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An assessment of population trends and abundance of harbour seals (*Phoca vitulina*) in British Columbia

Une évaluation des tendances démographiques et de l'abondance du phoque commun (*Phoca vitulina*) en Colombie-Britannique

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TABLE OF CONTENTS

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ABSTRACT

Population trends and abundance of harbour seals in British Columbia are assessed based on aerial surveys conducted during 1966-2008 (197 flights). The assessment is an update of earlier assessments published in the *Canadian Journal of Fisheries and Aquatic Sciences* (Olesiuk et al. 1990a) and as a *Canadian Science Advisor Secretariat Research Document* (Olesiuk 1999). Progress since the previous assessment include: 1) an analysis of recent population trends based on census data collected during 1999-2008 (38 flights); 2) expansion of baseline survey coverage to include the central and northern mainland coast, the Discovery Passage area, and more extensive coverage on the west coast of Vancouver Island and in the Queen Charlotte Islands (an increase in coverage from 36% to 82% of the total British Columbia coastline) (26 flights); 3) updated population estimates with confidence limits that account for the inherent variability of aerial counts, uncertainty in correction factors to account animals in the water that were not counted, and – for areas yet to be surveyed – the variability in the density of seals observed among surveyed areas; and 4) a reconstruction of historic population trends to assess whether recent population increases represent the recovery of population that had been depleted by bounty kills and commercial harvests prior to the species being protected in 1970. Its estimated that the number of harbour seals in the Strait of Georgia, the area with the longest survey time-series, increased ten-fold from 3,760 (95% confidence interval of 3,200 to 4,320) when the first standardized censuses were conducted in 1973 to about 39,100 (95% confidence interval of 33,200 to 45,000) by 1994-2008. Populations grew at an annual rate of about 11.5% (95% confidence interval of 10.9 to 12.6%) during the 1970s and 1980s, but the growth rate began to slow in the mid-1990s and the population now appears to have stabilized. Based on counts conducted in Index Areas distributed throughout the province, the trend observed in the Strait of Georgia appears to be indicative of harbour seal populations throughout British Columbia. Total abundance of harbour seals on the B.C. coast in 2008 was estimated to be on the order of about 105,000 (95% confidence interval of 90,900 to 118,900) seals. Historic reconstructions indicate the population was depleted by a period of commercial harvesting during 1879-1914, and subsequently maintained below natural levels by predator control programs until the early 1960s. Already depleted, the population could not sustain a second period of intense commercial harvesting during 1962-1968 and was further depleted, but now appears to have fully recovered.

RÉSUMÉ

Ce document présente une évaluation des tendances démographiques et de l'abondance du phoque commun en Colombie-Britannique qui est fondée sur des relevés aériens réalisés entre 1966 et 2008 (197 vols). Il s'agit d'une mise à jour d'évaluations antérieurement publiées dans le *Journal canadien des sciences halieutiques et aquatiques* (Olesiuk et coll. 1990a) et en tant qu'Avis scientifique du Secrétariat canadien de consultation scientifique (Olesiuk 1999). Les améliorations suivantes ont été apportées par rapport au relevé précédent : 1) une analyse des tendances démographiques récentes reposant sur les relevés effectués de 1999 à 2008 (38 vols); 2) l'élargissement de la couverture des relevés de base pour inclure le centre et le nord de la côte continentale, la région du passage Discovery, et une couverture plus élargie de la côte ouest de l'île de Vancouver et des îles de la Reine-Charlotte (une augmentation de la couverture de 36 % à 82 % pour toute la côte de la Colombie-Britannique) (26 vols); 3) une mise à jour de l'estimation de la population avec des limites de confiance qui tiennent compte de la variabilité inhérente aux décomptes aériens, de l'incertitude des facteurs de correction pour les animaux en plongés non dénombrés, et – pour les zones n'ayant pas encore fait l'objet de relevés – de la variabilité de la densité des phoques observés dans les zones de relevé; 4) une reconstitution des tendances démographiques historiques pour déterminer si les augmentations récentes de la population sont le reflet du rétablissement d'une population décimée par la chasse à prime et la chasse commerciale avant que l'espèce ne soit protégée en 1970. Selon les estimations, le nombre de phoques communs dans le détroit de Georgia, la zone ayant la plus longue série chronologique du relevé, a décuplé, passant de 3 760 individus (3 200 à 4 320, intervalle de confiance de 95 %) lors des premiers relevés standardisés effectués en 1973, à quelques 39 100 (33 200 à 45 000, intervalle de confiance de 95 %) entre 1994 et 2008. Le taux de croissance annuel de la population a augmenté de 11,5 % environ (10,9 à 12,6 %, intervalle de confiance de 95 %) au cours des décennies 1970 et 1980, mais leur taux de croissance a commencé à ralentir au début des années 1990. La population semble maintenant s'être stabilisée. D'après les dénombrements effectués dans des zones témoins couvrant l'ensemble de la province, la tendance observée dans le détroit de Georgia semble être représentative des populations de phoques communs dans toute la Colombie-Britannique. On a estimé que l'abondance totale des phoques communs en Colombie-Britannique en 2008 était de l'ordre de 105 000 (90 900 à 118 900, intervalle de confiance de 95 %). Les reconstitutions historiques indiquent que la population a été décimée par les prélèvements commerciaux qui ont eu lieu entre 1879 et 1914 et qu'elle s'est maintenue par la suite sous les niveaux naturels en raison de programmes de contrôle des prédateurs mis en place jusqu'au début des années 1960. Cette population déjà affaiblie n'a pu supporter la deuxième période de prélèvements commerciaux intenses survenus entre 1962 et 1968 a été gravement décimée. Toutefois, elle semble maintenant s'être complètement rétablie.

