traps are required for other types of fishing.

If the sampling objective is to measure the availability of legal size crabs caught in a manner comparable to commercial fishing, then one would fish commercial traps with open escape ports.

### *5.1.2 Bait*

Crab surveys provide a relative abundance index, not an absolute estimate of population size. Changing bait during surveys can result in a perceived change in abundance, as one bait may fish better than another. This bait effect can also make it difficult to compare survey data to commercial fishing data, or may make it impossible to use commercial data as part of a survey program. Higher bait loads and certain types of bait often attract more crabs than standard bait; however, the type and amount of bait should be consistent throughout the survey and between surveys.

DFO personnel use herring as standard bait. Bait is replaced for each new soak. Some commercial fishers use squid because it works well for longer soak times. Fresh clams also work well. Crabs' preference for salmon can be somewhat seasonal; crabs in small estuaries tend to target salmon in the fall as the fish move into rivers to spawn (and die) so this type of bait may not be as effective at other times of the year. Some people use fish carcasses; however, it is difficult to keep the "bait load" consistent and amphipods can eat the bait quickly which reduces trap efficiency. Chicken pieces are not effective bait.

For all bait types, bait jars (volume 500 millilitres) are used to standardize the bait load and keep amphipods from consuming the bait. Bait jars should have small holes (one millimetre in diameter) to keep amphipods out and allow the scent to disperse. Bait jars should be suspended in the centre of the trap and not touch the ground. Jars should be cleaned after every use.

#### *5.1.3 Soak time*

DFO standardizes soak time by soaking all traps approximately 24 hours. Precise timing related to tide cycles is not required; however, data from short and long soaks (e.g. less than 16 hours or greater than 28 hours) is less reliable for comparisons. Generally shorter soaks (less than one day) will catch more small crabs whereas longer soaks catch more big crabs.

#### *5.1.4 How many traps?*

Fifty or 60 traps are useful for exploratory research, but fishing this many traps will require a larger boat and it may take a full day for an inexperienced crew to measure all crabs caught. For survey programs with limited budgets, 20 traps can be transported in a small boat and redeployed at different locations over several consecutive days. For DFO surveys, hauling and resetting 100 traps, using both a skiff and research vessel, and with the benefit of direct electronic data entry, takes a full day with most of the time used to collect biological data from individual crabs. Using paper data sheets and transferring data to a computer later will take additional time. The time required to assess and measure the crabs caught is related to abundance and generally takes longer in the spring.

To ensure adequate replication, a minimum of three traps should be set, either randomly throughout a small area where crab habitat and depth is relatively constant or in each group along a particular depth contour. Trap catches are highly variable so the more traps fished the better. If possible, we recommend fishing upward to 10 traps at each location.

### 5.2 Single Buoys or Ground Lines

Usually DFO personnel fish crab traps in groups of ten, either single buoyed or attached to a ground line. A group of traps can also be referred to as a *string* or *set*. Single buoyed traps are equipped with 25 meters of sinking line and a bullet-shaped Carlin solid foam float. Single buoyed traps are used in shallow waters (<15 meters) or to prevent crossing over ground lines if survey traps are being set in a commercially fished area. As a rule, single buoyed traps are not set in water greater than 15 meters or in currents exceeding one meter per second (two knots). Traps are usually set 100 meters apart on a transect line (Fig. 6A). A gillnet float is attached to each float on the two end traps of a transect; this makes it easier to identify the ends of a trap line in areas with many floats or in foggy conditions. Traps are recovered using a skiff equipped with a hydraulic trap hauler.

Single buoyed traps can also be fished in water deeper than 15 meters. Heavier (40 kilogram) standardized traps should be used for deep water single float applications. A good rule of thumb for buoy lines is to allow at least 20 percent more than the set depth, and even more line in higher current areas. If a float cannot be located during maximum tide, then return at slack tide and search for it again. It is not a good idea to use single buoyed traps adjacent to a drop-off—any current or disturbance will carry them over the edge and they will be lost. We recommend users ensure buoy lines are at least as long as the deepest hole in the immediate area. Buoy lines should be made with sinking rope to reduce loss through entanglement with boat propellers.

DFO personnel use ground lines in water depth greater than 20 meters to save on buoy line lengths. If the buoy line cannot be coiled and stored in the trap then consider using ground lines. DFO's standard ground line is 3/8 inch three strand polypropylene rope 360 meters in length with 10 marks at intervals of 40 meters. The line itself is buoyant to reduce snagging on underwater obstacles. Traps are attached to the ground line by means of stainless snaps on short beckets attached to the traps. A different colour rope woven into the ground line at 40 meter intervals indicates where to snap on traps when setting the ground line. The ground line is anchored at either end with 20 kilogram chain anchors to prevent the end traps from dragging. Buoy lines at either end of the ground line have a section of sinking line near the surface to prevent vessel entanglement and are suspended from air-filled bladders 60 centimetres in diameter, appropriately identified (Fig. 6B). When setting ground lines in very shallow water (less than 5 meters), use sinking ground lines to avoid navigation concerns.

### *5.2.1 Inter-trap spacing*

During DFO crab surveys, traps are spaced 100 meters apart when single floated and 40 meters on ground lines. We assume traps are fishing independently at these distances, but the distances are arbitrary and may not reflect the attractive radius of a particular trap, which will be influenced by currents, etc. Traps set closer than 40 meters may not fish independently and CPUE estimates could be affected. Where possible, when survey fishing among other crab gear, we suggest spacing survey traps at least 50 meters from other traps.

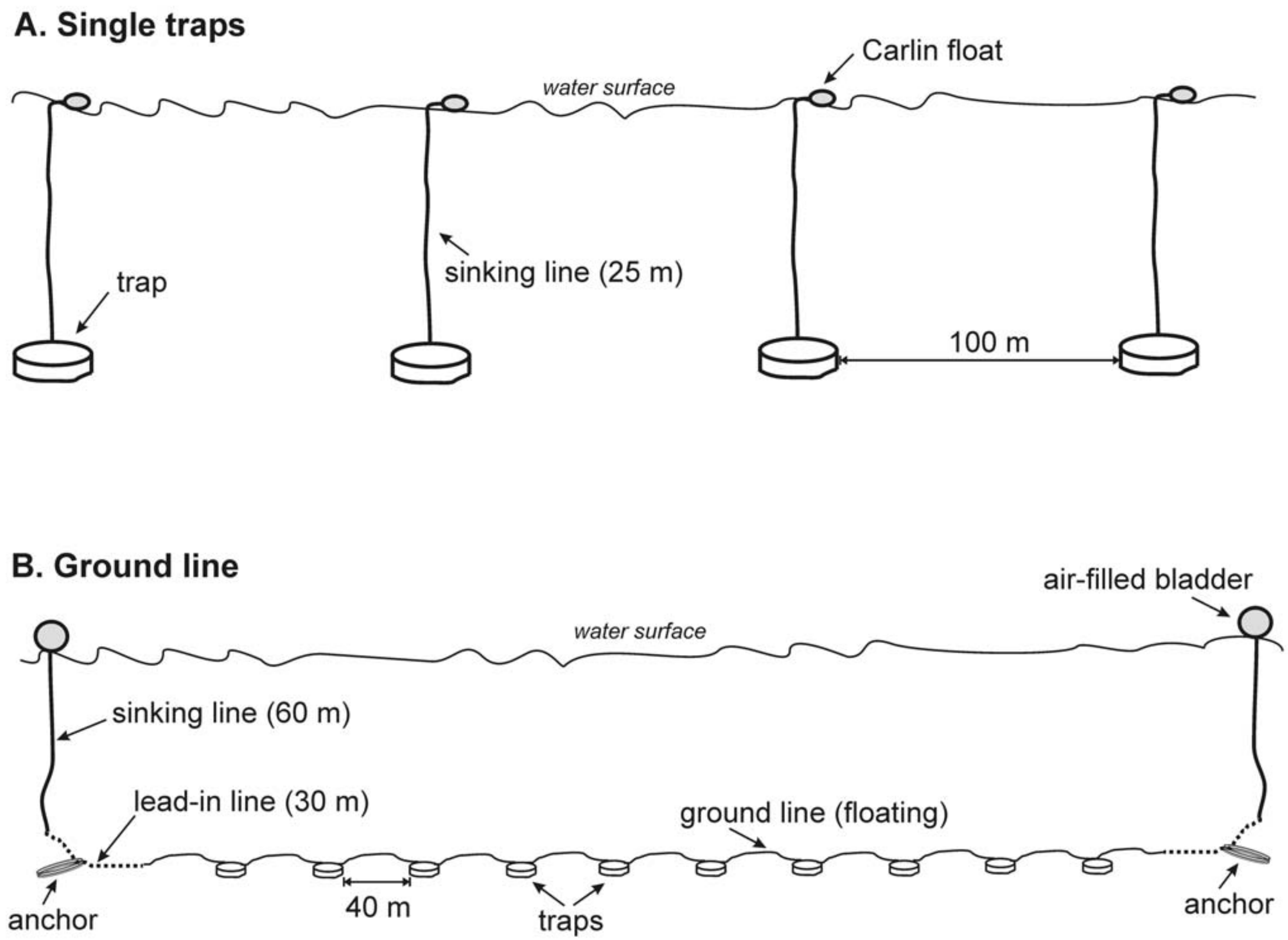



Figure 6. Dungeness crab trap sampling gear utilized by DFO: A) traps with single buoys, and B) traps on a ground line fished at depths between 20 and 60 meters. For depths 70 to 120 meters, another 60 meter sinking line is added to the existing sinking lines.

### *5.2.2 Position in string*

It is important to identify the first and last traps in a string as these may fish differently from other traps due to upstream or downstream current effects. This phenomenon, known as “end trap effect”, occurs when end traps outperform other traps in a string because they are the first trap encountered by a crab following a scent trail produced by the entire group of traps. This should be taken into account when performing CPUE analyses.

## 5.3 DFO Standardized Fishing

DFO uses commercial style circular stainless traps 90 centimetres (36 inches) diameter by 26 centimetres (10 inches) high with two opposing tunnels, each with a single set of triggers. The frames are steel, rubber wrapped on the bottom ring, and covered by stainless steel mesh with approximately 6 centimetre (2½ inch) squares or diamonds. Existing escape ports are closed with rot cord. Two large herring torn in half are placed in a 500 millilitre bait jar with small (one millimetre in diameter) holes in the lid and sides to prevent consumption by crabs and entry of amphipods while allowing the scent to escape. The bait jar is suspended not touching the ground in the center of the trap. Traps are soaked overnight between 16 and 28 hours, as close to 24 hours as possible.

## 5.4 Gear Recovery

Traps are recovered by a hydraulic line hauler attached to a davit. On recovery, each trap is emptied into its own bin (one suggestion is blue plastic recycle bins 60 × 40 × 40 centimetres with drain holes in the bottom). Bins are normally stacked until processed. Crabs should be kept out of water for as little time as possible. Generally not more than two groups/strings of gear should be recovered at one time to reduce the time out of water for the crabs. In hot weather it is sometimes necessary to process one group/string at a time. We recommend where possible processing crabs after every ground line (10 traps) is hauled. Each crab should be gently returned to the water—not tossed—immediately following measurement to minimize handling injuries and mortality.

### *5.4.1 Trap fishing success*

Generally traps fish normally, but there are circumstances when a particular trap does not, such as a trap malfunctions or a fish dies in a trap and alters the bait load. These problems are identified through trap usability codes so data from malfunctioning traps are not included when calculating CPUE.

## 5.5 Gear List for DFO Surveys

### *5.5.1 Fishing gear*

- Crab traps (closed escape ports)
- Trap repair kit - twine, stainless wire, needle-nose pliers, rubber strips (cut from inner tubes), rot twine, plastic trap closure hooks, knives, tape, zap straps, snaps
- Beckets. One is required for each trap when fishing ground lines. A becket is a rope approximately 60 centimetres long with a loop at one end and a snap on the other. Each trap has a becket attached to a solid portion of the frame. The trap is attached to the ground line with the snap.
- Hanging bait jars and lids
- Bait (herring)
- Totes (2) for washing bait jars
- Scrub brush
- Soap such as bilge cleaner for washing bait jars and containers
- Ground lines
- Air-filled bladders (scotchmen) for ground lines (marked with name)
- Line anchors
- Single float lines
- Bullet floats for single buoy traps (marked with name)
- Gillnet floats with snaps or equivalent to mark the first and last single float traps in a transect.
- Sample totes for crabs - ecotainer buckets or equivalent sturdy plastic containers 35.6 × 40.6 × 50.8 centimetres (14 × 16 × 20 inches) or larger with drain holes, to hold catch from each trap. At least 10 are needed for each string or transect which will be sampled.
- Herring buckets – 35.6 × 35.6 × 35.6 centimetres (14 × 14 × 14 inches) with lids, four or more, without drain holes, to hold miscellaneous items like bait jars and lids, bait, repair materials. These can be used for sample buckets as well depending on the local abundance of crabs.
- Grapple for finding lost traps/ground lines.

