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Framework for Estimating Quota Options for the Red Sea Urchin (*Strongylocentrotus franciscanus*) Fishery in British Columbia Using Shoreline Length and Linear Density Estimates

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Foreword

This series documents the scientific basis for the evaluation of aquatic resources and ecosystems in Canada. As such, it addresses the issues of the day in the time frames required and the documents it contains are not intended as definitive statements on the subjects addressed but rather as progress reports on ongoing investigations.

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ABSTRACT

Recent analyses of digitized spatial data provided by red sea urchin (RSU) harvesters indicated that the annually fished bed areas had steadily declined in most areas for the last 3-5 years. Harvesters were recording fishing events more accurately than previously, as well as being increasingly selective for areas with high RSU gonad quality within the population at large. Fishery-dependent data indicate fished areas were not representative of the areas occupied by the whole fishable RSU population. These bed area declines presented several problems for the assessment process of RSU stocks in British Columbia (BC), and work was undertaken to develop a modified framework to assess RSU populations in BC. The paper describes a linear density model for estimating current biomass (B_c) combining shoreline length with linear density estimates as an alternative to bed area and spatial density estimates. We suggest that, generally, the shoreline length method is more appropriate than the bed area method, especially with a moderately mobile species in a complex coastal environment and where a RSU "bed" with fixed borders and known depths is hard to define. Preliminary large-scale biomass estimates and quota options from the proposed shoreline length method compare closely to values from the bed area method, yielding a 0.7% and 3.0% increase to coast wide mean quota options, to 4705t and 5371t, for RSU size classes of 90-140mm test diameter (TD) and $\geq$90mm TD, respectively. Further refinement of the estimation of potential RSU habitat and fishable RSU habitat is required through additional surveys and consultation with managers, First Nations and other stakeholders.

Cadre d'estimation des options de quotas pour la pêche à l'oursin rouge (*Strongylocentrotus franciscanus*) en Colombie-Britannique au moyen de la longueur du rivage et d'estimations de la densité linéaire

RÉSUMÉ

Des analyses récentes de données spatiales numérisées, fournies par des pêcheurs d'oursin rouge, indiquent que la superficie des gisements pêchés chaque année a régulièrement décliné dans toutes les zones, depuis 3 à 5 ans. Les pêcheurs enregistraient les prises plus précisément que par le passé et ont été de plus en plus sélectifs de façon à choisir des zones où la qualité des gonades d'oursin rouge était élevée par rapport à celle de la population générale. Les données de la pêche montrent des zones pêchées qui ne sont pas représentatives des zones occupées par toute la population d'oursins rouges susceptible d'être pêchée. Les déclins de superficies de gisement enregistrés ont posé plusieurs problèmes pour le processus d'évaluation des stocks d'oursin rouge en Colombie-Britannique (C.-B.). C'est pourquoi un travail a été entrepris pour modifier le cadre d'évaluation des populations d'oursin rouge dans la province. L'article décrit un modèle de densité linéaire d'estimation de la biomasse actuelle (B_A), qui associe la longueur du rivage à des estimations de densité linéaire, destiné à remplacer les estimations de superficie de gisement et de densité spatiale. Nous estimons qu'en général, la méthode reposant sur la longueur de rivage convient mieux que celle s'appuyant sur la superficie de gisement, particulièrement pour une espèce à la mobilité modérée dans un milieu côtier complexe, où il est difficile de définir un « gisement » aux limites fixes et à la profondeur connue. Les estimations préliminaires à grande échelle et les options de quotas tirées de la méthode fondée sur la longueur de rivage sont très comparables aux valeurs de la méthode de superficie de gisement. Elles notent une augmentation de 0,7 % et de 3,0 % des options moyennes de quota sur l'ensemble de la côte, à 4 705 t et 5 371 t, pour les classes d'oursins dont la taille du diamètre du test (DT) est respectivement de 90 à 140 mm et $\geq$ 90 mm. Il est nécessaire de préciser l'estimation de l'habitat potentiel de l'oursin rouge et de l'habitat de l'oursin rouge susceptible d'être pêché, au moyen de relevés et de consultations avec des gestionnaires, les Premières Nations et d'autres intervenants.

1 INTRODUCTION

The commercial dive fishery for the red sea urchin (*Strongylocentrotus franciscanus*) in British Columbia (BC) landed 4358.6 t, valued at approximately $7.3 million (CAD) wholesale, with 110 licenses issued during the 2004-2005 fishing season. The history of fishery management is summarised in Campbell and Harbo (1991) and Campbell *et al.* (2004, 1999a).

Science advice for the management of the red sea urchin (RSU) fishery takes the form of annual quota options (Q) based on a proportion of estimated fishable biomass. Location-specific quotas are estimated as $X*M*B_c$, where the precautionary scaling factor (X) is set at 0.2, natural mortality (M) is set at 0.10 (but has been provided as a range of 0.05–0.15 to managers), and current biomass (B_c) is calculated as the product of estimates of density, mean individual weight of legal-sized urchins (test diameter $\geq$90mm) and fished bed area. Current biomass is used rather than initial or virgin biomass, as described in the surplus production model of Gulland (1971) and Schaeffer (1954). To date, the estimation of RSU biomass in BC has involved a bed area method of applying spatial density estimates, derived from population surveys, to the area of commercially-harvested beds, derived from harvest events recorded by harvesters (Campbell *et al.* 2001).

Estimates of area fished (beds) are assumed to be made without error, despite high uncertainty related to charted bathymetry in the spatially-complex coastal BC. Prior to 2001, RSU beds were represented by polygons drawn around cumulative harvest events beginning with the 1982 fishery, and area was obtained by digitizing these polygons. A review of spatial fishery data revealed that area estimates based on cumulative fishing locations were likely overestimating the bed area. Explanations include the fact that RSU populations are somewhat transient and concentrations tend to shift in space; some areas no longer support urchin populations because of overharvest; predation by sea otters is having an impact; and/or some areas were erroneously recorded in the first place.

In an attempt to rectify this uncertainty, an improved process for representing RSU beds was recommended and implemented in 2001 (Campbell *et al.* 2001) whereby individual fishing events that were accurately recorded by harvesters were digitized and the data stored on an annual basis. The increased accuracy was made possible by improvements in Global Positioning Systems (GPS), enhanced computer capacity and Geographic Information System (GIS) software and the dockside validation process starting in 1997. These changes to spatial data capture provided the advantage of being able to make a one-to-one linkage of the location of harvest to the harvest data (landings and effort) and allowed an analysis of effort distribution on an annual basis. Quotas for the 2002-2003 season were derived from bed areas that were based on the three most recent, complete, fishing seasons (1997-2000) (Campbell *et al.* 2001).

Unfortunately, this change in process for estimating RSU bed area led to the reverse problem, of underestimating bed area. Firstly, harvesters report being increasingly selective for urchins with high gonad quality and generally avoiding areas with urchins of low-quality gonads. Secondly, since the RSU fishery is conducted by divers, the full extent of the fishable population is not visited simply because of the limitations inherent in SCUBA diving. Therefore, cumulative harvest log data of fishing events within a year do not reflect the total area occupied by fishable RSU populations. As stated in Campbell *et al.* (2001), one source of uncertainty in bed area estimation is the number of years to include in a rolling-accumulation that would provide a reasonable representation of urchin population distribution.

A final issue with the calculation of biomass from spatial estimates of density and estimates of bed area is the mis-match between the locations of the considerably-reduced areas fished reported by harvesters and the location of survey transects. Abundance surveys have evolved from the random placement of transects along large sections of coastline in the mid-1990s (termed ‘broadbrush’ surveys) to random placement of transects in smaller focal areas that specifically include harvested beds and directly adjacent unfished areas (Campbell 1998; Campbell *et al.* 2000; Campbell *et al.*

2001; Bureau *et al.* 2000a-d; Tzotzos *et al.* 2003a-d, 2006; Atkins *et al.* 2006a-h). More spatially-specific data have been required in the last few years in order to estimate biomass density in fished areas. However, since earlier surveys were comprised of randomly-placed transects along coastlines which could include non-RSU habitat, it was important to understand the effect on density estimates of using only those transects that occurred in fished bed areas.

Given these difficulties, it was concluded that calculating RSU biomass from spatial density estimates and bed area was yielding unrealistic and unreliable estimates. A method of estimating biomass that is independent of fishing events and more inclusive of the full range of RSU populations was felt to be more appropriate for RSU. The main objective of this paper is to describe a framework for the use of shoreline length measurements and linear density estimates as an alternative to use of bed area and spatial density for estimating current biomass (B_c). We suggest that the shoreline length method is more appropriate than the bed area method for species that are moderately mobile and which exist in a complex coastal environment. An urchin bed with fixed borders and known depth is hard to define, whereas, shoreline length estimates of potential RSU habitat would be relatively easy to define. The shoreline length method of biomass estimation is currently used in sea cucumber assessments in BC and Southeast Alaska (Woodby *et al.* 1993; Campagna and Hand 2004).

Other objectives of this paper are to: (1) compare densities of RSU between inside and outside of defined beds from surveys conducted during 2000-2004; (2) compare biomass estimates between the bed area and the shoreline length method using as detailed data as possible from the recent surveys and GIS analyses; (3) present shoreline length, linear density and biomass estimates for RSU; (4) present annual quota options for the RSU fishery in BC based on the shoreline method and compare the results with quota options based on spatial estimates of density and bed area, reported in Campbell *et al.* (2001).

In this paper, the BC coast was divided into two main regions, the 'North Coast' and the 'South Coast' and further subdivided into Pacific Fishery Management (PFM) Areas and PFM Subareas for management purposes (Figs. 1 & 2).

2 BIOLOGY

A number of papers review various aspects of RSU biology (Ebert 1998; Lai and Bradbury 1998; Botsford *et al.* 1993, 1994; Campbell and Harbo 1991; Tegner 1989; Sloan *et al.* 1987; Breen 1980; Mottet 1976; Bernard and Miller 1973).

2.1 Recruitment

Sloan *et al.* (1987) estimated recruitment to be, on average, approximately 9.5% of the total population size of RSU, with a large amount of variability between areas of BC. Little is known about the stock/recruitment relationship of RSU in BC.

Breen (1984) argued that a size limit could be used to protect sufficient reproductive potential to help ensure that recruitment did not fall below replacement. A special argument for a maximum size limit can be made for RSU, as large adult urchins provide a spine cover for juveniles that may be necessary for good survival (Zhang *et al.* 2011; Nishizaki and Ackerman 2007; Tegner and Dayton 1977). Minimum and maximum size limits, as used in Washington State (Lai and Bradbury 1998), would leave enough large adults to protect the settlement of juveniles. Breen (1984) further suggested that using a size limit as the only control mechanism to prevent recruitment overfishing would not be effective with the $\geq$100 mm TD size limit. A larger size limit would be required but it would be larger than the industry's upper limit for market quality. Breen (1984) recommended that a better way of preventing recruitment overfishing was "controlling effort or catch in such a way as to protect local stocks from over harvesting".

There are a number of complex density dependent compensatory and depensatory mechanisms that may affect RSU growth, mortality, survival of juveniles due to protection by adult spine canopies, spawning success, roe quality and egg viability. A stock at low density levels may impact the population negatively, e.g. "the Allee affect" (Allee 1931), reducing the reproductive success of the animals. This is particularly important in organisms that are broadcast spawners. Levitan *et al.* (1992) found that fertilization success was dependent upon factors such as the number of RSU, distance apart, position in the cluster, and the water current direction and velocity. For animals with broadcast spawning, reproductive mechanisms should be considered in the management system by providing various forms of harvest refugia (e.g. size restrictions, catch limits through quotas or rotating spatial harvests and spatial closures) (Botsford *et al.* 1993; Quinn *et al.* 1993; Pfister and Bradbury 1996; Levitan and Sewell 1998). Ebert (1998) found potentially little Allee effect on population growth of RSU in Oregon and Washington using simulation techniques. He recommended to not automatically assume that Allee effects are important in local areas without some evaluation, such as incorporating sensitivity analyses in dynamic modelling methods.

2.2 Natural mortality

There are no published estimates of instantaneous natural mortality rate (M) for RSU from northern BC. Breen (1984) estimated that M ranged from 0.016 to 0.22 for RSU from three sites in southern BC and proposed a value between 0.1 and 0.2. Woodby (1992) estimated M = 0.16 for RSU from the Sitka, Alaska area. Botsford *et al.* (1993) estimated M = 0.14 for a population of RSU in California. Lai and Bradbury (1998) estimated M to be about 0.16 for RSU from Washington. Based on published values, Campbell (1998) assumed M to be 0.15 in calculating quota options for the 1995 RSU fishery in BC. However, all these authors considered growth rates of RSU to be faster (e.g., 4 - 6 years to reach 100 mm TD) than that reported by Ebert (1998) who found tagged sea urchins from Washington and Oregon take about 10 years to reach 100 mm TD and 50 years to reach 140 mm TD. Ebert and Southon (2003) suggested that some large urchins found from northern California to Alaska could be over 100 years in age. Ebert *et al.* (1999) calculated the mean instantaneous total mortality rate (Z) of RSU from Oregon, Washington and Alaska to range from 0.016 to 0.133. Clearly M will vary between areas and between size classes for RSU in BC. Since the longevity in RSU has been found to be greater than previously believed, we assumed the lower and more conservative of Breen's proposed values of M, 0.10 for fishable legal size RSU in BC, for the purpose of the present paper.

3 METHODS

3.1 Survey methods

Methods have varied between surveys (Jamieson *et al.* 1998a-d; Jamieson and Schwarz 1998; Breen *et al.* 1976, 1978). In general, densities of RSU were estimated within 1 square metre quadrats along transects that were placed randomly along the shoreline. These 'broadbrush' surveys were not stratified by known urchin distribution. Transects were laid out from shallow water to approximately 10 m chart datum depth, transect length thus being dependent on the subtidal slope, and typically every second quadrat was surveyed. For all surveys, the test diameter (TD, in mm) of the urchins was measured and recorded from a subset of quadrats (usually half).

General habitat characteristics were also recorded, including depth, substrate type, exposure, and types and percent cover of algae. Depth (m) was corrected to chart datum for each quadrat. Substrate within each quadrat was classified as one of nine codes: 1 = smooth bedrock; 2 = bedrock with crevices; 3 = boulders (bigger than a basketball); 4 = cobble (between 7.5cm and basketball size); 5 = gravel (between 2cm and 7.5cm); 6 = pea gravel (between 0.25cm and 2cm); 7 = sand; 8 = shell; and 9 = mud. General exposure values were estimated for each transect as: 1=minimal sea movement; 2=well sheltered; 3=occasional current; 4=moderate exposure; 5=strong tidal flow; 6=high tide surge only; 7=ground swell normal; 8=high exposure. The habitat details are

important in defining suitable habitat for RSU and identifying features associated with a lack of urchins, for instance sand or mud substrate and/or very sheltered exposure.

3.2 Survey data used

Updates have been made during revisions of this paper to include additional data. Results from the 1994 to 2007 surveys were used in this paper (Jamieson *et al.* 1998c, Atkins *et al.* 2006a-h; Bureau *et al.* 2000a-d; Tzotzos *et al.* 2003a-d). The survey data prior to 1994 were collected using a different survey method and could not be used in the analyses. The density estimates from unpublished surveys conducted during 2001 and 2004 were also included in the present paper, as well as unpublished survey results from the Cordero Channel (PFM Area 13) and the Tree Nob Group (PFM Area 4) conducted during 2006 and 2007. Density estimates from population surveys were assumed to remain constant over time.

3.3 Density calculations

Transects were treated as the primary sampling unit. Since quadrats along the transect were subsampled, the total number of urchins in each transect was determined using simple linear interpolation to estimate the number of urchins in the unsurveyed quadrats

Campbell *et al.* (2001) showed that BC harvesters are preferentially fishing specific size classes. Density calculations in this paper are presented for all legal sized RSU (TD≥90mm) as well as the commercially targeted size range (TD 90-140mm).

For each transect, the number of urchins in each size range was calculated as:

$$u_t = f_t * \sum_{quadrat} x_{quadrat} \quad (1)$$

where

u_t is the estimated number of urchins in the size range in the t^{th} transect

f_t is the fraction of measured urchins that are in the size range

$x_{quadrat}$ is the total number of urchins (measured or interpolated) in the quadrat

The test diameter measurements were also used to convert the estimated number of urchins into a biomass estimate. The following length-weight relationship was taken from Campbell (1998):

$$W = \alpha * L^{\beta} \quad (2)$$

where

W is the weight in grams

L is the test diameter in millimetres

α is a constant with an estimated value of 0.0012659 $\left(grams * mm^{-\beta}\right)$

β is a dimensionless constant with an estimated value of 2.7068

Equation (2) was applied to each measured urchin in the given size range. The mean weight of urchins in each size range is:

$$\overline{W_t} = \frac{1}{m_t} * \sum_{i=1}^{m_t} \left(\alpha * L_{t,i}{}^{\beta}\right) \quad (3)$$

where

$\overline{W_t}$ is the mean weight of urchins in the t^{th} transect (grams) for the size range

m_t is the number of measured urchins in the t^{th} transect for the size range

$i = 1,2,...,m_t$ is an index for individual urchins in the t^{th} transect for the size range

$L_{i,t}$ is the test diameter in millimetres of the i^{th} urchin in the t^{th} transect for the size range

Within each size range, the biomass (grams) of urchins for a transect is:

$$b_t = u_t * \overline{W_t} \quad (4)$$

Mean densities could be estimated from the transect population and biomass estimations. Densities were considered on a (1) spatial (per metre-squared of bed area) and (2) linear (per metre of shoreline) basis.

3.3.1 Spatial density estimates

Previous quota calculations (Campbell *et al.* 2001) have applied spatial density estimates (number per metre-squared) to an estimate of the area of a bed to produce biomass estimates. The spatial densities were estimated using ratio estimators (Thompson 1992).

Spatially, the estimated mean population-density is:

$$\overline{d}_S = \frac{\sum_t u_t}{q \sum_t L_t} \quad (5)$$

L_t is the length (m) of the t^{th} transect

q is the width (m) of the transects (1m)

Similarly, the estimated mean biomass-density is:

$$\overline{b}_S = \frac{\sum_t b_t}{q \sum_t L_t} \quad (6)$$

The *bootstrap* and *limits.bca* functions from S-plus (Insightful Corporation 2004) were used to generate confidence bounds. In *bootstrap,* transects were resampled with replacement and the resulting estimate of density and biomass was denoted d_S^* or b_S^* . One thousand values of d_S^* (or b_S^*) were generated in this way. In *limits.bca*, the results of *bootstrap* were used to generate bias-corrected and accelerated (Davison and Hinkley 1997) confidence bounds. Confidence bounds were not calculated when the number of transects was less than 5.

3.3.2 Linear density estimates

The linear (number/metre of shoreline) densities were estimated as simple averages (Thompson 1992). The estimated mean population-density is:

$$\overline{d}_L = \frac{\sum_t u_t}{n * q} \quad (7)$$

n is the number of surveyed transects

q is the width of the transects (1 m)

Similarly, the estimated mean biomass-density is:

$$\bar{b}_L = \frac{\sum_t b_t}{n * q} \quad (8)$$

Bootstrapping was used to generate the lower and upper 90% confidence bounds using the same method as described in the spatial density estimates section.

3.4 Population size and biomass

3.4.1 Bed area method

To obtain total population numbers or total biomass, the spatial density estimates ($\bar{d}_S$ or $\bar{b}_S$) and their confidence bounds were multiplied by the area of a given bed. Thus, total current biomass of RSU (B_c, grams), for each size group and survey area, was calculated as

$$B_c = A * \bar{b}_S \quad (9)$$

where A is the estimated commercial RSU bed area (m^2), digitised from nautical charts and summed for each survey area (see section below) and $\bar{b}_S$ is the estimated mean spatial biomass-density (g/m^2) of RSU in the size group (i.e., $\geq$ 90 mm or 90-140 mm TD). The values for B_c were subsequently converted to tonnes for presentation.

3.4.2 Shoreline length method

Linear density estimates ($\bar{d}_L$ or $\bar{b}_L$) were multiplied by shoreline length to calculate estimates of total population and total biomass. Thus, total current biomass of RSU (B_c, grams), for each size group and survey area and PFM Subarea was calculated as

$$B_c = L * \bar{b}_L \quad (10)$$

where L is the shoreline length (m) associated with urchin habitat measured from nautical charts (see section below) and summed for each PFM Subarea, and $\bar{b}_L$ is the estimated mean linear biomass-density (g/m) of RSU in the size group (i.e., $\geq$ 90 mm or 90-140 mm TD). The values for B_c were subsequently converted to tonnes for presentation. The lower and upper 90% confidence bounds (LCB and UCB) of B_c using the shoreline length method were also calculated, as described above.

3.5 Bed Areas

Campbell *et al.* (2001) proposed a new method for estimating RSU bed areas. Prior to 1997, harvest events recorded by harvesters on charts or diagrams were transcribed onto a master nautical chart, digitized, and sea surface area of urchin beds was calculated with a raster based software called Compugrid. Both harvester compliance and recording accuracy contributed to variation between area estimates of urchin beds and actual harvest events. Beginning with the 1997 fishing season, harvest log data became more reliable, with harvest weights provided through the dockside validation program and submission of chart information facilitated by a third-party service provider (hired by the Pacific Urchin Harvesters Association, PUHA) to administer the validation/harvest log program. Spatially discreet harvest location information provided by the harvesters was digitised directly from the chart record to an electronic spatial file in the form of polygons. Area measurements were generated using a Universal Transverse Mercator projection, zone 9, consistent with previous analyses. The analysis utilised ArcView 3.2 (ESRI Corporation 1999), a vector-based GIS software package. A “fishing event” approach was applied to location information provided for the 1997 through 1999-2000 fishing seasons. A fishing event was defined

as a single record as reported in the harvest logbook, representing one dive by one commercial harvester in a single location. The fishing event locations, recorded by harvesters on charts as polygons, were digitised in reference to the same land basemap used in previous area analyses (Campbell *et al.* 2001). The fishing event record could thus be linked via a one-to-one relationship to an entry in the GIS spatial data set. A separate spatial file was developed for each fishing season to allow (a) review of harvest locations from within a single season, and (b) comparison of fishing locations from one season to the next to review trends over time. Procedures were implemented to ensure that, where fishing event polygons were wholly or partially coincident, the events were combined to eliminate double counting the area of the coincident portions. The beds were restricted to a depth range of 0 - 9.1m (0-5 fm) below chart datum, based on the distribution of harvest over three fishing seasons (1997-2000). Any fishing event falling in areas officially closed to the fishery were excluded from the bed area totals.

The bed areas were not measured empirically in the field and all measurements were of sea surface area only. The proportion of different substrate types was unknown but likely varied between areas. The measurements of area as defined by fishing events did not include areas of unexploited habitat, which may have contained populations of RSU.

3.6 Shoreline length

Boutillier *et al.* (1998) identified problems with estimates of bed area reported in the sea cucumber (*Parastichopus californicus*) fishery in BC, including incomplete reporting of fishing locations and difficulty in defining preferred habitat. An alternative approach to the assessment is described, using estimates of potentially harvestable shoreline length as an input to biomass calculations.

Shoreline length measurements were generated using ArcView 3.2 (ESRI Corporation 1999), with the spatial data model defined at the outset by a user-specified choice of base map or charts and the definition of shoreline (i.e. high or low water). Shoreline used in these analyses was generated from the Canadian Hydrographic Service (CHS) charts for the high tide water line. Since RSU populations reside predominantly in the 0~10m depth range, shoreline length for the low water shoreline or for 5m or 10m isobaths may be more appropriate, however these data sets were not available for BC.

The shoreline length method was evaluated at a detailed scale to compare the spatial and linear biomass estimates from inside and outside of defined beds, and at a BC coastal scale to compare biomass estimates and quota options derived from each method.

3.6.1 Detailed scale analyses

A subset of surveys was selected to compare biomass estimates using spatial and linear density estimates. Surveys were chosen over a range of shoreline complexities to examine how this variable may affect biomass estimates. The survey areas, year conducted and PFM Subarea, used for the analysis in order from less to more complex shoreline included (Year, PFMA): Laredo Channel (2000, 6-14 & 6-15), Robson Bight (2001, 12-3), Campbell River (2002, 13-2), Tofino (2000, 24-6), Price Island (2001, 7-3), Dundas Group (2003, 4-1), Beaver Pass (2002, 5-10), Deserters (2000, 12-13) and Barkley Sound (2003, PFM Subarea 23-11).

The first step in the analysis was to use ArcView 3.2 (ESRI Corporation 1999) to extract the CHS high-water coastline in each of the survey areas. The next step, to classify portions of the extracted coastline as urchin habitat, was done in two stages. First, shoreline associated with commercial harvest was identified by mapping all fishing event locations, as reported on harvest logs, from 1997 through 2005 and projecting the linear extent of these events onto the shoreline, using the event's adjacency to the shoreline and a general cardinal direction (North, East, West, and South) (Fig. 3). Second, shoreline was identified as urchin habitat from transect data. Transect locations had to meet three criteria in order to be included: 1) RSU were present, 2) considered as potential RSU habitat based on substrate (i.e. code < 7) and/or exposure (code > 4, see Surveys section), and 3)

the transect was outside of the fishing event shoreline lengths already identified. A mean distance between all transect locations was calculated and a buffer, equal to the mean distance, was drawn around each transect of suitable habitat (Fig. 3).

Further refinements to RSU fishable shoreline lengths were made in the surveyed areas to remove sections that were closed for conservation or otherwise defined in the Integrated Fisheries Management Plan (Red Sea Urchin By Dive) as being closed.

For each of the nine survey areas analyzed, inside/outside of bed comparisons of spatial and linear estimates of RSU population size and biomass were made by survey and PFM Subarea. Ratios of the linear estimates to spatial estimates were calculated. We also compared linear and spatial population densities (number/m^2) from transects surveyed within and outside of beds, as defined in Campbell *et al.* (2001), for each survey conducted in BC during 2000-04.

The Kruskal-Wallace nonparametric test was used to compare transect densities occurring inside and outside the beds. Following the interpretation suggested by Sokal and Rohlf (1995), statistical significance indicates that there are sufficient data to suggest there is a difference in the "locations" of the statistical distributions occurring inside and outside the beds.

Each of the surveyed areas were generally ranked into one of three categories of shoreline complexity: 1 = simple, 2 = moderately complex, 3 = highly complex with multiple archipelagos.

The locations of some of the PFM Subarea borders as well as classification of some transects as 'in' or 'out' of harvest beds in this report have changed from the earlier survey publications, leading to discrepancies between the two. This is due to advances in data collection techniques, like GPS, which prompted a new GIS PFM Subarea layer being released by Fisheries & Oceans Canada, Oceans, Habitat and Enhancement Branch (OHEB). We have used this new GIS layer in the current analyses. Also, transects previously classified as out-of-bed may now be reclassified as in-bed due to recent fishing events occurring at their location.

3.6.2 BC coastal scale analyses

The process of estimating RSU biomass with linear density shoreline length estimates is outlined in flow chart form (Fig. 4). Firstly, ArcView 3.2 (ESRI Corporation 1999) was used to extract the entire BC high-water shoreline from CHS Coastline charts to produce an ArcView layer identifying total BC Shoreline. The base map used in all analyses of shoreline lengths was the CHS Coastline spatial file (Figure 4 – first definition). CHS Coastline is a product of the Environmental Dataset that contains vector shoreline extracted from the digital nautical charts compiled by the Government of Canada, Department of Fisheries and Oceans, Canadian Hydrographic Service (Published 2004/03/01).