1. INTRODUCTION

Harbour seals (*Phoca vitulina*) are widely distributed in temperate and subarctic waters throughout much of the Northern Hemisphere. Two subspecies occur in the Pacific, with *P. v. stejnegeri* inhabiting the western Pacific near Japan, and *P.v. richardsi* the eastern Pacific. The latter ranges from central Baja California northward as far as Bristol Bay and westward to the Aleutian and Pribilof Islands in Alaska (Shaughnessy and Fay 1977; Bigg 1981; Rice 1998). Harbour seals are common in coastal areas, inlets and estuaries throughout British Columbia, and also occur in some rivers and lakes (Fisher 1952; Spalding 1964; Bigg 1969*a*). Although animals may undertake local movements of up to several hundreds of kilometers associated with feeding, breeding, and moulting (Scheffer and Slipp 1944; Fisher 1952; van Bemmel 1956; Vaughn 1971; Paulbitski and Maguire 1972; Brown and Mate 1983; Jeffries 1986; Thompson 1989), the species is considered to be non-migratory. Indeed, satellite and radio telemetry have shown that animals generally exhibit a high degree of site fidelity, with movements greater than a few hundred kilometers being relatively uncommon (Pitcher and McAllister 1981; Harvey 1987; Huber et al. 1992; Olesiuk et al. 1995; Frost et al. 1996; Swain and Small 1997). Recent studies have indicated that breeding females exhibit strong fidelity to natal areas (Harkonen and Harding 2001), and populations exhibit significant mitochondrial DNA differences on scales on the order of a few hundred kilometers (O'Corry-Crowe et al. 2003), suggesting subpopulations need to be managed on a local scale.

In recent years there has been much interest in the status of harbour seal populations in the northeastern Pacific. In the southern part of their range (California to southeast Alaska), abundance of harbour seals, as have most other pinnipeds, increased dramatically following their protection in the early 1970s (Boveng 1988; Carretta et al. 2008; Olesiuk et al. 1990a; Olesiuk 1999; Jeffries et al. 2003; Brown et al. 2005; Pitcher et al. in 2007), and there is growing concern over their interactions with fishing activities and impact on fishery resources such as salmon (Mate 1980; Olesiuk 1993; Olesiuk et al. 1995, 1996; NMFS 1997). In the northern part of their range (Gulf of Alaska and Bering Sea), abundance of harbour seals, again as has been the case for many other pinnipeds, appear to have declined (Pitcher 1990; Frost et al. 1999; Small et al. 2003, 2008; Jemison et al. 2006; Mathews and Pendleton 2006; Angliss and Allen 2009), and the main focus has been on assessing the extent and ascertaining the causes of these declines (Small et al. 1997, 1998; ADF&G 2001; Springer et al. 2003; Herreman et al. 2009). There has also been growing interest in ecosystem-based management, and the role of seals as apex predators and how they may be impacted by or respond to changes in ocean conditions.

Knowledge of abundance and population trends is central to the management of wildlife and ecosystems, and considerable effort has recently been invested to census harbour seal populations in the northeastern Pacific. Since the early 1980s, a series of systematic harbour seal surveys has been conducted annually along the California coast (Miller et al. 1983; Hanan 1996; Lowry and Carretta 2003; Lowry et al. 2004). During the 1970s and 1980s, surveys were periodically conducted to monitor changes in relative abundance in Oregon and Washington State (Johnson and Jeffries 1977; Calambokidis et al. 1979; Brown and Mate 1983; Brown 1986; Jeffries 1986). During 1991-93 an intensive 3-year project was undertaken to determine total abundance off Washington and Oregon (Huber et al. 1992; Huber 1995; Brown 1997), and populations in those two states are now monitored routinely (Jeffries et al. 2003; Brown et al. 2005). In the early 1980s, several trend routes were established in Alaska to monitor harbour seal numbers at a fixed set of haulout sites, and the routes were monitored sporadically during the 1980s (Calkins and Pitcher 1984; Pitcher 1986, 1989). In the 1990s, the trend route surveys were expanded to other regions, and have since been monitored on an annual or semi-annual basis (Lewis et al. 1996; Mathews and Womble 1997; Frost et al. 1999; Hoover-Miller et al. 2001; Small et al. 1997, 1988; Jemison et al. 2006; Mathews and Pendleton 2006). In 1990, a major effort was launched to survey the entire state of Alaska (Loughlin 1992, 1993, 1994; Withrow and Loughlin 1995a), and the state-wide surveys are now being repeated on a 5-year rotational basis (Withrow and Loughlin 1996a, 1997a; Boveng et al. 2003). In each case, small fixed-wing aircraft have been used to count seals hauled out on land during peak diurnal haulout periods (typically low tide) either during the pupping season (California, Oregon, Washington and British Columbia) or the annual moult (Alaska).

It is widely recognized that harbour seal counts made at haulout sites will miss some proportion of animals that are dispersed at sea and virtually impossible to census. Coinciding with the recent increase in survey effort, there have been several important advancements in developing correction factors to account for swimming animals missed during surveys. During the late 1970s and through the 1980s, researchers began to use telemetry to establish the proportion of animals hauled out on land at any given time and how it varied seasonally, diurnally, and with environmental conditions (Pitcher and McAllister 1981; Stewart and Yochem 1983; Stewart 1984; Harvey 1987; Yochem et al. 1987), which provided the first basis for inferring what proportion of animals might have been seen during surveys (Harvey 1987; see also review by Boveng 1988). By the 1990s, researchers had begun to conduct surveys and telemetry studies concurrently, such that it was possible to calculate corrections that were more directly applicable to the census count. Hanan (1996) monitored radio-tagged animals at several haulout sites in California and was thus able to calculate correction factors based on the proportion of animals that came ashore each day during the survey period. Huber (1995) monitored radio-tagged seals during the actual survey flights, and was thus able to calculate correction factors based on the proportion of animals hauled out while counts were actually being made (Huber et al. 2001). These techniques have been employed to investigate how these correction factors vary geographically, by substrate type, and with survey conditions (Withrow and Loughlin 1995b, 1996b, 1997b; Simpkins et al. 2003; Harvey and Goley 2005).

Significant developments have also been made in assessing population trends from survey data. Frost et al. (1997, 1999) noted that it is impossible to always conduct harbour seal surveys under ideal or sometime even under similar conditions, so underlying population trends tend to be masked by “noise” introduced by factors that may confound counts, such as date, time-of-day, and time relative to low tide. In order to minimize such noise, they developed generalized linear (Poisson regression) models to adjust survey counts to a standardized set of “optimal” conditions, and showed that such standardized counts were far more powerful and accurate at detecting underlying population trends (Frost et al. 1996, 1999). Analogous models have been refined to include variables on continuous scales, interactions among them, and differences among haulout sites, and are now routinely applied in harbour seal assessments throughout Alaska (Lewis et al. 1996; Small et al. 1997, 1998; Adkison et al. 2003; Boveng et al. 2003; ver Hoef and Frost 2003).