### *5.5.2 Sampling gear*

- Vernier callipers (2) in millimetres
- Data forms on waterproof paper – Fishing Gear Header, Crab Biological Data, and Bycatch forms
- Dungeness crab survey manual!
- Clipboard
- Data box with data form codes, contact numbers, pencils
- Nautical charts
- Bycatch books (for fish and invertebrates)
- Laptop with Access database and Crab Bio Data Entry program
- Digital camera

- Spare batteries

### *5.5.3 Work apparel*

- Lifejacket
- Rain gear
- Rubber boots
- Gloves
- Sunglasses, sunscreen
- Knife
- Radio
- Hearing protection
- First aid kit

## 6.0 Crab Biological Information

Information recorded by fisheries biologists for crabs captured is standard throughout BC. This information is applicable to all species of crabs with the exception of King crabs (Golden king, *Lithodes aequispinus*; Red king, *Paralithodes camtschaticus*; Puget Sound king, *Lopholithodes mandtii*) where length is substituted for the width measurement. The codes presented here, developed over the last 50 years, are unique to BC; however, the information collected is similar to many other jurisdictions in North America. The examples listed apply primarily to Dungeness crabs.

Crab biological data collection requires a team of at least two people. Typically one person holds and measures the crabs; the other person records biological data either on waterproof data sheets or electronically. The person measuring crabs is somewhat exposed to the weather as it is impractical to move large numbers of crabs into a cabin for analysis and measurement. If information is being recorded on data sheets, then the second person will also be nearby on deck. These data must then be entered into a computer at a later date. In contrast, field data can be entered directly into a computer without using data sheets by transmitting information from the person on deck to someone in the wheelhouse by means of a hands-free duplex radio link. This technology is reliable and eliminates the need to move heavy totes of crabs to a convenient place for processing. It is possible to fish over 100 traps in a day depending on crab abundance as the slow step is recording data for all crabs in every trap.

All species of crabs caught in each trap should be described with respect to sex, shell condition, injuries, and other characteristics, and the maximum carapace width exclusive of spines (notch-to-notch) measured. Normally all crabs in all traps are measured during research sampling, or all crabs in selected traps when commercial sampling. The information for individual crabs is recorded by trap.

To safely pick up a crab: using your left hand grasp the crab from behind with your fingers on the back of the carapace and your thumb on the abdomen. Rotate your hand and turn the crab upside down.

6.1 Species

It is important to be able to identify Dungeness crabs from other crab species caught in traps (Fig. 1). Most often graceful crabs (*C. gracilis*) are incorrectly assumed to be small Dungeness crabs. But graceful crabs are generally purpler, their carapace is widest at the $9^{th}$ antero-lateral spine, not the $10^{th}$ spine, they have a small postero-lateral tooth, their walking legs are more slender, and the tip of the male telson is pointed, not rounded.

6.2 Sex

Crabs are either male or female; data are collected for both sexes. Males are identified by their narrow pointed abdomen which is held tightly against the sternum (Figs. 7 and 8).

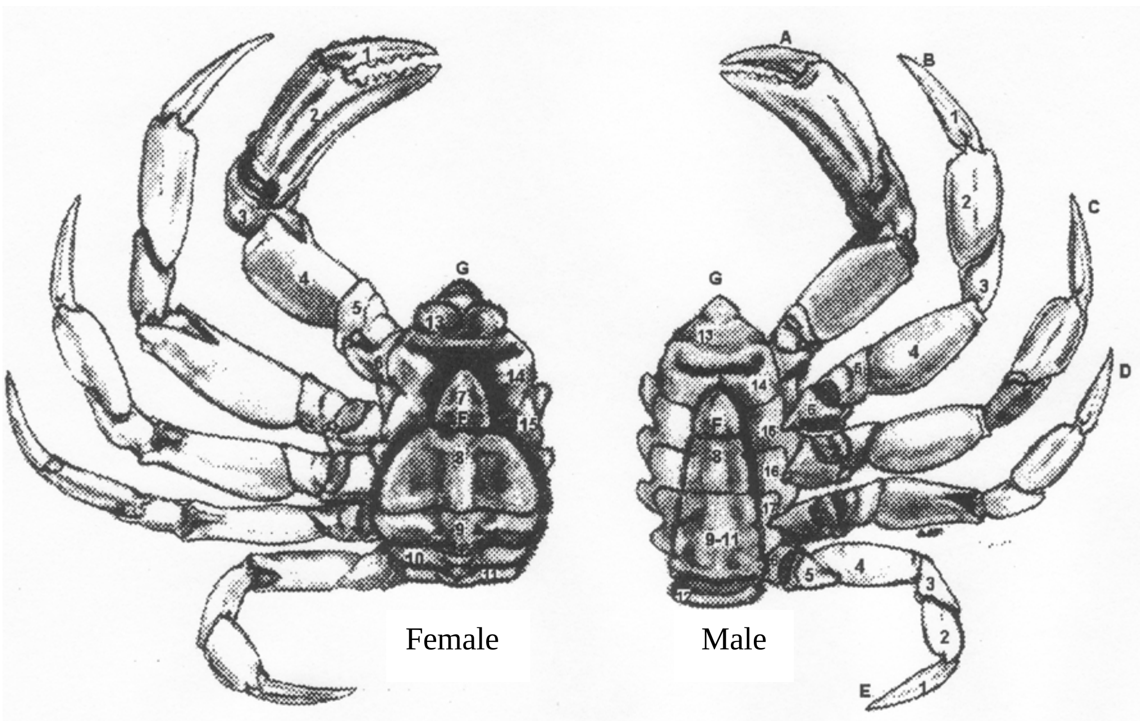


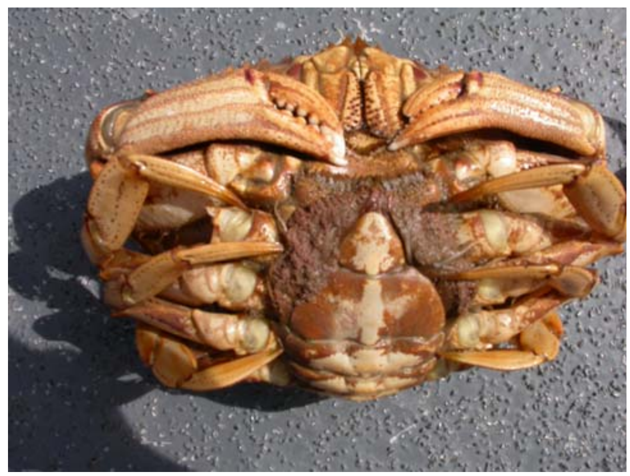

Figure 7. Ventral view of abdomen, sternum, and thoracic appendages of female and male Dungeness crabs (Butler, in prep).

| | |
|---|---|
| A. | Cheliped (claw). 1, dactylus; 2, propodus; 3, carpus; 4, merus; 5, ischium; 6, coxa. |
| B-E. | Second to fifth pereiopods (walking legs 1-4). Podomeres numbered as in A. |
| F Female. | Female abdomen |
| F Male. | Male abdomen |
| G. | Sternum |

a) Male Dungeness crab
(sex code 1)

b) Female Dungeness crab
(sex code 3)

c) Female Dungeness crab with eggs
(sex code 4)



d) Female Dungeness crab releasing eggs
(sex code 5)

Figure 8. Ventral view of male and female Dungeness crabs showing the different shaped abdomens, and egg masses in females.

Females have a broader paddle-shaped abdomen with pleopods to accommodate a large egg mass (Figs. 7, 8). A clutch of eggs under a female's abdomen looks like a distinct orange mass (Fig. 8c). There are separate codes for females with eggs and those in the process of releasing eggs, the latter identified as an incomplete dark brown egg mass with some eggs still adhering to the pleopods (Fig. 8d).

Sex is more difficult to determine in small, young crabs less than 20 millimetres carapace width because the abdomens in males and females are similarly shaped, except the sides of the male abdomen are slightly more concave, and less straight, compared to the female abdomen.

6.3 Shell Condition and Age

Shell condition is a subjective estimate of the inter-moult stage of the crab based on defined characteristics of shell plasticity, overall body wear, and epiphytic growth. A shell evaluation (inter-moult stage) is made based on the overall appearance and color of the shell and appendages, the wear on the walking legs and claws, and the presence of barnacles and other fouling organisms.

Dungeness crab shells are either soft or hard. Shell hardness reflects a crab's ability to withstand capture and handling. During crab surveys shell hardness is determined subjectively by checking the flexibility of the carapace. This is done by exerting pressure with the thumb of the right hand immediately posterior to the claw on the underside of the shell (Fig. 9).

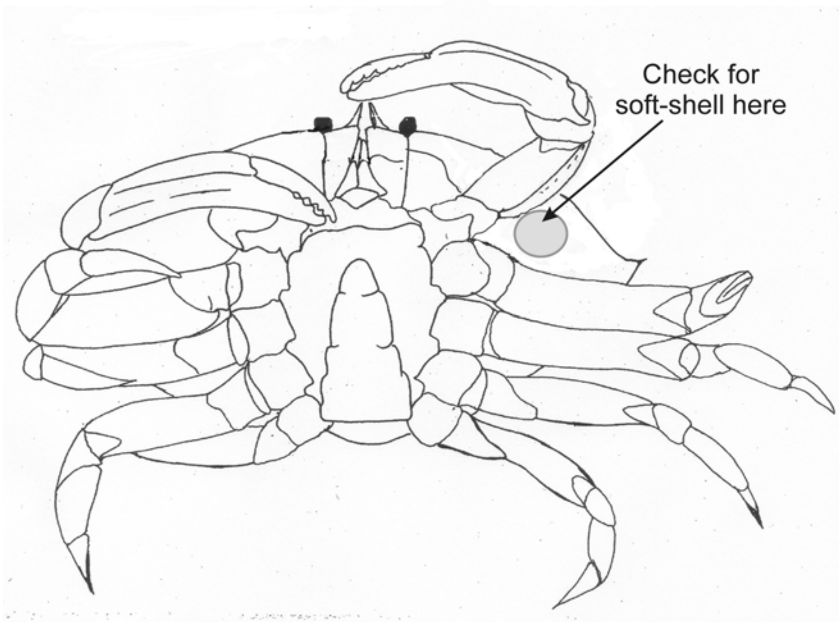



Figure 9. Location on a Dungeness crab where to determine whether the shell is soft or hard. Slide the left claw up out of the way and press with your thumb on the underside of the carapace. There will be no give to a hard shell.

Crab shell hardness can also be measured using a durometer, which is a spring driven device specifically designed to measure the shell hardness of Dungeness crab. Please note, however, that DFO biologists do not use durometers and, therefore, do not record such measurements. This is why crab biological data sheets and the database have not been designed to accommodate durometer measurements. Regardless, a durometer may be a helpful tool for training purposes to show whether a particular crab is soft or hard-shelled. Soft shell crabs are those crabs that do not exceed a durometer measurement of 70 units (Fisheries and Oceans Canada 2010).

When using a durometer, the appropriate place on a crab to determine if the crab shell is soft is on the underside of the carapace between the widest point of the carapace and the attachment of the leg bearing the claw. The durometer should be positioned just anterior to the shell suture line as indicated in Appendix 6 of Fisheries and Oceans Canada (2010). The durometer shall be applied to this location on the crab as per the manufacturer's instructions. The indenter of the durometer should be pressed to the crab shell until the foot of the durometer is flush with the surrounding shell.

Shell condition/age can be broadly categorized as "soft" (moulted not more than three months ago), "new hard" (moulted between three and 12 months ago) or "old hard" (moulted more than 12 months ago) (Table 1).

Table 1. Dungeness crab shell conditions, approximate time since the last moult, and corresponding shell condition codes (seven of nine are listed here).

| Shell Condition | | Time Since Moult | Code |
|---|---|---|---|
| Soft | Just moulted | 2-6 days | 4 |
| | Very new | 6 days – 1 month | 3 |
| | New | 1 – 3 months | 2 |
| Hard | New | 3 – 6 months | 1 |
| | Between new and old | 6 – 12 months | 8 |
| | Old | 12 – 24 months | 6 |
| | Very old | > 24 months | 7 |

Nine shell condition codes are used to identify soft or newly moulted crabs, those with new hard shells, those with old worn shells, and those somewhere between new and old shell status (Tables 1, 2; Fig. 10). *Reliable estimation of shell condition requires training and much experience.*

The most important identifying characteristic for determining shell condition is claw abrasion, in particular on two parts of the claw, the hook on the tip and teeth. For a new shelled crab, claw tips will be hooked and the teeth sharp (Table 2; Fig. 11). As the crab ages, the claws wear down from feeding activity which gradually causes the tips to smooth or break off, and the teeth to become blunt. Old claw tips are ivory coloured and the entire claw becomes yellowish. Small crabs (less than 120 millimetres) seldom have old shells because the frequency of moulting is less than one year.