Subsequently, the shoreline was defined on a PFM Subarea-scale, based on criteria that would indicate areas suitable for RSU habitat (i.e. rock substrate and adequate water flow/exposure). The next step was to eliminate shoreline lengths associated with non-RSU habitat, such as steep fjords and sandy or muddy inlets and bays. The 1997-2005 RSU fishing event information was used as a visual source to ensure no potential RSU habitat was eliminated. The result was a defined shoreline of Total RSU Potential Habitat (Figure 4 – second definition).

Otter-inhabited areas and all fisheries closures (parks etc.) were removed from Total RSU Potential Habitat to give the maximum theoretical shoreline available to the RSU fishing industry (Fishable RSU Potential Habitat, Figure 4 – first refinement). This shoreline was presented to industry for identification of known RSU habitat. The information gathered from harvesters was encoded onto the RSU Potential Habitat layer and supplemented with shoreline associated with any RSU fishing events occurring from the 1997/1998 season to the 2004/2005 season to produce a shoreline of known RSU Confirmed Habitat (Figure 4 – second refinement).

Some shoreline identified by fishing events or by harvesters and classified as RSU Confirmed Habitat has more recently been inhabited by otters or affected by Parks and other closures. This

shoreline was not included in the "Confirmed Fishable RSU Habitat" (Figure 4 – second refinement). Linear Densities from surveys were applied to Confirmed Fishable RSU Habitat shoreline lengths to produce estimates of biomass and quota options (Figure 4 – recommendations).

Sea otters are a major predator of RSU and are of particular concern in assessment and management of RSU stocks. Reliable estimates of RSU density and biomass were not made in areas partially or fully inhabited by the sea otter as no measurable impacts of sea otter presence on RSU densities were available. Generally, where sea otters have become established, the abundance of RSU was assumed to have been reduced to the point where commercial harvest of RSU would no longer be viable. Known areas with sea otters are shown in Fig. 5 (DFO 2007).

On-going refinement of shoreline definition will occur following additional surveys and consultation with managers, First Nations and other stake holders.

3.7 Quota options estimation

A conservative management approach is used to determine quota options (Q) for the RSU fishery in BC. A modified surplus production model is used to estimate a maximum sustainable yield (MSY) from a stock that is in the early stages of fishing (Schaefer 1954; Gulland 1971). The model assumes that the MSY occurs when the maximum sustainable fishing mortality is equal to (M).

$$Q = X*M*B_c \qquad (11)$$

where B_c is the current biomass estimated using the shoreline length method from Fishable RSU Habitat and linear biomass density estimates (equation 10), M is the instantaneous natural mortality rate (assumed to be 0.10 for fishable legal size RSU in BC) and X is a correction factor to ensure that a sustainable fishing mortality rate is well below the calculated MSY. We chose the value of *X* = 0.20 in this paper as a reasonably conservative safeguard to account for errors in estimating the current biomass values (Caddy 1986; Garcia *et al.* 1989). The correction factor should provide for a conservative annual harvest in a developing fishery where little is known about the productivity of the population. Since equation 11 is derived from a Graham-Schaefer production model, recruitment is assumed to be unaltered by these low fishing levels. Although this approximation was developed for an unexploited virgin stock (B_o) we assumed that $B_c = B_o$. Density estimates used to estimate biomass included all transects whether in or out of beds. Also, no density data were excluded (i.e., zero density) from transects in non-RSU habitat.

Although we previously examined two alternative formulations, proposed by Garcia *et al.* (1989) (i.e., based on the Schaefer (1954) and Fox (1970) production models), to estimate Q and MSY by including current yield (Y_c) in an exploited population, both formulae were unstable when attempting to obtain MSY estimates below Y_c. Garcia *et al.* (1989) also indicated that these formulae are unstable under other conditions. Die and Caddy (1997) question whether any simple approximation method alone, in obtaining sustainable yield indicators from biomass estimates, can provide a safe yield target. They advocated use of low conservative targets for fishing mortality and several biological reference points (BRPs) as a precautionary approach, similar to Botsford *et al.* (2004). Lai and Bradbury (1998), through simulation of RSU populations in Washington, suggested that target harvest rates should be well below biological references points such as $F_{max} = 0.48$ (fishing mortality at which Y/R is maximised) and $F_{0.1} = 0.19$ (at which slope of Y/R curve is 10% of the slope at origin) calculated from a yield per recruit model. Campbell *et al.* (1999b: Table 3 in appendix B), using a yield per recruit analysis, found $F_{0.1} = 0.11$ and 0.16 for a size limit of $\geq$ 90 mm TD and 90-140 mm TD, respectively.

Caution is required in the interpretation of these calculations for the quota options because of the many assumptions in the parameters used in the oversimplified model. Since many of the surveys were conducted >5 years ago and there could be considerable uncertainty in the mean biomass-density estimates in some areas, we have adopted the Woodby (1992) method by also including the

approximate lower 90% confidence bound (LCB) as a reasonable alternative for the $\bar{b}_s$ or $\bar{b}_L$ values in the B_c calculations. The upper 90% confidence bounds (UCB) were also included in case they were of use to the managers.

4 RESULTS AND DISCUSSION

4.1 Detailed comparisons of spatial and linear estimates

4.1.1 Density

There were no statistically significant differences in population estimates for either the spatial or the linear densities between 'inside' and 'outside' of identified beds for each of nine surveys examined (Table 1). Similar results were found in comparisons of spatial density estimates in recent surveys of some areas (Atkins *et al.* 2006b,c,d,e,h) while other areas (Atkins *et al.* 2006a,b,g) showed some significant differences. Those reports included more PFM Subareas in the analyses than this paper. The results suggest that there are non-harvested RSU populations along the coast with similar densities to harvested beds. The ratio of inside to outside density was generally higher for linear estimates than spatial estimates except for the Deserters and Barkley Sound surveys (Table 1). The comparison of ratios for densities in and out of beds suggested that the linear density estimate varied more than the spatial. A possible explanation for this may be the effect of varying slope, and therefore transect length, between locations. Additional analyses with data from more surveys may provide further indications of the causative factors.

4.1.2 Population size and biomass

The linear/spatial ratios of the mean population and biomass estimates varied considerably between surveys, from 0.31 to 6.02. The population (Table 2a) and biomass (Table 2b) estimates were larger in the Robson Bight, Tofino, Deserters and Barkley Sound surveys using the shoreline length method whereas the bed area method yielded the larger estimates in the remaining five surveys for both inside beds or outside bed comparisons. There was no clear relationship between these ratios across the three categories of shoreline complexity. The overall mean linear/spatial ratio for the population and biomass density estimates from all nine surveys combined was 1.06 and 1.07, respectively (Table 2a,b).

4.2 Potential shoreline length

The North Coast estimate for Total Potential RSU Habitat was 11992 km and for Fishable Potential Habitat was 10094 km, while the South Coast had 8190 km and 5218 km, respectively (Table 3a,b). The BC Total Potential RSU habitat was 20182 km and Fishable Potential Habitat was 15312 km (Table 3a).

The potential shoreline lengths reported for each PFM Subarea are considered preliminary. For the calculation of quota options using the shoreline length method, only the Fishable RSU Confirmed Habitat was used, which was 5460 km for the North Coast, 2876 km for the South Coast and 8336 km total for the BC coast (Table 3a). The expansion of sea otter populations on the BC coast is expected to continue to reduce the amount of shoreline associated with commercially viable RSU populations. The sea otter range expansion and the preliminary status of the shoreline classifications highlights the need for further refinement of shoreline length estimates, as outlined in the iterative flow diagram shown in Fig. 4.

4.3 Density and biomass

In general, there was considerable variation in the size structure and densities of local RSU populations. Estimated linear mean population (number/m) and biomass (g/m) densities for each size group of RSU varied between PFM Areas, Subareas and years (Tables 4a, 4b, 5).

Surveys for RSU density are required in PFM Areas and Subareas in BC where surveys are absent or greater than 5 years old, especially in highly productive RSU areas (e.g., PFM Areas 5, 6 12, 13 and 24), with large shorelines of RSU Potential Habitat, and/or those re-colonised by sea otters. Many of the abundance estimates and quota options presented are based upon pre-otter surveys. RSU biomass in areas where sea otter populations have become re-established are not estimated (Table 6).

4.4 Preliminary Biomass and Quota Options

Red sea urchin biomass (B_c) estimated by the shoreline length method differed considerably between PFM Subareas (Table 6). Total biomass of RSU in the 90-140 mm TD size group was estimated at 183906 t for the North Coast and 51333 t for the South Coast (Table 6).

Since harvesters tend to select for better gonad quality from smaller animals, it may be more appropriate to select the quota option from B_c calculated on the 90-140 mm TD size group rather than $\geq$ 90 mm TD (Table 7a,b). Choice of a conservative mean quota based on an M = 0.10 (fishing rate of $\leq$ 2%), the 90-140 mm TD size group and the shoreline length method would provide an overall BC coast wide 2008/2009 quota option of 4705t (Table 8). This value is similar to the 4,679t which was the equivalent calculated by the bed area method (Campbell *et al.* 2001; their Table 9). Indeed, comparing mean quota options in Table 8 with those in the previous 2001 PSARC paper (Campbell *et al.* 2001), there was little change in coast wide totals (0.7% and 3.0% increase for the two given size ranges). However, in comparing mean quota options by region between the 2001 assessment and Table 8, there are substantial increases in South Coast estimates for both the $\geq$ 90 mm TD and 90-140 mm TD size ranges (72% and 77%), and a corresponding decrease in the North Coast.

One possibility for the quota difference using the proposed shoreline length method could be differential knowledge/understanding of North and South Coast RSU habitat. This did not appear to be the case with 48% of the North Coast and 46% of the South Coast confirmed as potential RSU habitat (Table 3a).

In contrast, comparisons at a PFM Subarea level between quota options from 2001 and those in Table 8 showed a greater number of discrepancies. Case by case analysis of these discrepancies showed two primary causes: a) localised lack of knowledge of RSU habitat and b) areas with RSU populations not associated with shoreline (i.e. submerged archipelagos).

More intensive surveying of a pilot study area containing a clearly defined population of RSU both before and after a commercial harvest may allow a comparison of population estimates from both the linear and spatial methods, as well as determining a more accurate estimation of actual harvest pressure.

In some areas there may be large reserves of RSU deeper than 9.1 m (D. Bureau, Fisheries & Oceans Canada, Nanaimo, BC, personal communication, 2005; W. Bradbury, Washington State Fisheries and Wildlife, personal communication, 2005). There may be areas still unexplored, especially in the North Coast, which may contain unfished “virgin” populations not included in the density estimates. Excluding these RSU from population estimates may make our biomass estimates more conservative, supporting a precautionary approach to stock management.

These biomass and quota estimates must be treated as preliminary, especially when considering the requirement for further refinement of Fishable RSU Confirmed Habitat.

5 GENERAL DISCUSSION

The general framework for assessing RSU in BC in this paper is essentially the same as advocated previously (e.g., Campbell *et al.* 2001) except in two approaches of calculating B_c. In the first approach, we rejected the idea of trying to identify and refine bed areas as was done in previous

papers, but rather proposed to identify all potential RSU habitat and refine the locations of fishable RSU habitat according to criteria summarized in Fig. 4. In the second approach, we estimated shoreline lengths to identify and generally quantify these habitats.

Ideally these habitats could be quantified by a bed area method (e.g., square metres of benthos within a certain depth range). However, bed areas are more difficult to estimate accurately than shoreline lengths. Also, at present, there is a greater degree of unquantifiable measurement uncertainty for the bed area method than the shoreline length method. The spatial and linear approaches in calculating B_c are likely equally valid given accurate measurements can be obtained. We believe that, given the present technology, we are better in measuring shoreline lengths than bed areas. The onus then will be to obtain more numerous and accurate linear density estimates via surveys throughout the BC coastline.

There are benefits and drawbacks to both the shoreline length and bed area methods of quantifying RSU habitat. The shoreline length method was developed to overcome issues with the existing spatial definition of RSU habitat; that of bed area derived from fishing events reported on harvest logs. The process of recording and digitizing these events was prone to error and there was low expectation of improvement. Furthermore, survey analyses showed that using fishing events alone led to the exclusion of substantial portions of RSU habitat and the resultant underestimation of biomass. The shoreline length method improves on the bed area method through the expansion of the definition of RSU habitat to include non-harvested populations. Both linear and spatial methods incorporate fishing events as an indicator of habitat and thus any possible errors in these data are included, however the shoreline length method is vulnerable to any errors in the inclusion of non-fished and erroneously defined RSU habitat. Currently, the linear shoreline length estimates of RSU habitat are assumed correct, however ground-truthing of these data is planned through further surveys and examination of other habitat data sets, for example the Province of BC's Coastal Resource Information System and various Parks Canada data sets. Further refinement in shoreline length estimates and focal areas for future density surveys will require consultation with managers, First Nations and other stake holders. Coordinating habitat data collection with other underwater survey programs at Fisheries and Oceans Canada (DFO) may enable additional verification of habitat predictions.

Another weakness in the shoreline length method is the assumption that all RSU habitat is associated with shoreline. Areas with submerged reefs or archipelagos may have little or no shoreline associated with the RSU habitat. In these cases, the bed area method may be more appropriate. A new survey protocol should be developed to estimate RSU biomass in complex submerged reefs and archipelagos and the results compared with those of existing survey methods.

The degree of shoreline complexity and its influence on the biomass estimated from shoreline length needs to be examined. Analogous issues exist with spatial estimates concerning slope and substrate complexity. Future analyses of shoreline complexity with regards to fractal extent, similar to Pennycuick and Kline (1986), may help address these issues.

The following are other factors in the assessment process for RSU in BC which also need to be considered:

The digitization of log book harvest locations should continue to be made on an annual basis. Clear identification of fishing events in relation to the amount of RSU removed from each location needs to be recorded carefully by harvesters and on-ground monitors to allow detailed stock analyses on a location by location and/or PFM Subarea basis in both the North and South Coasts.

The commercial quality of RSU roe is based on a combination of criteria such as colour, texture, size and taste. Generally, good quality roe from RSU is considered to have a yellow/gold consistent colour, firm texture (growing or premature gonads), sweet taste and of medium size. Of the commercially available RSU, these characteristics are mainly found in the approximately 90 –120 mm TD size range. Poor quality roe is generally considered to have variable yellow/brown colour,

soft texture and or oozing gametes (from mature, post spawn or spent gonads). RSU >130 mm TD generally have large gonads and inconsistent colour quality which are still commercially valuable, but less desirable by the industry than smaller mature individuals. There is an annual reproductive cycle with the timing of the spawning season varying within the period from February to September depending on local environmental conditions such as food availability and water temperature (Bernard 1977). Gonads usually increase in size from September to January (Kramer and Nordin 1975). The effect of food quality and availability to support growth and reproduction are important limiting factors on urchin populations. Although RSU are omnivorous grazers, kelps, such as *Nereocystis leutkeana*, provide optimal growth and gonad quality (Vadas 1977; Bureau *et al.* 1997; Morris and Campbell 1996). In areas of low food supply or quality, individuals may re-allocate nutrients causing poor quality gonads thereby reducing reproduction potential of local RSU populations. The influence of age, especially in large old RSU, on fecundity, senescence, roe quality and larval survival is unknown. Studies on changes in habitat, especially algal composition, should be encouraged to better understand RSU population dynamics and roe quality.

In addition to resource monitoring through fishery independent surveys, further biological information on source and seed populations, and growth, mortality and recruitment rates is required for production modelling of RSU populations in different areas of BC. Surveys of RSU density and habitat characteristics are required to account for localised differences in RSU productivity. The effect of the expansion of sea otter population range and density and the biological characteristics of RSU need to be examined to better manage the RSU fishery.

Continued monitoring (perhaps at 2-3 year intervals) of harvested RSU at ports and/or at commercial processing plants will provide the means to track temporal changes and area differences in size frequency and provide a tool to assess the appropriate size range upon which to set quotas.

To date, measureable criteria used to identify populations of RSU vulnerable to stock collapse have not been defined. Identifying shoreline (or beds) with depleted RSU stocks depends on feedback from industry, First Nations and other stakeholders, as resources required to monitor coast wide RSU populations are not available. DFO and the Pacific Urchin Harvesters Association (PUHA) have a functional working relationship, with PUHA often recommending reduced quotas in areas where they have observed decreases in population density or supporting closures in depleted areas.

Both the proposed shoreline length method and the bed area method utilize fishery-dependant data. The shoreline length method improves on the bed area method in that it also incorporates fishery-independent data, however it still depends upon a relatively sparse dataset to define RSU habitat in un-harvested areas of the BC coast. Some data are available from stock assessment surveys however the longevity of these data is unknown. Resurveying some harvested locations over time may give an indication as to the longevity of survey data and help to reassure stocks are not being depleted at current harvest limits.

6 RECOMMENDATIONS

(1) The shoreline length method and linear density estimates should be adopted to estimate red sea urchin current biomass (B_c) and annual quota options (Q) for the red sea urchin fishery in British Columbia after consultation with managers, First Nations and other stake holders.

(2) Continue refining the shoreline length estimation of potential habitat and fishable habitat for red sea urchins through surveys, the review of fishing events and consultation with managers, First Nations and other stake holders. Recording, validation and digitization of fishing events should continue to be updated on an annual basis.

(3) Surveys for the abundance estimates of RSU in alternative areas in BC should be conducted on an annual basis. Areas with no surveys for over 5 years, especially in highly productive red sea

urchin areas, with large potential red sea urchin shorelines, and/or those re-colonised by sea otters should be considered a priority.

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Table 1. Comparison of mean spatial (number/m^2) and linear (number/m) density estimates of red sea urchins ≥ 90 mm TD between inside and outside commercially fished beds by Pacific Fishery Management (PFM) Subarea from nine surveys of North and South Coast BC. Kruskal-Wallace non parametric test for differences in density in and out of beds are indicated as "ns" = not significantly different at p>0.05, na = not applicable (insufficient data for statistical analyses). Ratio In/Out compares the density estimates in and out of beds between the bed area and shoreline length methods.

PFM Subarea	Survey	Year	Transect					Spatial density		Kruskal-Wallace Test	Linear density		Kruskal-Wallace Test	Ratio of densities In/Out of beds	
			Number			Mean Length (m)									
			In Bed	Out of Bed*		In Bed	Out of Bed	In Bed	Out of Bed		In Bed	Out of Bed		Spatial	Linear
6-014 & 6-015	Laredo	2000	54	9	a	56	30	0.50	0.41	ns	28.31	12.28	ns	1.24	2.31
12-003	Robson Bight	2001	50	0		39	0	0.72	0.00	na	28.16	0.00	na	na	na
13-002	Campbell River	2002	21	0		177	0	0.57	0.00	na	100.35	0.00	na	na	na
24-006	Tofino	2000	20	6	b	109	71	0.84	0.88	ns	91.94	62.21	ns	0.96	1.48
7-003	Price Island	2001	9	1		30	11	3.25	1.57	ns	97.76	17.31	ns	2.06	5.65
4-001	Dundas Group	2003	35	5		57	54	0.96	0.56	ns	54.54	30.00	ns	1.73	1.82
5-010	Beaver Pass	2002	22	11	c	35	30	0.90	1.08	ns	31.23	31.98	ns	0.83	0.98
12-013	Deserters	2000	23	33	d	31	35	2.24	2.45	ns	70.11	84.78	ns	0.91	0.83
23-011	Barkley Sound	2003	15	2		44	51	1.83	1.63	ns	81.35	83.23	ns	1.12	0.98

**Transects & estimated km of shoreline that were excluded from out-of-bed calculations (a =9 & 11.5; b =1 & 3.5; c =1 & 4.4; d =2 & 2.2) due to absence of red sea urchins and thus considered unrepresentative of urchin habitat (i.e., categories Exposure <4 or Substrate >7): see text for explanation.*

Table 2a. Comparison of spatial and linear estimates of red sea urchin population size (number of red sea urchins x 10^3) by Pacific Fishery Management (PFM) Subarea from nine surveys of North and South Coast BC. Areas ranked into three categories of shoreline complexity SLC (1=linear, 2=moderately complex, 3=highly complex with multiple archipelagos); LCB=Lower 90% Confidence Bound, UCB=Upper 90% Confidence Bound. Ratio = mean linear population size estimate divided by mean spatial population size estimate.

PFM Subarea	Survey	Year	SLC	Transects			Spatial				Linear				Ratio
							Bed Area (ha)	Population Size (RSUx10^3)			Shore Length (km)	Population Size (RSUx10^3)			Linear/Spatial
				In/Out of Bed	(n)			Mean	LCB	UCB		Mean	LCB	UCB	Mean
6-014 &	Laredo Channel	2000	1	In	54		453.7	2198	1404	3226	65.4	1788	1380	2325	0.81
6-015				Out	9	a	43.4	177	72	335	6.9	85	36	148	0.48
				Total	**63**		**497.1**	**2377**	**1597**	**3457**	**72.3**	**1822**	**1420**	**2349**	**0.77**
12-003	Robson Bight	2001	1	In	50		91.6	658	496	844	92.6	2609	2064	3214	3.96
				Total	**50**		**91.6**	**658**	**496**	**844**	**92.6**	**2609**	**2064**	**3214**	**3.96**
13-002	Campbell River	2002	1	In	21		169.5	964	702	1437	8.0	803	558	1144	0.83
				Total	**21**		**169.5**	**964**	**639**	**1374**	**8.0**	**803**	**563**	**1144**	**0.83**
24-006	Tofino	2000	2	In	20		528.9	4453	2807	6540	74.6	6855	4550	10059	1.54
				Out	6	b	48.9	431	129	1031	7.6	473	253	850	1.10
				Total	**26**		**577.8**	**4901**	**3252**	**6878**	**82.2**	**6990**	**4820**	**9630**	**1.43**
7-003	Price Island	2001	2	In	9		311.7	10120	7645	15024	87.4	8542	5373	14497	0.84
				Out	1		2.3	36	0	0	0.7	11	0	0	0.31
				Total	**10**		**314.0**	**9990**	**7571**	**14597**	**88.0**	**7898**	**4846**	**13657**	**0.79**
4-001	Dundas Group	2003	3	In	35		1155.2	11131	9401	13088	159.1	8679	7009	10083	0.78
				Out	5		37.9	211	0	648	5.4	162	0	324	0.77
				Total	**40**		**1193.1**	**10917**	**8856**	**13298**	**164.5**	**8469**	**6704**	**10068**	**0.78**
5-010	Beaver Pass	2002	3	In	22		481.2	4339	3076	5828	118.4	3697	2664	5038	0.85
				Out	11	c	48.0	520	257	896	13.1	419	276	601	0.81
				Total	**33**		**529.2**	**5058**	**3780**	**6672**	**131.5**	**4140**	**3189**	**5198**	**0.82**
12-013	Deserters	2000	3	In	23		31.6	709	552	853	42.8	3003	2426	3600	4.24
				Out	33	d	7.0	172	143	198	12.2	1037	836	1252	6.02
				Total	**56**		**38.6**	**916**	**783**	**1029**	**55.1**	**4336**	**3716**	**5002**	**4.74**
23-011	Barkley Sound	2003	3	In	15		39.4	723	551	939	17.7	1440	1119	1769	1.99
				Out	2		2.6	42	0	0	1.2	102	0	0	2.45
				Total	**17**		**42.0**	**758**	**568**	**923**	**18.9**	**1544**	**1215**	**1871**	**2.04**
				Overall Total			**3452.9**	**36538.9**	**27542.9**	**49070.6**	**713.1**	**38610.0**	**28537.0**	**52131.9**	**1.06**

**Transects & estimated km of shoreline that were excluded from out-of-bed calculations (a =9 & 11.5; b =1 & 3.5; c =1 & 4.4; d =2 & 2.2) due to absence of red sea urchins and thus considered unrepresentative of urchin habitat (i.e., categories Exposure <4 or Substrate >7): see text for explanation.*

Table 2b. Comparison of spatial and linear estimates of red sea urchin population biomass (t) by Pacific Fishery Management (PFM) Subarea in nine surveyed areas of North and South Coast BC. Areas ranked into three categories of shoreline complexity SLC (1=linear, 2=moderately complex, 3=highly complex with multiple archipelagos); LCB=Lower 90% Confidence Bound, UCB=Upper 90% Confidence Bound. Ratio = mean linear population biomass estimate divided by mean spatial population biomass estimate.

PFM Subarea	Survey	Year	SLC	Transects			Spatial				Linear				Ratio
							Bed Area (ha)	Biomass (t)			Shore Length (km)	Biomass (t)			Linear/Spatial
				In/Out of Bed	(n)			Mean	LCB	UCB		Mean	LCB	UCB	Mean
6-014 &	Laredo Channel	2000	1	In	54		453.7	1008	674	1497	65.4	820	632	1050	0.81
6-015				Out	9	a	43.4	112	42	192	6.9	54	23	87	0.48
				Total	63		497.1	1119	734	1545	72.3	857	686	1093	0.77
12-003	Robson Bight	2001	1	In	50		91.6	445	323	577	92.6	1766	1389	2214	3.96
				Total	50		91.6	445	323	577	92.6	1766	1389	2214	3.96
13-002	Campbell River	2002	1	In	21		169.5	391	264	544	8.0	326	236	461	0.83
				Total	21		169.5	391	273	540	8.0	326	237	470	0.83
24-006	Tofino	2000	2	In	20		528.9	1742	1154	2582	74.6	2681	1882	4038	1.54
				Out	6	b	48.9	197	59	435	7.6	217	119	385	1.10
				Total	26		577.8	1973	1355	2739	82.2	2814	2075	4014	1.43
7-003	Price Island	2001	2	In	9		311.7	4122	3067	6240	87.4	3479	2177	6352	0.84
				Out	1		2.3	17	0	0	0.7	5	0	0	0.31
				Total	10		314.0	4082	3047	6069	88.0	3227	2049	5884	0.79
4-001	Dundas Group	2003	3	In	35		1155.2	5533	4618	6462	159.1	4314	3621	5112	0.78
				Out	5		37.9	86	0	247	5.4	66	0	132	0.77
				Total	40		1193.1	5355	4270	6369	164.5	4154	3417	5094	0.78
5-010	Beaver Pass	2002	3	In	22		481.2	2756	1959	3798	118.4	2348	1736	3282	0.85
				Out	11	c	48.0	314	154	519	13.1	253	172	364	0.81
				Total	33		529.2	3158	2340	4104	131.5	2585	2039	3323	0.82
12-013	Deserters	2000	3	In	23		31.6	341	267	421	42.8	1445	1191	1777	4.24
				Out	33	d	7.0	81	69	94	12.2	488	404	584	6.02
				Total	56		38.6	434	379	491	55.1	2058	1779	2372	4.74
23-011	Barkley Sound	2003	3	In	15		39.4	301	227	385	17.7	599	475	734	1.99
				Out	2		2.6	17	0	0	1.2	42	0	0	2.45
				Total	17		42.0	316	245	383	18.9	642	503	759	2.04
				Overall Total			**3452.9**	**17273.6**	**12966.2**	**22817.6**	**713.1**	**18428.7**	**14174.0**	**25223.7**	**1.07**

**Transects & estimated km of shoreline that were excluded from out-of-bed calculations (a =9 & 11.5; b =1 & 3.5; c =1 & 4.4; d =2 & 2.2) due to absence of red sea urchins and thus considered unrepresentative of urchin habitat (i.e., categories Exposure <4 or Substrate >7): see text for explanation.*

Table 3a. Summary of North and South coast shoreline lengths (km) by Pacific Fishery Management (PFM) Subarea used to calculate Fishable RSU Confirmed Habitat (Shoreline Length column in Table 6) for 2008/2009 quota options. Definitions of shoreline classifications are in Table 3b.