In British Columbia, the first aerial harbour seal surveys were undertaken in the mid-1960s, and standardized aerial censuses were conducted periodically during the 1970s and regularly since the early 1980s. In the first harbour seal assessment, Olesiuk et al. (1990a) analyzed survey data collected up to 1988, and concluded that harbour seal populations in British Columbia had been increasing at a rate of about 12.5% per annum. Using a crude correction factor based on the variability of replicated surveys, they speculated that total abundance in B.C. had increased from about 9,000-10,500 when the species was protected in 1970, to about 75,000-88,000 in 1988, which they suggested represented the recovery from predator control kills and especially commercial harvests conducted between the late 1800s and 1960s. The most recent assessment (Olesiuk 1999), which included survey counts from 1988-

98 and increased survey coverage from 24% to 36% of the B.C. coastline, confirmed that populations had increased dramatically during the 1970s and 1980s, but that the growth showed signs of slowing or slowing by the mid-1990s. An improved correction factor to account for animals in the water and thus missed during surveys was also developed based on an analysis of haulout patterns from time-depth recorders. Applying the survey correction factor to estimate abundance in surveyed areas, and extrapolating the average density of seals observed in surveyed areas to unsurveyed areas, total harbour seal abundance in B.C. in 1998 was estimated to be about 108,000 (likely range 77,000 -156,000).

This report represents the third major assessment of harbour seal populations in British Columbia. Census data are updated to include surveys conducted during 1999-2008, which focused on obtaining baseline data in the Discovery Passage area (between Campbell River and the Broughton Archipelago) and the central-northern mainland coast, the last two large expanses of coastline in B.C. that had never been surveyed. Survey time-series for the Strait of Georgia, Broughton Archipelago, and Skeena River were also updated to establish recent population trends. The correction factors derived by Olesiuk (1999) from time-depth recorders are used to correct for swimming animals missed during surveys. Given the more widespread - and presumably more representative - survey coverage, improved estimates of total abundance are derived based on the density of seals observed in each statistical area (as opposed to extrapolations from other regions). Statistical confidence intervals for the abundance estimates are developed that incorporate 3 components: 1) the inherent variability of survey counts; 2) the uncertainty in survey correction factors based on variability of in haulout patterns; and 3) for areas where baseline surveys have not been conducted, the uncertainty in seal densities based on the range of seal densities observed in surveyed areas. To evaluate whether recent population increases represent the recovery of populations that had been depleted by over-hunting, historic population trends are reconstructed based on the number of animals killed for bounty and pelts.

2. METHODS

2.1 Study Area and Duration

Aerial harbour seal censuses (197 flights; Appendix I) were conducted throughout British Columbia. To facilitate compilation of survey data, 5 main regions were identified: 1) the Strait of Georgia including Jervis Inlet; 2) the west coast of Vancouver Island; 3) Queen Charlotte Strait including the Broughton Archipelago; 4) the Queen Charlotte Islands; and 5) the central-northern mainland coast including the lower Skeena and Nass Rivers and surrounding area (Figure 1). The surveyed portions of each region were further partitioned into subareas. The Strait of Georgia was partitioned into 8 subareas (*SGULF*, *BBAY, FRASERR*, *HOWESD*, *GULFISL*, *NEGULF*, *NWGULF, JERVIS*), the Queen Charlotte Islands into 4 subareas (*NEQCI*, *SEQCI*, *SQCI*, and *SWQCI*), the west coast of Vancouver Island into 5 subareas (*SWVANISL*, *BARKLYSD*, *CLAYOQUOT, MWVANISL*, *NWVANISL*), Queen Charlotte Strait into 3 subareas (*SQCSTR*, *NQCSTR*, and *BROUGHT*), and the central-northern mainland coast into 8 subareas (*DUNDAS-NASS, SKEENA, PORCHERISL, BANKSISL, MILLBANK, HUNTERISL, RIVERS, SMITH*). The subarea boundaries were originally delineated on the basis of areas that could be or had been surveyed within a single low-tide census window (see *Census Techniques*). Exceptions were *BBAY*, *FRASERR* and *HOWESD*, which could be surveyed together on one flight. Because of the expanded abundance of seals and number of haulout sites, the Strait of Georgia subareas, which were delineated in the early 1980s, can no longer be surveyed during a single tidal window. Nevertheless, the boundaries have been retained for consistency, such that comparisons for population trend analysis can be made for the exact same areas.

The primary study area was the Strait of Georgia (123 flights) which is herein defined as all Canadian waters from Race Rocks in the Strait of Juan de Fuca to the north end of Quadra Island (Figure 1). Traditional haulout sites in this area were first noted by the late Dr. Michael A. Bigg in the early-1960s during field studies and conversations with seals hunters. Subareas BBAY, FRASERR, GULFISL and a portion of SGULF were first surveyed in 1966. All subareas were surveyed at least once and most twice during 1973-74 with the exception of the NWGULF, which was first surveyed in 1976. During 1982-87, three to seven (mean=4.3) of the subareas were surveyed annually. Duplicate censuses were conducted in BBAY-FRASERR in 1985 and 1986, and the SGULF in 1987. In 1988, the entire Strait of Georgia was surveyed once just prior to and again toward the end of the pupping season (14 flights), and a major portion was surveyed a third time during the autumn moult (4 flights). During the 1990s the entire Strait of Georgia was surveyed biennially (1990, 1992, 1994, 1996, 1998, 2000), and again in 2003 and 2008. This area provides the most extensive time-series for assessing population trends.

Two or more censuses have also been conducted off the southwest and midwest coasts of Vancouver Island (10 flights), in Queen Charlotte Strait (9 flights), in a large portion of the Queen Charlotte Islands (11 flights) (see Olesiuk et al. 1993), and in the lower Skeena River and surrounding area (11 flights). These time-series, albeit short and sporadic, provide additional information on changes in abundance, and were thus useful for determining whether the population trends observed in the Strait of Georgia were indicative of those in other regions of the province.