One way to learn to recognize variations in shell wear is to compare fouling growth, barnacles, etc on a new soft crab (shell 3) to an older shelled crab (shell 6). *It is crucial one gains sufficient experience to be able to confidently tell the difference between new and old shell crabs.*

Table 2. Shell condition characteristics of Dungeness crabs.

| Crab Characters | New soft shell Shell Codes 4, 3, 2 | New hard shell Shell Code 1 | Between new hard and old hard shell Shell Code 8 | Old hard shell Shell Code 6 |
|---|---|---|---|---|
| Claw hook | Sharp, pointed | Sharp, pointed | Still a hook, but claw tips may be white | Worn down, blunt; claw tips are ivory |
| Claw teeth | Sharp, well defined | Sharp, well defined | May be well defined, but sharp edges have been lost | Worn down; this is affected by type of food eaten |
| Leg tips | Sharp, pointed | Sharp, pointed | Not as sharp | Worn down; this is affected by habitat |
| Leg colour | Bright, clean | Bright, clean | May be some brown discolouration | Patchy brown discolouration; bright color may be maintained in some areas with current and sand |
| Carapace spines | Shell horns are sharp | Shell horns are sharp | | Shell horns are blunt |
| Hairs on underside of shell | Bright downy orange or yellowish | Bright downy orange or yellowish | Brown | Darker brown or mottled with black; worn; may be bare spots |

Table 2 (continued). Shell condition characteristics of Dungeness crabs.

| Crab Characters | New soft shell<br>Shell Codes 4, 3, 2 | New hard shell<br>Shell Code 1 | Between new hard and old hard shell<br>Shell Code 8 | Old hard shell<br>Shell Code 6 |
|---|---|---|---|---|
| Shell | No signs of wear or abrasion, no barnacles | Few signs of wear or abrasion, few barnacles | Small barnacles scattered | Often barnacle encrusted; males with mating marks; may be signs of carapace break-down (e.g. black spot disease) |
| | Shell is extremely soft – shell code 4<br>Shell is crackly soft – shell code 3<br>Shell is springy, nearly hard – shell code 2 | Shell is hard, no softness | Shell is usually hard. May feel slightly soft if crab is preparing to moult | Shell is hard |

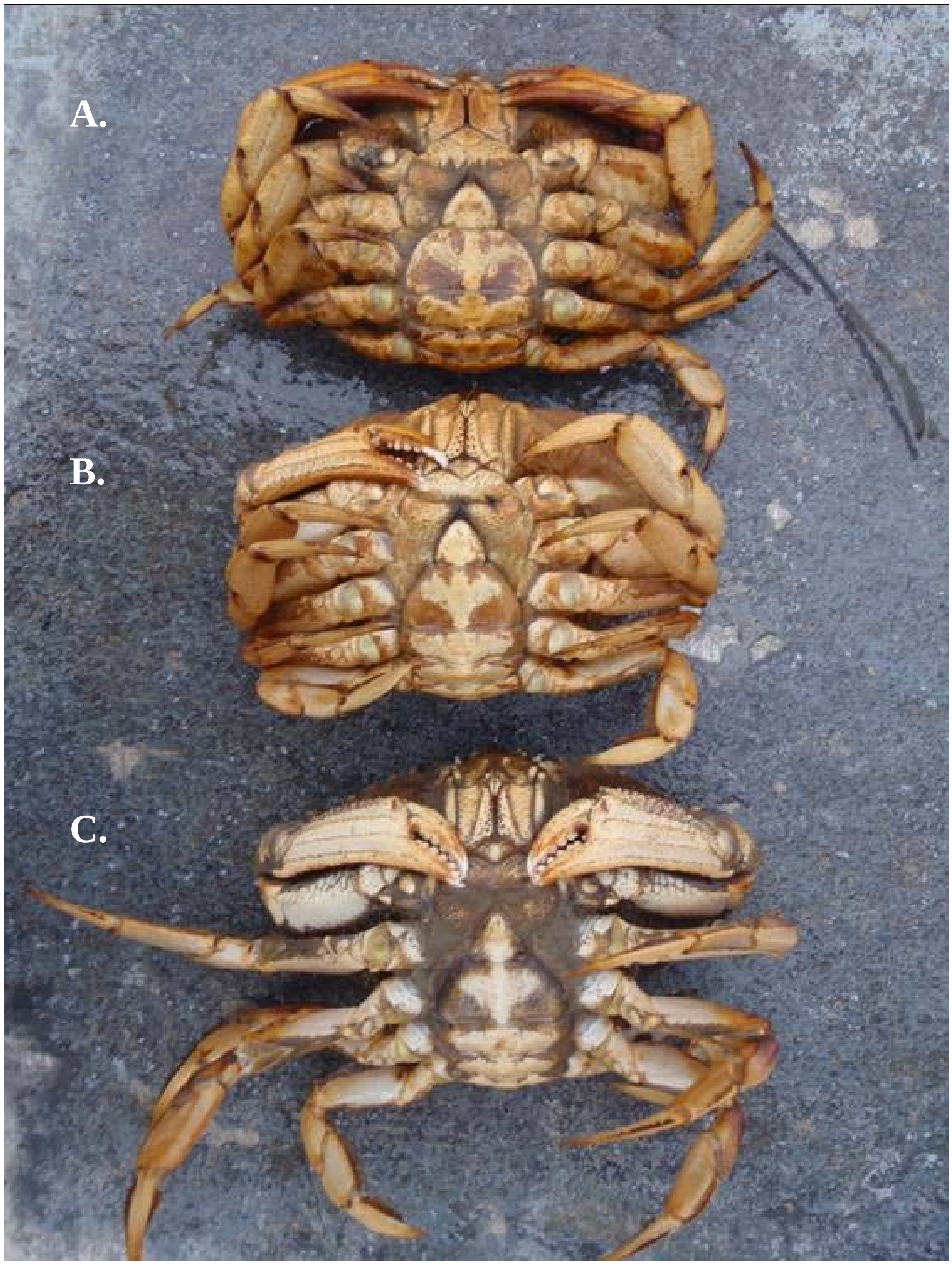
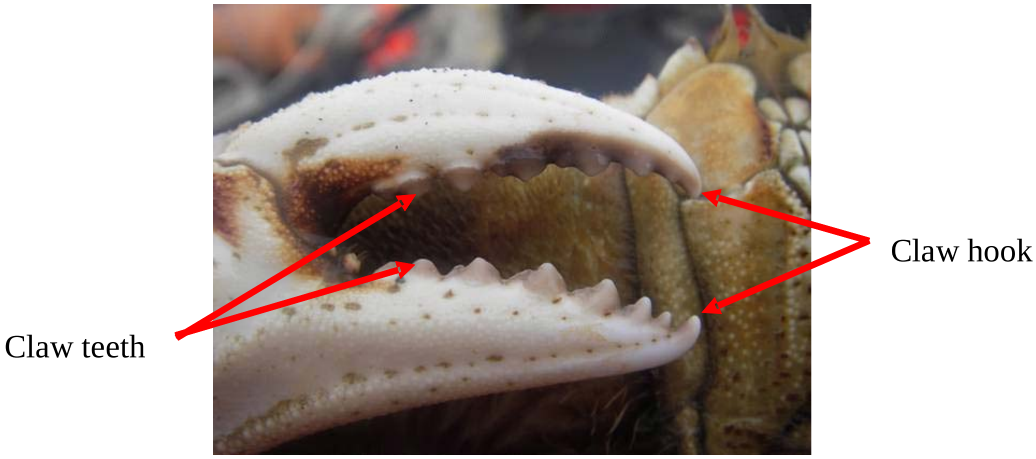



Figure 10. Comparative shell conditions of three female Dungeness crabs. A = old shell, shell code 6; B = between new and old shell, shell code 8; and C = hard new shell, shell code 1.




New shell (shell code 1)

Between new and old shell (shell code 8)

Old shell (shell code 6)

Figure 11. Stages of claw wear on Dungeness crabs.

## 6.4 Injuries

Crabs are injured naturally through antagonistic interactions with each other, from unsuccessful predator attacks, and fishery-related handling. There are nine injury codes to record damage to the shell and abdomen, regenerating limbs, shell disease, and death as a consequence of capture (Fig. 12). The numbers of missing/regenerating appendages are also documented, but not their specific locations. Moreover, only older injuries, those missing limbs where the stump end has a black sheath covering it, are noted (Fig. 12i). Recent limb losses, which sometime occur during sampling, are not recorded. These can be distinguished from older injuries because the stump will be white. Injury data are useful for determining the degree of damage inflicted during handling of undersize and female crabs, especially if they can be compared to background injury rates either at the start of a fishery or in an area with little or no fishing.

## 6.5 Mating Marks

Male Dungeness crab can have marks on the inside of the claws caused by abrasion from the female carapace during the post mating embrace (Fig. 13). Mating marks indicate the male has engaged in breeding, but absence of marks does not necessarily indicate abstention from breeding activity. Typically mating marks are visible on crabs with old shells or very hard new shells. Large crabs (greater than legal width) or crabs below 140 millimetre notch width seldom show marks. Mating marks look like scratches or can be deep, nearly worn through the claw. Marks can be classified as old marks (yellow or orange, overgrown with fouling organisms, or ulcerated) or new marks (whitish).

For those Tanner crabs (*C. bairdi*) occasionally captured with Dungeness crabs, marks are recorded for the female crab as grasping marks. These are caused when the male grasps the female by the legs and holds her off the bottom while competing with other males for access to breeding. No other near-shore crab species exhibit mating marks.

## 6.6 Observations

These are records of other information such as moult increment, mating pairs, formation of limb buds prior to a moult, and pink joints, which may indicate a microsporidia infection. Of these four observations, limb buds are encountered most often. If a limb bud is present on a missing appendage, then this is recorded as a regenerating appendage (not missing) and observation code 3 for limb bud. For example, a missing claw with a limb bud would be injury code 4, observation code 3 (Fig. 14a).

Observations of crabs with microsporidia infections are very rare. Infected crabs may have pink or orange coloured joints on the ventral surface in the coxa region (Fig. 14b). In healthy crabs the joints are usually clear or light green color.

a) Deformed shell (Injury code 1)

b) Cracked shell with hole (Injury code 2)

c) Torn abdomen (Injury code 3)

d) Regenerating claw (Injury code 4)

e) Regenerating leg (Injury code 5)

f) Regenerating claw and leg (Injury code 6)

Figure 12. Dungeness crab injuries.

g) Shell disease (Injury code 8)

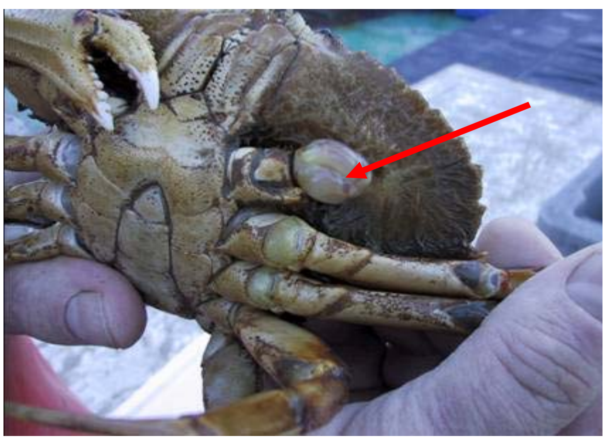
h) Missing claw

i) Missing leg (stump with black sheath)

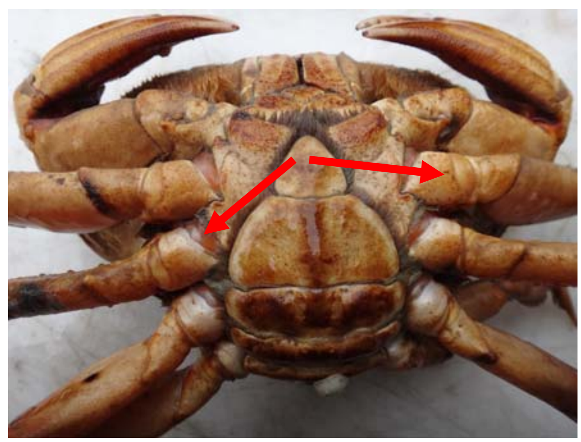
j) Missing claw and leg

Figure 12 continued.  Dungeness crab injuries.

Figure 13. Mating marks (new; white scratches) on inside of a claw on a male Dungeness crab.



a) Limb bud - regenerating claw (Injury code 4, observation code 3)



b) Pink joints – suspected microsporidia infection (Observation code 4)

Figure 14. Select observations including the formation of a limb bud and pink joints which is indicative of a microsporidia infection.