Subarea	Total Shoreline	Total RSU Potential Habitat	Otter Populated Shoreline	Closures from Parks, FSC etc.	**Fishable RSU Potential Habitat**	RSU Confirmed Habitat	Otter Populated RSU Confirmed Habitat	**Fishable RSU Confirmed Habitat**
North Coast								
1-1	112.26	112.26			**112.26**	91.40	0.00	**91.40**
1-2	54.16	54.16		12.02	**42.40**	42.40	0.00	**42.40**
1-3	50.31	50.31		1.82	**48.49**	41.40	0.00	**41.40**
1-4	55.63				**0.00**	0.00	0.00	**0.00**
1-5	69.22	69.22			**69.22**	6.62	0.00	**6.62**
1-6	458.39				**0.00**	0.00	0.00	**0.00**
1-7	31.83	31.83		4.07	**27.75**	26.42	0.00	**26.42**
2-1	248.45	21.16			**21.16**	21.16	0.00	**21.16**
2-2	31.78	0.86			**0.86**	0.86	0.00	**0.86**
2-3	62.36	62.36		3.80	**58.56**	19.24	0.00	**19.24**
2-4	46.73	46.73		45.15	**1.58**	0.00	0.00	**0.00**
2-5	25.01	25.01		25.01	**0.00**	0.00	0.00	**0.00**
2-6	163.34	163.34		163.34	**0.00**	0.00	0.00	**0.00**
2-7	64.31	64.31		63.63	**0.92**	0.92	0.00	**0.92**
2-8	122.39	94.05		7.44	**86.60**	53.03	0.00	**53.03**
2-9	35.71	6.85			**6.85**	3.86	0.00	**3.86**
2-10	124.97	87.49			**87.49**	14.31	0.00	**14.31**
2-11	246.66	205.67		129.05	**76.62**	16.11	0.00	**16.11**
2-12	85.86	85.86		1.68	**84.19**	47.81	0.00	**47.81**
2-13	78.00	78.00		67.12	**10.88**	5.72	0.00	**5.72**
2-14	71.10	66.33			**66.33**	50.74	0.00	**50.74**
2-15	78.64	52.05		1.33	**50.72**	39.23	0.00	**39.23**
2-16	29.49	29.49		29.49	**0.00**	0.00	0.00	**0.00**
2-17	54.09	42.00			**42.00**	39.18	0.00	**39.18**
2-18	104.81	93.17			**93.17**	84.31	0.00	**84.31**
2-19	70.14	51.63			**51.63**	47.95	0.00	**47.95**
2-31	159.63	159.63		32.70	**126.93**	92.96	0.00	**92.96**
2-32	10.63	10.63			**10.63**	8.16	0.00	**8.16**
2-33	11.22	5.00			**5.00**	3.77	0.00	**3.77**
2-34	15.42	0.52			**0.52**	0.52	0.00	**0.52**
2-35	40.78				**0.00**	0.00	0.00	**0.00**
2-36	21.00				**0.00**	0.00	0.00	**0.00**
2-37	10.90				**0.00**	0.00	0.00	**0.00**
2-38	238.34	161.06			**161.06**	5.33	0.00	**5.33**
2-39	8.11	7.27			**7.27**	3.21	0.00	**3.21**
2-40	8.90	4.29			**4.29**	0.00	0.00	**0.00**
2-41	8.69				**0.00**	0.00	0.00	**0.00**
2-42	22.94	5.61			**5.61**	5.61	0.00	**5.61**
2-43	9.51				**0.00**	0.00	0.00	**0.00**
2-44	14.62				**0.00**	0.00	0.00	**0.00**
2-45	16.26				**0.00**	0.00	0.00	**0.00**

Subarea	Total Shoreline	Total RSU Potential Habitat	Otter Populated Shoreline	Closures from Parks, FSC etc.	**Fishable RSU Potential Habitat**	RSU Confirmed Habitat	Otter Populated RSU Confirmed Habitat	**Fishable RSU Confirmed Habitat**
2-46	30.40				**0.00**	0.00	0.00	**0.00**
2-47	24.44	0.38			**0.38**	0.38	0.00	**0.38**
2-48	5.96	5.96			**5.96**	0.00	0.00	**0.00**
2-49	45.84	45.84			**45.84**	40.56	0.00	**40.56**
2-50	35.79	35.79			**35.79**	27.44	0.00	**27.44**
2-51	6.64	6.64			**6.64**	0.68	0.00	**0.68**
2-52	23.52	23.52			**23.52**	0.56	0.00	**0.56**
2-53	20.04	20.04			**20.04**	15.00	0.00	**15.00**
2-54	11.03	11.03			**11.03**	6.17	0.00	**6.17**
2-55	8.84	8.84			**8.84**	2.09	0.00	**2.09**
2-56	18.71				**0.00**	0.00	0.00	**0.00**
2-57	9.98				**0.00**	0.00	0.00	**0.00**
2-58	15.17				**0.00**	0.00	0.00	**0.00**
2-59	16.81	16.81			**16.81**	0.52	0.00	**0.52**
2-60	20.93	20.93			**20.93**	11.69	0.00	**11.69**
2-61	25.36	25.36			**25.36**	0.65	0.00	**0.65**
2-62	44.16				**0.00**	0.00	0.00	**0.00**
2-63	51.12	51.12		51.12	**0.01**	0.01	0.00	**0.01**
2-64	15.71	15.71		15.48	**0.31**	0.31	0.00	**0.31**
2-65	29.23	29.23		0.56	**28.67**	3.21	0.00	**3.21**
2-66	16.27	16.27		16.27	**0.00**	0.00	0.00	**0.00**
2-67	31.82	31.82		31.82	**0.04**	0.04	0.00	**0.04**
2-68	84.11	70.29			**70.29**	67.19	0.00	**67.19**
2-69	28.76	28.76			**28.76**	19.66	0.00	**19.66**
2-70	23.71	23.71			**23.71**	1.00	0.00	**1.00**
2-71	18.29	18.29			**18.29**	15.31	0.00	**15.31**
2-72	2.69	2.69			**2.69**	1.57	0.00	**1.57**
2-73	5.13	5.13			**5.13**	5.13	0.00	**5.13**
2-74	1.33	1.33			**1.33**	1.33	0.00	**1.33**
2-75	43.99	43.99			**43.99**	39.57	0.00	**39.57**
2-76	22.17	22.17		0.14	**22.04**	1.52	0.00	**1.52**
2-77	31.91	31.91		29.39	**2.52**	0.00	0.00	**0.00**
2-78	19.35	19.35			**19.35**	18.40	0.00	**18.40**
2-79	21.16	21.16			**21.16**	21.05	0.00	**21.05**
2-80	9.36	9.36			**9.36**	9.36	0.00	**9.36**
2-81	10.72	10.72			**10.72**	2.61	0.00	**2.61**
2-82	25.57	25.57			**25.57**	21.01	0.00	**21.01**
2-83	7.94	2.50			**2.50**	0.00	0.00	**0.00**
2-84	11.29				**0.00**	0.00	0.00	**0.00**
2-85	33.31	33.31			**33.31**	18.29	0.00	**18.29**
2-86	13.34	13.34			**13.34**	13.34	0.00	**13.34**
2-87	28.79	28.79			**28.79**	21.91	0.00	**21.91**
2-88	52.09	52.09			**52.09**	38.23	0.00	**38.23**
2-89	20.58	20.58			**20.58**	15.92	0.00	**15.92**
2-90	22.26	22.26			**22.26**	13.52	0.00	**13.52**
2-91	14.90	1.34			**1.34**	1.34	0.00	**1.34**

Subarea	Total Shoreline	Total RSU Potential Habitat	Otter Populated Shoreline	Closures from Parks, FSC etc.	**Fishable RSU Potential Habitat**	RSU Confirmed Habitat	Otter Populated RSU Confirmed Habitat	**Fishable RSU Confirmed Habitat**
2-92	7.63	7.63			**7.63**	6.49	0.00	**6.49**
2-93	10.41	10.41			**10.41**	7.08	0.00	**7.08**
2-94	6.25				**0.00**	0.00	0.00	**0.00**
2-95	12.36	5.56			**5.56**	2.74	0.00	**2.74**
2-96	5.31	5.31			**5.31**	5.22	0.00	**5.22**
2-97	11.91	11.91			**11.91**	7.65	0.00	**7.65**
2-98	17.94	17.94			**17.94**	17.94	0.00	**17.94**
2-99	5.64	5.64			**5.64**	5.64	0.00	**5.64**
2-100	5.74	5.74			**5.74**	1.78	0.00	**1.78**
3-1	191.74	162.30			**162.30**	142.33	0.00	**142.33**
3-2	10.98	10.98			**10.98**	10.98	0.00	**10.98**
3-3	47.64	47.64			**47.64**	11.62	0.00	**11.62**
3-4	36.16	36.16			**36.16**	0.65	0.00	**0.65**
3-5	5.79				**0.00**	0.00	0.00	**0.00**
3-6	183.71				**0.00**	0.00	0.00	**0.00**
3-7	150.77				**0.00**	0.00	0.00	**0.00**
3-8	52.58				**0.00**	0.00	0.00	**0.00**
3-9	33.16				**0.00**	0.00	0.00	**0.00**
3-10	79.39				**0.00**	0.00	0.00	**0.00**
3-11	91.06				**0.00**	0.00	0.00	**0.00**
3-12	83.53				**0.00**	0.00	0.00	**0.00**
3-13	35.65				**0.00**	0.00	0.00	**0.00**
3-14	329.57				**0.00**	0.00	0.00	**0.00**
3-15	70.65				**0.00**	0.00	0.00	**0.00**
3-16	44.20				**0.00**	0.00	0.00	**0.00**
3-17	28.03				**0.00**	0.00	0.00	**0.00**
3-18	16.92				**0.00**	0.00	0.00	**0.00**
4-1	265.87	265.87			**265.87**	145.73	0.00	**145.73**
4-2	353.65	327.29			**327.29**	122.64	0.00	**122.64**
4-3	24.68	24.68			**24.68**	22.78	0.00	**22.78**
4-4	19.05	19.05			**19.05**	11.06	0.00	**11.06**
4-5	121.42	121.42			**121.42**	43.79	0.00	**43.79**
4-6	3.37				**0.00**	0.00	0.00	**0.00**
4-7	5.97				**0.00**	0.00	0.00	**0.00**
4-8	25.52	4.81			**4.81**	0.00	0.00	**0.00**
4-9	136.27	117.06			**117.06**	70.94	0.00	**70.94**
4-10	151.83	2.00			**2.00**	2.00	0.00	**2.00**
4-11	101.48	2.94			**2.94**	2.94	0.00	**2.94**
4-12	263.74	188.16			**188.16**	43.00	0.00	**43.00**
4-13	32.85	32.85			**32.85**	32.85	0.00	**32.85**
4-14	1.74	1.74			**1.74**	0.00	0.00	**0.00**
4-15	39.18	39.18			**39.18**	0.00	0.00	**0.00**
5-1	48.30				**0.00**	0.00	0.00	**0.00**
5-2	70.68	59.13		0.27	**58.86**	7.61	0.00	**7.61**

Subarea	Total Shoreline	Total RSU Potential Habitat	Otter Populated Shoreline	Closures from Parks, FSC etc.	**Fishable RSU Potential Habitat**	RSU Confirmed Habitat	Otter Populated RSU Confirmed Habitat	**Fishable RSU Confirmed Habitat**
5-3	91.14	91.14		91.14	**0.00**	0.00	0.00	**0.00**
5-4	64.19	29.04			**29.04**	2.75	0.00	**2.75**
5-5	16.10				**0.00**	0.00	0.00	**0.00**
5-6	11.32				**0.00**	0.00	0.00	**0.00**
5-7	22.06				**0.00**	0.00	0.00	**0.00**
5-8	22.86				**0.00**	0.00	0.00	**0.00**
5-9	91.44	34.47			**34.47**	19.68	0.00	**19.68**
5-10	282.78	282.78		68.59	**214.19**	129.75	0.00	**129.75**
5-11	34.35	34.35			**34.35**	23.60	0.00	**23.60**
5-12	53.68	53.68			**53.68**	36.48	0.00	**36.48**
5-13	159.02	130.46			**130.46**	101.33	0.00	**101.33**
5-14	108.88	98.79			**98.79**	27.57	0.00	**27.57**
5-15	42.22				**0.00**	0.00	0.00	**0.00**
5-16	266.21	88.74			**88.74**	24.10	0.00	**24.10**
5-17	221.55	193.98			**193.98**	142.76	0.00	**142.76**
5-18	36.59	6.24			**6.24**	2.11	0.00	**2.11**
5-19	75.40	75.40			**75.40**	1.92	0.00	**1.92**
5-20	177.56	155.21			**155.21**	110.74	0.00	**110.74**
5-21	141.91	104.46			**104.46**	44.45	0.00	**44.45**
5-22	270.21	223.32			**223.32**	184.46	0.00	**184.46**
5-23	200.51				**0.00**	0.00	0.00	**0.00**
5-24	111.78	28.78			**28.78**	9.69	0.00	**9.69**
6-1	476.60				**0.00**	0.00	0.00	**0.00**
6-2	176.51				**0.00**	0.00	0.00	**0.00**
6-3	164.42				**0.00**	0.00	0.00	**0.00**
6-4	339.75				**0.00**	0.00	0.00	**0.00**
6-5	254.86	218.30			**218.30**	27.38	0.00	**27.38**
6-6	101.26	63.65			**63.65**	19.78	0.00	**19.78**
6-7	33.10				**0.00**	0.00	0.00	**0.00**
6-8	46.90	2.16			**2.16**	0.00	0.00	**0.00**
6-9	465.38	465.27			**465.27**	285.80	0.00	**285.80**
6-10	228.66	228.66			**228.66**	121.42	0.00	**121.42**
6-11	9.81	9.81			**9.81**	9.56	0.00	**9.56**
6-12	123.98	56.44			**56.44**	8.22	0.00	**8.22**
6-13	419.99	376.42			**376.42**	304.99	0.00	**304.99**
6-14	70.35	47.23			**47.23**	41.47	0.00	**41.47**
6-15	32.38	25.85			**25.85**	25.24	0.00	**25.24**
6-16	171.83	156.69			**156.69**	127.87	0.00	**127.87**
6-17	62.08	62.08			**62.08**	56.00	0.00	**56.00**
6-18	58.97	19.02			**19.02**	19.02	0.00	**19.02**
6-19	238.76	132.30			**132.30**	47.97	0.00	**47.97**
6-20	204.84	15.93			**15.93**	6.43	0.00	**6.43**
6-21	19.13				**0.00**	0.00	0.00	**0.00**
6-22	18.58				**0.00**	0.00	0.00	**0.00**
6-23	30.73				**0.00**	0.00	0.00	**0.00**
6-24	19.21				**0.00**	0.00	0.00	**0.00**

Subarea	Total Shoreline	Total RSU Potential Habitat	Otter Populated Shoreline	Closures from Parks, FSC etc.	**Fishable RSU Potential Habitat**	RSU Confirmed Habitat	Otter Populated RSU Confirmed Habitat	**Fishable RSU Confirmed Habitat**
6-25	87.75	59.98			**59.98**	17.07	0.00	**17.07**
6-26	18.19	18.19			**18.19**	14.35	0.00	**14.35**
6-27	9.82	9.82			**9.82**	0.00	0.00	**0.00**
6-28	24.67	6.33			**6.33**	0.00	0.00	**0.00**
7-1	18.76	18.76	16.44		**2.32**	13.37	11.03	**2.34**
7-2	7.32	7.32	0.25		**7.07**	7.12	0.07	**7.05**
7-3	142.83	102.74	0.24		**102.50**	84.67	0.24	**84.43**
7-4	76.53	53.07			**53.07**	43.30	0.00	**43.30**
7-5	65.04	65.04			**65.04**	25.51	0.00	**25.51**
7-6	122.33	6.88			**6.88**	4.36	0.00	**4.36**
7-7	66.50				**0.00**	0.00	0.00	**0.00**
7-8	15.64	5.82			**5.82**	5.82	0.00	**5.82**
7-9	344.56	248.72			**248.72**	124.53	0.00	**124.53**
7-10	61.91				**0.00**	0.00	0.00	**0.00**
7-11	65.42				**0.00**	0.00	0.00	**0.00**
7-12	92.51	92.51	9.48		**83.03**	52.04	9.13	**42.91**
7-13	85.72	5.94			**5.94**	5.94	0.00	**5.94**
7-14	238.13	11.37			**11.37**	11.37	0.00	**11.37**
7-15	180.94	117.60			**117.60**	0.31	0.00	**0.31**
7-16	102.78				**0.00**	0.00	0.00	**0.00**
7-17	286.32	235.62	0.29		**235.33**	46.65	0.29	**46.37**
7-18	263.41	256.35	256.35		**0.00**	153.71	153.71	**0.00**
7-19	42.75	42.75	42.75		**0.00**	15.09	15.09	**0.00**
7-20	48.46	48.46	48.46		**0.00**	11.60	11.60	**0.00**
7-21	108.03	32.04	25.96		**6.08**	5.81	0.46	**5.35**
7-22	16.39	1.75			**1.75**	1.75	0.00	**1.75**
7-23	179.60	95.33	95.33		**1.13**	16.38	15.25	**1.13**
7-24	57.37	18.65	6.01		**12.63**	9.22	4.13	**5.10**
7-25	390.99	369.42	259.83		**109.59**	128.12	90.56	**37.56**
7-26	17.65	17.65	6.90		**10.75**	7.92	4.41	**3.51**
7-27	309.49	290.91			**290.91**	138.65	0.00	**138.65**
7-28	161.38	64.21			**64.21**	30.39	0.00	**30.39**
7-29	55.32				**0.00**	0.00	0.00	**0.00**
7-30	43.88	0.54			**0.54**	0.54	0.00	**0.54**
7-31	148.26	148.26		142.49	**5.95**	5.95	0.00	**5.95**
7-32	125.82	90.60	90.60		**0.00**	36.55	36.55	**0.00**
8-1	68.13	68.13			**68.13**	57.77	0.00	**57.77**
8-2	141.28	96.65			**96.65**	79.73	0.00	**79.73**
8-3	44.37	15.88			**15.88**	14.64	0.00	**14.64**
8-4	323.30	304.69			**304.69**	141.20	0.00	**141.20**
8-5	60.33	3.71			**3.71**	3.71	0.00	**3.71**
8-6	28.29	3.85			**3.85**	3.85	0.00	**3.85**
8-7	223.83				**0.00**	0.00	0.00	**0.00**
8-8	98.75				**0.00**	0.00	0.00	**0.00**
8-9	72.75				**0.00**	0.00	0.00	**0.00**

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8-10	34.77				**0.00**	0.00	0.00	**0.00**
8-11	56.66				**0.00**	0.00	0.00	**0.00**
8-12	112.10				**0.00**	0.00	0.00	**0.00**
8-13	150.54	12.53			**12.53**	12.53	0.00	**12.53**
8-14	81.42				**0.00**	0.00	0.00	**0.00**
8-15	105.22				**0.00**	0.00	0.00	**0.00**
8-16	86.29	54.20			**54.20**	37.98	0.00	**37.98**
9-1	57.83	57.83			**57.83**	32.91	0.00	**32.91**
9-2	229.05	164.21			**164.21**	48.81	0.00	**48.81**
9-3	33.75	8.73			**8.73**	8.73	0.00	**8.73**
9-4	37.55	1.10			**1.10**	1.10	0.00	**1.10**
9-5	18.00				**0.00**	0.00	0.00	**0.00**
9-6	63.31				**0.00**	0.00	0.00	**0.00**
9-7	24.50				**0.00**	0.00	0.00	**0.00**
9-8	37.32				**0.00**	0.00	0.00	**0.00**
9-9	36.05				**0.00**	0.00	0.00	**0.00**
9-10	100.07	9.37			**9.37**	3.57	0.00	**3.57**
9-11	98.99	13.76			**13.76**	5.42	0.00	**5.42**
9-12	240.75	126.56			**126.56**	32.98	0.00	**32.98**
10-1	62.32	62.32			**62.32**	50.81	0.00	**50.81**
10-2	57.12	57.12			**57.12**	55.56	0.00	**55.56**
10-3	38.34	38.34			**38.34**	33.56	0.00	**33.56**
10-4	67.88	67.88			**67.88**	40.10	0.00	**40.10**
10-5	38.07	25.08			**25.08**	10.79	0.00	**10.79**
10-6	49.35	15.15			**15.15**	1.01	0.00	**1.01**
10-7	65.74	27.49			**27.49**	8.64	0.00	**8.64**
10-8	11.47	7.21			**7.21**	3.11	0.00	**3.11**
10-9	20.54				**0.00**	0.00	0.00	**0.00**
10-10	56.99				**0.00**	0.00	0.00	**0.00**
10-11	46.89	0.74			**0.74**	0.53	0.00	**0.53**
10-12	104.45	95.06			**95.06**	6.66	0.00	**6.66**
101-1	10.89	10.89			**10.89**	10.89	0.00	**10.89**
101-2	6.68	6.68		0.11	**6.57**	6.21	0.00	**6.21**
101-6	10.41	10.41		1.86	**8.61**	8.61	0.00	**8.61**
101-7	3.39	3.39			**3.39**	3.29	0.00	**3.29**
101-10	2.32	2.32			**2.32**	0.00	0.00	**0.00**
102-1	88.82				**0.00**	0.00	0.00	**0.00**
102-2	2.24	2.24		0.11	**2.14**	2.14	0.00	**2.14**
102-3	4.89	4.89			**4.89**	3.85	0.00	**3.85**
105-1	20.46	20.46			**20.46**	18.62	0.00	**18.62**
105-2	5.04	5.04			**5.04**	2.43	0.00	**2.43**

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106-1	9.45	9.45			**9.45**	5.59	0.00	**5.59**
106-2	99.88	99.88			**99.88**	97.52	0.00	**97.52**
107-2	0.44	0.44	0.44		**0.00**	0.00	0.00	**0.00**
107-3	0.42	0.42	0.42		**0.00**	0.00	0.00	**0.00**
108-1	3.10	3.10			**3.10**	2.76	0.00	**2.76**
109	0.02	0.02			**0.02**	0.02	0.00	**0.02**
110	1.47	1.47			**1.47**	0.00	0.00	**0.00**
130-3	5.74	5.74			**5.74**	0.60	0.00	**0.60**
142-1	32.21	32.21		1.58	**30.62**	1.49	0.00	**1.49**
142-2	26.57	26.57		2.09	**24.48**	17.52	0.00	**17.52**
N. Coast Total	**21444.54**	**11992.00**	**859.75**	**1040.68**	**10093.58**	**5812.19**	**352.51**	**5459.68**
South Coast								
11-1	18.19	18.19	18.19		**0.00**	17.13	17.13	**0.00**
11-2	274.13	219.27			**219.27**	171.13	0.00	**171.13**
11-3	167.46				**0.00**	0.00	0.00	**0.00**
11-4	102.79				**0.00**	0.00	0.00	**0.00**
11-5	74.71				**0.00**	0.00	0.00	**0.00**
11-7	97.94				**0.00**	0.00	0.00	**0.00**
11-8	67.91				**0.00**	0.00	0.00	**0.00**
11-9	82.60				**0.00**	0.00	0.00	**0.00**
11-10	101.99				**0.00**	0.00	0.00	**0.00**
12-1	44.56	44.56			**44.56**	34.89	0.00	**34.89**
12-2	52.61	31.32			**31.32**	20.85	0.00	**20.85**
12-3	92.73	86.94			**86.94**	66.59	0.00	**66.59**
12-4	20.25	7.49			**7.49**	7.05	0.00	**7.05**
12-5	60.87	51.17			**51.17**	42.25	0.00	**42.25**
12-6	181.24	118.40			**118.40**	112.02	0.00	**112.02**
12-7	78.80	78.80		15.29	**63.51**	51.16	0.00	**51.16**
12-8	19.18	19.18			**19.18**	19.18	0.00	**19.18**
12-9	0.24	0.24		0.00	**0.24**	0.24	0.00	**0.24**
12-10	0.34	0.34			**0.34**	0.34	0.00	**0.34**
12-11	118.42	108.13			**108.13**	95.56	0.00	**95.56**
12-12	56.09	56.09	56.09		**0.00**	47.29	47.29	**0.00**
12-13	240.21	222.91			**222.91**	182.32	0.00	**182.32**
12-14	53.51	53.51	53.51		**0.00**	53.51	53.51	**0.00**
12-15	98.12	96.34	54.27		**42.14**	57.37	15.23	**42.14**
12-16	115.01	99.15			**99.15**	91.55	0.00	**91.55**
12-17	23.83	23.83			**23.83**	11.40	0.00	**11.40**

Subarea	Total Shoreline	Total RSU Potential Habitat	Otter Populated Shoreline	Closures from Parks, FSC etc.	**Fishable RSU Potential Habitat**	RSU Confirmed Habitat	Otter Populated RSU Confirmed Habitat	**Fishable RSU Confirmed Habitat**
12-18	77.00	77.00			**77.00**	49.12	0.00	**49.12**
12-19	53.97	28.75			**28.75**	23.33	0.00	**23.33**
12-20	11.35	2.45			**2.45**	1.88	0.00	**1.88**
12-21	8.97	4.18			**4.18**	2.83	0.00	**2.83**
12-22	43.09				**0.00**	0.00	0.00	**0.00**
12-23	52.64				**0.00**	0.00	0.00	**0.00**
12-24	5.71	5.71			**5.71**	5.71	0.00	**5.71**
12-25	49.18	49.18		49.18	**0.00**	0.00	0.00	**0.00**
12-26	346.41	37.84			**37.84**	2.02	0.00	**2.02**
12-27	78.15				**0.00**	0.00	0.00	**0.00**
12-28	11.40				**0.00**	0.00	0.00	**0.00**
12-29	22.06				**0.00**	0.00	0.00	**0.00**
12-30	46.20				**0.00**	0.00	0.00	**0.00**
12-31	28.26				**0.00**	0.00	0.00	**0.00**
12-32	18.28				**0.00**	0.00	0.00	**0.00**
12-33	16.54				**0.00**	0.00	0.00	**0.00**
12-34	48.09				**0.00**	0.00	0.00	**0.00**
12-35	140.08				**0.00**	0.00	0.00	**0.00**
12-36	26.73				**0.00**	0.00	0.00	**0.00**
12-37	19.29				**0.00**	0.00	0.00	**0.00**
12-38	36.66				**0.00**	0.00	0.00	**0.00**
12-39	401.57	304.52			**304.52**	87.66	0.00	**87.66**
12-40	157.48				**0.00**	0.00	0.00	**0.00**
12-41	321.45	60.94			**60.94**	52.31	0.00	**52.31**
12-42	161.34	4.53			**4.53**	4.53	0.00	**4.53**
12-43	41.63				**0.00**	0.00	0.00	**0.00**
12-44	0.22				**0.00**	0.00	0.00	**0.00**
12-45	61.27				**0.00**	0.00	0.00	**0.00**
12-46	33.10				**0.00**	0.00	0.00	**0.00**
12-47	14.05				**0.00**	0.00	0.00	**0.00**
12-48	35.93				**0.00**	0.00	0.00	**0.00**
13-1	4.50	4.50		0.19	**4.31**	4.26	0.00	**4.26**
13-2	8.00	8.00		0.24	**7.77**	7.77	0.00	**7.77**
13-3	82.19	82.19		82.18	**0.01**	0.00	0.00	**0.00**
13-4	6.62	6.62		6.62	**0.00**	0.00	0.00	**0.00**
13-5	26.62	26.47		26.47	**0.00**	0.00	0.00	**0.00**
13-6	17.65	17.65		4.17	**13.48**	8.14	0.00	**8.14**
13-7	22.58	15.55			**15.55**	8.35	0.00	**8.35**
13-8	3.39	3.39			**3.39**	3.21	0.00	**3.21**
13-9	19.83	15.62			**15.62**	10.81	0.00	**10.81**
13-10	42.74	42.74			**42.74**	14.30	0.00	**14.30**
13-11	35.69	10.35			**10.35**	4.83	0.00	**4.83**
13-12	137.32	112.36			**112.36**	40.75	0.00	**40.75**
13-13	40.98	40.98			**40.98**	5.18	0.00	**5.18**
13-14	15.24	15.24			**15.24**	2.25	0.00	**2.25**