In addition, Jervis Inlet was surveyed once in 1987 (one flight), the Discovery Passage area between Campbell River and the Broughton Archipelago was surveyed in 2003 (3 flights) and the central-northern mainland coast in 2004-2008 (16 flights). Portions of the Queen Charlotte Islands and west coast of Vancouver Island that had been missed during the original baseline surveys were surveyed in 2007 (2 flights) and 2008 (2 flights) respectively. Although trends in abundance could not be assessed from these single surveys, they nevertheless provided additional information on the density of seals in other regions and thus facilitated improved estimates of total abundance on the British Columbia coast.

2.2 Census Techniques

Aerial censuses were conducted from small, fixed-wing aircraft, typically a *Cessna 172, 180* or *185* or a *de Havilland Beaver*. The later model of aircraft was much preferred owing to its superior stalling characteristics, slower cruising speed, and because its window configuration was generally more suitable for photography. Aircraft were flown at an altitude of about 150-200 meters and an airspeed of 125 $km \cdot hr^{-1}$. Shorelines were followed and all islands circumnavigated at a distance of about 100-200 meters. All known haulout sites were specifically checked, and 1-3 observers scanned, usually with the aid of 8X40 or 7X35 binoculars, for new haulout sites and swimming animals. We always conducted detailed searches of the entire survey area, even during replicate surveys, as opposed to the site-to-site type replicates that have been conducted by some other agencies. Since 1998, portable Global Positioning Devices have been used to record locations of haulout sites. In 2003 we began recording flight tracklines at 5-10 second intervals as a more precise record of survey coverage. Visual counts were made of swimming animals and small groups (<10) of hauled out animals. Larger groups, unless widely scattered, were typically photographed with a hand held 35-mm SLR camera equipped with a motor drive and 135-200 mm lens using high speed *Ektachrome*

(*ISO* 200-400) or *Kodachrome* (*ISO* 200) colour slide film, and subsequently counted from projected transparencies. In 2003, we began using digital photography, and took images with a 6.1 megapixel *Nikon* D100 or 12.1 megapixel *Nikon* D200 camera equipped with a 135-200 mm lens (equivalent to a 200-300mm lens on a film camera). Digital images were shot in JPEG format (or RAW format and converted to JPEG format), and renamed and managed using *ACDSee* or *Aperture* software. Images were imported into Adobe PhotoShop CS for analysis, contrast and brightness levels adjusted if necessary, and counting areas delineated and seals tallied on separate layers using the Reindeer Graphics Image Processing Tool Kit plug-in (D. Withrow, National Marine Mammal Laboratory, Seattle, WA, pers. comm.).

The above protocol had to be modified for two categories of haulout sites. In the smaller estuaries along the east side of Vancouver Island, animals typically hauled out on logbooms primarily during the high tides that occurred at night (see Figures 6b and 7b), and during the day animals not out foraging were usually found resting in groups on the ocean bottom in shallow water. In such cases it was difficult to photograph animals and we would therefore circle these restricted areas and obtain relatively good visual counts of animals in the water. During the June-August census period, these small estuaries account for only about 5% of the total Strait of Georgia population (Olesiuk et. al 1990b). Some haulout sites, notably those in the northern Strait of Georgia, were comprised of numerous inter-tidal boulders scattered along beaches, and seals would haul out individually or in very small groups on each boulder. Some of these haulout sites were utilized by several hundred seals (the largest being Marina Reef with a maximum count of 594; Appendix II). Since these animals were usually too scattered to photograph, we would circle the area continuously, sometimes for up to 20 minutes, and make visual counts with the aid of binoculars until our estimates had stabilized[1].

Since 1973, censuses have been conducted under standardized conditions during which it was believed that maximum numbers of seals were hauled out (see *Results*; Olesiuk et al 1990a). Most importantly, censuses were timed to coincide with low tides that occurred between approximately 08:30 and 11:30 PDT. Summer tides in British Columbia are generally mixed semi-diurnal, such that there are generally two daily low tides that differ considerably in height, with a maximum scope of about 5 meters. Censuses usually began about 2.0-2.5 hours prior to the lower daily low tide, which typically ranged from about 0 to 1.5 meters above datum, and ended just before or within an hour after low tide. The precise point at which surveys were initiated and terminated was dictated by observations of seals made during the census flight (see *Discussion*). When possible, censuses in high traffic areas were conducted on weekdays so as to minimize disturbance by recreational boaters. Flights were canceled during inclement weather (i.e. rough seas, high winds or heavy precipitation) as seals appeared to be less inclined to haul out under such conditions and were difficult to count in the water. Censuses were generally conducted toward the end of the pupping season (see *Count Adjustments*). These preconditions limited censuses in a given region to usually two tidal cycles each year, each lasting 3-5 days. However, because pupping was earlier, census windows occurred about 1-1/2 months earlier on the northern coast than on the southern coast of the province.

[1]Given the larger buffers and faster memory cards offered in the latest generation of digital cameras, its possible to shoot longer sequences of overlapping images more rapidly, allowing even scattered animals to be photographed. In the most recent survey in the Strait of Georgia in 2008, essentially all seals observed (21,777 of 21,871) were photographed and subsequently counted from images.

2.3 Count Adjustments

Prior to trend analysis, survey counts were adjusted to account for: 1) known haulout sites that may have been missed during the survey flight; and 2) differences in the seasonal timing of surveys:

$$[1]\quad SC_{it} = C_{it} \cdot (1-M_{it})^{-1} \cdot B_{it}$$

where C_{it} is the raw count and SC_{it} referred to as the standardized count for the *i*th subarea in the *t*th year respectively.

The first adjustment, $(1-M_{it})^{-1}$, was made to account for known haulout sites in the subarea that were known to have been missed. Because flight paths varied slightly between years, some known haulout sites in a subarea, particularly those near its periphery, were occasionally not surveyed. In a few instances counts were not attempted or were discarded when it was obvious the site had recently been disturbed (evidence of the disturbance was seen at the time of the census). In such cases the expected proportion of seals in the subarea that would have been on the missed sites, M_{it}, was estimated based on the proportion of the total number of animals in the subarea that occupied the missed sites during the closest preceding or proceeding complete census. This adjustment was usually very minor because surveys were not used in the analysis unless coverage was nearly complete (range 82.0 to 100%; mean = 99.4%).