## 6.7 Carapace Width (Size)

The commercial fishery is regulated by a size limit which is the maximum overall width including the prominent spines at the outer margin of the shell. Carapace width of a legal male crab is 165 millimetres or more. However, for research surveys, the measurement recorded is the maximum carapace width not including spines. This notch-to-notch measurement represents a more accurate width assessment because there is considerable variation in the size of spines which tend to wear down or break with age. Using the notch-to-notch method, a legal size male crab is greater than or equal to 154 millimetres, about one centimetre smaller than the regulated legal width of 165 millimetres. Occasionally a shell is deformed during the moult and this is recorded as an injury indicating the shell measurement may not be reliable. DFO biologists use 300 millimetre stainless steel vernier callipers (ex. Mitutoyo Corporation; http://www.auto-met.com/mitutoyo/calipers.htm) to measure crabs. Electronic callipers do not function well because of the salt water and grit encountered while measuring, and crabs' tendencies to seize electronic cords.

To obtain a size measurement of a Dungeness crab, face the crab, thumb on its abdomen, and curl your left hand toward you so you can put the callipers across the shell. Watch out for the hook on the legs that can interfere with the notch-to-notch measurement. Do not measure the crab from behind as this will often produce an inaccurate width measurement.

## 6.8 Weight

It is not necessary to record weight. However, if weight is recorded, it should be done in grams as soon as practicable after capture. Weight measurements require a stable platform in order to be meaningful unless a motion-compensated balance is used. Note that weights will vary with shell age and time out of water.

## 6.9 Egg Colour

Newly extruded eggs are yellow to orange while older eggs are brown to black as the eyes form in the larvae. Recording egg color allows estimates to be made regarding egg extrusion and hatching times.

# 7.0 Bycatch Information

Fishing crabs affects other species. Part of this impact is measured by recording other species caught in traps, in addition to Dungeness crabs. Bycatch is grouped by string rather than by trap. As traps in a particular string are being processed, bycatch should be pooled in a separate container. When finished with the last crab in the last trap, the various bycatch species collected from the string need to be separated, identified, weighed (estimated), counted, and data recorded. To prevent fish mortality, one may choose to immediately discard fish after capture instead of placing them in a separate container as long as the relevant biological information is recorded.

## 8.0 Recording Crab Survey Information on Data Sheets

Crab survey data can first be recorded on data sheets and then entered into the custom designed Access database or recorded directly into Access using a laptop on a boat. When recording crab survey data in the field onto paper, the following forms should be completed for every group/string of traps (singles or ground lines):

a) Fishing Gear Header Form
b) Crab Biological Data Form
c) Bycatch Form.

The Fishing Gear Header Form provides general information about each string. This form is linked to the Crab Biological Data Form where individual trap and crab data are recorded. The Bycatch Form is where catch data of species other than crabs are recorded.

### 8.1 <u>Fishing Gear Header Form</u>

For each group of traps, information such as general location, date, GPS position, details about the fishing gear, depth, and soak time is collated on the Header Form and will be linked to all traps and crabs in the sample. Refer to Appendix 1 for a template that can be printed on water proof paper, and form fields and codes. Please also read Section 9.3, “Fishing Gear Header Section” for more instructions and detailed field descriptions.

### 8.2 <u>Crab Biological Data Form</u>

Individual trap catch information for a particular group of traps is recorded on the Crab Biological Data Form along with individual crab biological data. Normally all crabs caught in traps are measured during research sampling. Relevant crab biological information includes species, sex, shell condition, injuries, marks, observations, and size. Refer to Appendix 2 for a template that can be printed on water proof paper, and data fields and codes. Please also read Section 9.4, “Crab Biological Data Section” for more instructions and detailed field descriptions.

### 8.3 <u>Bycatch Form</u>

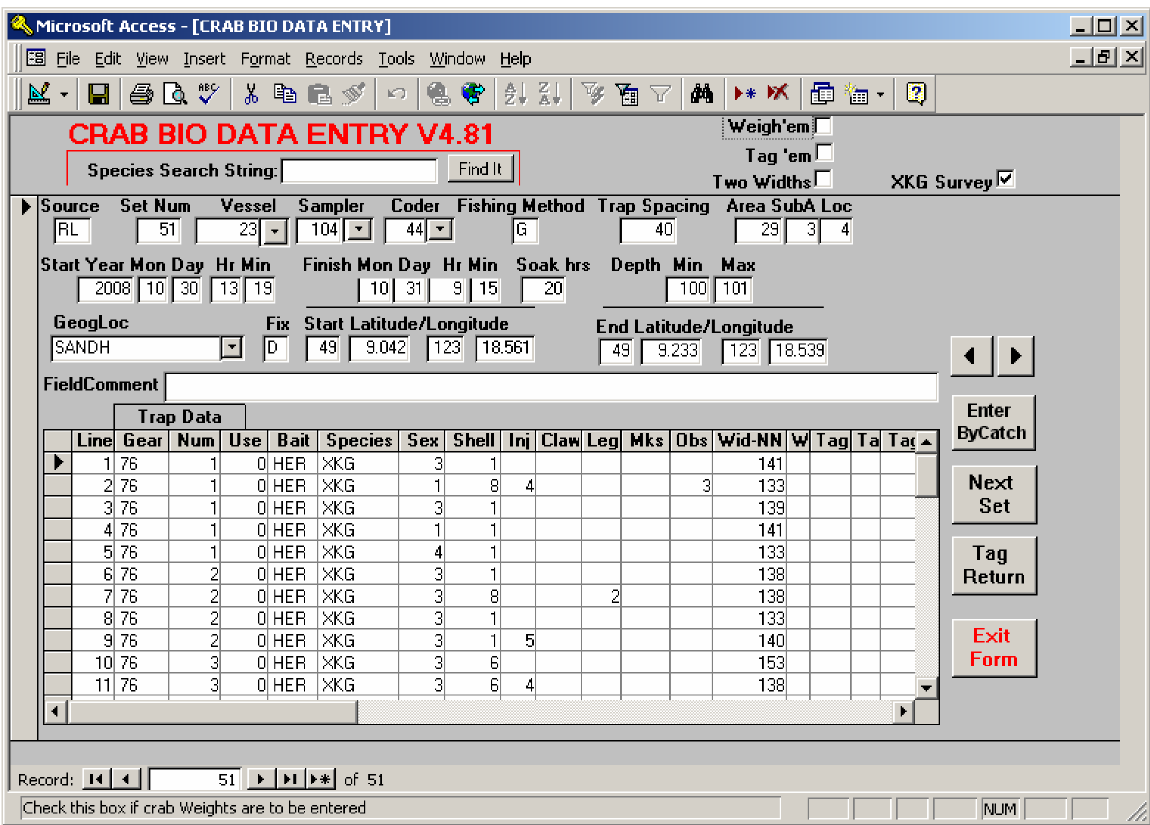
Bycatch is pooled for all traps sampled in a particular string and recorded on the Bycatch Form. Refer to Appendix 3 for a template that can be printed on water proof paper, and form fields and codes. Please also read Section 9.5, “Bycatch Data” for more instructions and detailed field descriptions.

## 9.0 Recording Crab Survey Information Electronically in an Access Database

### 9.1 Overview

While paper forms are still used and are necessary in some situations, data collection is moving toward electronic format, thereby eliminating the costly, error producing, and time consuming process of keypunching hand-written data. However, data can be lost should something happen to the computer as there is no immediate hard copy produced. Most DFO research surveys presently conducted from larger vessels collect data electronically and, with the advent of weatherproof laptop computers, this will extend to smaller vessels in the future. Electronic data collection enables data to be analysed immediately using standard software.

Crabbio.mdb is the generic name of the custom designed Microsoft Access database used to enter data from crab surveys. To open, double click on the Crabbio Access file icon. The “Crab Bio Data Entry” window should automatically pop up when the database is opened. Figure 15 shows the data entry form where header, crab biological, and bycatch data are entered.




| Line | Gear | Num | Use | Bait | Species | Sex | Shell | Inj | Claw | Leg | Mks | Obs | Wid-NN | W | Tag | Ta | Tag |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 76 | 1 | 0 | HER | XKG | 3 | 1 | | | | | | 141 | | | | |
| 2 | 76 | 1 | 0 | HER | XKG | 1 | 8 | 4 | | | | 3 | 133 | | | | |
| 3 | 76 | 1 | 0 | HER | XKG | 3 | 1 | | | | | | 139 | | | | |
| 4 | 76 | 1 | 0 | HER | XKG | 1 | 1 | | | | | | 141 | | | | |
| 5 | 76 | 1 | 0 | HER | XKG | 4 | 1 | | | | | | 133 | | | | |
| 6 | 76 | 2 | 0 | HER | XKG | 3 | 1 | | | | | | 138 | | | | |
| 7 | 76 | 2 | 0 | HER | XKG | 3 | 8 | | | 2 | | | 138 | | | | |
| 8 | 76 | 2 | 0 | HER | XKG | 3 | 1 | | | | | | 133 | | | | |
| 9 | 76 | 2 | 0 | HER | XKG | 3 | 1 | 5 | | | | | 140 | | | | |
| 10 | 76 | 3 | 0 | HER | XKG | 3 | 6 | | | | | | 153 | | | | |
| 11 | 76 | 3 | 0 | HER | XKG | 3 | 6 | 4 | | | | | 138 | | | | |

Figure 15. Crab data entry form in Access database for survey header, biological, and bycatch data.

The “Crab Bio Data Entry” window is divided into two sections: the top half is where fishing gear information is recorded, the bottom half is where crab biological data are recorded. On the right side there is a button called “Enter ByCatch”. After all crab data have been recorded for the string, clicking the “Enter ByCatch” button will open another window where bycatch data are recorded.

Header section information (top half of the screen) applies to the entire set (string) which typically consists of 10 traps and represents one record in the Header table. The Biological Data section (bottom half of the screen) stores information about each crab and will have as many records as there are crabs caught in that particular set. As data are keyed into the ‘form’, they are simultaneously entered in the Header and Length Frequency (LF) ‘Tables’; that is, the ‘form’ is just a tool for getting data into the tables in the database for permanent storage.

In addition to the two main sections, there are several buttons to help navigate to other forms, and several check boxes used to modify the behaviour of the form for various purposes depending on the nature of the survey.

## 9.2 Check Boxes

There are four boxes in the top right corner of the window that can be used to influence the behaviour of the form (Fig. 15).

The “**XKG Survey**” box is selected by default for standard Dungeness crab surveys. XKG is the code for Dungeness crab and when the box is checked the species code reverts to “XKG” for each new trap. For other types of crab surveys, click this box to de-select it.

The other three boxes allow the user to enter additional data that are not normally collected on a standard survey:

The “**Weigh ‘em**” box is selected when weight data are to be recorded.
The “**Tag ‘em**” box is selected when tagging data are to be recorded.
The “**Two Widths**” box is selected when both notch-to-notch and point-to-point measurements are to be recorded. For Dungeness crab surveys usually only notch-to-notch widths are recorded.

**Note** each box can be selected and deselected as needed.
**Note** the weight, tagging, and two widths boxes are designed to operate independently and selecting more than one simultaneously may result in the program behaving unpredictably (i.e., the cursor may jump around haphazardly).

## 9.3 Fishing Gear Header Section

The Header Section is the upper part of the form, just below the check box section (Fig. 15). Use either the Tab key or the right-arrow key to move across the fields in an orderly manner, and the left-arrow key to move backward. Click with the mouse pointer to move directly to any given field.

For all fields, *check the status line at the bottom of the screen* for lists of valid entries and other hints about what is expected for a particular field. Most of the code fields have validation triggers attached to check for valid data entry, and will flash a message if an invalid value is entered.

All character fields that should be *upper case* will automatically convert to upper case.

"**Source**": First Nations should enter "FL" here. Do not enter "RL" as this is reserved for DFO. Other possibilities are on the status line.

"**Set Num**": established using the sequence in which the sets are hauled.

"**Vessel**": originally used only for Commercial Fishing Vessel Number (CFV or VRN). However, it should be used to code all sampling vessels, including research boats and skiffs. Click the "drop-down" arrow beside the field to see a "look-up" list of vessel names and the code to use; update as needed. Vessel names can be added to the look-up table "Vessel codes". They must be given unique codes starting at 600 unless it is a commercial vessel, in which case include the VRN (aka CFV) number. Add the necessary information in the field version of the look-up table.

"**Sampler**" and "**Coder**": The sampler measures crabs, the coder records data (either to paper or electronic form). Click the 'drop-down' arrows for a list of codes; update as needed. New samplers and coders can be added to the "luSamplers" list. Give them a unique code starting at 600 and add the necessary information in the field version of the look-up table.

<u>Important Note</u>: It is acceptable to delete all records in "Vessel codes" and "luSamplers" that are not being used as most will be DFO codes. However, do not use any code that already exists. To add new codes, first contact the Shellfish Data Unit (Appendix 4) so they can ensure the codes are unique and add them to the master database.

"**Fishing Method**" options are shown in the status line and in Appendix 1.