Subarea	Total Shoreline	Total RSU Potential Habitat	Otter Populated Shoreline	Closures from Parks, FSC etc.	**Fishable RSU Potential Habitat**	RSU Confirmed Habitat	Otter Populated RSU Confirmed Habitat	**Fishable RSU Confirmed Habitat**
13-15	60.35	3.22			**3.22**	3.22	0.00	**3.22**
13-16	51.64	26.16			**26.16**	0.00	0.00	**0.00**
13-17	100.77	39.26			**39.26**	0.00	0.00	**0.00**
13-18	39.97	32.26			**32.26**	13.30	0.00	**13.30**
13-19	47.75				**0.00**	0.00	0.00	**0.00**
13-20	29.29	3.52			**3.52**	3.52	0.00	**3.52**
13-21	76.33				**0.00**	0.00	0.00	**0.00**
13-22	114.74				**0.00**	0.00	0.00	**0.00**
13-23	81.06	57.71			**57.71**	24.65	0.00	**24.65**
13-24	30.63				**0.00**	0.00	0.00	**0.00**
13-25	52.19	52.19			**52.19**	38.72	0.00	**38.72**
13-26	72.70	43.56			**43.56**	4.83	0.00	**4.83**
13-27	9.91	9.91			**9.91**	3.54	0.00	**3.54**
13-28	51.30	50.30			**50.30**	45.79	0.00	**45.79**
13-29	13.31	13.31			**13.31**	12.67	0.00	**12.67**
13-30	15.28	15.28			**15.28**	11.54	0.00	**11.54**
13-31	15.15	15.15			**15.15**	12.24	0.00	**12.24**
13-32	31.56	31.56			**31.56**	30.09	0.00	**30.09**
13-33	14.25	14.25			**14.25**	13.53	0.00	**13.53**
13-34	28.04	28.04			**28.04**	0.00	0.00	**0.00**
13-35	24.78	24.78			**24.78**	9.01	0.00	**9.01**
13-36	26.51	0.90			**0.90**	0.90	0.00	**0.90**
13-37	30.11				**0.00**	0.00	0.00	**0.00**
13-38	13.35				**0.00**	0.00	0.00	**0.00**
13-39	18.93	18.93			**18.93**	15.55	0.00	**15.55**
13-40	13.43	13.43			**13.43**	12.95	0.00	**12.95**
13-41	33.43	33.43			**33.43**	14.25	0.00	**14.25**
13-42	48.90				**0.00**	0.00	0.00	**0.00**
13-43	68.03				**0.00**	0.00	0.00	**0.00**
14-1	41.19	21.73			**21.73**	5.76	0.00	**5.76**
14-2	0.54	0.54			**0.54**	0.19	0.00	**0.19**
14-3	51.41	51.41			**51.41**	10.72	0.00	**10.72**
14-4	20.70	20.70			**20.70**	0.00	0.00	**0.00**
14-5	18.99	18.99		0.48	**18.51**	1.03	0.00	**1.03**
14-6	0.23	0.23			**0.23**	0.10	0.00	**0.10**
14-7	30.28	30.28		17.30	**12.98**	10.48	0.00	**10.48**
14-8	54.59	33.94			**33.94**	4.57	0.00	**4.57**
14-9	14.34	14.34		3.10	**11.24**	5.80	0.00	**5.80**
14-10	15.11	15.11			**15.11**	2.68	0.00	**2.68**
14-11	16.98	16.98			**16.98**	4.97	0.00	**4.97**
14-12	0.00	0.00			**0.00**	0.00	0.00	**0.00**
14-13	43.79	43.79		0.43	**43.37**	43.36	0.00	**43.36**
14-14	24.26				**0.00**	0.00	0.00	**0.00**
14-15	13.41	13.41			**13.41**	0.00	0.00	**0.00**

Subarea	Total Shoreline	Total RSU Potential Habitat	Otter Populated Shoreline	Closures from Parks, FSC etc.	**Fishable RSU Potential Habitat**	RSU Confirmed Habitat	Otter Populated RSU Confirmed Habitat	**Fishable RSU Confirmed Habitat**
15-1	85.51	85.51		1.22	**84.29**	0.00	0.00	**0.00**
15-2	62.02	62.02		2.19	**59.83**	4.36	0.00	**4.36**
15-3	87.41	87.41		2.77	**84.65**	0.00	0.00	**0.00**
15-4	100.04				**0.00**	0.00	0.00	**0.00**
15-5	383.94				**0.00**	0.00	0.00	**0.00**
15-6	104.81				**0.00**	0.00	0.00	**0.00**
16-1	77.70	56.61			**56.61**	39.16	0.00	**39.16**
16-2	23.82	23.73			**23.73**	5.28	0.00	**5.28**
16-3	5.69	5.69			**5.69**	0.00	0.00	**0.00**
16-4	32.90				**0.00**	0.00	0.00	**0.00**
16-5	26.49				**0.00**	0.00	0.00	**0.00**
16-6	46.03				**0.00**	0.00	0.00	**0.00**
16-7	83.75				**0.00**	0.00	0.00	**0.00**
16-8	42.62				**0.00**	0.00	0.00	**0.00**
16-9	24.93	13.15		13.15	**0.00**	0.00	0.00	**0.00**
16-10	44.76				**0.00**	0.00	0.00	**0.00**
16-11	70.83	1.57			**1.57**	1.57	0.00	**1.57**
16-12	57.03				**0.00**	0.00	0.00	**0.00**
16-13	89.02				**0.00**	0.00	0.00	**0.00**
16-14	36.63				**0.00**	0.00	0.00	**0.00**
16-15	67.81				**0.00**	0.00	0.00	**0.00**
16-16	62.10	1.83			**1.83**	1.83	0.00	**1.83**
16-17	37.48	37.48			**37.48**	1.13	0.00	**1.13**
16-18	37.10	37.10			**37.10**	7.60	0.00	**7.60**
16-19	72.30	72.30			**72.30**	32.39	0.00	**32.39**
16-20	15.84	15.84			**15.84**	7.85	0.00	**7.85**
16-21	66.75	66.75			**66.75**	31.11	0.00	**31.11**
16-22	11.09	11.09			**11.09**	2.09	0.00	**2.09**
17-1	11.21	11.21			**11.21**	4.85	0.00	**4.85**
17-2	73.52	73.52		1.95	**71.57**	8.15	0.00	**8.15**
17-3	21.75	21.75		4.05	**17.70**	13.60	0.00	**13.60**
17-4	27.16	27.16		26.81	**0.35**	0.00	0.00	**0.00**
17-5	28.04	28.04		28.03	**0.00**	0.00	0.00	**0.00**
17-6	40.10	40.10		40.10	**0.01**	0.00	0.00	**0.00**
17-7	34.27	34.27		34.25	**0.01**	0.00	0.00	**0.00**
17-8	26.66	26.66		26.44	**0.22**	0.00	0.00	**0.00**
17-9	54.47	54.43		54.41	**0.02**	0.00	0.00	**0.00**
17-10	36.62	36.62			**36.62**	21.02	0.00	**21.02**
17-11	1.45	0.97			**0.97**	0.97	0.00	**0.97**
17-12	26.24	26.24			**26.24**	18.49	0.00	**18.49**
17-13	24.79	8.88			**8.88**	8.88	0.00	**8.88**
17-14	44.51				**0.00**	0.00	0.00	**0.00**
17-15	4.91	4.91			**4.91**	1.73	0.00	**1.73**
17-16	32.66	32.66			**32.66**	11.98	0.00	**11.98**
17-17	39.32	39.32		10.61	**28.71**	4.93	0.00	**4.93**

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17-18	32.93	32.93			**32.93**	18.62	0.00	**18.62**
17-19	8.73	8.73			**8.73**	2.09	0.00	**2.09**
17-20	11.35	11.35			**11.35**	0.00	0.00	**0.00**
17-21	4.93	4.93			**4.93**	1.18	0.00	**1.18**
18-1	19.68	14.59			**14.59**	13.32	0.00	**13.32**
18-2	35.25	30.39			**30.39**	21.68	0.00	**21.68**
18-3	67.67	26.83			**26.83**	10.54	0.00	**10.54**
18-4	54.06	40.51			**40.51**	17.27	0.00	**17.27**
18-5	95.71	78.75			**78.75**	50.03	0.00	**50.03**
18-6	67.47	67.47		3.67	**63.80**	49.69	0.00	**49.69**
18-7	56.15	56.15		56.14	**0.01**	0.00	0.00	**0.00**
18-8	37.45	37.45		37.42	**0.02**	0.00	0.00	**0.00**
18-9	1.80				**0.00**	0.00	0.00	**0.00**
18-10	18.36	18.36		18.36	**0.01**	0.00	0.00	**0.00**
18-11	23.34	23.34			**23.34**	16.13	0.00	**16.13**
19-1	41.79	2.62			**2.62**	2.62	0.00	**2.62**
19-2	30.79				**0.00**	0.00	0.00	**0.00**
19-3	50.23	42.78		2.06	**40.73**	29.23	0.00	**29.23**
19-4	64.02	60.60		0.87	**59.73**	40.71	0.00	**40.71**
19-5	122.61	112.00		1.52	**110.48**	42.53	0.00	**42.53**
19-6	9.42				**0.00**	0.00	0.00	**0.00**
19-7	12.14	1.96			**1.96**	1.96	0.00	**1.96**
19-8	34.85	0.62			**0.62**	0.62	0.00	**0.62**
19-9	9.31				**0.00**	0.00	0.00	**0.00**
19-10	6.09				**0.00**	0.00	0.00	**0.00**
19-11	11.85				**0.00**	0.00	0.00	**0.00**
19-12	8.85				**0.00**	0.00	0.00	**0.00**
20-1	21.19	21.19		20.78	**0.41**	0.00	0.00	**0.00**
20-2	102.31				**0.00**	0.00	0.00	**0.00**
20-3	16.65	16.65		3.36	**13.29**	13.27	0.00	**13.27**
20-4	38.30	38.30			**38.30**	35.01	0.00	**35.01**
20-5	88.83	88.83		27.62	**61.21**	42.73	0.00	**42.73**
20-6	30.75	12.18			**12.18**	12.18	0.00	**12.18**
20-7	30.37				**0.00**	0.00	0.00	**0.00**
21	55.51	55.51			**55.51**	0.00	0.00	**0.00**
22	71.18				**0.00**	0.00	0.00	**0.00**
23-1	84.29				**0.00**	0.00	0.00	**0.00**
23-2	48.45				**0.00**	0.00	0.00	**0.00**
23-3	54.29	3.80			**3.80**	3.80	0.00	**3.80**
23-4	95.95	82.49		27.98	**54.50**	18.63	0.00	**18.63**
23-5	49.13	49.13		22.06	**27.07**	23.28	0.00	**23.28**

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23-6	129.90	44.57		0.38	**44.19**	18.10	0.00	**18.10**
23-7	82.32	82.32		58.91	**23.42**	18.89	0.00	**18.89**
23-8	235.41	202.39		202.33	**11.38**	11.38	0.00	**11.38**
23-9	21.69	7.01		0.13	**6.88**	3.59	0.00	**3.59**
23-10	88.38	36.57			**36.57**	6.49	0.00	**6.49**
23-11	68.63	33.80		0.00	**33.80**	33.80	0.00	**33.80**
24-1	34.82	34.82	34.82		**0.00**	0.00	0.00	**0.00**
24-2	203.38	203.38	168.40	34.98	**0.00**	76.57	76.57	**0.00**
24-3	36.82	34.52	34.52		**0.00**	1.68	1.68	**0.00**
24-4	72.81	52.09	52.09		**1.21**	1.21	0.00	**1.21**
24-5	72.80				**0.00**	0.00	0.00	**0.00**
24-6	184.93	184.93	123.69		**61.24**	157.78	117.26	**40.52**
24-7	97.43	17.15			**17.15**	0.00	0.00	**0.00**
24-8	77.00	77.00	11.37	14.63	**51.00**	47.85	11.37	**36.48**
24-9	132.74	6.45			**6.45**	6.45	0.00	**6.45**
24-10	76.85				**0.00**	0.00	0.00	**0.00**
24-11	51.79				**0.00**	0.00	0.00	**0.00**
24-12	134.60				**0.00**	0.00	0.00	**0.00**
24-13	27.84				**0.00**	0.00	0.00	**0.00**
24-14	39.61	27.43	27.43		**0.00**	5.65	5.65	**0.00**
25-1	63.77				**0.00**	0.00	0.00	**0.00**
25-2	27.19				**0.00**	0.00	0.00	**0.00**
25-3	48.09				**0.00**	0.00	0.00	**0.00**
25-4	73.34				**0.00**	0.00	0.00	**0.00**
25-5	41.78				**0.00**	0.00	0.00	**0.00**
25-6	172.91	106.84	32.87		**73.97**	9.77	0.00	**9.77**
25-7	29.48	29.48	28.17	1.30	**0.00**	24.56	24.56	**0.00**
25-8	63.79				**0.00**	0.00	0.00	**0.00**
25-9	52.83				**0.00**	0.00	0.00	**0.00**
25-10	21.55				**0.00**	0.00	0.00	**0.00**
25-11	55.39				**0.00**	0.00	0.00	**0.00**
25-12	39.78	30.64	30.64		**0.00**	0.00	0.00	**0.00**
25-13	215.36	167.73	167.73		**0.00**	108.41	108.41	**0.00**
25-14	71.75	12.76	12.76		**0.00**	0.00	0.00	**0.00**
25-15	27.83	7.60			**7.60**	3.34	0.00	**3.34**
25-16	15.26				**0.00**	0.00	0.00	**0.00**
26-1	102.37	102.37	102.24	0.12	**0.00**	0.00	0.00	**0.00**
26-2	83.10	11.88	11.88		**0.00**	0.00	0.00	**0.00**
26-3	33.88				**0.00**	0.00	0.00	**0.00**
26-4	67.07				**0.00**	0.00	0.00	**0.00**
26-5	81.42				**0.00**	0.00	0.00	**0.00**
26-6	102.38	86.48	71.89	14.52	**0.06**	0.00	0.00	**0.00**
26-7	88.34	88.34	23.73	64.59	**0.02**	0.00	0.00	**0.00**
26-8	37.84	30.20	30.20		**0.00**	0.00	0.00	**0.00**

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26-9	38.32	13.47	13.47		**0.00**	0.00	0.00	**0.00**
26-10	74.41	56.29	37.16	19.13	**0.00**	0.00	0.00	**0.00**
26-11	14.03	14.03	11.88	2.15	**0.00**	3.17	3.17	**0.00**
27-1	105.64	105.64	87.22		**18.42**	63.73	63.73	**0.00**
27-2	109.40	109.40	109.40		**0.00**	97.55	97.55	**0.00**
27-3	67.70	26.25	26.25		**0.00**	7.29	7.29	**0.00**
27-4	18.75	18.75	18.75		**0.00**	14.99	14.99	**0.00**
27-5	77.23	57.04	57.04		**0.00**	32.48	32.48	**0.00**
27-6	72.47	72.47	72.47		**0.00**	31.56	31.56	**0.00**
27-7	124.48	124.48	124.48		**0.00**	36.97	36.97	**0.00**
27-8	79.03	16.59	16.59		**0.00**	0.00	0.00	**0.00**
27-9	27.67	27.67	27.67		**0.00**	22.97	22.97	**0.00**
27-10	41.21	0.01			**0.01**	0.01	0.00	**0.01**
27-11	93.07	4.85			**4.85**	4.85	0.00	**4.85**
28-1	101.26	43.16			**43.16**	43.16	0.00	**43.16**
28-2	85.50	63.26		3.34	**63.26**	63.26	0.00	**63.26**
28-3	54.79	5.39			**5.39**	5.39	0.00	**5.39**
28-4	28.49	11.12		2.10	**11.12**	11.12	0.00	**11.12**
28-5	72.07	3.70			**3.70**	3.70	0.00	**3.70**
28-6	9.71	3.28			**3.28**	3.28	0.00	**3.28**
28-7	5.66	0.11			**0.11**	0.11	0.00	**0.11**
28-8	21.01	1.14			**1.14**	1.14	0.00	**1.14**
28-9	8.76	2.41			**2.41**	2.41	0.00	**2.41**
28-10	54.65				**0.00**	0.00	0.00	**0.00**
28-11	49.06				**0.00**	0.00	0.00	**0.00**
28-12	50.53				**0.00**	0.00	0.00	**0.00**
28-13	12.72				**0.00**	0.00	0.00	**0.00**
28-14	5.18				**0.00**	0.00	0.00	**0.00**
29-1	41.82	41.82			**41.82**	0.16	0.00	**0.16**
29-2	0.92	0.92			**0.92**	0.00	0.00	**0.00**
29-3	7.49	7.49			**7.49**	7.40	0.00	**7.40**
29-4	13.25	13.25			**13.25**	8.29	0.00	**8.29**
29-5	42.66	42.66			**42.66**	36.58	0.00	**36.58**
29-6	1.14				**0.00**	0.00	0.00	**0.00**
29-7	39.16				**0.00**	0.00	0.00	**0.00**
29-8	90.53				**0.00**	0.00	0.00	**0.00**
29-9	27.83				**0.00**	0.00	0.00	**0.00**
29-10	30.26				**0.00**	0.00	0.00	**0.00**
29-11	18.19				**0.00**	0.00	0.00	**0.00**
29-12	87.38				**0.00**	0.00	0.00	**0.00**
29-13	93.98				**0.00**	0.00	0.00	**0.00**
29-14	62.36				**0.00**	0.00	0.00	**0.00**
29-15	112.71				**0.00**	0.00	0.00	**0.00**
29-16	124.77				**0.00**	0.00	0.00	**0.00**

Subarea	Total Shoreline	Total RSU Potential Habitat	Otter Populated Shoreline	Closures from Parks, FSC etc.	**Fishable RSU Potential Habitat**	RSU Confirmed Habitat	Otter Populated RSU Confirmed Habitat	**Fishable RSU Confirmed Habitat**
29-17	20.75				**0.00**	0.00	0.00	**0.00**
111	86.95	86.95	4.41		**82.66**	87.07	4.41	**82.66**
121-1	0.92	0.92		0.26	**0.66**	0.00	0.00	**0.00**
121-2	0.20	0.20			**0.20**	0.00	0.00	**0.00**
123-1	32.84	32.84			**32.84**	7.79	0.00	**7.79**
123-3	10.80	10.80			**10.80**	10.80	0.00	**10.80**
123-5	26.08	26.08			**26.08**	16.97	0.00	**16.97**
124-1	7.16	7.16			**7.16**	0.00	0.00	**0.00**
124-3	75.77	75.77	24.95	0.82	**50.01**	32.76	18.49	**14.26**
124-4	0.04				**0.00**	0.00	0.00	**0.00**
125-1	50.39	50.39	50.39		**0.00**	20.06	20.06	**0.00**
125-2	1.09	1.09	1.09		**0.00**	0.00	0.00	**0.00**
125-3	31.02	31.02	31.02		**0.00**	10.51	10.51	**0.00**
125-5	0.47	0.47	0.47		**0.00**	0.00	0.00	**0.00**
126-1	18.80	18.80	0.04	18.76	**0.00**	0.00	0.00	**0.00**
126-4	0.33	0.33	0.33	0.00	**0.00**	0.00	0.00	**0.00**
127-1	2.15	2.15	2.15		**0.00**	1.32	1.32	**0.00**
127-2	0.52	0.52	0.52		**0.00**	0.00	0.00	**0.00**
127-3	15.11	15.11	13.76		**1.37**	15.13	13.76	**1.37**
127-4	17.26	17.26			**17.26**	17.26	0.00	**17.26**
S. Coast Total	**16924.93**	**8189.71**	**1877.99**	**1111.91**	**5217.99**	**3733.87**	**857.91**	**2875.96**
BC Total	**38369.47**	**20181.71**	**2737.74**	**2152.58**	**15311.57**	**9546.05**	**1210.41**	**8335.64**

Table 3b. Definition of inclusion/exclusion criteria and method for deriving values for shoreline classifications in Table 3a.

Column	Title	Calculation	Definition
a	**Total Shoreline**		Every km of shoreline in the corresponding Area/Subarea is included in this value
b	**Total RSU Potential Habitat**		Fjords, inlets, mud and other areas not believed to contain RSU have been removed from this shoreline
c	**Otter Populated Shoreline**		Every km of shoreline in the corresponding Area/Subarea that is inhabited by otters is included in this value except closed areas which are included in Closures from Parks, FSC etc. (d)
d	**Closures from Parks, FSC, etc.**		Every km of shoreline in the corresponding Area/Subarea that is closed to RSU fishing is included in this value
e	**Fishable RSU Potential Habitat**	**e=b-c-d**	Total of shoreline that is available to be fished and might contain RSU. This would be the maximum available shoreline that could be identified as RSU habitat and so would be the current theoretical maximum shoreline the quota could be based on if all of this shoreline was identified as RSU habitat.
f	**RSU Confirmed Habitat**		Portion of Total RSU Potential Habitat (b) confirmed as known RSU habitat by fishing events and/or fishermen
g	**Otter Populated RSU Confirmed Habitat**		Total of shoreline Identified as RSU Confirmed Habitat (f) but inhabited by otters (DFO 2007)
h	**Fishable RSU Confirmed Habitat**	**h=f-g**	Total of shoreline identified as RSU Confirmed Habitat (f) and is available for harvest (not Otter Populated[g]). *The quota options are based on applying this shoreline length (h) to the Linear RSU Density estimates from surveys.*

Table 4a. British Columbia red sea urchin linear population density (number/m) and biomass density (t/km) estimates, calculated by Pacific Fishery Management (PFM) Subarea and year from population surveys conducted from 1994-2006. LCB = Lower 90% confidence bound, UCB = upper 90% confidence bound; all transects included.

PFM Subarea	Survey	Year	Total Transect		Population Density (number/m)						Biomass Density (t/km)					
			Number	Length	TD≥90mm			TD 90-140mm			TD≥90mm			TD 90-140mm		
				(m)	Mean	LCB	UCB	Mean	LCB	UCB	Mean	LCB	UCB	Mean	LCB	UCB
North Coast of BC																
1.001	Langara	1994	6	1221	518.8	230.4	1008.3	517.0	233.7	1019.5	227.6	76.1	440.6	225.7	85.2	446.7
1.002	Langara	1994	15	1685	399.6	266.0	666.1	387.7	260.7	637.6	186.3	121.2	316.4	174.9	114.7	299.4
1.003	Langara	1994	15	1702	143.1	71.2	264.2	120.6	60.1	230.8	88.9	47.7	163.4	66.9	32.1	129.4
1.007	Langara	1994	9	2859	190.1	110.0	280.4	168.1	98.5	254.5	108.2	62.9	169.2	87.3	51.2	136.3
2.018	Rennell Sound	1995	13	1191	85.5	63.5	125.7	83.7	61.8	122.8	38.1	25.8	62.0	36.5	25.2	58.0
2.019	Rennell Sound	1995	3	473	51.7	0.0	0.0	51.7	0.0	0.0	22.1	0.0	0.0	22.1	0.0	0.0
2.031	Rennell Sound	1995	7	580	112.2	46.1	243.1	92.4	40.4	193.6	68.6	21.1	194.9	50.1	16.5	117.8
2.068	Rennell Sound	1995	3	239	83.0	0.0	0.0	83.0	0.0	0.0	29.3	0.0	0.0	29.3	0.0	0.0
2.069	Rennell Sound	1995	1	71	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.071	Rennell Sound	1995	2	124	70.6	0.0	0.0	70.6	0.0	0.0	24.1	0.0	0.0	24.1	0.0	0.0
2.074	Rennell Sound	1995	1	201	182.4	0.0	0.0	182.4	0.0	0.0	65.2	0.0	0.0	65.2	0.0	0.0
2.075	Rennell Sound	1995	4	412	100.5	0.0	0.0	100.5	0.0	0.0	38.5	0.0	0.0	38.5	0.0	0.0
2.078	Rennell Sound	1995	2	66	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.079	Rennell Sound	1995	1	80	73.5	0.0	0.0	73.5	0.0	0.0	26.3	0.0	0.0	26.3	0.0	0.0
2.082	Rennell Sound	1995	1	120	146.9	0.0	0.0	146.9	0.0	0.0	63.7	0.0	0.0	63.7	0.0	0.0
3.001	Dundas Group	2003	12	596	93.4	62.2	131.9	88.0	57.8	122.6	42.8	30.1	66.1	37.8	26.0	55.1
3.002	Dundas Group	2003	4	208	39.9	0.0	0.0	32.9	0.0	0.0	25.0	0.0	0.0	18.2	0.0	0.0
4.001	Dundas Group	2003	40	2250	51.5	41.3	62.2	46.9	37.2	56.8	25.2	20.5	30.4	20.7	16.6	25.2
4.002	Stephens Is.	1995	33	1926	108.3	83.5	151.1	95.7	74.5	130.3	55.1	40.6	82.1	41.9	32.5	56.4
4.004	Stephens Is.	1995	3	194	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4.005	Dundas Group	2003	11	605	19.8	9.8	34.6	18.6	8.8	32.1	10.7	5.2	19.0	9.5	4.6	17.2
4.009	Stephens Is.	1995	21	3226	50.2	26.9	88.6	48.3	25.5	84.7	23.2	12.0	40.8	21.2	10.9	36.5
5.010	Beaver Pass	2002	35	1169	29.7	22.9	38.2	23.5	18.1	31.0	18.5	14.5	24.0	12.5	9.5	16.5
5.011	Banks Is.	1997	5	906	295.3	5.3	870.1	278.1	4.2	821.8	133.8	0.0	391.3	118.4	0.0	348.0
5.012	Beaver Pass	2002	24	1072	18.2	10.1	28.7	15.3	8.3	24.3	10.2	5.6	15.4	7.5	4.0	11.4
5.013	Banks Is.	1997	3	396	53.8	0.0	0.0	43.4	0.0	0.0	30.4	0.0	0.0	20.2	0.0	0.0
5.021	Banks Is.	1997	24	2679	133.0	81.9	194.8	118.1	70.6	173.9	67.2	42.5	97.9	52.7	32.7	78.6
6.010	Campania	1994	33	5304	213.3	148.2	308.4	202.9	141.8	294.8	102.8	72.4	156.4	92.9	65.1	139.4
6.010	Campania	2004	68	2186	54.1	46.0	64.3	51.9	44.1	62.2	24.4	19.8	28.6	22.4	18.3	26.4
6.012	Campania	1994	4	248	8.3	0.0	0.0	6.0	0.0	0.0	5.6	0.0	0.0	3.5	0.0	0.0
6.014	Laredo	2000	51	2870	20.1	14.9	28.0	18.4	13.4	26.3	9.6	7.0	12.9	7.9	5.5	10.7