The second adjustment, B_{it}, accounted for differences in the dates of censuses, which was important when censuses were conducted at different stages of the pupping season. Life tables for harbour seals in the Strait of Georgia indicated that pups comprised 20.4% of the total (including pups) post-pupping population (Bigg 1969a; Olesiuk 1993), which is similar to the composition of pups at the end of the pupping season reported for other areas: 18.6% in the Shetland Islands (Venables and Venables 1955); 19.9-23.8% in Atlantic Canada (Boulva and McLaren 1979); 20.8% in Ireland (Summers et al. 1980); 16.3-21.4% and 14.2-17.8% in Netarts and Tillamook Bays, Oregon (Brown and Mate 1983), and 16.7% in Puget Sound (Calambokodis et al. 1985). Thus, if its assumed pups constitute 20% of the post-pupping population, the population would increase by a factor of 1.25 during the relatively brief pupping season. As a result, a series of counts conducted progressively later in the pupping season would tend to exaggerate the true rate of increase and *vice versa* (Jeffries 1986).

The potential for the aforementioned bias was minimized by adjusting all counts to post-pupping levels. Biggs's (1969a) observations of neonates in the Strait of Georgia indicated that pupping was normally distributed over time (Shapiro and Wilke's [1965] small sample procedure; W=0.976, n=39, P=0.648) with a mean pupping Julian date, μ, of 208 (27 July) and standard deviation, σ, of 16.1 days (Figure 2). Accordingly, correction factors to account for births subsequent to censuses in the Strait of Georgia, B_{it}, were obtained from a cumulative normal function:

$$[2]\quad B_{it} = 1.25 - \int_{-\infty}^{\frac{date-\mu}{\sigma}} \frac{1}{\sqrt{2\pi}} \cdot e \; dt \cdot 0.25$$

which was solved using standard normal tables (Snedecor and Cochran 1980). Corrections ranged from 1.25 for censuses conducted prior to any births to 1.00 for censuses conducted after pupping was completed. Except as noted below, censuses in the Strait of Georgia were conducted toward the end of the pupping season (03 August - 09 September) so this adjustment was generally minor, ranging from 1.000 to 1.082. However, corrections for the 1973 censuses (11-15 June) and the earliest 1988 census (30 May - 16 June), which were conducted prior to most births, ranged from 1.249 to 1.250. Corrections for the 1996 censuses of *SGULF*, *BBAY*, *FRASERR* and *GULFISL* (27-28 July), which was about midway through the pupping season, ranged from 1.107 to 1.131.

Since the pupping season varies with latitude (Bigg 1969b; Temte et al. 1991), it was assumed that the timing of pupping in Jervis Inlet, off the west coast of Vancouver Island, and in Queen Charlotte Strait was similar to that in the Strait of Georgia, and equation [2] was thus used to adjust counts in those areas to post-pupping levels. Any violation of this assumption would have had a minimal effect because the censuses were conducted late (25 August - 20 September) in the pupping season such that the corrections were minor; 1.001 to 1.011.

Quantitative data on the timing of pupping in the Skeena River were not available, but it is known to occur earlier than in the Strait of Georgia (Bigg 1969b). Fisher (1952) reported that pupping in the Skeena River began in late May, peaked in early June, and was completed by late June. Assuming that the mean pupping date was on Julian day 161 (10 June) and that the duration of the pupping season was similar to that in the Strait of Georgia, an adjustment for the Skeena River counts was obtained by displacing the Strait of Georgia curve 47 days to the left (Figure 2). Because the Skeena River censuses were conducted toward the end of the pupping season and on virtually the same date most years, the correction factors were generally minimal, 1.006 to 1.143, and had a negligible effect on population trends.

The Skeena River pupping curve was also applied to counts for the Queen Charlotte Islands, since the two regions were at similar latitudes. The applicability of the Skeena River curve was substantiated by the recoveries of term fetuses by seal hunters in the Queen Charlotte Islands (B. and D. McNaughton, General Delivery, Sechelt, British Columbia, V0N 3A0, pers. comm.), which indicated that pupping peaked during late May or early June (Olesiuk, unpublished data). Since the Queen Charlotte censuses were conducted after most pups had been born (04-24 July), the correction factors were small, 1.001-1.072.

The unadjusted counts for haulout sites, maps showing their location, the adjustment factors used for missed sites and unborn pups, and the total standardized counts are given Appendices II and III. The standardized counts are intended to represent counts made as if the geographic coverage and timing (relative to the pupping season) of surveys had been identical in all years. They thus still reflect all of the inherent variability due to the inaccuracy of visual counts or interpretation of photographs, imprecision and inaccuracies in the adjustment factors, inter-observer biases, immigration and emigration from the census area, variability in numbers hauled out during surveys due to different tidal and environmental conditions, etc.

2.4 Absolute Abundance

The standardized counts undoubtedly underestimated actual abundance because some animals were not hauled out during the survey, and swimming animals were virtually impossible to census. Actual abundance in the *i*th subarea and *t*th year, N_{it}, was estimated from its corresponding standardized counts, SC_{it}, as:

[3] $N_{it} = SC_{it} \cdot p_{it}^{-1}$

where p_{it} is the estimated proportion of animals hauled out during the survey, with its reciprocal $1/p_{it}$ commonly referred to as the census correction factor (Huber 1995; Huber et al. 2001).

The proportion of seals hauled out during surveys was estimated based on haulout patterns as indicated by time-depth recorders (TDRs). That study will be reported in detail elsewhere, and the following brief overview is provided only to assist readers in understanding the census correction factors developed and utilized in this study. The analysis is based on TDRs deployed at 10 haulout sites (although many animals were subsequently observed utilizing haulouts other than where they were captured) in the Strait of Georgia during 1990-94 and subsequently recovered from 34 animals (Table 1). The instruments provided a continuous record (at 20-30 second intervals) of whether an animal was hauled out or in the water over deployment periods ranging from 12 to 154 days (mean=94.3 days), primarily between early May and the end of August (Figure 3). The entire TDR database was comprised of data for 3,209 seal·days^{-1} (about 11.6 million data points), during which period the instruments recorded a total of 3,632 haulout bouts over the course of about 6,160 low tide cycles.