"**Trap Spacing**" is given in meters and should be as accurate as possible.

"**Area**" and "**SubArea**" are established from reference charts available from the Shellfish Data Unit. Ensure that at least the Area and Subarea are entered. The "Loc" field is only used for special interest areas in the Fraser River and Tofino areas.

**Start** "**Year**", "**Mon**", "**Day**", "**Hr**", "**Min**" are the setting date and time. It will default to the current day's date when you tab through them, but it can be overwritten. Enter Hour and Minute accordingly for the start of the soak time. Time is recorded using the 24 hour clock (ex. 3:26 pm is 1526).

**Finish** "**Mon**", "**Day**", "**Hr**", "**Min**" are the haul date and time. Time is recorded using the 24 hour clock.

"**Soak hrs**" is automatically calculated in hours. The cursor normally does not stop in this calculated field unless the form cannot calculate a soak value.

**Depth** "**Min**" and "**Max**" covers the depth range where a group of traps has been set. Depths are measured in meters. The fields will display an error message if the maximum depth is less than the minimum depth, but will allow it anyway.

"**GeogLoc**" has two modes: for standard survey locations such as the Fraser River, click the 'drop-down' arrow for a list of valid code values (found in the table "luGeogLoc"). If these locations are not desired, enter any text up to 32 characters to identify the general location of the set.

"**Fix**" describes what technology was used to determine the Latitude and Longitude of the set. Codes are shown on the status bar and in Appendix 1; the most common ones have a convenient numeric equivalent that the user may enter.

"**Start Latitude/Longitude**" and "**End Latitude/Longitude**" will default to the Start Lat and Long 'Degrees' values, but can be overwritten.

"**FieldComment**" allows the user to enter interesting or useful information about the set, up to 255 characters.

## 9.4 Crab Biological Data Section

Biological data for individual crabs are recorded under the Header data on the lower half of the Crab Bio Data Entry window. Although the 14 most common fields appear on the screen, there are 32 fields in the Biological Data sub-form. Experience has shown this sequence represents the most efficient order for entering data.

"**Line**" number is generated automatically. It is not possible to tab into the field, and it is not recommended putting the cursor in this field unless it is absolutely necessary. See section *9.8.2* for instructions about how to fix Line number problems.

"**Gear**" is the first field when you enter the Biological Data sub-form. A standard commercial trap of appropriate size with closed escape ports is code 76. The user can double-click or press F9 to look up the proper code. Codes are listed in Appendix 2.

Trap "**Num**" values start with "1" and are incremented by the user for each new trap sampled on a particular string. The last trap in the string is indicated by the value "99". Both "1" and "99" are defined as being end traps. It does not matter which end of the string is hauled first.

"**Use**" (trap usability) describes the fishing success of the trap. Normally the code is "0" indicating the trap fished normally. An empty trap without obvious reason for being empty is given code "15" to make sense of the empty width field that follows. Double-click or press F9 on the field for a list of values, or consult Appendix 2, but a code still has to be entered manually in the first line.

"**Bait**" has many valid codes. The code for herring is "HER". Consult Appendix 2 or double-click or enter F9 in the bait field to open a new form with a list of valid codes. Use the up and down arrow keys to navigate through the list. When the correct code is found, press "Enter" to select that code, exit the look-up list and have the code entered in the "Bait" field. To exit the look-up form without selecting a code, click on the Exit button. The code entered must be on the list or the form will generate an error message when it checks for valid codes.

**"Species"** defaults to XKG for Dungeness crab, but can be overwritten for other species. The most common codes are found on the status line at the bottom of the screen. Consult Appendix 2 or double-click or enter F9 in the species field to open a new form with a list of valid crab codes. Use the up and down arrow keys to navigate through the list. When the correct code is found, press "Enter" to select that code, exit the look-up list and have the code entered in the species field. To exit the look-up form without selecting a code, click the Exit button. The code entered must be on the species list or the form will generate an error message when it checks for valid codes.

The Species Search String feature near the top of the form is useful. Any submitted name resembling the unknown will produce a short list of candidates from which it is usually possible to determine the correct species and its corresponding code. From the "Species" field, press the "Home" key to navigate to the "Species Search String" field, and then enter the text to search and press the "Enter" key. When the desired code is found, press the "Enter" key and the selected code will be copied to the "Species" field in the Data sub-form. A quirk in the forms prevents the cursor from returning to the "Species" field so, when done, use the Left Arrow Key to move the cursor over to the Species Search String control, then press the "End" key from there. This utility also exists within the Enter Bycatch sub-form.

At this point the next step is to pick up the first crab from the first trap and record its biological data. For each trap, it is recommended to measure all the Dungeness crabs first and then proceed to other crab species, such as red rocks, to keep from switching between different crab codes.

"**Sex**" choices appear in the status line at the bottom of the screen and are listed in Appendix 2.

"**Shell**" choices are available by double-clicking or entering F9 in the field to open the "look-up" table. Codes are listed in Appendix 2.

“**Inj**” (injuries) choices are available by double-clicking or entering F9 in the field to open the “look-up” table. Codes are listed in Appendix 2. Leave blank if no injuries are observed.

“**Claw**” and “**Leg**” store the number of limbs missing. Do not count those injuries caused by sampling. Leave blank if all appendages are intact.

“**Mks**” accepts information about mating marks. The codes appear in the status line at the bottom of the screen, or double-click the field for the full look-up table. The codes are also listed in Appendix 2. Leave blank if no mating marks are observed.

“**Obs**” records other facts observed about the crab. The most common is code 3 for limb bud. Choices are available by double-clicking or entering F9 in the field to open up the look-up table. Codes are also listed in Appendix 2. Leave blank if not applicable.

“**Wid-NN**” is the notch-to-notch measurement in millimetres. This is the last of the regular fields that are always recorded for every crab.

At minimum, every crab should have codes entered for “**Species**”, “**Sex**”, “**Shell**”, and “**Wid-NN**” fields. If there are no injuries or mating marks, then leave these columns blank (do not enter zeros). Note, however, that blank fields still mean the crab was assessed by the biologist for injuries and marks, but none were observed.

*For the next crab in the same trap*, press “Enter” after recording a value in the “**Wid-NN**” field. This will automatically fill in various repeating fields (the “**Line**”, the trap data fields “**Gear**”, “**Num**”, “**Use**”, “**Bait**” and “**Species**”) in the next record (line) and place the cursor in the “**Sex**” field for the next crab.

*For the next crab in a new trap*, press “Enter” from the “**Wid-NN**” field. Trap data will default to the previous trap information, but can be overwritten using the left arrow key. The “**Num**” field will have to be changed to a new trap number, and the “**Use**” and “**Species**” fields may also have to be changed.

Subsequent fields after “**Wid-NN**” are not usually reached, but there are exceptions:

- female crabs with eggs – use the right-arrow key to enter egg colour.
- tanner crab species - require extra morphometric data to be entered. When the species code is entered, the cursor will jump to the appropriate field when it Tabs past the “**Wid-NN**” field. For male *C. bairdi,* in order to determine sexual maturity, right claw length (measured diagonally) and height (greatest height excluding spines) are recorded (Jadamec et al. 1999).
- if one of the check boxes for weight, tagging, or two widths has been checked:
    - Weights are entered by checking the ‘Weigh’em’ box at the top of the form prior to entering the weights. When the cursor tabs past the last regular field on the screen (“**Wid-NN**”), it automatically jumps to the “**Weight**” field. Pressing “Enter” then places the cursor in the correct field on the next line. Click ‘Weigh’em’ again to turn it off.

- Tagging data are entered by checking the “Tag ‘em” box at the top of the form prior to entering tagging information.
- Both notch-to-notch and point-to-point widths are entered by clicking the “Two Widths” box prior to entering the widths.

### 9.5 Bycatch Data

Click the "Enter ByCatch" button on the right side of the form to open the "Bycatch Data Entry" form.

For species codes refer to Appendix 3 or use the "Species Search String" field in the red rectangle at the top of the form. To get to the field either press the “Home” key from the “**Species**” field or click it with the mouse. Type some text that helps identify the species into the "Species Search String" window, and press Enter (or click the "Find It" button). A new form will open named “Search Species” and return all records from the Species look-up table where some part of either the common name or the scientific name matches the text that was typed in. Scroll through the list with the up and down arrow keys. When the species is found, press Enter while the desired code is highlighted, and the “Search Species” form will close and the selected code will automatically be copied to the “Bycatch Data Entry” form. To exit “Search Species” without selecting a code, click the Exit button.

The entire species list may be searched by entering nothing in the “Species Search String” field before pressing Enter to go to the “Search Species” form.

If the species has been weighed, enter the weight in kilograms into the "**Weight**" field. Enter “0.1” if it is a *trace* amount. If the weight is an estimate, tab to the "**Est (Y/N)**" field and select it (to select and unselect, tap the spacebar key when the cursor is in the field; it is selected when there is an "x" in the box). The form assumes weights are estimated by default.

If the animals have been counted for this species, enter the result in the "**Num Caught**" field. Tab over to the “**Num/Kg**” field and the form will calculate this value.

When all bycatch have been recorded, exit the form by pressing the “End” key while in the “**Num/Kg**” field or click the Exit button.

### 9.6 Tag Returns

If a tagged crab is recaptured, then data need to be entered into the TagReturns table. To do so, the user must first enter all the regular data in the Biological Data sub-form, as far as the “**Wid-NN**” field. Once that is done, click the “<u>Tag Return</u>” button to open the “DataEntryTagReturns” form. In that form, one can fill in the fields and then return to the main form. The TagReturns form will automatically fill in the other fields in the underlying TagReturns table.

## 9.7 Navigating, Entering More Data, Exiting the Active Window

To navigate between records, click the arrow buttons located above the "Enter ByCatch" button.

If entering more data, (i.e., another string of traps), press the "Next Set" button. When the new Header record opens, it will have some default values in the Header Section; many fields that are not likely to change are copied from the previous set by default. Any of these fields can be overwritten if necessary.

To exit the Crab Bio Data Entry form click the "Exit Form" button on the bottom right rather than using the windows 'off button' in the top right corner. The "Exit Form" route performs the "count crab and trap" functions, which fill in a number of summary fields in the Headers table.

By the end of the survey there should be no relevant empty fields in the form. Remember to enter all data recorded on data sheets as soon as possible, preferably each evening, for that day's entries. It is useful to enter the Header information that will be used for tomorrow's sets in the evening prior as well. Fields can be filled directly to the Header Table. Remember that all modifications made in the 'Tables' will automatically happen in the 'Form', and vice versa. *Inadvertent deletion in a table or form could result in permanent loss of data.*

Please send copies (paper and electronic) of your crab survey data to the Shellfish Data Unit to ensure your data are safely stored in the central crab database for BC.

## 9.8 Miscellaneous Notes and Trouble-Shooting Instructions

### *9.8.1 Unable to open Access database*

If your computer cannot open the Access database with the extension ".mdb", try opening the attached file after changing the ".mdb" extension to ".txt". If this works, save the file and then change the name from ".txt" back to ".mdb".

### *9.8.2 Line count disruption*

When a data entry error occurs, the computer may inform you that it cannot proceed, probably because a **Line** value has been duplicated. What usually happens is the automatic Line counter has started counting again from 'zero' within the same trap string. This is problematic because the program cannot abide duplicate Line numbers. In order to get past the 'Error Message Notification', try the following fixes, in order:

1. Mouse-Click to the offending Line number and manually change it to a number that does not already exist above, i.e., the next available unique number in sequence; then Double-Click on this number to re-set the counter.

2. If #1 did not work, then delete the entire offending row(s), double-click the cursor in the Line field of the last valid record, and tab across until the cursor moves to the next empty row and displays the correct sequence number in the Line field.
3. If there is still a problem, delete the offending row, mouse-click out of the Biological Data Sub-Form to some field in the Headers, then click back into the Line field in the last valid record and double-click on it to reset the counter.
4. If the Error Message Notification window will not disappear or the proper numbering sequence cannot be started, then delete the offending line(s), close down the form, re-open it, and start again. Data should not be lost performing this manoeuvre. Try to exit the form using the "Exit Form" button; if that does not work then use the regular "x" button in the upper right corner.

#### *9.8.3 To remove an undesired Biological Data Form record*

Use the “Undo” tool in the toolbar (the backwards arrow icon, same as in MS Word). Note that “Undo” undoes the last change made, so Undo right away before continuing.

#### *9.8.4 Adding codes*

If adding a new Coder/Sampler, update the table “luSamplers” and use a temporary code starting at 600. Please INFORM THE SHELLFISH DATA UNIT of any new codes and/or changes made in look-up tables so that all changes are incorporated in all relevant files and program codes.

#### *9.8.5 Key and HKey fields*

When looking in the underlying Headers and LF Tables, do not worry about the “Key” and “HKey” fields. ‘Key’ is automatically filled while ‘Hkey’ has to be entered by someone in order to link the record to the matching Header record (which has the same value in its Key field).