PFM Subarea	Survey	Year	Total Transect		Population Density (number/m)						Biomass Density (t/km)					
			Number	Length (m)	TD≥90mm			TD 90-140mm			TD≥90mm			TD 90-140mm		
					Mean	LCB	UCB	Mean	LCB	UCB	Mean	LCB	UCB	Mean	LCB	UCB
6.015	Laredo	2000	35	1651	31.3	21.3	42.0	30.1	20.2	40.4	13.8	9.8	18.9	12.7	8.9	17.7
6.016	Price Is.	1995	26	1347	39.8	30.1	50.2	39.1	29.5	49.6	15.9	12.1	20.6	15.2	11.4	19.8
6.017	Price Is.	1995	9	515	101.2	45.3	236.2	98.4	45.0	227.4	49.1	18.9	136.8	46.6	18.4	128.2
7.001	Price Is.	1995	3	53	26.1	0.0	0.0	26.1	0.0	0.0	10.3	0.0	0.0	10.3	0.0	0.0
7.001	Heiltsuk	1997	7	482	2.6	0.9	5.4	2.6	0.9	5.4	0.8	0.2	1.7	0.8	0.2	1.7
7.001	Price Is.	2001	5	119	66.9	51.1	100.0	65.4	48.3	98.9	24.8	19.0	32.5	23.4	17.6	32.2
7.002	Price Is.	1995	1	67	113.2	0.0	0.0	113.2	0.0	0.0	37.4	0.0	0.0	37.4	0.0	0.0
7.002	Price Is.	2001	9	247	118.7	91.2	156.5	118.0	90.8	154.9	44.0	33.6	57.6	43.5	33.3	56.1
7.003	Price Is.	2001	11	319	93.5	61.4	157.9	93.0	60.7	155.4	38.1	25.0	64.1	37.6	24.4	63.5
7.018	Heiltsuk	1994	33	1719	99.0	71.2	130.4	98.2	70.2	129.5	39.4	28.9	55.6	38.6	28.3	54.3
7.018	Heiltsuk	1995	36	2028	126.7	83.1	204.4	124.4	82.3	203.1	49.5	34.2	79.3	47.4	33.1	77.4
7.018	Heiltsuk	1996	55	4777	123.0	95.2	154.8	121.6	93.7	153.5	51.0	41.3	66.0	49.8	39.7	65.0
7.018	Heiltsuk	1997	30	1943	66.7	45.6	90.4	66.5	45.5	90.2	25.7	18.6	36.5	25.5	18.3	36.2
7.019	Heiltsuk	1997	1	49	180.4	0.0	0.0	178.1	0.0	0.0	67.3	0.0	0.0	65.1	0.0	0.0
7.025	Heiltsuk	1994	19	1035	72.8	35.5	152.5	71.3	34.5	150.3	32.2	15.7	68.9	30.1	14.6	64.9
7.025	Heiltsuk	1995	27	1792	49.5	29.3	92.4	49.0	28.6	91.9	19.0	12.0	36.6	18.5	11.5	35.8
7.025	Heiltsuk	1997	26	2511	2.6	0.0	5.3	2.6	0.0	5.3	1.0	0.0	2.9	1.0	0.0	2.9
7.026	Heiltsuk	1995	6	705	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7.026	Heiltsuk	1997	7	533	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7.031	Price Is.	1995	20	638	85.4	56.3	142.9	85.3	56.2	142.8	32.4	20.1	58.0	32.2	19.8	58.0
7.031	Price Is.	2001	10	308	79.3	51.1	117.4	79.3	51.1	117.4	27.9	18.4	41.9	27.9	18.4	41.9
8.003	FitzHugh	2001	3	95	46.8	0.0	0.0	46.8	0.0	0.0	16.8	0.0	0.0	16.8	0.0	0.0
8.004	FitzHugh	2001	40	1178	14.9	10.1	21.1	14.3	9.7	20.4	6.6	4.1	9.0	6.1	3.8	8.4
8.016	FitzHugh	2001	17	737	22.0	12.8	39.3	21.8	12.6	39.1	9.8	5.3	18.2	9.6	5.2	18.2
101.007	Langara	1994	1	93	254.5	0.0	0.0	205.8	0.0	0.0	168.0	0.0	0.0	119.1	0.0	0.0
106.002	Campania	1994	28	2633	231.8	189.8	291.0	228.7	186.7	285.3	96.0	78.5	124.3	92.5	75.9	118.5
South Coast of BC																
11.002	Cape Sutil	1996	31	1434	59.0	42.5	79.9	50.9	35.2	70.3	36.2	26.5	49.3	28.4	20.0	39.8
12.001	Kelsey Bay	1999	13	633	26.5	15.4	40.6	24.3	13.9	37.9	14.2	8.5	20.6	12.2	7.2	18.1
12.002	Kelsey Bay	1999	16	830	20.0	8.6	38.3	16.6	7.4	30.3	11.6	5.1	24.9	8.4	3.8	16.2
12.003	Queen Charl. Strait	1994	9	292	68.6	43.0	96.7	54.9	34.8	74.0	45.9	29.4	72.3	32.2	19.5	46.5
12.003	Robson Bight	2001	50	1960	28.2	22.2	35.1	20.5	15.8	26.2	19.1	14.9	23.6	11.4	8.5	14.3
12.004	Queen Charl. Strait	1994	2	86	34.6	0.0	0.0	24.2	0.0	0.0	20.2	0.0	0.0	9.5	0.0	0.0
12.005	Queen Charl. Strait	1994	9	551	51.9	35.4	86.2	35.1	22.3	55.0	37.9	25.0	63.0	21.4	13.5	35.1
12.006	Queen Charl. Strait	1994	14	1102	23.7	12.0	45.2	18.5	9.2	41.6	15.4	7.8	24.9	9.9	5.0	18.0

PFM Subarea	Survey	Year	Total Transect		Population Density (number/m)						Biomass Density (t/km)					
			Number	Length	TD≥90mm			TD 90-140mm			TD≥90mm			TD 90-140mm		
				(m)	Mean	LCB	UCB	Mean	LCB	UCB	Mean	LCB	UCB	Mean	LCB	UCB
12.006	Queen Charl. Strait	1995	1	58	89.5	0.0	0.0	82.3	0.0	0.0	56.5	0.0	0.0	49.9	0.0	0.0
12.007	Queen Charl. Strait	1994	4	203	35.3	0.0	0.0	25.1	0.0	0.0	24.5	0.0	0.0	14.6	0.0	0.0
12.007	Queen Charl. Strait	1995	5	186	15.8	6.8	26.4	8.0	1.0	15.0	12.9	5.8	20.3	5.2	0.6	9.8
12.008	Queen Charl. Strait	1994	3	280	21.6	0.0	0.0	16.0	0.0	0.0	12.4	0.0	0.0	7.1	0.0	0.0
12.009	Queen Charl. Strait	1994	2	170	173.9	0.0	0.0	163.7	0.0	0.0	90.0	0.0	0.0	74.1	0.0	0.0
12.011	Queen Charl. Strait	1994	12	613	96.4	71.7	126.4	91.1	67.5	119.6	48.5	35.9	66.6	43.2	31.4	56.5
12.011	Queen Charl. Strait	2004	44	2288	110.9	84.9	142.9	106.8	81.2	138.0	50.3	40.0	65.3	46.3	36.7	61.0
12.012	Queen Charl. Strait	1994	2	69	71.7	0.0	0.0	71.7	0.0	0.0	32.4	0.0	0.0	32.4	0.0	0.0
12.013	Queen Charl. Strait	1995	21	1363	92.7	52.4	165.5	74.3	39.4	134.2	58.6	34.3	114.2	41.1	23.6	78.3
12.013	Cape Sutil	1996	10	269	51.2	32.3	70.1	45.0	27.0	65.5	28.1	18.6	41.9	22.4	14.7	36.8
12.013	Deserters	2000	57	1899	77.4	67.5	90.0	74.0	63.9	86.5	36.7	31.4	42.3	33.4	28.4	39.0
12.014	Cape Sutil	1996	5	414	167.9	0.0	503.1	162.0	0.0	485.5	69.0	0.0	206.5	63.9	0.0	191.4
12.015	Queen Charl. Strait	1994	2	57	91.1	0.0	0.0	91.1	0.0	0.0	36.2	0.0	0.0	36.2	0.0	0.0
12.016	Queen Charl. Strait	1994	19	1418	77.3	43.4	115.8	60.9	32.1	96.9	48.1	27.0	78.2	32.2	16.2	59.8
12.016	Queen Charl. Strait	2004	26	1068	36.2	28.1	44.2	33.4	25.9	40.9	17.7	14.3	21.4	14.9	11.9	18.2
12.017	Queen Charl. Strait	1994	2	443	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12.018	Queen Charl. Strait	1994	15	765	64.3	46.8	82.0	61.2	44.8	78.7	32.6	23.0	42.7	29.7	20.9	38.4
12.019	Queen Charl. Strait	1994	5	464	36.9	19.0	60.2	31.2	16.8	53.4	20.6	8.9	36.5	15.5	7.4	28.6
12.020	Queen Charl. Strait	1994	1	59	165.5	0.0	0.0	104.5	0.0	0.0	119.3	0.0	0.0	64.2	0.0	0.0
12.021	Queen Charl. Strait	1994	1	28	59.6	0.0	0.0	59.6	0.0	0.0	28.6	0.0	0.0	28.6	0.0	0.0
12.021	Robson Bight	2001	9	331	20.9	10.5	33.5	14.9	7.1	24.2	14.1	6.6	21.7	8.2	3.9	13.2
12.039	Queen Charl. Strait	1994	7	461	5.7	0.0	11.4	5.7	0.0	11.4	3.1	0.0	6.2	3.1	0.0	6.2
12.039	Queen Charl. Strait	1995	15	957	7.9	3.7	13.6	4.9	2.1	9.0	6.1	2.8	10.5	3.1	1.3	5.7
12.041	Queen Charl. Strait	1995	8	239	42.5	15.5	104.1	19.1	8.2	40.5	35.1	10.9	89.3	11.8	4.9	23.9
13.001	Campbell River	2002	14	2200	162.8	94.1	244.5	162.3	93.3	244.0	63.6	37.0	93.8	63.0	36.7	93.8
13.002	Campbell River	2002	21	3707	100.4	71.9	142.1	98.3	70.3	138.8	40.7	28.6	57.2	38.7	27.3	54.3
13.009	Cordero Channel	2006	14	948	19.7	9.8	33.2	15.0	7.2	24.8	11.5	5.2	19.3	7.0	3.3	11.0
13.025	Cordero Channel	2006	19	1017	18.6	10.6	28.8	17.7	10.0	27.2	8.9	5.3	14.0	8.1	4.7	12.5
13.027	Cordero Channel	2006	1	15	4.0	0.0	0.0	4.0	0.0	0.0	1.4	0.0	0.0	1.4	0.0	0.0
13.028	Cordero Channel	2006	19	1287	39.6	27.5	60.1	36.9	25.1	57.8	19.6	14.1	29.9	17.1	12.1	28.3
13.031	Kelsey Bay	1999	5	229	83.9	46.9	120.1	82.3	46.9	119.7	38.8	24.3	59.3	37.3	21.6	55.1
13.032	Kelsey Bay	1999	18	868	69.2	45.3	107.0	67.4	43.8	103.6	34.0	21.4	52.0	32.2	20.3	48.9
13.033	Kelsey Bay	1999	7	463	121.9	65.4	229.3	119.6	64.2	226.0	56.6	30.8	108.7	54.5	28.9	103.0
13.035	Kelsey Bay	1999	9	319	23.9	13.2	39.4	16.1	7.1	30.9	17.2	9.8	28.6	9.6	4.3	19.1
13.041	Cordero Channel	2006	1	51	21.0	0.0	0.0	21.0	0.0	0.0	10.2	0.0	0.0	10.2	0.0	0.0
14.005	Comox, Denman Isl.	1999	2	202	40.9	0.0	0.0	39.9	0.0	0.0	16.4	0.0	0.0	15.5	0.0	0.0

PFM Subarea	Survey	Year	Total Transect		Population Density (number/m)						Biomass Density (t/km)					
			Number	Length (m)	TD≥90mm			TD 90-140mm			TD≥90mm			TD 90-140mm		
					Mean	LCB	UCB	Mean	LCB	UCB	Mean	LCB	UCB	Mean	LCB	UCB
14.007	Comox, Denman Isl.	1999	8	1242	52.0	24.6	98.7	49.7	21.9	94.5	25.6	12.3	48.4	23.4	10.4	45.4
14.008	Comox, Denman Isl.	1999	6	812	71.1	36.0	94.9	68.8	34.6	92.1	34.9	18.8	47.7	32.7	16.4	43.5
14.009	Comox, Denman Isl.	1999	22	3776	54.3	32.2	77.9	52.6	30.1	75.8	24.3	15.8	35.8	22.7	14.7	34.3
14.011	Comox, Denman Isl.	1999	17	1715	9.1	0.0	22.1	8.0	0.0	19.7	5.6	0.0	13.8	4.4	0.0	11.2
14.012	Comox, Denman Isl.	1999	5	503	30.3	0.0	49.6	30.3	0.0	49.6	12.8	0.0	20.3	12.8	0.0	20.3
14.013	Campbell River	2002	19	3287	15.5	3.8	42.3	15.4	3.8	42.2	6.7	1.5	16.6	6.6	1.5	16.6
17.002	Gulf Isl.	1998	2	131	1.5	0.0	0.0	0.8	0.0	0.0	1.3	0.0	0.0	0.6	0.0	0.0
18.001	Gulf Isl.	1998	6	366	9.9	1.9	17.8	8.6	1.9	14.2	6.1	1.5	10.6	4.9	1.5	8.0
18.002	Gulf Isl.	1998	7	291	10.5	4.8	20.9	7.4	3.0	16.5	7.0	3.6	12.9	4.1	1.9	8.4
18.003	Gulf Isl.	1998	11	625	3.4	0.9	6.1	1.1	0.2	2.1	3.2	0.8	6.0	0.7	0.2	1.6
18.004	Gulf Is.,Cowichan	1999	8	576	17.9	7.4	37.7	6.7	2.5	14.9	15.3	6.8	32.5	4.5	1.7	9.6
18.005	Gulf Is.,Cowichan	1999	6	460	14.0	0.0	31.0	12.7	0.0	31.0	8.4	0.0	18.4	7.1	0.0	18.6
18.006	Gulf Is.,Cowichan	1999	22	2714	47.6	26.4	91.6	32.2	15.8	70.4	34.4	19.6	60.8	19.2	9.3	44.3
18.011	Gulf Isl.	1998	4	178	31.6	0.0	0.0	25.4	0.0	0.0	20.6	0.0	0.0	14.7	0.0	0.0
20.005	Becher Bay	2001	30	1842	11.0	6.7	17.1	8.2	4.7	13.0	7.4	4.5	11.0	4.5	2.6	7.2
23.005	Barkley Sound	2003	18	682	22.2	14.5	33.8	21.4	13.9	33.5	9.1	5.9	12.5	8.2	5.4	11.8
23.007	Barkley Sound	2003	16	654	89.7	71.6	106.8	88.0	70.9	105.1	35.6	27.8	43.9	33.8	26.5	42.0
23.011	Barkley Sound	2003	17	767	81.6	63.1	97.6	79.5	61.5	95.2	33.9	26.2	40.4	32.0	24.7	38.3
24.002	Tofino	2000	9	491	23.8	12.4	40.3	23.5	12.2	40.4	9.1	4.6	15.3	8.7	4.4	15.1
24.006	Tofino	2000	27	2617	81.9	60.5	119.6	80.3	59.3	117.9	33.0	23.4	45.4	31.4	22.0	43.6
24.008	Tofino	2000	8	920	163.9	86.0	290.6	156.7	80.8	276.3	67.9	36.9	112.2	61.0	33.0	101.2
27.001	Cape Sutil	1996	1	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
123.003	Barkley Sound	2003	4	164	98.0	0.0	0.0	98.0	0.0	0.0	39.3	0.0	0.0	39.3	0.0	0.0
124.003	Tofino	2000	12	660	105.5	60.1	224.7	104.9	59.8	225.8	38.0	20.7	77.6	37.4	20.4	77.0

Table 4b. British Columbia red sea urchin linear population density (number/m) and biomass density (t/km) estimates, calculated by Pacific Fishery Management (PFM) Area and year from population surveys conducted from 1994-2006. LCB = Lower 90% confidence bound, UCB = upper 90% confidence bound; all transects included.

PFM Area	Survey	Year	Total Transect		Population Density (number/m)						Biomass Density (t/km)					
			Number	Length (m)	TD≥90mm			TD 90-140mm			TD≥90mm			TD 90-140mm		
					Mean	LCB	UCB	Mean	LCB	UCB	Mean	LCB	UCB	Mean	LCB	UCB
North Coast of BC																
1	Langara	1994	45	7467	288.1	215.2	406.3	272.0	200.8	387.3	143.7	101.9	202.5	128.1	88.9	183.0
2	Rennell Sound	1995	46	4211	78.7	62.1	105.5	75.0	59.6	95.1	36.1	27.2	55.5	32.6	24.9	45.8
3	Dundas Group	2003	16	804	80.0	56.0	112.1	74.2	51.7	103.6	38.4	27.9	54.0	32.9	23.8	46.0
4	Stephens Is.	1995	57	5346	81.2	62.5	110.9	73.2	57.6	97.7	40.5	30.6	61.3	32.0	24.5	43.5
4	Dundas Group	2003	51	2855	44.6	35.9	54.9	40.8	32.3	50.5	22.1	17.5	26.5	18.3	14.6	22.2
5	Banks Is.	1997	57	6377	173.7	129.8	234.6	159.9	119.0	218.4	83.7	63.8	111.9	70.3	54.0	96.2
5	Beaver Pass	2002	59	2241	25.0	20.0	31.6	20.2	16.0	25.8	15.2	12.0	18.8	10.4	8.1	13.2
6	Campania	1994	37	5552	191.2	125.2	285.7	181.7	120.0	270.5	92.3	62.8	135.0	83.2	56.0	122.9
6	Price Is.	1995	35	1862	55.6	40.0	99.1	54.3	39.2	95.4	24.4	16.5	48.1	23.3	15.8	45.0
6	Laredo	2000	86	4521	24.7	19.5	31.2	23.1	18.0	29.4	11.3	9.1	13.9	9.8	7.7	12.3
6	Campania	2004	68	2186	54.1	45.0	64.4	51.9	43.2	62.0	24.4	20.5	29.1	22.4	18.8	26.8
7	Heiltsuk	1994	52	2754	89.5	64.8	120.0	88.4	64.0	118.3	36.7	26.9	51.7	35.5	26.1	50.0
7	Heiltsuk	1995	69	4525	85.5	60.8	127.0	84.1	60.3	125.6	33.3	23.9	48.6	32.0	22.6	46.5
7	Heiltsuk	1995	24	758	79.2	53.0	129.0	79.0	52.8	128.9	29.8	19.8	52.5	29.7	19.7	52.4
7	Heiltsuk	1996	55	4777	123.0	96.9	155.0	121.6	95.8	154.2	51.0	39.9	63.3	49.8	38.9	62.5
7	Heiltsuk	1997	71	5518	31.9	21.0	46.5	31.8	21.0	46.4	12.2	8.6	18.3	12.1	8.5	18.2
7	Price Is.	2001	35	993	92.1	75.1	114.5	91.6	74.7	114.2	34.8	29.2	44.4	34.3	28.7	43.7
8	FitzHugh	2001	60	2010	18.5	13.8	26.3	18.1	13.5	25.7	8.0	5.9	10.8	7.6	5.5	10.3
101	Langara	1994	1	93	254.5	0.0	0.0	205.8	0.0	0.0	168.0	0.0	0.0	119.1	0.0	0.0
106	Campania	1994	28	2633	231.8	188.0	284.9	228.7	185.6	279.9	96.0	80.0	121.0	92.5	77.4	115.3
South Coast of BC																
11	Cape Sutil	1996	31	1434	59.0	43.7	78.7	50.9	36.5	69.0	36.2	26.8	48.5	28.4	20.4	39.1
12	Queen Charl. Strait	1994	109	7061	58.8	49.2	69.7	50.0	41.4	60.0	34.1	28.3	41.1	25.4	21.2	30.9
12	Queen Charl. Strait	1995	50	2803	51.5	33.1	86.8	38.2	23.8	69.3	34.5	22.1	56.7	21.6	13.0	37.2
12	Cape Sutil	1996	15	683	90.1	31.9	236.8	84.0	28.0	229.6	41.7	18.0	102.7	36.2	15.0	94.2
12	Kelsey Bay	1999	31	1535	22.7	15.4	34.7	19.8	13.7	29.4	12.7	8.2	19.4	10.0	6.6	14.5
12	Deserters	2000	57	1899	77.4	65.7	90.0	74.0	62.3	86.3	36.7	31.4	42.2	33.4	28.2	38.8
12	Robson Bight	2001	59	2291	27.1	21.2	33.3	19.7	15.0	24.9	18.3	14.7	22.8	10.9	8.6	13.9
12	Queen Charl. Strait	2004	70	3356	83.2	65.8	105.0	79.5	62.4	100.8	38.1	30.6	48.2	34.6	27.4	44.3
13	Kelsey Bay	1999	43	2041	64.9	48.4	89.6	61.8	45.4	85.8	32.2	23.4	43.0	29.3	20.9	39.8

PFM Area	Survey	Year	Total Transect		Population Density (number/m)						Biomass Density (t/km)					
			Number	Length (m)	TD≥90mm			TD 90-140mm			TD≥90mm			TD 90-140mm		
					Mean	LCB	UCB	Mean	LCB	UCB	Mean	LCB	UCB	Mean	LCB	UCB
13	Campbell River	2002	35	5907	125.3	93.6	171.3	123.9	92.4	169.6	49.8	37.0	64.8	48.4	36.1	63.2
13	Cordero Channel	2006	54	3318	26.1	19.8	34.1	23.6	17.8	31.2	13.2	10.0	17.2	10.9	8.2	14.7
14	Comox, Denman	1999	61	8391	40.6	30.2	52.3	39.1	29.1	50.9	19.2	14.4	25.0	17.7	13.1	23.1
14	Campbell River	2002	19	3287	15.5	3.8	44.2	15.4	3.8	44.1	6.7	1.9	17.5	6.6	1.8	17.4
17	Gulf Isl.	1998	6	363	2.8	0.0	7.5	2.3	0.0	6.3	2.0	0.0	5.2	1.5	0.0	4.1
18	Gulf Isl.	1998	29	1505	10.2	6.4	15.4	7.5	4.5	11.6	7.0	4.5	10.5	4.3	2.6	7.0
18	Gulf Is.,Cowichan	1999	36	3750	35.4	23.0	65.5	23.3	13.8	50.4	25.8	16.7	46.3	13.9	8.2	30.7
20	Becher Bay	2001	30	1842	11.0	6.9	16.7	8.2	5.1	13.3	7.4	4.7	11.2	4.5	2.7	7.3
23	Barkley Sound	2003	64	2702	53.8	46.0	65.2	52.6	45.2	64.5	21.8	18.1	26.0	20.6	17.1	24.5
24	Tofino	2000	44	4028	84.9	62.6	117.9	82.6	60.3	113.6	34.4	25.0	46.9	32.1	23.7	43.7
27	Cape Sutil	1996	1	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
111	Cape Sutil	1996	6	598	255.6	196.7	294.4	252.5	193.9	289.7	105.2	79.2	121.4	102.4	75.8	116.4
123	Barkley Sound	2003	7	357	154.7	61.7	352.6	151.3	61.0	343.6	67.0	24.7	159.9	64.0	24.5	149.5
124	Tofino	2000	12	660	105.5	55.2	206.7	104.9	55.0	205.8	38.0	21.0	75.2	37.4	20.8	78.6

Table 5. British Columbia red sea urchin linear population density (number/m) and biomass density (t/km) estimates, calculated by Pacific Fishery Management (PFM) Area from population surveys conducted from 1994-2006. LCB = Lower 90% confidence bound, UCB = upper 90% confidence bound; all transects included and mean estimates weighted to total length of surveyed transects.

PFM Area	Year	Total Transect		Population Density (number/m)						Biomass Density (t/km)					
		Number	Length (m)	TD≥90mm			TD 90-140mm			TD≥90mm			TD 90-140mm		
				Mean	LCB	UCB	Mean	LCB	UCB	Mean	LCB	UCB	Mean	LCB	UCB
North Coast of BC															
1	1994	45	7467	288.1	215.2	414.1	272.0	199.9	394.2	143.71	103.90	193.61	128.13	90.71	173.75
2	1995	46	4211	78.7	61.6	103.7	75.0	59.2	95.3	36.07	27.41	57.46	32.55	25.68	46.99
3	2003	16	804	80.0	56.4	113.5	74.2	51.2	105.5	38.35	27.77	54.02	32.92	23.37	45.46
4	1995	108	8201	63.9	53.5	80.4	57.9	48.2	71.8	31.79	25.73	41.41	25.55	20.75	31.87
5	1997-2002	116	8618	98.1	77.5	137.9	88.8	69.7	128.2	48.84	38.85	65.59	39.84	30.82	54.89
6	1994-2004	226	14121	65.6	54.0	84.4	62.6	51.3	80.3	30.54	24.57	38.72	27.71	22.37	35.35
7	1994-2001	306	19325	80.7	69.4	92.5	79.9	68.7	91.6	32.09	27.60	36.61	31.26	26.81	35.71
8	2001	60	2010	18.5	13.1	25.2	18.1	12.7	24.6	8.00	5.75	10.58	7.60	5.45	10.20
101	1994	1	93	254.5	0.0	0.0	205.8	0.0	0.0	167.97	0.00	0.00	119.14	0.00	0.00
106	1994	28	2633	231.8	192.4	292.5	228.7	189.8	287.5	96.01	79.29	124.81	92.46	76.32	118.72
107	1995-1997	3	171	0	0	0	0	0	0	0	0	0	0	0	0
North Coast Overall:		**955**	**67654**	**87.46**	**79.32**	**96.62**	**83.48**	**75.82**	**92.57**	**39.68**	**36.14**	**43.85**	**35.77**	**32.75**	**39.83**
South Coast of BC															
11	1996	31	1434	59.0	45.2	81.2	50.9	37.8	71.7	36.19	27.22	48.66	28.41	20.68	40.06
12	1994-2004	391	19628	58.5	52.0	66.5	51.6	45.8	59.3	31.47	28.48	35.75	24.74	22.20	27.99
13	1999-2006	132	11266	65.0	54.2	80.3	62.6	51.6	77.5	29.12	23.75	35.07	26.83	21.53	32.48
14	1999	80	11678	34.6	25.4	44.6	33.5	24.4	43.4	16.23	12.65	21.52	15.09	11.48	20.00
17	1998	6	363	2.8	0.0	7.0	2.3	0.0	6.0	2.03	0.00	4.78	1.50	0.00	3.93
18	1998-1999	65	5255	24.1	16.9	42.3	16.2	10.8	31.7	17.41	11.92	28.69	9.63	6.04	18.35
20	2001	30	1842	11.0	6.6	16.8	8.2	4.7	13.4	7.43	4.51	11.31	4.51	2.70	7.72
23	2003	64	2702	53.8	43.2	63.7	52.6	42.2	62.6	21.81	17.86	26.32	20.63	16.67	24.99
24	2000	44	4028	84.9	60.0	116.5	82.6	58.2	113.3	34.44	25.76	45.95	32.13	23.72	42.40
27	1996	1	100	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00
111	1996	6	598	255.6	196.0	298.4	252.5	191.2	293.5	105.20	77.09	119.78	102.43	76.24	115.34
123	2003	7	357	154.7	63.1	333.6	151.3	62.6	325.2	66.96	26.42	169.10	63.96	26.10	157.27
124	2000	12	660	105.5	58.8	225.4	104.9	58.0	224.7	37.98	20.56	74.45	37.43	20.10	74.22
South Coast Overall:		**869**	**59911**	**56.42**	**51.36**	**60.97**	**51.61**	**46.87**	**56.16**	**28.08**	**25.97**	**30.54**	**23.38**	**21.49**	**25.47**
BC Overall:		**1824**	**127565**	**72.67**	**68.35**	**78.11**	**68.29**	**64.11**	**73.35**	**34.16**	**32.05**	**36.67**	**29.87**	**27.91**	**32.16**