The proportion of time animals spent hauled out was fairly consistent and did not differ significantly among years (Figure 4a; $F_{4,29}$=1.08; P=0.385), between areas (Figure 4b; $F_{3,30}$=0.66; P=0.584), among age- and sex-classes (Figure 4c; $F_{2,31}$=0.46; P=0.633), or with body size (Figure 4d; r^2=0.0958; $F_{1,32}$=3.39; P=0.075). Data for all years, areas and animals were thus pooled for subsequent analysis. There was, however, a significant seasonal trend, with animals spending significantly more time hauled out in August than earlier months (Figure 4e; $F_{3,113}$=10.16; P<0.001). The seasonal increase in time spent ashore was primarily attributable to and significant only for adult females (Figure 4f; $F_{3,41}$=21.73; P<0.001), and was not evident in any of the other sex- or age-classes ($F_{3,30}$=0.02; $F_{3,24}$=2,43; $F_{3,1}$=0.61 for adult males and juvenile females and males; 0.085<P<0.997). The increase in time spent ashore for adult females appeared to be associated with a suite of behavioural changes that coincided with parturition (Figure 5a). Further analysis showed that while these presumably nursing females hauled out more frequently, most of the extra time spent ashore occurred at high tides and during the night (Figure 5b). In other words, although nursing females spent a greater amount of time ashore, the probability of them being hauled out and seen during surveys did not change appreciably because most of the extra time spent ashore occurred outside the survey window. Data were thus also pooled seasonally in estimating census correction factors.

The TDR records indicated that seals tended to initiate haulout bouts in mid-morning and terminate haulout bouts in late-afternoon (Figure 6a), such that the proportion of animals hauled out peaked just after mid-day (Figure 6b). Seals also tended to initiate haulout bouts several hours before low tide on ebbing tides, and terminate haulout bouts on several hours after low tide on flooding tides (Figure 7a), such that the proportion of animals hauled was greatest during low water levels (Figure 7b). Not unexpectedly, the two animals captured in Cowichan Bay, one of the small estuaries along the east side of Vancouver Island, exhibited a striking departure from this normal pattern, hauling out most often at night and on high tides (Figure 6b and 7b). A third animal, caught at Snake Island (a typical tidal haulout site) but subsequently observed to frequent the Nanaimo River estuary on a regular basis, also spent an inordinate amount of time hauled out at night and on high tides (Figures 6b and 7b).

The most dominant factors dictating the proportion of animals hauled out at a given time were time-of-day, height of the low tide, and most importantly the time relative to low tide. The latter was deemed the most important because, irrespective of the time or height of the low tide, the TDR data revealed a consistent (outside of estuaries) pattern in which the proportion of seals ashore increased during ebbing tides, peaked at low tide, and subsequently decreased during flooding tides. This consistent pattern is subsequently referred to as the *haulout* *response curve* (Figure 8). While consistent in its general shape, it varied in amplitude depending on the height and time of the low tide. In general, there was an inverse relationship between the height of the low tide and the peak proportion of seals hauled (Figure 8a). However, there was also a significant effect of time, particularly for higher low tides, such that a greater proportion of animals hauled out when the low tide occurred during daylight as opposed to night (Figure 8b).

In order to estimate the proportion of animals hauled out and presumably counted during aerial surveys, a haulout response curve was generated that approximated the tidal conditions during each survey flight. In doing so, first I excluded all time-depth records on days there was heavy precipitation, as it adversely affected haulout behaviour ($F_{3,3101}$=13.00; P<0.001) (Figure 9) and censuses were never conducted under such conditions (see *Census Techniques*). Because heavy rain was relatively uncommon during summer months, this resulted in the exclusion of only about 0.2% of all time-depth records. Second, since my objective was to derive a correction factor for typical tidal haulout sites[2], I also excluded the time-depth records for the two Cowichan Bay animals as well as a third animal that frequented the Nanaimo River estuary on a regular basis. I then generated a haulout response curve for tidal conditions similar to the low tide that prevailed during the survey; similar tides being defined as those that occurred at approximately the same time of day (±1.0 hours) and were similar in height (±0.5 meters). Data for all similar tides were tabulated for each of the remaining 31 instrumented animals, and subsequently averaged to determine the mean proportion hauled out (and its standard error) as a function of time relative to low tide. Although much greater precision could have been obtained by simply averaging all similar tide cycles (because of the larger sample sizes and also because there was generally less intra-animal than inter-animal variation), I nevertheless averaged over animals as the objective was to estimate the mean proportion of *animals* hauled out at a given time (as opposed to the mean *proportion of time* that all instrumented animals had spent hauled out at a given time).

The haulout response curve was subsequently used to adjust each count during the survey flight based on the time it had been made relative to low tide. In other words, the correction depended not only on the height and time of the low tide on which the survey was conducted, but also precisely when within the tide cycle the counts had been made. The overall weighted mean proportion of animals hauled out during the survey, p_{it}, was calculated as:

$$[4] \quad p_{it} = \sum_{j=1}^{n} \left[p_{ijt} \cdot SC_{ijt} \right] \Big/ \sum_{j=1}^{n} SC_{ijt}$$

where SC_{ijt} represents the adjusted count for the jth of n haulout sites in the ith subarea in the tth year, and p_{ijt} the estimated proportion hauled out when the jth count had been made.

An example illustrating the derivation of the correction factor for the most recent survey flight (prior to the 1998 survey data being available) on 14-August-96 is shown in Figure 10.

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[2]A crude correction factor was also developed for small estuaries based on the two Cowichan Bay TDRs. It was assumed that animals were either actively foraging or were resting in the estuary, and since both hauled out and swimming animals were counted in estuaries, it was further assumed that all non-foraging animals would have been counted during surveys. From the TDR records, it was estimated that during the typical 08:00 to 12:00 PDT census period the two estuarine animals spent an average of 62% (range 51-72%) of their time actively diving (to depths greater than 10 meters (which is deeper than the shallows where animals were typically seen resting and could be counted) and the remaining 38% hauled out or milling in shallow water. It was therefore assumed that 38% of all estuary animals were counted during surveys, giving a correction factor of 2.6. This crude correction factor had little effect on the overall results since animals inhabiting the small estuaries accounted for only about 5% of the total Strait of Georgia population during the June-August census period (Olesiuk et al. 1990b).