#### *9.8.6 Record indicator*

The Record indicator at the bottom of the form is for the number of Header records. Check the Line field for the number of LF records for the current Header record.

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## Appendix 1 – Fishing Gear Header Form Template

### Crab Header Form

**Source:** ☐ **Set No.** ☐☐☐ **Vessel:** ____________________

**Sampler:** ____________________ **Coder:** ____________________

**Fish Method:** ☐ singles ☐ ground line **Trap Spacing:** ☐☐☐

☐☐☐ Area ☐☐ Subarea Geographic Location **Fix:** ☐ DGPS ☐ Chart ☐ Approx

**Start:** ☐☐☐☐ Year ☐☐ Month ☐☐ Day ☐☐ : ☐☐ Time (24 hr. clock) **Soak Hrs:** ☐☐

**Finish:** ☐☐ Month ☐☐ Day ☐☐ : ☐☐ Time (24 hr) **Depth:** ☐☐☐ min ☐☐☐ max

**Start: Lat** ☐☐ Degree ☐☐ Minutes . ☐☐☐ dec. min. **Long** 1☐☐ Degree ☐☐ Minutes . ☐☐☐ dec. min.

**End: Lat** ☐☐ Degree ☐☐ Minutes . ☐☐☐ dec. min. **Long** 1☐☐ Degree ☐☐ Minutes . ☐☐☐ dec. min.

**Field Comments:** ____________________

____________________

____________________

____________________

<u>Header Form Fields</u>

**Source –** code for where the data came from ("FL" for First Nations).
**Set Number –** unique identifier for each group of traps. Should start at 001 and be consecutive.
**Vessel –** name of the vessel used for sampling.
**Sampler –** name and contact information.
**Coder –** name and contact information.
**Fishing Method –** are trap gear set on ground lines or as singles? Codes are provided.
**Trap Spacing –** spacing between traps in meters.
**Area –** Pacific Fishery Management Area (e.g. 17).
**Subarea –** Pacific Fishery Management Subarea (e.g. 13).
**Geog Loc –** general location where sampling is being conducted (e.g. Departure Bay).
**Fix –** How was position determined? Codes are provided.
**Start Year** (e.g. 2011)
**Start Month –** month when trap gear was set. Months are numbered 1 to 12 (e.g. 08 would be August).
**Start Day –** day when trap gear was set. Days are numbered 1 to 31 (e.g. 22).
**Start Time –** time when traps entered the water. Use the 24-hour clock (e.g. 14:15).
**Soak Hours –** time between the Start Time and Finish Time, rounded to the nearest hour (e.g. 21 hours).
**Finish Month –** month when trap gear was hauled (e.g. 08 would be August).
**Finish Day –** day when trap gear was hauled (e.g. 23).
**Finish Time –** time when traps were hauled. Use the 24-hour clock (e.g. 09:25).
**Min Depth –** minimum depth gear fished in a set. Record in meters.
**Max Depth –** maximum depth gear fished in a set. Record in meters.
**Start Latitude Degrees –** GPS position at one end of the string. Record in degrees.
**Start Latitude Minutes –** GPS position at one end of the string. Record in minutes and tenths of minutes.
**Start Longitude Degrees –** GPS position at one end of the string. Record in degrees.
**Start Longitude Minutes –** GPS position at one end of the string. Record in minutes and tenths of minutes.
**End Latitude Degrees –** GPS position at other end of the string. Record in degrees.
**End Latitude Minutes –** GPS position at other end of the string. Record in minutes and tenths of minutes.
**End Longitude Degrees –** GPS position at other end of the string. Record in degrees.
**End Longitude Minutes –** GPS position at other end of the string. Record in minutes and tenths of minutes.
**Field Comments –** record anything about the set that may influence how someone will interpret the data (e.g. lost two traps in the set or plenty of juvenile flatfish in the traps, etc.).

Appendix 1 continued

Header Form Codes

*Fishing Method*

| Code | Description |
|---|---|
| S | Single |
| G | Ground line |

*Fix*

| Code | Description |
|---|---|
| D | WAAS |
| G | GPS |
| C | Chart |
| L | Loran |

# Appendix 2 – Crab Biological Data Form Template

## Crab Data Form

| Set number | Year | Month | Day | Vessel | Geographic Location |
|---|---|---|---|---|---|
| | | | | | |

| Gear | Trap no. | Trap usabil. | Bait | Species | Sex | Shell | Injury | Claw | Leg | Marks | Observ | Notch Width (mm) | Point Width (mm) | Weight (g) | *Species* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | . | Dung XKG |
| | | | | | | | | | | | | | | . | Red Rck XLA |
| | | | | | | | | | | | | | | . | Grac. XKE |
| | | | | | | | | | | | | | | . | |
| | | | | | | | | | | | | | | . | *Shell* |
| | | | | | | | | | | | | | | . | 1 new hard |
| | | | | | | | | | | | | | | . | 2 soft springy |
| | | | | | | | | | | | | | | . | 3 soft crackly |
| | | | | | | | | | | | | | | . | 4 soft plastic |
| | | | | | | | | | | | | | | . | 5 moulting |
| | | | | | | | | | | | | | | . | 6 old shell |
| | | | | | | | | | | | | | | . | 7 very old shell |
| | | | | | | | | | | | | | | . | 8 between new and old |
| | | | | | | | | | | | | | | . | 9 moult |
| | | | | | | | | | | | | | | . | |
| | | | | | | | | | | | | | | . | *Injury* |
| | | | | | | | | | | | | | | . | 1 deformed |
| | | | | | | | | | | | | | | . | 2 hole or crack |
| | | | | | | | | | | | | | | . | 3 torn abdomen |
| | | | | | | | | | | | | | | . | 4 regen claw |
| | | | | | | | | | | | | | | . | 5 regen leg |
| | | | | | | | | | | | | | | . | 6 regen both |
| | | | | | | | | | | | | | | . | 7 multiple injury |
| | | | | | | | | | | | | | | . | 8 shell disease |
| | | | | | | | | | | | | | | . | 9 dead |
| | | | | | | | | | | | | | | . | |
| | | | | | | | | | | | | | | . | *Observation* |
| | | | | | | | | | | | | | | . | 1 moult pair |
| | | | | | | | | | | | | | | . | 2 mating pair |
| | | | | | | | | | | | | | | . | 3 limb bud |

Appendix 2 continued

<u>Data Form Fields</u>

**Set Number –** unique identifier for each group of traps. This field relates the Data Form to the Header Form. Should start at 001 and be consecutive.
**Finish Year –** last two digits of the year when the trap was hauled (e.g. 11).
**Finish Month –** month when trap gear was hauled (e.g. 08).
**Finish Day –** day when trap gear was hauled (e.g. 23). This field relates the Data Form to the Header Form.
**Vessel –** name of the vessel used for sampling. This field relates the Data Form to the Header Form.
**Geographic Location –** general location where survey is being conducted (e.g. Departure Bay).
**Gear –** describes the type of traps being fished. Codes are provided (e.g. 76, a standard commercial trap with escape ports closed).
**Trap Number –** consecutive, starting at 01. The last trap in the group/string is 99.
**Trap Usability –** identifies circumstances that may influence trap catch. Codes are provided. Normally the trap usability code = 0 (no problems with the trap).
**Bait Code –** type of bait used in the traps. Codes are provided (e.g. HER for herring).
**Species –** codes for various crab species captured in the trap. Codes are provided (e.g. XKG for Dungeness crab).
**Sex –** male or female. Codes are provided.
**Shell –** shell condition, an indicator of shell hardness and age. Codes are provided.
**Injury –** codes for various injuries. Codes are provided. Leave blank if no injuries are observed.
**Claw –** number of missing claws not caused by sampling. Can be 1 or 2. Leave blank if claws are intact.
**Leg –** number of missing legs not caused by sampling. Can be 1 to 8. Leave blank if legs are intact.
**Marks –** mating marks on the insides of the claws on older shell males. Codes are provided. Leave blank if no mating marks are observed.
**Observation –** a list of a variety of observations. Codes are provided. Code 3 (limb bud) is most frequently used. Leave blank if not applicable.
**Notch Width –** width of the crab measured in millimetres, notch-to-notch, excluding the spines (e.g. 158). This is preferred over point-to-point measurements.
**Point Width –** width of the crab measured in millimetres, point-to-point, including the spines (e.g. 163). Not a necessary measurement.
**Weight –** weight of the crab measured in grams. Not a necessary measurement.

Appendix 2 continued

Data Form Codes

*Gear*

| Code | Description |
|---|---|
| 40 | Box Crab Traps, circular, 42” × 12”, stainless, modified tunnels |
| 41 | Box Crab Traps, igloo shape, 42” diameter, top loading |
| 42 | Box Crab Traps, Oregon Style, large volume, 78” diameter × 12” high |
| 43 | Box Crab Traps, “Dorian” style, top-loading traps, 40” diameter × 20” deep pot covered with a red 1” mesh and with an 8” diameter × 6” deep plastic entrance tunnel |
| 70 | Commercial Crab Trap with regulation escape ports |
| 71 | Circular Crab Traps, 40” × 12” light rubber wrapped steel frame, synthetic mesh, open ports |
| 71A | Circular Crab Traps, 40” × 12” steel rubber wrapped frame, stainless mesh, 2 soft mesh tunnels, no escape ports |
| 72 | 42” diameter circular Crab Trap, ocean type, Hecate Strait heavy steel frame |
| 73 | Tanner Crab Trap, commercial, square pyramidal large top loading traps (with 120 mm escape ring), 2.75” mesh |
| 73H | Tanner Crab Trap, commercial, square pyramidal large top loading traps, 120 mm escape ring mounted HIGH, 2.75” mesh |
| 73L | Tanner Crab Trap, commercial, square pyramidal large top loading traps, 120 mm escape ring mounted LOW, 2.75” mesh |
| 73M | Tanner Crab Trap, commercial, square pyramidal large top loading traps, 120 mm escape ring mounted MIDDLE, 2.75” mesh |
| 74 | Tanner Crab Trap, square pyramidal research trap, no escape ring, 2.75” mesh |
| 75 | Research Crab Trap, inlet type, 36” diameter, escape ports open, stainless (same as code 76 but with ports open) |
| 76 | Research Crab Trap, inlet type, 36” diameter, no escape ports, stainless, regular survey traps used by DFO |
| 80 | Crab Ring |
| 82 | Conical Nesting Snow Crab Trap, top loading, 48” × 18” with A1 mesh |
| 82A | Conical Nesting Snow Crab trap, side loading, 48” × 18” with 2” synthetic mesh |
| 83 | Pacific Coast Fishery Services Dungeness crab trap, 36” diameter × 10” high, stainless, no escape ports |
| 99 | Unknown or Other |

Appendix 2 continued

*Trap Usability*

| Codes | Description |
|---|---|
| 0 | Trap is fishing normally, no problems. This is the default. |
| 1 | Hole in trap. |
| 2 | Trap malfunction (triggers open, trap upside down, lid sprung, etc.) |
| 3 | No bait. |
| 4 | Freshly dead fish in trap causes unusual attraction. |
| 5 | Trap contents stolen by someone else. |
| 6 | Cannibalism event. Crabs in trap have been dismembered and eaten by other crabs. Most common with soft shell crabs. Shell and body parts show claw marks, meat incompletely extracted. Marked difference from octopus predation. |
| 7 | Octopus predation. Remains of dismembered shells present, but some parts may be intact with all the meat gone. Octopus enzymes dissolve all the meat. Few to no live crabs in the trap. |
| 8 | Octopus in trap. Usually empty shells and a notable absence of live crabs. |
| 11 | Live fish in trap. |
| 12 | Starfish in trap. Sometimes starfish, especially sunflower stars, smother the bait and reduce attraction. Crabs may not enter or the starfish kills and eats them. Record this usability code only if there is a noticeable effect in trap catch. |
| 15 | Functional trap empty. Nothing wrong with the trap, but no crabs caught. Note when code 15 is used, 848 should be entered as the species code. |