*Table 6. Quota options (tonnes) for the 2008/2009 red sea urchin (RSU) fishery by Pacific Fishery Management (PFM) Area, Subarea and test diameter (TD) calculated with the proposed shoreline length method (where 1 ton=2204.6 lbs). Test diameters are for legal sized (TD≥90mm) and commercially targeted (TD 90-140mm) size ranges with lower (LCB) and upper (UCB) 90% confidence bounds. Shoreline length is from Fishable RSU Confirmed Habitat in Table 3a. NB: a=Insufficient data available for PFM Subarea so values are derived from combined overall linear density estimates from all surveys conducted in PFM Area; b=only most recent survey data used when surveys conducted over multiple years in same area; c# (e.g., c8)=insufficient data available for PFM Area so data from an adjacent PFM Area (identified by #) used; n=new area added; o=otter inhabited shoreline excluded from RSU habitat with no current RSU density data available; ?-no current RSU density data available; *-area has shoreline which, in the future, may be identified as RSU habitat.*

PFM Subarea	NB	Transect			Linear Biomass Density (t/km)						Shoreline Length (km)	B_c Biomass (t)						Quota 0.2*M*B_c (where M=0.10) (t)					
					TD≥90mm			TD 90-140mm				TD≥90mm			TD 90-140mm			TD≥90mm			TD 90-140mm		
		Year	(n)	Length (m)	Mean	LCB	UCB	Mean	LCB	UCB		Mean	LCB	UCB	Mean	LCB	UCB	Mean	LCB	UCB	Mean	LCB	UCB
North Coast of BC																							
1.001		1994	6	1221	228	76	441	226	85	447	91.40	20803	6959	40276	20633	7787	40829	416	139	806	413	156	817
1.002		1994	15	1685	186	121	316	175	115	299	42.40	7900	5139	13416	7415	4865	12696	158	103	268	148	97	254
1.003		1994	15	1702	89	48	163	67	32	129	41.40	3680	1976	6764	2768	1329	5357	74	40	135	55	27	107
1.005	a	1994	45	7467	144	104	194	128	91	174	6.62	951	688	1281	848	600	1150	19	14	26	17	12	23
1.007		1994	9	2859	108	63	169	87	51	136	26.42	2857	1662	4471	2305	1351	3602	57	33	89	46	27	72
1										**Area Total:**	**208.24**	**36191**	**16424**	**66209**	**33970**	**15933**	**63634**	**724**	**328**	**1324**	**679**	**319**	**1273**
2.001	a,n	1995	46	4211	36	27	57	33	26	47	21.16	763	580	1216	689	543	994	15	12	24	14	11	20
2.002	a,n	1995	46	4211	36	27	57	33	26	47	0.86	31	24	49	28	22	40	1	0	1	1	0	1
2.003	a	1995	46	4211	36	27	57	33	26	47	19.24	694	527	1105	626	494	904	14	11	22	13	10	18
2.004	a,n										0.00*												
2.006	a										0.00	0	0	0	0	0	0	0	0	0	0	0	0
2.007	a	1995	46	4211	36	27	57	33	26	47	0.92	33	25	53	30	24	43	1	1	1	1	0	1
2.008	a	1995	46	4211	36	27	57	33	26	47	53.03	1913	1454	3047	1726	1362	2492	38	29	61	35	27	50
2.009	a	1995	46	4211	36	27	57	33	26	47	3.86	139	106	222	126	99	181	3	2	4	3	2	4
2.010	a	1995	46	4211	36	27	57	33	26	47	14.31	516	392	822	466	368	673	10	8	16	9	7	13
2.011	a	1995	46	4211	36	27	57	33	26	47	16.11	581	442	926	524	414	757	12	9	19	10	8	15
2.012	a	1995	46	4211	36	27	57	33	26	47	47.81	1725	1311	2747	1556	1228	2246	34	26	55	31	25	45
2.013	a	1995	46	4211	36	27	57	33	26	47	5.72	206	157	329	186	147	269	4	3	7	4	3	5
2.014	a	1995	46	4211	36	27	57	33	26	47	50.74	1830	1391	2915	1652	1303	2384	37	28	58	33	26	48
2.015	a	1995	46	4211	36	27	57	33	26	47	39.23	1415	1075	2254	1277	1007	1843	28	22	45	26	20	37
2.017	a	1995	46	4211	36	27	57	33	26	47	39.18	1414	1074	2251	1275	1006	1841	28	21	45	26	20	37
2.018		1995	13	1191	38	26	62	36	25	58	84.31	3215	2177	5225	3074	2123	4886	64	44	104	61	42	98
2.019	a	1995	46	4211	36	27	57	33	26	47	47.95	1730	1315	2755	1561	1231	2253	35	26	55	31	25	45
2.031		1995	7	580	69	21	195	50	16	118	92.96	6381	1962	18115	4654	1533	10953	128	39	362	93	31	219
2.032	a	1995	46	4211	36	27	57	33	26	47	8.16	294	224	469	266	210	383	6	4	9	5	4	8
2.033	a,n	1995	46	4211	36	27	57	33	26	47	3.77	136	103	217	123	97	177	3	2	4	2	2	4
2.034	a,n	1995	46	4211	36	27	57	33	26	47	0.52	19	14	30	17	13	25	0	0	1	0	0	0

PFM Subarea	NB	Transect			Linear Biomass Density (t/km)						Shoreline Length (km)	B_c Biomass (t)						Quota 0.2*M*B_c (where M=0.10) (t)					
		Year	(n)	Length	TD≥90mm			TD 90-140mm				TD≥90mm			TD 90-140mm			TD≥90mm			TD 90-140mm		
				(m)	Mean	LCB	UCB	Mean	LCB	UCB		Mean	LCB	UCB	Mean	LCB	UCB	Mean	LCB	UCB	Mean	LCB	UCB
2.036	a										0.00	0	0	0	0	0	0	0	0	0	0	0	0
2.037	a										0.00	0	0	0	0	0	0	0	0	0	0	0	0
2.038	a	1995	46	4211	36	27	57	33	26	47	5.33	192	146	306	173	137	250	4	3	6	3	3	5
2.039	a,n	1995	46	4211	36	27	57	33	26	47	3.21	116	88	184	104	82	151	2	2	4	2	2	3
2.040	a,n										0.00*												
2.042	a,n	1995	46	4211	36	27	57	33	26	47	5.61	203	154	323	183	144	264	4	3	6	4	3	5
2.047	a,n	1995	46	4211	36	27	57	33	26	47	0.38	14	10	22	12	10	18	0	0	0	0	0	0
2.048	a										0.00*												
2.049	a	1995	46	4211	36	27	57	33	26	47	40.56	1463	1112	2331	1320	1042	1906	29	22	47	26	21	38
2.050	a	1995	46	4211	36	27	57	33	26	47	27.44	990	752	1577	893	705	1290	20	15	32	18	14	26
2.051	a	1995	46	4211	36	27	57	33	26	47	0.68	25	19	39	22	17	32	0	0	1	0	0	1
2.052	a	1995	46	4211	36	27	57	33	26	47	0.56	20	15	32	18	14	26	0	0	1	0	0	1
2.053	a	1995	46	4211	36	27	57	33	26	47	15.00	541	411	862	488	385	705	11	8	17	10	8	14
2.054	a,n	1995	46	4211	36	27	57	33	26	47	6.17	223	169	355	201	159	290	4	3	7	4	3	6
2.055	a	1995	46	4211	36	27	57	33	26	47	2.09	75	57	120	68	54	98	2	1	2	1	1	2
2.059	a	1995	46	4211	36	27	57	33	26	47	0.52	19	14	30	17	13	24	0	0	1	0	0	0
2.060	a	1995	46	4211	36	27	57	33	26	47	11.69	422	320	671	380	300	549	8	6	13	8	6	11
2.061	a	1995	46	4211	36	27	57	33	26	47	0.65	24	18	37	21	17	31	0	0	1	0	0	1
2.063	a	1995	46	4211	36	27	57	33	26	47	0.01	0	0	0	0	0	0	0	0	0	0	0	0
2.064	a	1995	46	4211	36	27	57	33	26	47	0.31	11	9	18	10	8	15	0	0	0	0	0	0
2.065	a	1995	46	4211	36	27	57	33	26	47	3.21	116	88	184	104	82	151	2	2	4	2	2	3
2.066	a										0.00	0	0	0	0	0	0	0	0	0	0	0	0
2.067	a	1995	46	4211	36	27	57	33	26	47	0.04	1	1	2	1	1	2	0	0	0	0	0	0
2.068	a	1995	46	4211	36	27	57	33	26	47	67.19	2424	1842	3861	2187	1726	3157	48	37	77	44	35	63
2.069	a	1994	46	4211	36	27	57	33	26	47	19.66	709	539	1129	640	505	924	14	11	23	13	10	18
2.070	a	1995	46	4211	36	27	57	33	26	47	1.00	36	27	57	33	26	47	1	1	1	1	1	1
2.071	a	1995	46	4211	36	27	57	33	26	47	15.31	552	420	880	498	393	720	11	8	18	10	8	14
2.072	a	1995	46	4211	36	27	57	33	26	47	1.57	57	43	90	51	40	74	1	1	2	1	1	1
2.073	a	1995	46	4211	36	27	57	33	26	47	5.13	185	141	295	167	132	241	4	3	6	3	3	5
2.074	a	1995	46	4211	36	27	57	33	26	47	1.33	48	36	76	43	34	62	1	1	2	1	1	1
2.075	a	1995	46	4211	36	27	57	33	26	47	39.57	1428	1085	2274	1288	1016	1860	29	22	45	26	20	37
2.076	a	1995	46	4211	36	27	57	33	26	47	1.52	55	42	87	49	39	71	1	1	2	1	1	1
2.078	a	1995	46	4211	36	27	57	33	26	47	18.40	664	504	1057	599	473	865	13	10	21	12	9	17
2.079	a	1995	46	4211	36	27	57	33	26	47	21.05	759	577	1209	685	541	989	15	12	24	14	11	20
2.080	a	1995	46	4211	36	27	57	33	26	47	9.36	337	256	538	305	240	440	7	5	11	6	5	9
2.081	a	1995	46	4211	36	27	57	33	26	47	2.61	94	72	150	85	67	123	2	1	3	2	1	2

PFM Subarea	NB	Transect			Linear Biomass Density (t/km)						Shoreline Length (km)	B_c Biomass (t)						Quota 0.2*M*B_c (where M=0.10) (t)					
		Year	(n)	Length	TD≥90mm			TD 90-140mm				TD≥90mm			TD 90-140mm			TD≥90mm			TD 90-140mm		
				(m)	Mean	LCB	UCB	Mean	LCB	UCB		Mean	LCB	UCB	Mean	LCB	UCB	Mean	LCB	UCB	Mean	LCB	UCB
2.082	a	1995	46	4211	36	27	57	33	26	47	21.01	758	576	1207	684	540	987	15	12	24	14	11	20
2.083	a,n										0.00*												
2.085	a	1995	46	4211	36	27	57	33	26	47	18.29	660	501	1051	595	470	859	13	10	21	12	9	17
2.086	a	1995	46	4211	36	27	57	33	26	47	13.34	481	366	767	434	343	627	10	7	15	9	7	13
2.087	a	1995	46	4211	36	27	57	33	26	47	21.91	790	601	1259	713	563	1029	16	12	25	14	11	21
2.088	a	1995	46	4211	36	27	57	33	26	47	38.23	1379	1048	2197	1245	982	1797	28	21	44	25	20	36
2.089	a	1995	46	4211	36	27	57	33	26	47	15.92	574	436	914	518	409	748	11	9	18	10	8	15
2.090	a	1995	46	4211	36	27	57	33	26	47	13.52	488	371	777	440	347	636	10	7	16	9	7	13
2.091	a,n	1995	46	4211	36	27	57	33	26	47	1.34	48	37	77	44	35	63	1	1	2	1	1	1
2.092	a	1995	46	4211	36	27	57	33	26	47	6.49	234	178	373	211	167	305	5	4	7	4	3	6
2.093	a	1995	46	4211	36	27	57	33	26	47	7.08	255	194	407	230	182	332	5	4	8	5	4	7
2.094	a										0.00	0	0	0	0	0	0	0	0	0	0	0	0
2.095	a	1995	46	4211	36	27	57	33	26	47	2.74	99	75	158	89	70	129	2	2	3	2	1	3
2.096	a	1995	46	4211	36	27	57	33	26	47	5.22	188	143	300	170	134	245	4	3	6	3	3	5
2.097	a	1995	46	4211	36	27	57	33	26	47	7.65	276	210	440	249	197	360	6	4	9	5	4	7
2.098	a	1995	46	4211	36	27	57	33	26	47	17.94	647	492	1031	584	461	843	13	10	21	12	9	17
2.099	a	1995	46	4211	36	27	57	33	26	47	5.64	204	155	324	184	145	265	4	3	6	4	3	5
2.100	a	1995	46	4211	36	27	57	33	26	47	1.78	64	49	103	58	46	84	1	1	2	1	1	2
2										**Area Total:**	**1075.12**	**41986**	**28753**	**74926**	**36952**	**26714**	**58028**	**840**	**575**	**1499**	**739**	**534**	**1161**
3.001		2003	12	596	43	28	63	38	25	54	142.33	6093	4036	8964	5384	3562	7661	122	81	179	108	71	153
3.002	a	2003	16	804	38	27	56	33	23	47	10.98	421	302	610	361	255	519	8	6	12	7	5	10
3.003	a	2003	16	804	38	27	56	33	23	47	11.62	446	319	645	383	270	550	9	6	13	8	5	11
3.004	a	2003	16	804	38	27	56	33	23	47	0.65	25	18	36	22	15	31	1	0	1	0	0	1
3										**Area Total:**	**165.59**	**6985**	**4675**	**10255**	**6150**	**4103**	**8761**	**140**	**93**	**205**	**123**	**82**	**175**
4.001		2003	40	2250	25	21	31	21	17	26	145.73	3679	3000	4445	3019	2449	3731	74	60	89	60	49	75
4.002		1995	33	1926	55	41	82	42	33	56	122.64	6763	4980	10073	5133	3986	6912	135	100	201	103	80	138
4.003	a	95-03	108	8201	32	26	41	26	21	32	22.78	724	586	943	582	473	726	14	12	19	12	9	15
4.004	a	95-03	108	8201	32	26	41	26	21	32	11.06	352	284	458	283	229	352	7	6	9	6	5	7
4.005		2003	11	605	11	5	19	9	5	17	43.79	468	237	820	414	202	732	9	5	16	8	4	15
4.008	a										0.00*												
4.009		1995	21	3226	23	12	41	21	11	36	70.94	1643	854	2897	1505	776	2587	33	17	58	30	16	52
4.010	a,n	95-03	108	8201	32	26	41	26	21	32	2.00	64	51	83	51	41	64	1	1	2	1	1	1
4.011	a,n	95-03	108	8201	32	26	41	26	21	32	2.94	94	76	122	75	61	94	2	2	2	2	1	2
4.012	a	95-03	108	8201	32	26	41	26	21	32	43.00	1367	1106	1780	1099	892	1370	27	22	36	22	18	27

PFM Subarea	NB	Transect			Linear Biomass Density (t/km)						Shoreline Length (km)	B_c Biomass (t)						Quota 0.2*M*B_c (where M=0.10) (t)					
		Year	(n)	Length	TD≥90mm			TD 90-140mm				TD≥90mm			TD 90-140mm			TD≥90mm			TD 90-140mm		
				(m)	Mean	LCB	UCB	Mean	LCB	UCB		Mean	LCB	UCB	Mean	LCB	UCB	Mean	LCB	UCB	Mean	LCB	UCB
4.013	a	95-04	108	8201	32	26	41	26	21	32	32.85	1044	845	1360	839	682	1047	21	17	27	17	14	21
4.014	a										0.00*												
4.015	a										0.00*												
4										**Area Total:**	**497.73**	**16199**	**12020**	**22983**	**13000**	**9791**	**17614**	**324**	**240**	**460**	**260**	**196**	**352**
5.002	a	97-02	116	8618	49	39	66	40	31	55	7.61	371	296	499	303	234	418	7	6	10	6	5	8
5.003	a,n	97-02	116	8618	49	39	66	40	31	55	0.00	0	0	0	0	0	0	0	0	0	0	0	0
5.004	a	97-03	116	8618	49	39	66	40	31	55	2.75	134	107	181	110	85	151	3	2	4	2	2	3
5.009	a	97-02	116	8618	49	39	66	40	31	55	19.68	961	765	1291	784	606	1080	19	15	26	16	12	22
5.010		2002	35	1169	19	14	24	12	10	17	129.75	2405	1860	3124	1618	1268	2162	48	37	62	32	25	43
5.011		1997	5	906	134	0	391	118	0	348	23.60	3158	0	9234	2794	0	8210	63	0	185	56	0	164
5.012		2002	24	1072	10	6	16	7	4	12	36.48	374	207	579	272	145	430	7	4	12	5	3	9
5.013	a	97-02	116	8618	49	39	66	40	31	55	101.33	4949	3937	6646	4037	3123	5563	99	79	133	81	62	111
5.014	a	97-02	116	8618	49	39	66	40	31	55	27.57	1347	1071	1809	1098	850	1514	27	21	36	22	17	30
5.016	a	97-02	116	8618	49	39	66	40	31	55	24.10	1177	936	1581	960	743	1323	24	19	32	19	15	26
5.017	a	97-02	116	8618	49	39	66	40	31	55	142.76	6972	5547	9363	5687	4400	7837	139	111	187	114	88	157
5.018	a	97-02	116	8618	49	39	66	40	31	55	2.11	103	82	139	84	65	116	2	2	3	2	1	2
5.019	a	97-02	116	8618	49	39	66	40	31	55	1.92	94	75	126	77	59	106	2	1	3	2	1	2
5.020	a	97-02	116	8618	49	39	66	40	31	55	110.74	5408	4303	7263	4411	3413	6079	108	86	145	88	68	122
5.021		1997	24	2679	67	42	98	53	33	79	44.45	2986	1887	4350	2345	1454	3495	60	38	87	47	29	70
5.022	a	97-02	116	8618	49	39	66	40	31	55	184.46	9008	7167	12098	7348	5685	10126	180	143	242	147	114	203
5.024	a,n	97-02	116	8618	49	39	66	40	31	55	9.69	473	376	635	386	298	532	9	8	13	8	6	11
5										**Area Total:**	**868.99**	**39919**	**28616**	**58918**	**32313**	**22429**	**49141**	**798**	**572**	**1178**	**646**	**449**	**983**
6.005	a	94-02	226	14121	31	25	39	28	22	35	27.38	836	673	1060	759	612	968	17	13	21	15	12	19
6.006	a	94-02	226	14121	31	25	39	28	22	35	19.78	604	486	766	548	442	699	12	10	15	11	9	14
6.008	a,n										0.00*												
6.009	a	94-02	226	14121	31	25	39	28	22	35	285.80	8729	7022	11067	7919	6394	10104	175	140	221	158	128	202
6.010	b	2004	68	2186	24	21	29	22	19	27	121.42	2959	2496	3522	2714	2293	3236	59	50	70	54	46	65
6.011	a	94-02	226	14121	31	25	39	28	22	35	9.56	292	235	370	265	214	338	6	5	7	5	4	7
6.012	a	94-02	226	14121	31	25	39	28	22	35	8.22	251	202	318	228	184	291	5	4	6	5	4	6
6.013	a	94-02	226	14121	31	25	39	28	22	35	304.99	9315	7493	11810	8451	6823	10783	186	150	236	169	136	216
6.014		2000	51	2870	10	7	13	8	6	11	41.47	400	287	535	326	231	449	8	6	11	7	5	9
6.015		2000	35	1651	14	9	19	13	9	18	25.24	349	238	479	322	215	446	7	5	10	6	4	9
6.016		1995	26	1347	16	12	21	15	11	20	127.87	2027	1544	2635	1947	1457	2537	41	31	53	39	29	51
6.017		1995	9	515	49	19	137	47	18	128	56.00	2750	1056	7658	2609	1032	7177	55	21	153	52	21	144

PFM Subarea	NB	Transect			Linear Biomass Density (t/km)						Shoreline Length (km)	B_c Biomass (t)						Quota 0.2*M*B_c (where M=0.10) (t)					
		Year	(n)	Length	TD≥90mm			TD 90-140mm				TD≥90mm			TD 90-140mm			TD≥90mm			TD 90-140mm		
				(m)	Mean	LCB	UCB	Mean	LCB	UCB		Mean	LCB	UCB	Mean	LCB	UCB	Mean	LCB	UCB	Mean	LCB	UCB
6.018	a	94-02	226	14121	31	25	39	28	22	35	19.02	581	467	736	527	425	672	12	9	15	11	9	13
6.019	a	94-02	226	14121	31	25	39	28	22	35	47.97	1465	1179	1858	1329	1073	1696	29	24	37	27	21	34
6.020	a	94-02	226	14121	31	25	39	28	22	35	6.43	196	158	249	178	144	227	4	3	5	4	3	5
6.025	a	94-02	226	14121	31	25	39	28	22	35	17.07	521	419	661	473	382	604	10	8	13	9	8	12
6.026	a	94-02	226	14121	31	25	39	28	22	35	14.35	438	352	556	398	321	507	9	7	11	8	6	10
6.027	a,n										0.00*												
6.028	a,n										0.00*												
6										**Area Total:**	**1132.57**	**31715**	**24308**	**44281**	**28994**	**22243**	**40734**	**634**	**486**	**886**	**580**	**445**	**815**
7.001	o										2.34												
7.002	o										7.05												
7.003	o										84.43												
7.004	a	94-01	306	19325	32	28	37	31	27	36	43.30	1390	1195	1585	1354	1161	1546	28	24	32	27	23	31
7.005	a	94-01	306	19325	32	28	37	31	27	36	25.51	819	704	934	798	684	911	16	14	19	16	14	18
7.006	a	94-01	306	19325	32	28	37	31	27	36	4.36	140	120	160	136	117	156	3	2	3	3	2	3
7.008	a	94-01	306	19325	32	28	37	31	27	36	5.82	187	161	213	182	156	208	4	3	4	4	3	4
7.009	a	94-01	306	19325	32	28	37	31	27	36	124.53	3996	3437	4559	3894	3339	4447	80	69	91	78	67	89
7.012	o										42.91												
7.013	a,n	94-01	306	19325	32	28	37	31	27	36	5.94	191	164	217	186	159	212	4	3	4	4	3	4
7.014	a,n	94-01	306	19325	32	28	37	31	27	36	11.37	365	314	416	356	305	406	7	6	8	7	6	8
7.015	a,n	94-01	306	19325	32	28	37	31	27	36	0.31	10	9	11	10	8	11	0	0	0	0	0	0
7.017	o										46.37												
7.018	o										0.00												
7.019	o										0.00												
7.020	o										0.00												
7.021	o										5.35												
7.022	a,n	94-01	306	19325	32	28	37	31	27	36	1.75	56	48	64	55	47	62	1	1	1	1	1	1
7.023	o										1.13												
7.024	o										5.10												
7.025	o										37.56												
7.026	o										3.51												
7.027	a	94-01	306	19325	32	28	37	31	27	36	138.65	4449	3827	5076	4335	3717	4951	89	77	102	87	74	99
7.028	a	94-01	306	19325	32	28	37	31	27	36	30.39	975	839	1112	950	815	1085	20	17	22	19	16	22
7.030	a,n	94-01	306	19325	32	28	37	31	27	36	0.54	17	15	20	17	15	19	0	0	0	0	0	0
7.031	b	2001	10	308	28	18	42	28	18	42	5.95	166	108	247	166	108	247	3	2	5	3	2	5
7.032	o										0.00												
7										**Area Total:**	**634.17**	**12760**	**10940**	**14616**	**12437**	**10630**	**14261**	**255**	**219**	**292**	**249**	**213**	**285**

PFM Subarea	NB	Transect			Linear Biomass Density (t/km)						Shoreline Length (km)	B_c Biomass (t)						Quota 0.2*M*B_c (where M=0.10) (t)					
		Year	(n)	Length	TD≥90mm			TD 90-140mm				TD≥90mm			TD 90-140mm			TD≥90mm			TD 90-140mm		
				(m)	Mean	LCB	UCB	Mean	LCB	UCB		Mean	LCB	UCB	Mean	LCB	UCB	Mean	LCB	UCB	Mean	LCB	UCB
8.001	a	2001	60	2010	8	6	11	8	6	11	57.77	462	353	637	439	334	614	9	7	13	9	7	12
8.002	a	2001	60	2010	8	6	11	8	6	11	79.73	637	487	879	606	460	848	13	10	18	12	9	17
8.003	a	2001	60	2010	8	6	11	8	6	11	14.64	117	89	161	111	85	156	2	2	3	2	2	3
8.004		2001	40	1178	7	4	9	6	4	8	141.20	928	573	1265	859	532	1185	19	11	25	17	11	24
8.005	a,n	2001	60	2010	8	6	11	8	6	11	3.71	30	23	41	28	21	39	1	0	1	1	0	1
8.006	a,n	2001	60	2010	8	6	11	8	6	11	3.85	31	23	42	29	22	41	1	0	1	1	0	1
8.013	a,n	2001	60	2010	8	6	11	8	6	11	12.53	100	76	138	95	72	133	2	2	3	2	1	3
8.016		2001	17	737	10	6	18	10	6	18	37.98	372	217	699	363	209	701	7	4	14	7	4	14
8										**Area Total:**	**351.42**	**2677**	**1841**	**3862**	**2532**	**1736**	**3718**	**54**	**37**	**77**	**51**	**35**	**74**
9.001	c8	2001	60	2010	8	6	11	8	6	11	32.91	263	201	363	250	190	350	5	4	7	5	4	7
9.002	c8	2001	60	2010	8	6	11	8	6	11	48.81	390	298	538	371	282	519	8	6	11	7	6	10
9.003	c8	2001	60	2010	8	6	11	8	6	11	8.73	70	53	96	66	50	93	1	1	2	1	1	2
9.004	c8,n	2001	60	2010	8	6	11	8	6	11	1.10	9	7	12	8	6	12	0	0	0	0	0	0
9.010	c8	2001	60	2010	8	6	11	8	6	11	3.57	29	22	39	27	21	38	1	0	1	1	0	1
9.011	c8	2001	60	2010	8	6	11	8	6	11	5.42	43	33	60	41	31	58	1	1	1	1	1	1
9.012	c8	2001	60	2010	8	6	11	8	6	11	32.98	264	201	363	251	190	351	5	4	7	5	4	7
9										**Area Total:**	**133.52**	**1067**	**815**	**1471**	**1015**	**771**	**1420**	**21**	**16**	**29**	**20**	**15**	**28**
10.001	c8	2001	60	2010	8	6	11	8	6	11	50.81	406	310	560	386	293	540	8	6	11	8	6	11
10.002	c8	2001	60	2010	8	6	11	8	6	11	55.56	444	339	612	422	321	591	9	7	12	8	6	12
10.003	c8	2001	60	2010	8	6	11	8	6	11	33.56	268	205	370	255	194	357	5	4	7	5	4	7
10.004	c8	2001	60	2010	8	6	11	8	6	11	40.10	321	245	442	305	232	426	6	5	9	6	5	9
10.005	c8	2001	60	2010	8	6	11	8	6	11	10.79	86	66	119	82	62	115	2	1	2	2	1	2
10.006	c8	2001	60	2010	8	6	11	8	6	11	1.01	8	6	11	8	6	11	0	0	0	0	0	0
10.007	c8,n	2001	60	2010	8	6	11	8	6	11	8.64	69	53	95	66	50	92	1	1	2	1	1	2
10.008	c8	2001	60	2010	8	6	11	8	6	11	3.11	25	19	34	24	18	33	0	0	1	0	0	1
10.011	c8	2001	60	2010	8	6	11	8	6	11	0.53	4	3	6	4	3	6	0	0	0	0	0	0
10.012	c8	2001	60	2010	8	6	11	8	6	11	6.66	53	41	73	51	38	71	1	1	1	1	1	1
10										**Area Total:**	**210.79**	**1685**	**1286**	**2323**	**1603**	**1217**	**2242**	**34**	**26**	**46**	**32**	**24**	**45**
101.001	c1	1994	45	7467	144	104	194	128	91	174	10.89	1564	1131	2108	1395	987	1891	31	23	42	28	20	38
101.002	c1	1994	45	7467	144	104	194	128	91	174	6.21	892	645	1201	795	563	1078	18	13	24	16	11	22
101.006	c1	1994	45	7467	144	104	194	128	91	174	8.61	1237	894	1667	1103	781	1496	25	18	33	22	16	30
101.007	c1	1994	45	7467	144	104	194	128	91	174	3.29	473	342	637	421	298	572	9	7	13	8	6	11
101.010	c1										0.00*												
101										**Area Total:**	**28.99**	**4166**	**3012**	**5612**	**3714**	**2629**	**5037**	**83**	**60**	**112**	**74**	**53**	**101**