Figure 10a gives an overview of the survey day, which was a bit unusual in that it had only one low tide. This happens about once a month because the lunar tidal cycle is slightly longer than a solar day. Nevertheless, there was a low tide just before midnight and another just after midnight. As is typical of the spring tides (it being two days before new moon) on which the censuses were usually conducted, the lower low tide (1.09 meters at 11:23 PDT) was the only low tide that occurred during daylight and was considerably lower than the low tides that preceded and proceeded it (3.87 meters at 23:35 PDT and 3.03 meters at 00:10 PDT).

The three haulout response curves corresponding to similar low tides (in this case defined at tides of 3.37 to 4.37 meters between 22:35 and 00:35 PDT, 0.59 to 1.59 meters between 10:23 and 12:23 PDT, and 2.53 to 3.53 meters between 23:10 and 01:10 PDT respectively; of which 110, 520 and 629 such tides had been monitored by the time-depth recorders) indicated that seals clearly preferred to haul out on the lower low tide that occurred during daylight as opposed to the higher low tides that occurred at night. Indeed, a maximum of nearly 70% of animals would expected to be ashore at the lower low tide. Incidentally, integration of the area beneath the three haulout response curves from midnight to midnight indicates that animals spent an average of about 25.0% of the day hauled out, which is slightly above the overall mean of 21.2% (Figure 4a).

Figure 10b shows the survey period in much greater detail. As indicated in the top panel, the first of the 38 haulout sites surveyed on the flight was counted at 09:24 (119 minutes before low tide), and the last counted at precisely noon (37 minutes after low tide). As indicated in the middle panel, the survey period generally coincided with the peak of the haulout response curve for similar tidal conditions. The estimated proportion of animals hauled out increased from 0.563 for the first count to a peak of 0.673 at 11:12 (11 minutes before low tide), and subsequently declined to 0.650 by the last count. The bottom panel shows the raw survey counts (solid bars) and the corresponding actual abundance estimates (vertical lines with SE bars) based on the proportion of animals hauled out at the time the count had been made (middle panel). Summing the abundance estimates for all sites, and dividing by the sum of the adjusted counts (equation [4]) gives a mean overall weighted estimate of 0.624 (SE=0.051), with a corresponding census correction factor of 1.60 for the 14-August-96 survey flight.

The variance of the correction factor was estimated, as per Mood et al (1974) cited in Huber (1995), using the delta method:

$$[5] \quad \mathrm{Var}\,(1/p_{it}) \approx \mathrm{Var}\,(p_{it})\,/\,p_{it}^{4}$$

where Var(p_{it}) represents the square of the weighted standard error.

Assuming that the variances of the correction factor (derived from time-depth recorders) and of the adjusted counts (based on aerial survey counts and pupping curves) were independent of one another, the overall variance of the abundance estimate, Var(N_{it}), can be gotten by:

$$[6] \quad \mathrm{Var}(N_{it}) = 1/p_{it}^{2}.\mathrm{Var}(SC_{it}) + SC_{it}^{2}.\mathrm{Var}(1/p_{it}) - \mathrm{Var}(1/p_{it}).\mathrm{Var}(SC_{it})$$

as per Goodman (1960). However, one might actually expect the two variances to be inversely related (see example in *Discussion*), the resulting confidence limits may be conservative (i.e. wider than necessary).

Since tidal regimes (mean sea level, scope of tides, general patterns) vary in other regions of the province, no attempt was made to extrapolate the haulout response curves beyond the Strait of Georgia. Nevertheless, because the basic haulout behaviour appears to be similar throughout the species range (see Discussion) and because the surveys in other regions were conducted under comparable conditions, abundance for other regions was estimated by applying the overall mean ot the correction factors derived for the Strait of Georgia surveys.

On 29 August, 2000, a series of surveys (7 flights) was conducted to evaluate the performance of the correction factor. An area containing 17 haulout sites (peak count 0,000 seals) that could be surveyed in about 1.5 hours was repetitively surveyed 7 times throughout the tide cycle, with the first survey starting at 06:37 PDT (5.6 hours prior to low tide), and last survey finishing at 18:26 PDT (6.2 hours after low tide). The mean and CV for the raw and adjusted counts were calculated for each survey to determine how much of the diurnal variability of counts was removed by the correction factor.

2.5 Trend Analysis

Population growth rates for each of the *i*th subareas were estimated from log-linear regressions of abundance, N_{it}, over time, t. Mean annual finite growth rates, α, were derived from the slopes of the regressions, b, by:

[7] $\alpha = e^{b} - 1$

In order to determine whether growth rates had been constant over the study period, I also fitted second-order polynomial regressions:

[8] $\ln N_{it} = [a + b \cdot t] + [c \cdot t^2]$

whereby the first-order term was forced into the regression and the improvement gained by adding the second-order term evaluated. This procedure is in essence a modification of DeMaster et al's (1982) Dynamic Response Assessment in that the first term of the equation describes a population increasing exponentially at a constant rate, whereas the second term allows for depensatory changes in the growth rate over time.

Where there was evidence of density dependence, population trajectories were described by a generalized logistic model:

[9] $N_{t+1} = N_t + N_t \cdot R_{max} [1-(N_t/K)^{\theta})]$

where R_{max} represents the maximum finite rate of increase that occurs in the absence of any density dependence, K the level at which the population stablizes (carrying capacity), and θ a shape parameter that allows for non-linear depensatory responses (θ=1 represents the classic logistic model). The model was constrained such that N_t never exceeded K (i.e. any overshooting and subsequent oscillations around K were considered as noise), and was fitted by least squares criteria assuming that errors were proportional to counts (constant *CV*) with a FORTRAN routine kindly made available by J. Laake (National Marine Mammal Laboratory, 7600 Sand Point Way N.E., Bldg. 4, Seattle, Washington, 98115, personal communication). The annual abundance estimates were weighted by the square root of number of replicate surveys conducted (for subareas) or proportion of animals surveyed for the entire Strait of Georgia (see below). Confidence intervals for the parameter estimates were obtained by bootstrapping, with 1,000 replicates.