Appendix 2 continued

*Bait*

| Code | Description |
|---|---|
| AST | Fish Paste |
| AWC | Fish Paste With Clams |
| AWD | Fish Paste With Dogfish |
| AWE | Fish Paste With Eulachons (all smelt species) |
| AWF | Fish Paste With Fish Frames (Not Salmon) |
| AWG | Fish Paste With Geoducks |
| AWH | Fish Paste With Herring |
| AW | Fish Paste With Mixed Fish Species (+ offal + scraps) |
| AWO | Fish Paste With Octopus |
| AWP | Fish Paste With Pellets |
| AWQ | Fish Paste With Squid |
| AWR | Fish Paste With Whole Rock Fish |
| AWS | Fish Paste With Salmon (all species + heads + frames) |
| AWT | Fish Paste With Tinned Fish |
| AWZ | Fish Paste With Razor Clams |
| BBB | Gurdy bait - mixed fish scraps from catch |
| CLA | Clams (not razor clams) |
| CWA | Clams With Fish Paste |
| CWD | Clams With Dogfish |
| CWE | Clams With Eulachons (all smelt species) |
| CWF | Clams With Fish Frames (Not Salmon) |
| CWG | Clams With Geoducks |
| CWH | Clams With Herring |
| CW | Clams With Mixed Fish Species (+ offal + scraps) |
| CWO | Clams With Octopus |
| CWP | Clams With Pellets |
| CWQ | Clams With Squid |
| CWR | Clams With Whole Rock Fish |
| CWS | Clams With Salmon (all species + heads + frames) |
| CWT | Clams With Tinned Fish |
| CWZ | Clams With Razor Clams |
| DOG | Dogfish |
| DWA | Dogfish With Fish Paste |
| DWC | Dogfish With Clams |
| DWE | Dogfish With Eulachons (all smelt species) |
| DWF | Dogfish With Fish Frames (Not Salmon) |
| DWG | Dogfish With Geoducks |
| DWH | Dogfish With Herring |
| DW | Dogfish With Mixed Fish Species (+ offal + scraps) |
| DWO | Dogfish With Octopus |
| DWP | Dogfish With Pellets |

Appendix 2 continued

*Bait*

| Code | Description |
|---|---|
| DWQ | Dogfish With Squid |
| DWR | Dogfish With Whole Rock Fish |
| DWS | Dogfish With Salmon (all species + heads + frames) |
| DWT | Dogfish With Tinned Fish |
| DWZ | Dogfish With Razor Clams |
| EUL | Eulachons (all smelt species) |
| EWA | Eulachons (all smelt species) With Fish Paste |
| EWC | Eulachons (all smelt species) With Clams |
| EWD | Eulachons (all smelt species) With Dogfish |
| EWF | Eulachons (all smelt species) With Fish Frames (Not Salmon) |
| EWG | Eulachons (all smelt species) With Geoducks |
| EWH | Eulachons (all smelt species) With Herring |
| EW | Eulachons (all smelt species) With Mixed Fish Species (+offal + scraps) |
| EWO | Eulachons (all smelt species) With Octopus |
| EWP | Eulachons (all smelt species) With Pellets |
| EWQ | Eulachons (all smelt species) With Squid |
| EWR | Eulachons (all smelt species) With Whole Rock Fish |
| EWS | Eulachons (all smelt species) With Salmon (all species + heads + frames) |
| EWT | Eulachons (all smelt species) With Tinned Fish |
| EWZ | Eulachons (all smelt species) With Razor Clams |
| FRA | Fish Frames (Not Salmon) |
| FWA | Fish Frames (Not Salmon) With Fish Paste |
| FWC | Fish Frames (Not Salmon) With Clams |
| FWD | Fish Frames (Not Salmon) With Dogfish |
| FEW | Fish Frames (Not Salmon) With Eulachons (all smelt species) |
| FWG | Fish Frames (Not Salmon) With Geoducks |
| FWH | Fish Frames (Not Salmon) With Herring |
| FWM | Fish Frames (Not Salmon) With Mixed Fish Species (+ offal + scraps) |
| FWO | Fish Frames (Not Salmon) With Octopus |
| FWP | Fish Frames (Not Salmon) With Pellets |
| FWQ | Fish Frames (Not Salmon) With Squid |
| FWR | Fish Frames (Not Salmon) With Whole Rock Fish |
| FWS | Fish Frames (Not Salmon) With Salmon (all species + heads + frames) |
| FWT | Fish Frames (Not Salmon) With Tinned Fish |
| FWZ | Fish Frames (Not Salmon) With Razor Clams |
| GEO | Geoducks |
| GWA | Geoducks With Fish Paste |
| GWC | Geoducks With Clams |
| GWD | Geoducks With Dogfish |
| GWE | Geoducks With Eulachons (all smelt species) |
| GWF | Geoducks With Fish Frames (Not Salmon) |

Appendix 2 continued

*Bait*

| Code | Description |
| --- | --- |
| GWH | Geoducks With Herring |
| GW | Geoducks With Mixed Fish Species (+offal + scraps) |
| GWO | Geoducks With Octopus |
| GWP | Geoducks With Pellets |
| GWQ | Geoducks With Squid |
| GWR | Geoducks With Whole Rock Fish |
| GWS | Geoducks With Salmon (all species + heads + frames) |
| GWT | Geoducks With Tinned Fish |
| GWZ | Geoducks With Razor Clams |
| HCQ | Herring with Clams and Squid |
| HDB | Herring with Dogfish and Gurdy |
| HER | Herring |
| HWA | Herring With Fish Paste |
| HWB | Herring With Blackcod |
| HWC | Herring With Clams |
| HWD | Herring With Dogfish |
| HWE | Herring With Eulachons (all smelt species) |
| HWF | Herring With Fish Frames (Not Salmon) |
| HWG | Herring With Geoducks |
| HW | Herring With Mixed Fish Species (+ offal + scraps) |
| HWO | Herring With Octopus |
| HWP | Herring With Pellets |
| HWQ | Herring With Squid |
| HWR | Herring With Whole Rock Fish |
| HWS | Herring With Salmon (all species + heads + frames) |
| HWT | Herring With Tinned Fish |
| HWZ | Herring With Razor Clams |
| KKK | Hake |
| KOD | Codfish |
| MIX | Mixed Fish Species (+ offal + scraps) |
| MW | Mixed Fish Species (+ offal + scraps) With Fish Paste |
| MW | Mixed Fish Species (+ offal + scraps) With Clams |
| MW | Mixed Fish Species (+ offal + scraps) With Dogfish |
| MW | Mixed Fish Species (+ offal + scraps) With Eulachons (all smelt species) |
| MWF | Mixed Fish Species (+ offal + scraps) With Fish Frames (Not Salmon) |
| MW | Mixed Fish Species (+ offal + scraps) With Geoducks |
| MW | Mixed Fish Species (+ offal + scraps) With Herring |
| MW | Mixed Fish Species (+ offal + scraps) With Octopus |
| MWP | Mixed Fish Species (+ offal + scraps) With Pellets |
| MW | Mixed Fish Species (+ offal + scraps) With Squid |
| MW | Mixed Fish Species (+ offal + scraps) With Whole Rock Fish |

Appendix 2 continued

*Bait*

| Code | Description |
|---|---|
| MWS | Mixed Fish Species (+ offal + scraps) With Salmon (all species + heads + frames) |
| MW | Mixed Fish Species (+ offal + scraps) With Tinned Fish |
| MW | Mixed Fish Species (+ offal + scraps) With Razor Clams |
| OCA | Octopus with Clams and Fish Paste |
| OCT | Octopus |
| OWA | Octopus With Fish Paste |
| OWC | Octopus With Clams |
| OWD | Octopus With Dogfish |
| OWE | Octopus With Eulachons (all smelt species) |
| OWF | Octopus With Fish Frames (Not Salmon) |
| OWG | Octopus With Geoducks |
| OWH | Octopus With Herring |
| OW | Octopus With Mixed Fish Species (+ offal + scraps) |
| OWP | Octopus With Pellets |
| OWQ | Octopus With Squid |
| OWR | Octopus With Whole Rock Fish |
| OWS | Octopus With Salmon (all species + heads + frames) |
| OWT | Octopus With Tinned Fish |
| OWZ | Octopus With Razor Clams |
| PEL | Pellets |
| PHE | Crab Sex Pheromones (experimental study) |
| PIL | Pilchard |
| PWA | Pellets With Fish Paste |
| PWC | Pellets With Clams |
| PWD | Pellets With Dogfish |
| PWE | Pellets With Eulachons (all smelt species) |
| PWF | Pellets With Fish Frames (Not Salmon) |
| PWG | Pellets With Geoducks |
| PWH | Pellets With Herring |
| PWM | Pellets With Mixed Fish Species (+offal + scraps) |
| PWO | Pellets With Octopus |
| PWQ | Pellets With Squid |
| PWR | Pellets With Whole Rock Fish |
| PWS | Pellets With Salmon (all species + heads + frames) |
| PWT | Pellets With Tinned Fish |
| PWZ | Pellets With Razor Clams |
| QID | Squid |
| QWA | Squid With Fish Paste |
| QWC | Squid With Clams |
| QWD | Squid With Dogfish |
| QWE | Squid With Eulachons (all smelt species) |

Appendix 2 continued

*Bait*

| Code | Description |
|---|---|
| QWF | Squid With Fish Frames (Not Salmon) |
| QWG | Squid With Geoducks |
| QWH | Squid With Herring |
| QWK | Squid With Hake |
| QW | Squid With Mixed Fish Species (+ offal + scraps) |
| QWO | Squid With Octopus |
| QWP | Squid With Pellets |
| QWR | Squid With Whole Rock Fish |
| QWS | Squid With Salmon (all species + heads + frames) |
| QWT | Squid With Tinned Fish |
| QWY | Squid With Other stuff (e.g. Pilchards) |
| QWZ | Squid With Razor Clams |
| ROC | Whole Rock Fish |
| RWA | Whole Rock Fish With Fish Paste |
| RWC | Whole Rock Fish With Clams |
| RWD | Whole Rock Fish With Dogfish |
| RWE | Whole Rock Fish With Eulachons (all smelt species) |
| RWF | Whole Rock Fish With Fish Frames (Not Salmon) |
| RWG | Whole Rock Fish With Geoducks |
| RWH | Whole Rock Fish With Herring |
| RW | Whole Rock Fish With Mixed Fish Species (+ offal + scraps) |
| RWO | Whole Rock Fish With Octopus |
| RWP | Whole Rock Fish With Pellets |
| RWQ | Whole Rock Fish With Squid |
| RWS | Whole Rock Fish With Salmon (all species + heads + frames) |
| RWT | Whole Rock Fish With Tinned Fish |
| RWZ | Whole Rock Fish With Razor Clams |
| SAL | Salmon (all species + heads + frames) |
| SWA | Salmon (all species + heads + frames) With Fish Paste |
| SWC | Salmon (all species + heads + frames) With Clams |
| SWD | Salmon (all species + heads + frames) With Dogfish |
| SWE | Salmon (all species + heads + frames) With Eulachons (all smelt species) |
| SWF | Salmon (all species + heads + frames) With Fish Frames (Not Salmon) |
| SWG | Salmon (all species + heads + frames) With Geoducks |
| SWH | Salmon (all species + heads + frames) With Herring |
| SWM | Salmon (all species + heads + frames) With Mixed Fish Species (+offal + scraps) |
| SWO | Salmon (all species + heads + frames) With Octopus |
| SWP | Salmon (all species + heads + frames) With Pellets |
| SWQ | Salmon (all species + heads + frames) With Squid |
| SWR | Salmon (all species + heads + frames) With Whole Rock Fish |
| SWT | Salmon (all species + heads + frames) With Tinned Fish |

Appendix 2 continued

*Bait*

| Code | Description |
|---|---|
| SWZ | Salmon (all species + heads + frames) With Razor Clams |
| TBT | Turbot (new code 2007 for Box Crab study) |
| TIN | Tinned Fish |
| TNT | Tinned Tuna (new code 2008) |
| TWA | Tinned Fish With Fish Paste |
| TWC | Tinned Fish With Clams |
| TWD | Tinned Fish With Dogfish |
| TWE | Tinned Fish With Eulachons (all smelt species) |
| TWF | Tinned Fish With Fish Frames (Not Salmon) |
| TWG | Tinned Fish With Geoducks |
| TWH | Tinned Fish With Herring |
| TW | Tinned Fish With Mixed Fish Species (+offal + scraps) |
| TWO | Tinned Fish With Octopus |
| TWP | Tinned Fish With Pellets |
| TWQ | Tinned Fish With Squid |
| TWR | Tinned Fish With Whole Rock Fish |
| TWS | Tinned Fish With Salmon (all species + heads + frames) |
| TWZ | Tinned Fish With Razor Clams |
| UNK | Unknown |
| UWA | Unknown With Fish Paste |
| UWC | Unknown With Clams |
| UWD | Unknown With Dogfish |
| UWE | Unknown With Eulachons (all smelt species) |
| UWF | Unknown With Fish Frames (Not Salmon) |
| UWG | Unknown With Geoducks |
| UWH | Unknown With Herring |
| UW | Unknown With Mixed Fish Species (+ offal + scraps) |
| UWO | Unknown With Octopus |
| UWP | Unknown With Pellets |
| UWQ | Unknown With Squid |
| UWR | Unknown With Whole Rock Fish |
| UWS | Unknown With Salmon (all species + heads + frames) |
| UWT | Unknown With Tinned Fish |
| UWZ | Unknown With Razor Clams |
| XWA | Experimental With Fish Paste |
| XWC | Experimental With Clams |
| XWD | Experimental With Dogfish |
| XWE | Experimental With Eulachons (all smelt species) |
| XWF | Experimental With Fish Frames (Not Salmon) |
| XWG | Experimental With Geoducks |
| XWH | Experimental With Herring |