PFM Subarea	NB	Transect			Linear Biomass Density (t/km)						Shoreline Length (km)	B_c Biomass (t)						Quota 0.2*M*B_c (where M=0.10) (t)					
		Year	(n)	Length	TD≥90mm			TD 90-140mm				TD≥90mm			TD 90-140mm			TD≥90mm			TD 90-140mm		
				(m)	Mean	LCB	UCB	Mean	LCB	UCB		Mean	LCB	UCB	Mean	LCB	UCB	Mean	LCB	UCB	Mean	LCB	UCB
102.002	c2	1995	46	4211	36	27	57	33	26	47	2.14	77	59	123	70	55	101	2	1	2	1	1	2
102.003	c2	1995	46	4211	36	27	57	33	26	47	3.85	139	106	221	125	99	181	3	2	4	3	2	4
102										**Area Total:**	**5.99**	**216**	**164**	**344**	**195**	**154**	**282**	**4**	**3**	**7**	**4**	**3**	**6**
105.001	c5	97-02	116	8618	49	39	66	40	31	55	18.62	909	724	1221	742	574	1022	18	14	24	15	11	20
105.002	c5	97-02	116	8618	49	39	66	40	31	55	2.43	118	94	159	97	75	133	2	2	3	2	1	3
105										**Area Total:**	**21.05**	**1028**	**818**	**1381**	**839**	**649**	**1156**	**21**	**16**	**28**	**17**	**13**	**23**
106.001	a	1994	28	2633	96	78	124	92	76	119	5.59	537	439	695	517	424	663	11	9	14	10	8	13
106.002		1994	28	2633	96	78	124	92	76	119	97.52	9363	7654	12118	9016	7400	11559	187	153	242	180	148	231
106										**Area Total:**	**103.11**	**9900**	**8093**	**12813**	**9533**	**7824**	**12222**	**198**	**162**	**256**	**191**	**156**	**244**
108.001	c8,n	2001	60	2010	8	6	11	8	6	11	2.76	22	17	30	21	16	29	0	0	1	0	0	1
108										**Area Total:**	**2.76**	**22**	**17**	**30**	**21**	**16**	**29**	**0**	**0**	**1**	**0**	**0**	**1**
109	c8,n	2001	60	2010	8	6	11	8	6	11	0.02	0	0	0	0	0	0	0	0	0	0	0	0
109										**Area Total:**	**0.02**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
110	c8,n										0.00*												
110										**Area Total:**	**0.00***												
130.003	c2,n	1995	46	4211	36	27	57	33	26	47	0.60	22	16	34	20	15	28	0	0	1	0	0	1
130										**Area Total:**	**0.60**	**22**	**16**	**34**	**20**	**15**	**28**	**0**	**0**	**1**	**0**	**0**	**1**
142.001	c2	1995	46	4211	36	27	57	33	26	47	1.49	54	41	86	48	38	70	1	1	2	1	1	1
142.002	c2	1995	46	4211	36	27	57	33	26	47	17.52	632	480	1007	570	450	823	13	10	20	11	9	16
142										**Area Total:**	**19.01**	**686**	**521**	**1092**	**619**	**488**	**893**	**14**	**10**	**22**	**12**	**10**	**18**
										North Coast Total:	**5459.68**	**207224**	**142320**	**321150**	**183906**	**127343**	**279198**	**4144**	**2846**	**6423**	**3678**	**2547**	**5584**
South Coast of BC																							
11.001	o										0.00												
11.002	o										171.13												
11											**171.13**												
12.001		1999	13	633	14	9	21	12	7	19	34.89	496	297	745	425	252	651	10	6	15	9	5	13

PFM Subarea	NB	Transect			Linear Biomass Density (t/km)						Shoreline Length (km)	B_c Biomass (t)						Quota 0.2*M*B_c (where M=0.10) (t)					
		Year	(n)	Length	TD≥90mm			TD 90-140mm				TD≥90mm			TD 90-140mm			TD≥90mm			TD 90-140mm		
				(m)	Mean	LCB	UCB	Mean	LCB	UCB		Mean	LCB	UCB	Mean	LCB	UCB	Mean	LCB	UCB	Mean	LCB	UCB
12.002		1999	16	830	12	5	25	8	4	16	20.85	243	105	512	174	79	337	5	2	10	3	2	7
12.003	b	2001	50	1960	19	15	24	11	9	14	66.59	1269	990	1579	759	570	947	25	20	32	15	11	19
12.004	a	94-04	391	19628	31	28	36	25	22	28	7.05	222	201	252	174	156	197	4	4	5	3	3	4
12.005		1994	9	551	38	25	63	21	13	35	42.25	1602	1056	2664	903	569	1483	32	21	53	18	11	30
12.006	a	94-04	391	19628	31	28	36	25	22	28	112.02	3526	3191	4005	2772	2487	3135	71	64	80	55	50	63
12.007	b	1995	5	186	13	6	20	5	1	10	51.16	662	296	1038	264	32	500	13	6	21	5	1	10
12.008	a	94-04	391	19628	31	28	36	25	22	28	19.18	604	546	686	474	426	537	12	11	14	9	9	11
12.009	a	94-04	391	19628	31	28	36	25	22	28	0.24	8	7	9	6	5	7	0	0	0	0	0	0
12.010		1994	12	613	49	36	67	43	31	57	0.34	17	12	23	15	11	19	0	0	0	0	0	0
12.011	b	2004	44	2288	50	40	65	46	36	61	95.56	4802	3776	6246	4420	3418	5831	96	76	125	88	68	117
12.012	o										0.00												
12.013	b	2000	57	1899	37	31	42	33	28	39	182.32	6694	5661	7678	6084	5156	7106	134	113	154	122	103	142
12.014	o										0.00												
12.015	o										42.14												
12.016	b	2004	26	1068	18	14	22	15	12	18	91.55	1616	1301	1985	1364	1071	1675	32	26	40	27	21	33
12.017	a	94-04	391	19628	31	28	36	25	22	28	11.40	359	325	408	282	253	319	7	6	8	6	5	6
12.018		1994	15	765	33	23	43	30	21	38	49.12	1601	1129	2099	1458	1028	1887	32	23	42	29	21	38
12.019		1994	5	464	21	9	35	16	7	29	23.33	482	202	820	362	174	666	10	4	16	7	3	13
12.020	a	94-04	391	19628	31	28	36	25	22	28	1.88	59	53	67	46	42	53	1	1	1	1	1	1
12.021	b	2001	9	331	7	14	22	4	8	13	2.83	19	40	61	11	23	37	0	1	1	0	0	1
12.024	a	94-04	391	19628	31	28	36	25	22	28	5.71	180	163	204	141	127	160	4	3	4	3	3	3
12.026	a	94-04	391	19628	31	28	36	25	22	28	2.02	64	58	72	50	45	57	1	1	1	1	1	1
12.039	b	1995	15	957	6	3	10	3	1	6	87.66	535	252	919	275	110	500	11	5	18	5	2	10
12.041		1995	8	239	35	11	89	12	5	24	52.31	1835	570	4671	615	255	1249	37	11	93	12	5	25
12.042	a	94-04	391	19628	31	28	36	25	22	28	4.53	143	129	162	112	101	127	3	3	3	2	2	3
12										**Area Total:**	**1006.95**	**27034**	**20360**	**36904**	**21188**	**16389**	**27479**	**541**	**407**	**738**	**424**	**328**	**550**
13.001		2002	14	2400	60	34	93	59	33	92	4.26	256	145	396	252	140	391	5	3	8	5	3	8
13.002		2002	21	3507	43	31	59	41	29	57	7.77	334	238	457	321	228	441	7	5	9	6	5	9
13.003	a										0.00	0	0	0	0	0	0	0	0	0	0	0	0
13.006	a	99-06	132	11266	29	24	35	27	22	32	8.14	237	193	285	218	175	264	5	4	6	4	4	5
13.007	a	99-06	132	11266	29	24	35	27	22	32	8.35	243	198	293	224	180	271	5	4	6	4	4	5
13.008	a	99-06	132	11266	29	24	35	27	22	32	3.21	93	76	113	86	69	104	2	2	2	2	1	2
13.009		2006	14	948	11	5	19	7	3	11	10.81	124	56	208	75	35	118	2	1	4	2	1	2
13.010	a	99-06	132	11266	29	24	35	27	22	32	14.30	416	339	501	384	308	464	8	7	10	8	6	9
13.011	a	99-06	132	11266	29	24	35	27	22	32	4.83	141	115	169	130	104	157	3	2	3	3	2	3

PFM Subarea	NB	Transect			Linear Biomass Density (t/km)						Shoreline Length (km)	B_c Biomass (t)						Quota 0.2*M*B_c (where M=0.10) (t)					
		Year	(n)	Length	TD≥90mm			TD 90-140mm				TD≥90mm			TD 90-140mm			TD≥90mm			TD 90-140mm		
				(m)	Mean	LCB	UCB	Mean	LCB	UCB		Mean	LCB	UCB	Mean	LCB	UCB	Mean	LCB	UCB	Mean	LCB	UCB
13.012	a	99-06	132	11266	29	24	35	27	22	32	40.75	1187	968	1429	1093	877	1324	24	19	29	22	18	26
13.013	a	99-06	132	11266	29	24	35	27	22	32	5.18	151	123	182	139	112	168	3	2	4	3	2	3
13.014	a	99-06	132	11266	29	24	35	27	22	32	2.25	66	54	79	60	49	73	1	1	2	1	1	1
13.015	a,n	99-06	132	11266	29	24	35	27	22	32	3.22	94	76	113	86	69	104	2	2	2	2	1	2
13.016	a										0.00*												
13.017	a										0.00*												
13.018	a	99-06	132	11266	29	24	35	27	22	32	13.30	387	316	466	357	286	432	8	6	9	7	6	9
13.020	a	99-06	132	11266	29	24	35	27	22	32	3.52	103	84	124	95	76	114	2	2	2	2	2	2
13.023	a	99-06	132	11266	29	24	35	27	22	32	24.65	718	585	864	661	531	801	14	12	17	13	11	16
13.025		2006	19	1017	9	5	14	8	5	12	38.72	346	206	540	313	182	484	7	4	11	6	4	10
13.026	a	99-06	132	11266	29	24	35	27	22	32	4.83	141	115	170	130	104	157	3	2	3	3	2	3
13.027	a	99-06	132	11266	29	24	35	27	22	32	3.54	103	84	124	95	76	115	2	2	2	2	2	2
13.028		2006	19	1287	20	14	30	17	12	28	45.79	898	646	1370	781	552	1296	18	13	27	16	11	26
13.029	a	99-06	132	11266	29	24	35	27	22	32	12.67	369	301	444	340	273	412	7	6	9	7	5	8
13.030	a	99-06	132	11266	29	24	35	27	22	32	11.54	336	274	405	310	248	375	7	5	8	6	5	7
13.031		1999	5	229	39	22	58	37	22	55	12.24	475	274	706	457	265	674	9	5	14	9	5	13
13.032		1999	18	868	34	21	52	32	20	49	30.09	1023	645	1565	970	612	1470	20	13	31	19	12	29
13.033		1999	7	463	57	31	108	54	28	102	13.53	766	416	1467	737	384	1385	15	8	29	15	8	28
13.034	a										0.00*												
13.035		1999	8	300	18	10	30	10	4	20	9.01	165	89	267	91	36	177	3	2	5	2	1	4
13.036	a	99-06	132	11266	29	24	35	27	22	32	0.90	26	21	32	24	19	29	1	0	1	0	0	1
13.039	a	99-06	132	11266	29	24	35	27	22	32	15.55	453	369	545	417	335	505	9	7	11	8	7	10
13.040	a	99-06	132	11266	29	24	35	27	22	32	12.95	377	307	454	347	279	421	8	6	9	7	6	8
13.041	a	99-06	132	11266	29	24	35	27	22	32	14.25	415	338	500	382	307	463	8	7	10	8	6	9
13										**Area Total:**	**380.15**	**10442**	**7652**	**14268**	**9577**	**6910**	**13192**	**209**	**153**	**285**	**192**	**138**	**264**
14.001	a	99-02	80	11678	16	12	21	15	11	20	5.76	94	69	123	87	63	115	2	1	2	2	1	2
14.002	a	99-02	80	11678	16	12	21	15	11	20	0.19	3	2	4	3	2	4	0	0	0	0	0	0
14.003	a	99-02	80	11678	16	12	21	15	11	20	10.72	174	127	228	162	117	214	3	3	5	3	2	4
14.004	a										0.00*												
14.005	a	99-02	80	11678	16	12	21	15	11	20	1.03	17	12	22	15	11	20	0	0	0	0	0	0
14.006	a	99-02	80	11678	16	12	21	15	11	20	0.10	2	1	2	1	1	2	0	0	0	0	0	0
14.007		1999	8	1242	26	12	49	23	10	46	10.48	269	127	510	246	107	481	5	3	10	5	2	10
14.008		1999	6	812	35	19	48	33	17	45	4.57	159	85	221	149	79	206	3	2	4	3	2	4
14.009		1999	22	3596	21	13	33	20	12	31	5.80	124	78	190	115	71	181	2	2	4	2	1	4
14.010	a	99-02	80	11678	16	12	21	15	11	20	2.68	44	32	57	41	29	54	1	1	1	1	1	1

PFM Subarea	NB	Transect			Linear Biomass Density (t/km)						Shoreline Length (km)	B_c Biomass (t)						Quota 0.2*M*B_c (where M=0.10) (t)					
		Year	(n)	Length	TD≥90mm			TD 90-140mm				TD≥90mm			TD 90-140mm			TD≥90mm			TD 90-140mm		
				(m)	Mean	LCB	UCB	Mean	LCB	UCB		Mean	LCB	UCB	Mean	LCB	UCB	Mean	LCB	UCB	Mean	LCB	UCB
14.011		1999	17	1715	6	0	14	4	0	11	4.97	28	0	69	22	0	56	1	0	1	0	0	1
14.012	a	99-02	80	11678	16	12	21	15	11	20	0.00	0	0	0	0	0	0	0	0	0	0	0	0
14.013		2002	19	3287	7	2	17	7	2	17	43.36	292	66	719	288	66	720	6	1	14	6	1	14
14.014	a										0.00	0	0	0	0	0	0	0	0	0	0	0	0
14.015	a										0.00*												
14										**Area Total:**	**89.65**	**1203**	**600**	**2146**	**1129**	**547**	**2051**	**24**	**12**	**43**	**23**	**11**	**41**
15.001	c14,n										0.00*												
15.002	c14,n	99-02	80	11678	16	12	21	15	11	20	4.36	71	52	93	66	48	87	1	1	2	1	1	2
15.003	c14,n										0.00*												
15										**Area Total:**	**4.36**	**71**	**52**	**93**	**66**	**48**	**87**	**1**	**1**	**2**	**1**	**1**	**2**
16.001	c14,n	99-07	80	11678	16	12	21	15	11	20	39.16	635	466	834	591	429	781	13	9	17	12	9	16
16.002	c14,n	99-06	80	11678	16	12	21	15	11	20	5.28	86	63	112	80	58	105	2	1	2	2	1	2
16.003	c14,n										0.00*												
16.011	c14,n	99-04	80	11678	16	12	21	15	11	20	1.57	25	19	33	24	17	31	1	0	1	0	0	1
16.016	c14,n	99-03	80	11678	16	12	21	15	11	20	1.83	30	22	39	28	20	37	1	0	1	1	0	1
16.017	c14,n	99-02	80	11678	16	12	21	15	11	20	1.13	18	13	24	17	12	23	0	0	0	0	0	0
16.018	c14,n	99-01	80	11678	16	12	21	15	11	20	7.60	123	90	162	115	83	152	2	2	3	2	2	3
16.019	c14,n	99-00	80	11678	16	12	21	15	11	20	32.39	526	385	690	489	355	646	11	8	14	10	7	13
16.020	c14,n	99-01	80	11678	16	12	21	15	11	20	7.85	127	93	167	118	86	156	3	2	3	2	2	3
16.021	c14,n	99-02	80	11678	16	12	21	15	11	20	31.11	505	370	663	469	341	620	10	7	13	9	7	12
16.022	c14,n	99-02	80	11678	16	12	21	15	11	20	2.09	34	25	45	32	23	42	1	0	1	1	0	1
16										**Area Total:**	**130.01**	**2110**	**1547**	**2770**	**1962**	**1426**	**2592**	**42**	**31**	**55**	**39**	**29**	**52**
17.001	a	1998	6	363	2	0	5	1	0	4	4.85	10	0	23	7	0	19	0	0	0	0	0	0
17.002	a	1998	6	363	2	0	5	1	0	4	8.15	17	0	39	12	0	32	0	0	1	0	0	1
17.003	a	1998	6	363	2	0	5	1	0	4	13.60	28	0	65	20	0	54	1	0	1	0	0	1
17.004	a										0.00*												
17.005	a										0.00	0	0	0	0	0	0	0	0	0	0	0	0
17.006	a										0.00	0	0	0	0	0	0	0	0	0	0	0	0
17.008	a										0.00*												
17.010	a	1998	6	363	2	0	5	1	0	4	21.02	43	0	101	32	0	83	1	0	2	1	0	2
17.011	a,n	1998	6	363	2	0	5	1	0	4	0.97	2	0	5	1	0	4	0	0	0	0	0	0
17.012	a	1998	6	363	2	0	5	1	0	4	18.49	38	0	88	28	0	73	1	0	2	1	0	1
17.013	a,n	1998	6	363	2	0	5	1	0	4	8.88	18	0	42	13	0	35	0	0	1	0	0	1

PFM Subarea	NB	Transect			Linear Biomass Density (t/km)						Shoreline Length (km)	B_c Biomass (t)						Quota 0.2*M*B_c (where M=0.10) (t)					
		Year	(n)	Length	TD≥90mm			TD 90-140mm				TD≥90mm			TD 90-140mm			TD≥90mm			TD 90-140mm		
				(m)	Mean	LCB	UCB	Mean	LCB	UCB		Mean	LCB	UCB	Mean	LCB	UCB	Mean	LCB	UCB	Mean	LCB	UCB
17.015	a	1998	6	363	2	0	5	1	0	4	1.73	4	0	8	3	0	7	0	0	0	0	0	0
17.016	a	1998	6	363	2	0	5	1	0	4	11.98	24	0	57	18	0	47	0	0	1	0	0	1
17.017	a	1998	6	363	2	0	5	1	0	4	4.93	10	0	24	7	0	19	0	0	0	0	0	0
17.018	a	1998	6	363	2	0	5	1	0	4	18.62	38	0	89	28	0	73	1	0	2	1	0	1
17.019	a	1998	6	363	2	0	5	1	0	4	2.09	4	0	10	3	0	8	0	0	0	0	0	0
17.020	a										0.00*												
17.021	a	1998	6	363	2	0	5	1	0	4	1.18	2	0	6	2	0	5	0	0	0	0	0	0
17										**Area Total:**	**116.50**	**237**	**0**	**557**	**175**	**0**	**458**	**5**	**0**	**11**	**3**	**0**	**9**
18.001		1998	5	261	7	2	11	6	2	9	13.32	97	25	146	79	25	114	2	0	3	2	0	2
18.002		1998	8	396	6	3	12	4	2	8	21.68	133	69	264	78	37	172	3	1	5	2	1	3
18.003		1998	11	625	3	1	6	1	0	2	10.54	33	8	63	7	2	16	1	0	1	0	0	0
18.004		1999	8	576	15	7	32	4	2	10	17.27	264	117	561	77	30	166	5	2	11	2	1	3
18.005		1999	6	460	8	0	18	7	0	19	50.03	418	0	919	354	0	929	8	0	18	7	0	19
18.006		1999	22	2714	34	20	61	19	9	44	49.69	1709	973	3019	954	464	2199	34	19	60	19	9	44
18.007	a										0.00	0	0	0	0	0	0	0	0	0	0	0	0
18.009	a										0.00	0	0	0	0	0	0	0	0	0	0	0	0
18.010	a,n										0.00	0	0	0	0	0	0	0	0	0	0	0	0
18.011	a	98-99	65	5255	17	12	29	10	6	18	16.13	281	192	463	155	97	296	6	4	9	3	2	6
18										**Area Total:**	**543.77**	**5552**	**2955**	**9365**	**4048**	**2103**	**7442**	**111**	**59**	**187**	**81**	**42**	**149**
19.001	c18,n	98-99	65	5255	17	12	29	10	6	18	2.62	46	31	75	25	16	48	1	1	2	1	0	1
19.003	c18	98-99	65	5255	17	12	29	10	6	18	29.23	509	348	839	281	177	536	10	7	17	6	4	11
19.004	c18	98-99	65	5255	17	12	29	10	6	18	40.71	709	485	1168	392	246	747	14	10	23	8	5	15
19.005	c18	98-99	65	5255	17	12	29	10	6	18	42.53	741	507	1220	409	257	781	15	10	24	8	5	16
19.007	c18,n	98-99	65	5255	17	12	29	10	6	18	1.96	34	23	56	19	12	36	1	0	1	0	0	1
19.008	c18,n	98-99	65	5255	17	12	29	10	6	18	0.62	11	7	18	6	4	11	0	0	0	0	0	0
19										**Area Total:**	**117.67**	**2049**	**1402**	**3376**	**1133**	**711**	**2160**	**41**	**28**	**68**	**23**	**14**	**43**
20.001	a										0.00*												
20.003	a	2001	30	1842	7	5	11	5	3	7	13.27	99	61	147	60	34	94	2	1	3	1	1	2
20.004	a	2001	30	1842	7	5	11	5	3	7	35.01	260	160	387	158	90	249	5	3	8	3	2	5
20.005		2001	30	1842	7	4	11	5	3	7	42.73	317	184	472	193	112	313	6	4	9	4	2	6
20.006	a	2001	30	1842	7	5	11	5	3	7	12.18	90	56	134	55	31	87	2	1	3	1	1	2
20										**Area Total:**	**103.18**	**766**	**461**	**1140**	**466**	**267**	**743**	**15**	**9**	**23**	**9**	**5**	**15**

PFM Subarea	NB	Transect			Linear Biomass Density (t/km)						Shoreline Length (km)	B_c Biomass (t)						Quota 0.2*M*B_c (where M=0.10) (t)					
		Year	(n)	Length (m)	TD≥90mm			TD 90-140mm				TD≥90mm			TD 90-140mm			TD≥90mm			TD 90-140mm		
					Mean	LCB	UCB	Mean	LCB	UCB		Mean	LCB	UCB	Mean	LCB	UCB	Mean	LCB	UCB	Mean	LCB	UCB
21	c20										0.00*												
21										**Area Total:**	**0.00***												
23.003	a,n	2003	64	2702	22	18	26	21	17	25	3.80	83	69	100	78	65	95	2	1	2	2	1	2
23.004	a	2003	64	2702	22	18	26	21	17	25	18.63	406	339	492	384	319	467	8	7	10	8	6	9
23.005		2003	18	682	9	6	13	8	5	12	23.28	212	136	299	191	121	282	4	3	6	4	2	6
23.006	a	2003	64	2702	22	18	26	21	17	25	18.10	395	329	478	374	310	454	8	7	10	7	6	9
23.007		2003	16	654	36	28	43	34	27	41	18.89	672	520	805	639	503	769	13	10	16	13	10	15
23.008	a	2003	64	2702	22	18	26	21	17	25	11.38	248	207	301	235	195	285	5	4	6	5	4	6
23.009	a	2003	64	2702	22	18	26	21	17	25	3.59	78	65	95	74	61	90	2	1	2	1	1	2
23.010	a	2003	64	2702	22	18	26	21	17	25	6.49	141	118	171	134	111	163	3	2	3	3	2	3
23.011		2003	17	767	34	26	41	32	25	39	33.80	1147	892	1374	1083	844	1307	23	18	27	22	17	26
23										**Area Total:**	**137.97**	**3382**	**2674**	**4115**	**3192**	**2529**	**3912**	**68**	**53**	**82**	**64**	**51**	**78**
24.002	o										0.00	0	0	0	0	0	0	0	0	0	0	0	0
24.004	n,o										1.21												
24.006	o										40.52												
24.007	?										0.00*												
24.008	o										36.48												
24.009	?										6.45												
24										**Area Total:**	**84.66**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
25.006	n,o										9.77												
25.007	n,o										0.00	0	0	0	0	0	0	0	0	0	0	0	0
25.013	n,o										0.00*												
25.015	n,?										3.34												
25										**Area Total:**	**13.11**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
26.006	n,o										0.00*												
26.007	n,o										0.00*												
26										**Area Total:**	**0.00**												
27.001	n,o										0.00*												
27.007	n,o										0.00	0	0	0	0	0	0	0	0	0	0	0	0
27.009	n,o										0.00	0	0	0	0	0	0	0	0	0	0	0	0
27.010	n,o										0.01												

PFM Subarea	NB	Transect			Linear Biomass Density (t/km)						Shoreline Length (km)	B_c Biomass (t)						Quota 0.2*M*B_c (where M=0.10) (t)					
		Year	(n)	Length (m)	TD≥90mm			TD 90-140mm				TD≥90mm			TD 90-140mm			TD≥90mm			TD 90-140mm		
					Mean	LCB	UCB	Mean	LCB	UCB		Mean	LCB	UCB	Mean	LCB	UCB	Mean	LCB	UCB	Mean	LCB	UCB
27.011	n,o										4.85												
27										**Area Total:**	**4.86**												
28.001	n,?										43.16												
28.002	n,?										63.26												
28.003	n,?										5.39												
28.004	n,?										11.12												
28.005	n,?										3.70												
28.006	n,?										3.28												
28.007	n,?										0.11												
28.008	n,?										1.14												
28.009	n,?										2.41												
28										**Area Total:**	**133.57**												
29.001	n,?										0.16												
29.002	n,?										0.00*												
29.003	n,?										7.40												
29.004	n,?										8.29												
29.005	n,?										36.58												
29										**Area Total:**	**52.43**												
111	a	1996	6	598	105	77	120	102	76	115	82.66	8697	6372	9901	8467	6303	9534	174	127	198	169	126	191
111										**Area Total:**	**82.66**	**8697**	**6372**	**9901**	**8467**	**6303**	**9534**	**174**	**127**	**198**	**169**	**126**	**191**
121.001	c20										0.00*												
121.002	c20										0.00*												
121											**0.00**												
123.001	a	2003	7	357	67	26	169	64	26	157	7.79	521	206	1317	498	203	1224	10	4	26	10	4	24
123.003	a	2003	7	357	67	26	169	64	26	157	10.80	723	285	1826	691	282	1698	14	6	37	14	6	34
123.005	a	2003	7	357	67	26	169	64	26	157	16.97	1136	448	2870	1086	443	2669	23	9	57	22	9	53
123										**Area Total:**	**35.55**	**2381**	**939**	**6012**	**2274**	**928**	**5592**	**48**	**19**	**120**	**45**	**19**	**112**
124.001	?										0.00*												
124.003	o										14.26												
124										**Area Total:**	**14.26**												