Appendix 2 continued

*Bait*

| Code | Description |
|---|---|
| XW | Experimental With Mixed Fish Species (+offal + scraps) |
| XWO | Experimental With Octopus |
| XWP | Experimental With Pellets |
| XWQ | Experimental With Squid |
| XWR | Experimental With Whole Rock Fish |
| XWS | Experimental With Salmon (all species + heads + frames) |
| XWT | Experimental With Tinned Fish |
| XWZ | Experimental With Razor Clams |
| XXX | Experimental |
| YWA | Other With Fish Paste |
| YWC | Other With Clams |
| YWD | Other With Dogfish |
| YWE | Other With Eulachons (all smelt species) |
| YWF | Other With Fish Frames (Not Salmon) |
| YWG | Other With Geoducks |
| YWH | Other With Herring |
| YW | Other With Mixed Fish Species (+ offal + scraps) |
| YWO | Other With Octopus |
| YWP | Other With Pellets |
| YWQ | Other With Squid |
| YWR | Other With Whole Rock Fish |
| YWS | Other With Salmon (all species + heads + frames) |
| YWT | Other With Tinned Fish |
| YWZ | Other With Razor Clams |
| YYY | Other |
| ZOR | Razor Clams |
| ZWA | Razor Clams With Fish Paste |
| ZWC | Razor Clams With Clams |
| ZWD | Razor Clams With Dogfish |
| ZWE | Razor Clams With Eulachons (all smelt species) |
| ZWF | Razor Clams With Fish Frames (Not Salmon) |
| ZWG | Razor Clams With Geoducks |
| ZWH | Razor Clams With Herring |
| ZW | Razor Clams With Mixed Fish Species (+ offal + scraps) |
| ZWO | Razor Clams With Octopus |
| ZWP | Razor Clams With Pellets |
| ZWQ | Razor Clams With Squid |
| ZWR | Razor Clams With Whole Rock Fish |
| ZWS | Razor Clams With Salmon (all species + heads + frames) |
| ZWT | Razor Clams With Tinned Fish |

Appendix 2 continued

*Species (crab)*

| Code | Common Name | Scientific Name |
|---|---|---|
| VLC | Spiny lithode | *Acantholithodes hispidus* |
| VMI | Brown box | *Lopholithodes foraminatus* |
| ZCA | Graceful decorator | *Oregonia gracilis* |
| XKG | Dungeness | *Metacarcinus magister* |
| VMC | Golden king | *Lithodes aequispinus* |
| XKE | Graceful | *Cancer gracilis* |
| XMB | Green | *Carcinus maenas* |
| XAF | Helmet (Horse) | *Telmessus cheiragonus* |
| VAC | Hermit sp. | Family Paguridae |
| ZAF | Southern tanner | *Chionoecetes bairdi* |
| ZDF | Northern kelp | *Pugettia producta* |
| ZBA | Pacific lyre | *Hyas lyratus* |
| VMJ | Puget Sound king | *Lopholithodes mandtii* |
| VNI | Red king | *Paralithodes camtschaticus* |
| XLA | Red rock | *Cancer productus* |
| ZGE | Longhorn decorator | *Chorilia longipes* |
| VIF | Scaled | *Placetron wossnessenskii* |
| ZGC | Sharp nose | *Scyra acutifrons* |
| VSA | Squat lobster | Family Galatheidae |
| 848 | Only used with Trap Usability = 15. Signifies no crabs caught. | |

*Sex*

| Code | Description |
|---|---|
| 1 | Male |
| 3 | Female |
| 4 | Female with eggs |
| 5 | Female spent (eggs hatching) |

Appendix 2 continued

*Shell Condition*

| Code | Description |
|---|---|
| 1 | *New hard shell*. No deflection on underside of carapace with heavy pressure from thumb. Very little claw wear and tips of claws are sharp and hooked. Few signs of wear or abrasions on carapace. May have barnacles, but these may be small. |
| 2 | *New springy soft shell*. Evident by slight shell deflection with heavy pressure on underside of carapace. Little epiphytic growth, fouling, or abrasion. Barnacles, if present, will be small. Underside of carapace still has dense orange or yellowish hair. |
| 3 | *New crackly soft shell*. Shell is easily deformed by finger pressure. Usually there is bright orange downy hair on underside of carapace. |
| 4 | *New plastic soft shell*. Shell is extremely soft. Crab has moulted within the past few days. |
| 5 | *Moulting crab*. The shell has split at the suture line at the back; however, the crab has not yet exited the old shell. Generally this stage lasts only one day. Shell conditions 4 and 5 indicate a moult is in progress and tend to be rare in data because crabs often avoid traps when moulting. The exception is in abandoned traps which act as a refuge for moulting crabs. |
| 6 | *Old hard shell*. Shows claw wear and often barnacle encrustation or other fouling growth. In exposed conditions the shell may appear clean and bright, but the claws will show signs of wear. Carapace spines will also be blunted as may be tips of walking legs. |
| 7 | *Very old hard shell*. Much claw wear, fouling growth. Males typically show old mating marks which have worn through claw; may have shell disease; tips of walking legs may be black or rotting off. Crab is lethargic and likely will not moult again or may soon die. |
| 8 | *Between a new (code 1) and old (code 6) hard shell*. Shell shows signs of wear, especially on teeth and tips of claws, but the crab is still relatively clean and vigorous. Typically the shell is hard, although prior to a moult the shell will soften slightly. Many crabs with this code indicate a moult is imminent. |
| 9 | *Carapace in trap*. Possible reasons include: a newly moulted crab was so soft it managed to squeeze out of the trap, a crab was cannibalized or devoured by an octopus, or a crab died and washed out of the trap as it was hauled to the surface. |

Appendix 2 continued

*Injuries*

| Code | Description |
|---|---|
| 1 | Deformed shell. Occurs at time of moult. Often misshapen shell or point rounded. Cannot obtain an accurate width measurement and should not be used for shell width analysis. |
| 2 | Hole or crack in shell. |
| 3 | Torn abdomen. |
| 4 | Regenerating claw(s). |
| 5 | Regenerating leg(s). |
| 6 | Regenerating both claw(s) and leg(s). |
| 7 | Multiple injuries. Record when more than one injury code is required. |
| 8 | Shell disease. Black spots on legs, claws, and underside of shell. |
| 9 | Dead. Crab died in the trap. Likely to occur with moulting, soft-shell, or very old shell crabs. May also be the result of octopus predation or amphipod kill. Even if sex is not apparent (due to missing body) measure the crab anyway. Ensure the shell is actually from a dead crab and not from a new moult. If this were the case, the gills and usually the lower portion of the shell will be attached and there will be a very soft crab of larger size in the sample. |

*Missing Claw(s) and/or Leg(s)*

Record the number of missing claws and/or legs. Only older injuries, those missing limbs where the stump end has a black sheath covering it, are recorded.

*Mating Marks*

| Code | Description |
|---|---|
| 1 | Old (yellow) |
| 2 | New (white) |

Appendix 2 continued

*Observations*

| Code | Description |
|---|---|
| 1 | Moulting pair. When a moulted shell and the new crab are linked in the same trap. Data are recorded as if they are two separate crabs. The moulted shell is shell 9, the new crab is shell 4 and a 1 is entered for both crabs in the observation column. |
| 2 | Mating pair. Record in similar manner as for a moulting pair. |
| 3 | Limb bud. A fleshy miniature limb extruded sometime before a moult takes place. The bud indicates the crab is planning to moult as opposed to skip moulting. Record with the appropriate injury code. |
| 4 | Pink joints. Possible indication of microsporidia infection in the musculature. |

## Appendix 3 – Bycatch Form Template

# Crab Bycatch Form

| Set number | Year | Month | Day | Vessel | Geographic Location |
|---|---|---|---|---|---|
| | | | | | |

| Species | Number | Weight (kg) |
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Bycatch Form Fields

**Set Number –** unique identifier for each group of traps. This field relates the Bycatch Form to the Header and Data Forms. Should start at 001 and be consecutive.
**Finish Year –** last two digits of the year when trap was hauled (e.g. 11).
**Finish Month –** month when trap gear was hauled (e.g. 08).
**Finish Day –** day when trap gear was hauled (e.g. 23). This field relates the Bycatch Form to the Header and Data Forms.
**Vessel –** name of the vessel used for sampling. This field relates the Bycatch Form to the Header and Data Forms.
**Geographic Location –** general location where survey is being conducted (e.g. Departure Bay).
**Species –** species captured other than crabs. Codes are provided (e.g. 4XE; sunflower star).
**Number –** total number of each species other than crabs collected from the set (all traps pooled).
**Weight –** collective weight in kilograms of each species other than crabs collected from the set (all traps pooled). Can be estimated if no scale is available.

Appendix 3 continued

Bycatch Form Codes

| Cephalopods | Code | Common Name | Scientific Name |
|---|---|---|---|
| | 98E | Pacific giant octopus | *Enteroctopus dofleini* |
| | 98D | Octopus | Order Octopoda |
| | 98G | Red octopus | *Octopus rubescens* |
| | 98F | Smooth skin octopus | *Benthoctopus leioderma* |
| | 91G | Stubby squid | *Rossia pacifica pacifica* |
| | | | |
| Echinoderms | Code | Common Name | Scientific Name |
| | 4PD | Bat star | *Asterina miniata* |
| | 4RA | Blood star | *Henricia leviuscula* |
| | 5HA | Brittle stars | Class Ophiuroidea |
| | 4XF | Fish-eating star | *Stylasterias forreri* |
| | 6BB | Green urchin | *Strongylocentrotus droebachiensis* |
| | 4OC | Leather star | *Dermasterias imbricata* |
| | 4GD | Rainbow star | *Orthasterias koehleri* |
| | 4HC | Mud star | *Ctenodiscus crispatus* |
| | 4ZC | Giant pink | *Pisaster brevispinus* |
| | 4ZA | Purple star | *Pisaster ochraceus* |
| | 4GD | Sand star | *Luidia foliolata* |
| | 6NA | Sea cucumbers | Class Holothuroidea |
| | 4AB | Sea lilies | Class Crinoidea |
| | 4GA | Sea stars | Class Asteroidea |
| | 4TA | Sun star | Family Solasteridae |
| | 4XE | Sunflower star | *Pycnopodia helianthoides* |
| | 4JD | Vermillion star | *Mediaster aequalis* |
| | | | |
| Flatfish | Code | Common Name | Scientific Name |
| | 596 | Pacific sanddab | *Citharichthys sordidus* |
| | 625 | Slender sole | *Lyopsetta exilis* |
| | | | |
| Rockfish | Code | Common Name | Scientific Name |
| | 407 | Copper | *Sebastes caurinus* |
| | 410 | Darkblotched | *Sebastes crameri* |
| | 414 | Greenstriped | *Sebastes elongatus* |
| | 424 | Quillback | *Sebastes maliger* |
| | 442 | Yelloweye | *Sebastes ruberrimus* |

Appendix 3 continued

Bycatch Form codes

| Roundfish | Code | Common Name | Scientific Name |
|---|---|---|---|
| | 455 | Sablefish | *Anoplopoma fimbria* |
| | 225 | Pacific hake | *Merluccius productus* |
| | 467 | Lingcod | *Ophiodon elongatus* |
| | 319 | Northern ronquil | *Ronquilus jordani* |
| | 222 | Pacific cod | *Gadus macrocephalus* |
| | 228 | Pollock walleye | *Theragra chalcogramma* |
| | 230 | Red brotula | *Brosmophycis marginata* |
| | 461 | Kelp greenling | *Hexagrammos decagrammus* |
| | 466 | Whitespotted greenling | *Hexagrammos stelleri* |
| | | | |
| Sculpins | Code | Common Name | Scientific Name |
| | 519 | Blackfin | *Malacocottus kincaidi* |
| | 499 | Buffalo | *Enophrys bison* |
| | 508 | Dusky | *Icelinus burchami* |
| | 521 | Great | *Myoxocephalus polyacanthocephalus* |
| | 502 | Red Irish lord | *Hemilepidotus hemilepidotus* |
| | 491 | Roughback | *Chitonotus pugetensis* |
| | 522 | Sailfin | *Nautichthys oculofasciatus* |
| | 472 | Sculpins | Family Cottidae |
| | 497 | Spinyhead | *Dasycottus setiger* |
| | 513 | Spotfin | *Icelinus tenuis* |
| | 518 | Pacific staghorn | *Leptocottus armatus* |
| | 510 | Threadfin | *Icelinus filamentosus* |
| | | | |
| Selachii | Code | Common Name | Scientific Name |
| | 044 | Spiny dogfish | *Squalus acanthias* |
| | 066 | Spotted ratfish | *Hydrolagus colliei* |

## Appendix 4 - Contacts at Fisheries and Oceans Canada

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## Appendix 5 - Useful References To Use When Crab Sampling


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