PFM Subarea	NB	Transect			Linear Biomass Density (t/km)						Shoreline Length (km)	B_c Biomass (t)						Quota 0.2*M*B_c (where M=0.10) (t)					
		Year	(n)	Length	TD≥90mm			TD 90-140mm				TD≥90mm			TD 90-140mm			TD≥90mm			TD 90-140mm		
				(m)	Mean	LCB	UCB	Mean	LCB	UCB		Mean	LCB	UCB	Mean	LCB	UCB	Mean	LCB	UCB	Mean	LCB	UCB
125.001	n,o										0.00												
125.003	n,o										0.00*												
125										**Area Total:**	**0.00**												
127.003	n,o										1.37												
127.004	n,?										17.26												
127										**Area Total:**	**18.63**												
										South Coast Total:	**3241.07**	**63924**	**45015**	**90647**	**53676**	**38160**	**75242**	**1278**	**900**	**1813**	**1074**	**763**	**1505**
										BC Coast Total:	**8700.75**	**271148**	**187335**	**411797**	**237582**	**165504**	**354440**	**5423**	**3747**	**8236**	**4752**	**3310**	**7089**

*Table 7a. Quota options (tonnes) for the 2008/2009 red sea urchin (RSU) fishery by Pacific Fishery Management (PFM) Area and test diameter (TD) calculated with the proposed shoreline length method (where 1 ton=2204.6 lb). Test diameters are for legal sized (TD≥90mm) and commercially targeted (TD 90-140mm) size ranges with lower (LCB) and upper (UCB) 90% confidence bounds. * - Area has shoreline which, in the future, may be identified as RSU habitat.*

PFM Area	Shoreline Length (km)	Quota $0.2*M*B_c$ (where M=0.10) (t)					
		TD≥90mm			TD 90-140mm		
		Mean	LCB	UCB	Mean	LCB	UCB
North Coast of BC							
1	208.24	724	328	1324	679	319	1273
2	1075.12	840	575	1499	739	534	1161
3	165.59	140	93	205	123	82	175
4	497.73	324	240	460	260	196	352
5	868.99	798	572	1178	646	449	983
6	1132.57	634	486	886	580	445	815
7	634.17	255	219	292	249	213	285
8	351.42	54	37	77	51	35	74
9	133.52	21	16	29	20	15	28
10	210.79	34	26	46	32	24	45
101	28.99	83	60	112	74	53	101
102	5.99	4	3	7	4	3	6
105	21.05	21	16	28	17	13	23
106	103.11	198	162	256	191	156	244
108	2.76	0	0	1	0	0	1
109	0.02	0	0	0	0	0	0
110	0.00*	0	0	0	0	0	0
130	0.60	0	0	1	0	0	1
142	19.01	14	10	22	12	10	18
Total:	**5459.68**	**4144**	**2846**	**6423**	**3678**	**2547**	**5584**
South Coast of BC							
11	171.13	0	0	0	0	0	0
12	1006.95	541	407	738	424	328	550
13	380.15	209	153	285	192	138	264
14	89.65	24	12	43	23	11	41
15	4.36	1	1	2	1	1	2
16	130.01	42	31	55	39	29	52
17	116.50	5	0	11	3	0	9
18	543.77	111	59	187	81	42	149
19	117.67	41	28	68	23	14	43
20	103.18	15	9	23	9	5	15
21	0.00*	0	0	0	0	0	0
23	137.97	68	53	82	64	51	78
24	84.66	0	0	0	0	0	0
25	13.11	0	0	0	0	0	0
26	0.00	0	0	0	0	0	0
27	4.86	0	0	0	0	0	0
28	133.57	0	0	0	0	0	0
29	52.43	0	0	0	0	0	0
111	82.66	174	127	198	169	126	191
121	0.00	0	0	0	0	0	0
123	35.55	48	19	120	45	19	112
124	14.26	0	0	0	0	0	0
125	0.00	0	0	0	0	0	0
127	18.63	0	0	0	0	0	0
Total:	**3241.07**	**1278**	**900**	**1813**	**1074**	**763**	**1505**

*Table 7b. Quota options (lb) for the 2008/2009 red sea urchin (RSU) fishery by Pacific Fishery Management (PFM) Area and test diameter (TD) calculated with the proposed shoreline length method (where 1 ton=2204.6 lb). Test diameters are for legal sized (TD≥90mm) and commercially targeted (TD 90-140mm) size ranges with lower (LCB) and upper (UCB) 90% confidence bounds. * - Area has shoreline which, in the future, may be identified as RSU habitat.*

PFM Area	Shoreline Length (km)	Quota $0.2*M*B_c$ (where M=0.10) (lb)					
		TD≥90mm			TD 90-140mm		
		Mean	LCB	UCB	Mean	LCB	UCB
North Coast of BC							
1	208.24	1595732	724181	2919297	1497808	702543	2805759
2	1075.12	1851254	1267804	3303677	1629315	1177874	2558608
3	165.59	307977	206124	452184	271169	180890	386305
4	497.73	714235	530011	1013355	573197	431731	776666
5	868.99	1760131	1261747	2597820	1424771	988938	2166733
6	1132.57	1398399	1071788	1952448	1278407	980747	1796056
7	634.17	562639	482388	644442	548375	468705	628783
8	351.42	118048	81157	170289	111631	76549	163914
9	133.52	47068	35922	64874	44760	34000	62607
10	210.79	74308	56711	102418	70664	53677	98840
101	28.99	183678	132797	247467	163773	115937	222078
102	5.99	9532	7244	15182	8601	6786	12416
105	21.05	45326	36063	60876	36975	28605	50950
106	103.11	436522	356845	564948	420350	344987	538880
108	2.76	974	743	1343	926	704	1296
109	0.02	9	7	12	8	6	11
110	0.00*	0	0	0	0	0	0
130	0.60	954	725	1519	861	679	1243
142	19.01	30237	22979	48158	27283	21525	39385
Total:	**5459.68**	**9137023**	**6275236**	**14160308**	**8108873**	**5614883**	**12310531**
South Coast of BC							
11	171.13	0	0	0	0	0	0
12	1006.95	1192012	897736	1627185	934243	722645	1211624
13	380.15	460429	337408	629105	422258	304691	581673
14	89.65	53039	26443	94641	49760	24113	90446
15	4.36	3117	2285	4093	2899	2106	3830
16	130.01	93018	68201	122140	86497	62855	114285
17	116.50	10442	0	24563	7705	0	20209
18	543.77	244816	130302	412904	178506	92746	328143
19	117.67	90334	61818	148843	49939	31339	95224
20	103.18	33790	20319	50248	20528	11778	32748
21	0.00*	0	0	0	0	0	0
23	137.97	149136	117906	181456	140756	111495	172487
24	84.66	0	0	0	0	0	0
25	13.11	0	0	0	0	0	0
26	0.00	0	0	0	0	0	0
27	4.86	0	0	0	0	0	0
28	133.57	0	0	0	0	0	0
29	52.43	0	0	0	0	0	0
111	82.66	383450	280977	436561	373331	277894	420395
121	0.00	0	0	0	0	0	0
123	35.55	104966	41418	265091	100273	40910	246551
124	14.26	0	0	0	0	0	0
125	0.00	0	0	0	0	0	0
127	18.63	0	0	0	0	0	0
Total:	**3241.07**	**2818549**	**1984813**	**3996830**	**2366696**	**1682572**	**3317616**

Table 8. Quota options (tonnes and lb) for the 2008/2009 red sea urchin (RSU) fishery by region (North and South Coast) and test diameter (TD) calculated with the proposed shoreline length method (where 1 ton=2204.6 lb). Test diameters are for legal sized (TD≥90mm) and commercially targeted (TD 90-140mm) size ranges with lower (LCB) and upper (UCB) 90% confidence bounds.

Region	Shoreline Length (km)	Quota $0.2*M*B_c$ (where M=0.10)					
		TD≥90mm			TD 90-140mm		
		Mean	LCB	UCB	Mean	LCB	UCB
Metric ton (t)							
N. Coast Total:	5459.68	4144	2846	6423	3678	2547	5584
S. Coast Total:	3241.07	1278	900	1813	1074	763	1505
BC Coast Total:	**8700.75**	**5423**	**3747**	**8236**	**4752**	**3310**	**7089**
Pounds (lb)							
N. Coast Total:	5459.68	9137023	6275236	14160308	8108873	5614883	12310531
S. Coast Total:	3241.07	2818549	1984813	3996830	2366696	1682572	3317616
BC Coast Total:	**8700.75**	**11955573**	**8260049**	**18157138**	**10475569**	**7297455**	**15628147**

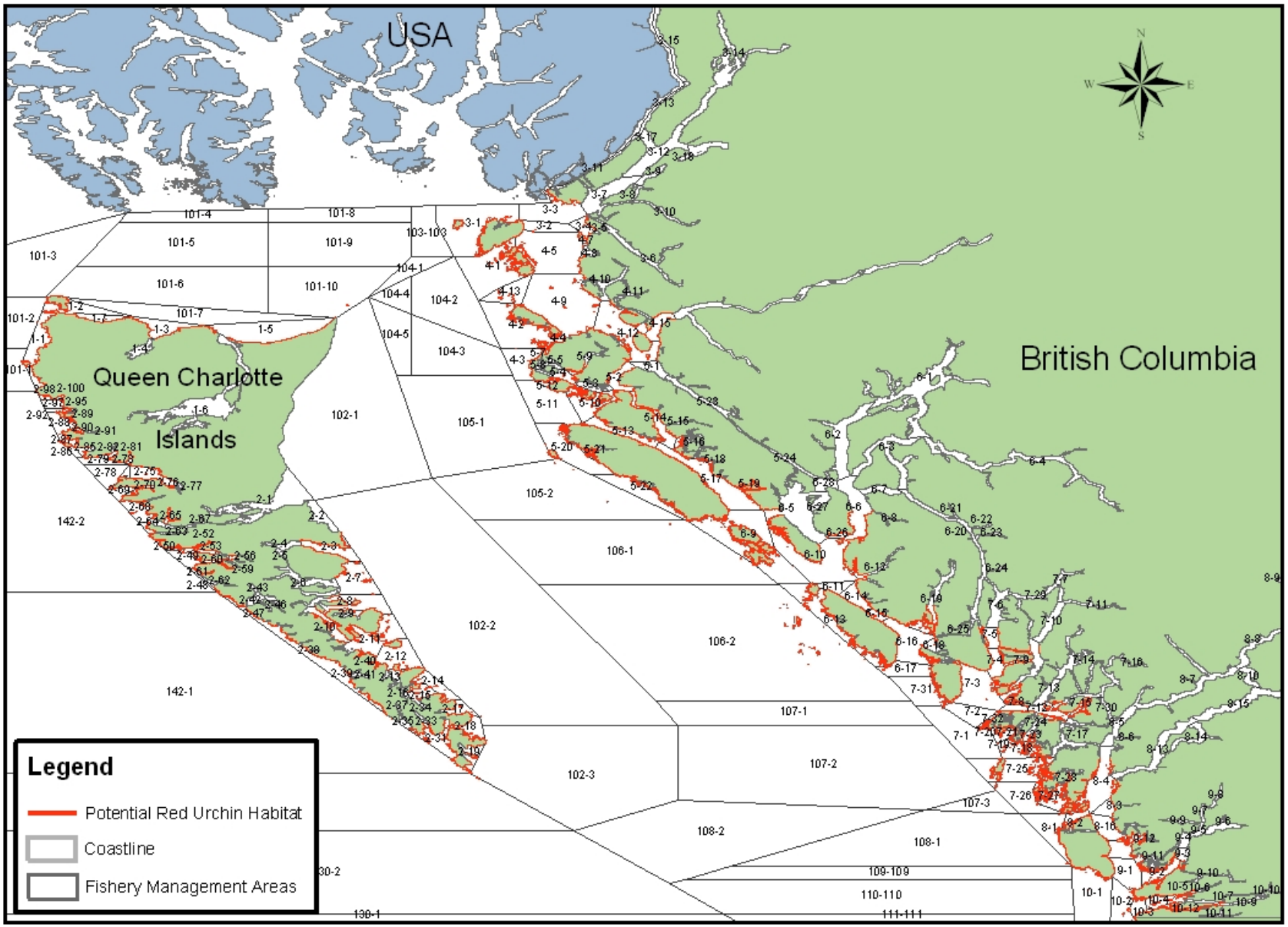

Figure 1. *Shoreline of potential red sea urchin habitat in the North Coast of British Columbia by PFM Area and Subarea.*

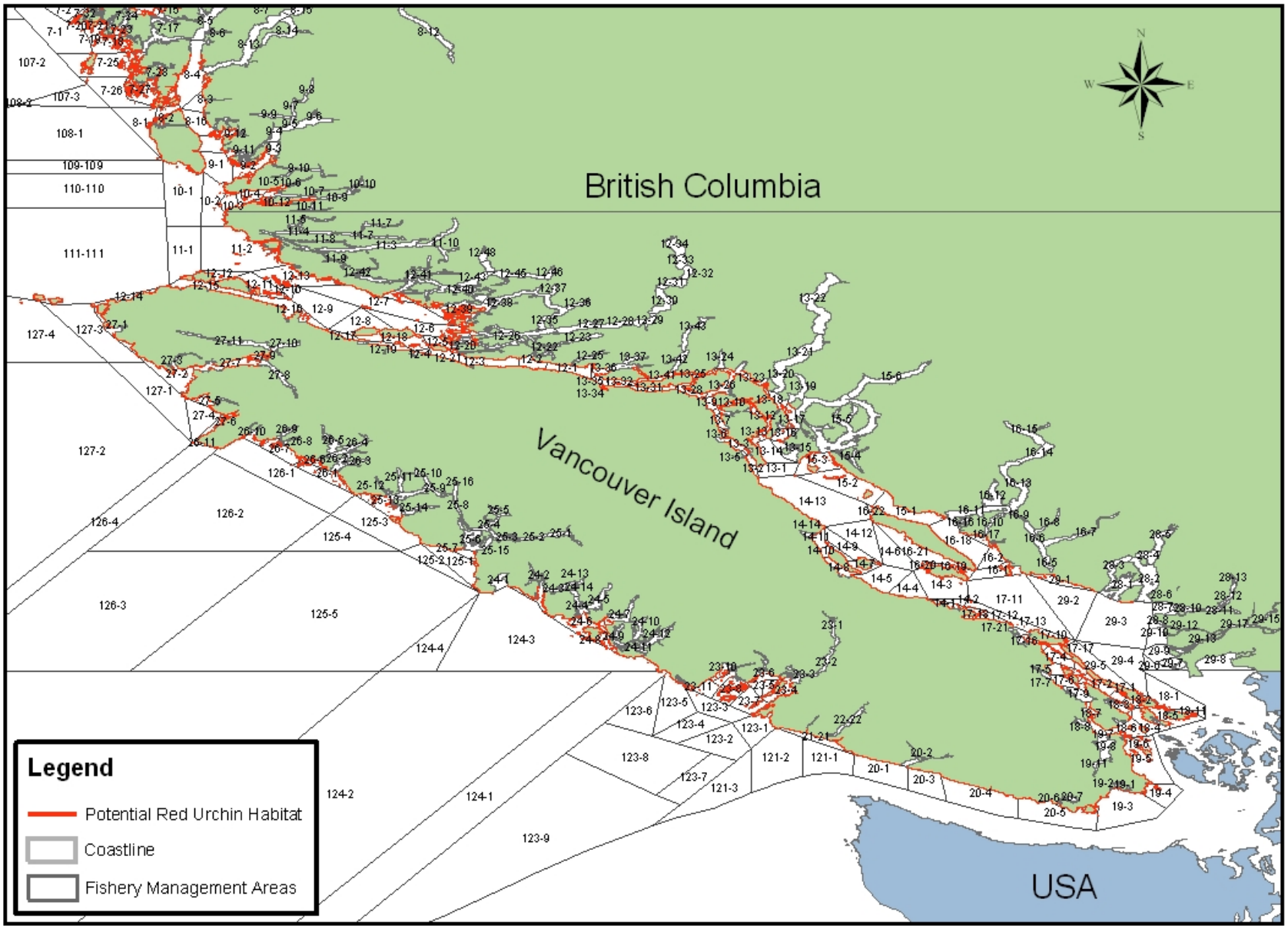

Figure 2. Shoreline of potential red sea urchin habitat in the South Coast of British Columbia by PFM Area and Subarea.

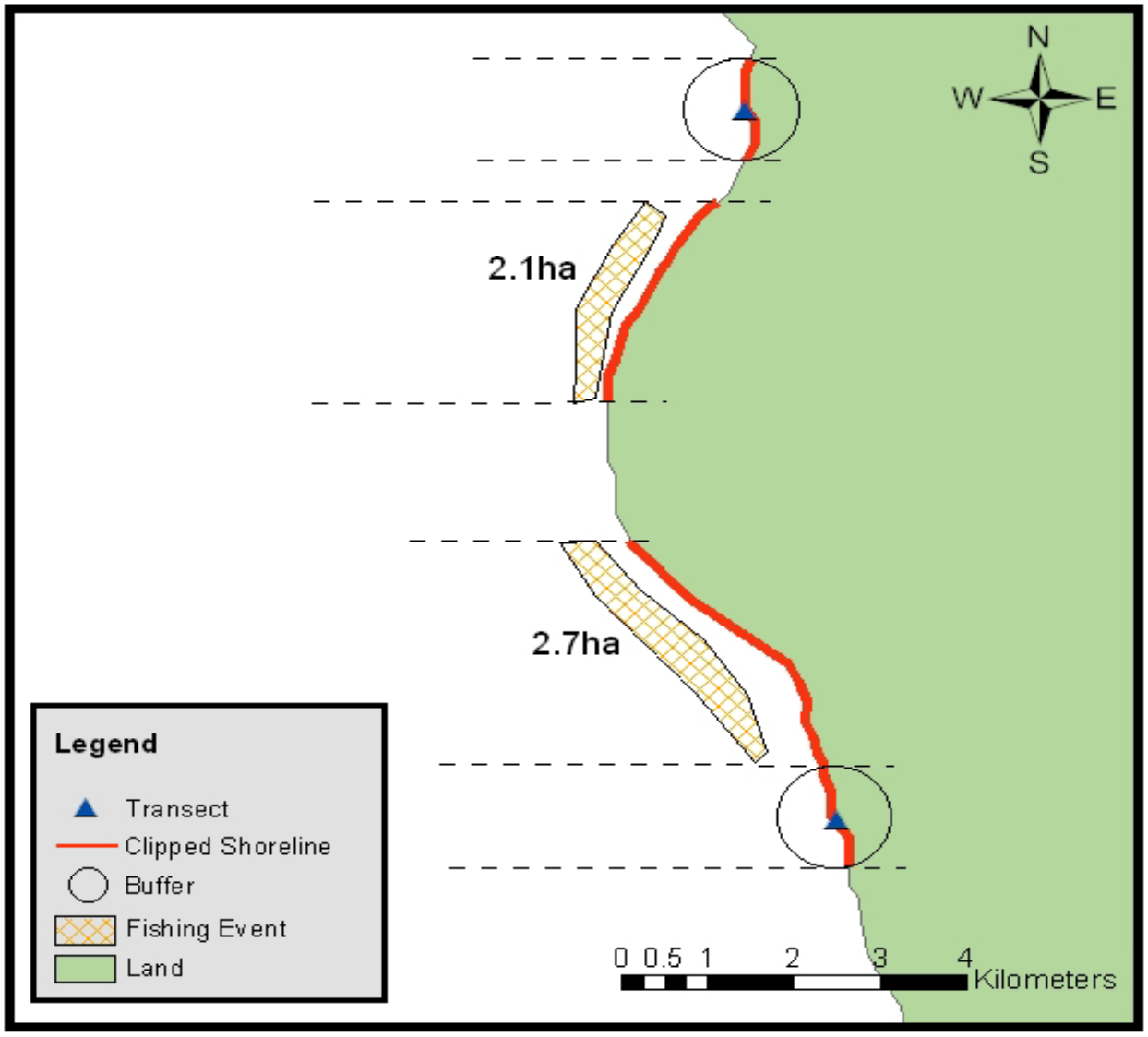

Figure 3. Identification of red sea urchin habitat from fishing events and the techniques used to extract Shoreline Length. Actual fishing events were not used in the figure above as this was for illustration purposes only.

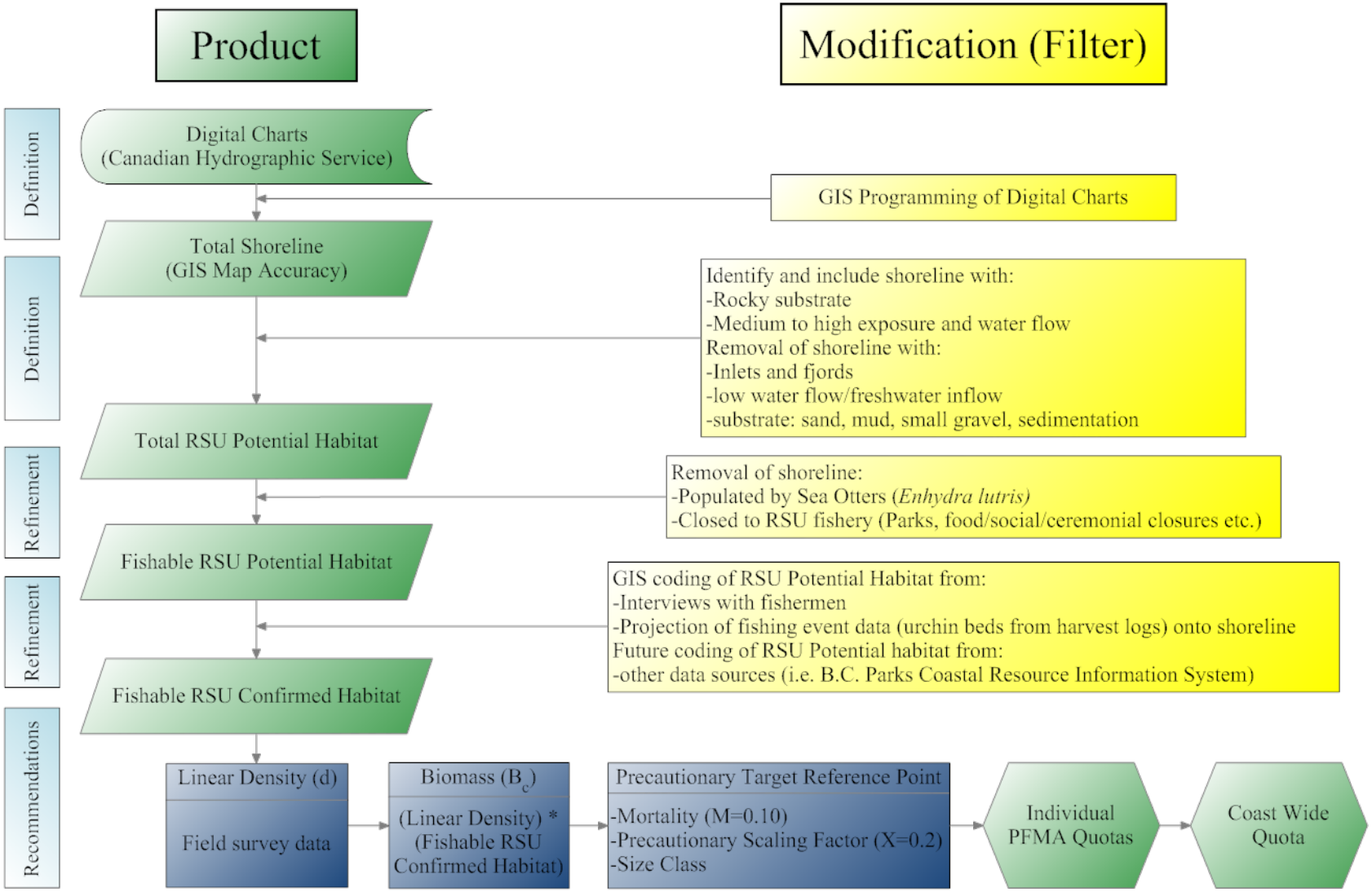

Figure 4. Iterative process for updating and refining estimates of red sea urchin (RSU) potential/confirmed habitat and quota options in BC.

Figure 5. Distribution of Sea Otters (Enhydra lutris) in British Columbia (DFO 2007).

9 APPENDIX 1: REQUEST FOR WORKING PAPER

PSARC INVERTEBRATE SUBCOMMITTEE

REQUEST FOR WORKING PAPER

Red Urchin Assessment Framework and Quota Options

Date Submitted: July 27, 2005

INDIVIDUAL OR GROUP REQUESTING ADVICE:

Resource Managers and Pacific Urchin Harvesters Association (PUHA)

PROPOSED PSARC PRESENTATION DATE:

November 2005

SUBJECT OF PAPER (TITLE IF DEVELOPED):

Assessment Framework for Red Sea Urchin Fishery and Quota Options for Fishing Season 2006/07

STOCK ASSESSMENT LEAD AUTHOR(S):

Alan Campbell and Dan Leus

FISHERIES MANAGEMENT AUTHOR(S)/REVIEWER(S):

Juanita Rogers, Guy Parker, Rick Harbo

OBJECTIVE OF THE WORKING PAPER:

Revise the assessment framework for red sea urchins (Campbell *et al.* 2001 *Quota options for the Red Sea Urchin fishery in British Columbia for fishing season 2002/2003*) using the most recent information for all parameters in the biomass estimation and produce quota options for fishing season 2006/2007.

RATIONAL FOR REQUEST:

In the past, quota options were presented on a biannual basis. An updated assessment framework will permit resource managers to work with stock assessment personnel to produce annual quota options, without requiring PSARC review.

Campbell *et al.* (2001) adopted a new process of estimating biomass to produce representative quota options. "Bed areas" for red sea urchins were redefined as those portions of the coast where urchins were likely found; consequently historical area estimates used in biomass estimations were "clipped" to use known fishing areas only. Subsequent to this paper the term "Bed areas" has been considered inappropriate and another term such as "fishable productive areas" is to be used for red sea urchins.

The assessment framework needs to be reviewed to reassess fishable productive areas information and, if necessary, to propose alternative methods to produce as up to date and accurate estimates as possible of red sea urchin biomass and quotas in British Columbia (B.C.).

The newly established assessment framework should permit the timely use of survey information, incorporating new fishable productive areas, animal weight and population density estimates into the stock assessment model in order to produce annual estimates of biomass and quotas.

QUESTIONS TO BE ADDRESSED IN THE WORKING PAPER:

1. Using digitized commercial fishery harvest charts, what is the most recent estimate of red sea urchin fishable productive areas on the B.C. coast?
2. What new data (i.e. fishable productive areas, observer fisheries, survey data, biological sampling data, market sampling data) are available and should be used for calculating quotas for fishing season 2006/2007?
3. How are parameter estimates extrapolated to fishable productive areas where no data are available and what are the sources of error that must be accounted for?
4. After considering all available data and the best possible method for calculating biomass, what is the total allowable catch available for fishing season 2006/2007 (mean estimate with confidence bounds). What levels of confidence/precaution can be applied to these estimates? The following is for example only: 1=surveyed, 2=unsurveyed but healthy population, 3=survey out of date, 4=area of concern.
5. What are the future directions for the quota calculation process?
6. What recommendations for collection of further information can be made that could assist and or improve the stock assessment process, i.e. which areas of the coast should be prioritized for survey, how often should areas be resurveyed, how could more accurate estimates of fishable productive areas be made?

STAKEHOLDERS AFFECTED:

ZC and FZC commercial licence holders, First Nations harvesters, other potential harvesters.

HOW ADVICE MAY IMPACT THE DEVELOPMENT OF A FISHING PLAN:

Essential to calculating quota options for the 2006/2007 commercial fishing season.