Abundance within the entire Strait of Georgia was estimated by summing the adjusted abundance estimates within each of its 7 subareas. Abundance for subareas not surveyed in a particular year was estimated by interpolating between the preceding and proceeding censuses on a logarithmic scale, which assumes that rate of population change was constant between surveys. Abundance for subareas prior to its first survey was extrapolated from the earliest survey by assuming that the proportion of the population within the subarea had remained constant relative to those subareas that had been surveyed. For example, the *NWGULF*, which comprised 12.5% of total abundance in the Strait of Georgia when first surveyed in 1976, was assumed to have also comprised 12.5% of total abundance in all years prior to 1976. In effect, this summation procedure merely re-scales the trends observed in surveyed subareas into terms of abundance in the entire Strait of Georgia.

The population growth rate for the entire Strait of Georgia was subsequently estimated from a log-linear regression of total abundance over time. However, in order to minimize the interdependence of the estimates arising from the between-census interpolations, each yearly estimate was weighted according to the square root of the proportion of the total population actually censused that year. Consequently, estimates that had been purely interpolated had no influence on the regression whereas estimates for years with extensive survey coverage exerted the greatest influence.

The same procedure of combining abundance estimates and fitting weighted log-linear regressions and generalized logistic models was used to examine overall population trends for all areas that had been surveyed outside the Strait of Georgia. Survey data for the Broughton Archipelago were excluded from the index, as there was evidence populations may be have locally depleted in the mid-1990s by predator control at salmon farms (Jamieson and Olesiuk 2001). Combined, the remaining index areas represented about 33% of the total estimated abundance outside of the Strait of Georgia (see Section 3.3).

2.6 Population Estimates

Following Olesiuk et al. (1999), total abundance of harbour seals on the British Columbia coast was estimated by extrapolating the abundance of seals observed in surveyed areas to those areas that have not yet been surveyed. Density was calculated in terms of number of seals per kilometer of shoreline. In the original analysis, shoreline lengths were interpolated from 1:100,000 scale digitized maps (World Database II), which had been shown to give good agreement with those manually traced from 1:525,000 scale nautical charts (Olesiuk et al. 1990a; Olesiuk 1999). For this analysis, the survey data were incorporated into a Geographic Information System using ArcView 9.3 software. Relative coastline length was interpolated from 1:50,000 scale digitized CHS charts from DFO Oceans and Habitat GIS Unit's spatial holding (http://www-heb.pac.dfo-mpo.gc.ca/maps/basedata_e.htm), which yielded shoreline lengths that were highly correlated with those used in the original analysis (r^2=0.844; $F_{1,28}$=0.00; P<0.001). Relative shoreline lengths were expressed in terms of an absolute total coastline length of 27,200 km (M. Browning, Canadian Hydrographic Service, Victoria, British Columbia, pers. comm.). Differences in the observed densities of seals was subsequently assessed with *ANOVA*, and the total number of seals in British Columbia estimated by extrapolating what was considered to be a representative density to the unsurveyed portion of the coast (see Section 3.3 for details).

2.7 Reconstruction of Historic Trends

Although survey data are not available to assess harbour seal trends prior to the species being protected in 1970, there are records on the number of bounty payments and the seal pelts harvested in British Columbia dating back to 1879 (Table 7). A simple model was used to assess whether these kills were of sufficient magnitude to have depleted the population prior to the first censuses being conducted in the early 1970s. The model, originally developed by Smith and Polacheck (1979), is based on the premise that the population change from year *t* to year *t*+1 will reflect the difference between the number of animals born into the population and the number of animals dying of natural causes or removed through hunting:

$$[10] \quad N_{t+1} = N_t - C_t + (N_t - C_t)\,(\beta - \delta)$$

where N_t and N_{t+1} represents the population size in year *t* and *t*-1 respectively, C_t is the number of animals killed in year *t* (assumed to be taken at the beginning of the year), and β and δ denote the annual finite birth and death rate respectively. Given that $(\beta-\delta)=\lambda$, the last term can be replaced with λ, the population multiplication rate, and the equation rearranged to give:

$$[11] \quad N_t = N_{t+1} / (1+\lambda) + C_t$$

Smith and Polacheck (1979) also described how the model could be modified when half the kill occurs at the beginning and half at the end of the year, and their modification can be generalized:

$$[12] \quad N_t = [N_{t+1} + F \cdot C_t / (1+\lambda)\,] + F \cdot C_t$$

where *F* represents the fraction of the kill taking place at the beginning of the year (prior to any births and deaths), with the remainder of the kills taken place at the end of the year (after births and deaths have occurred).

Given a record of the numbers of animals killed annually, the equation can be used to reconstruct historic population trends. Equation [12] predicts that the population will decline in years in which the harvest levels exceed the natural replacement rate, and the population will grown in years in which kills are below the replacement rate. Heide-Jorgensen and Harkonen (1988) used the model to reconstruct harbour seal populations in the Kattegat-Skagerrak, and Reijnders (1992, 1994) used it to reconstruct harbour seal populations in the Wadden Sea and in the Delta area in the Netherlands.

The model requires input in the form of three parameters: 1) an estimate of initial population size, N_0, at the beginning of the reconstruction; 2) an estimate of the finite growth or net replacement rate, λ; and 3) a time-series of the number of seals killed each year, K_t. Estimates of the initial population size in 1973 were derived in Section 3.1, and the finite growth rate is estimated in Section 3.2. Numbers of bounty payments paid for seal snouts and seal pelts purchased by fur buyers were compiled from Fisher (1952), Bigg (1969a), Annual Fisheries Reports, and unpublished archival files on the bounty program and commercial seal harvest, including semi-annual reports filed by fur buyers (Table 7). In addition to the bounty and commercial kills, there were records of smaller numbers of seals killed, or in a few cases probable kills, by DFO Departmental staff for predator control. Although a complete record of the number of bounties paid and pelts purchased is available dating back as far as 1879, this represents only a fraction of the number of seals actually killed, as many seals sink when shot and carcasses are lost. Also, its likely that only some fraction of Departmental predator control kills being recorded as probable predator were actually killed. The actual number of seals killed each year was thus estimated as:

$$[13]\ C_t = (B_t + H_t) \cdot R + DK_t + PDK_t \cdot PK_t$$

where B_t and H_t represents the number of bounties paid and pelts purchased in year t respectively, R denotes the recovery rate of carcasses, DK_t and PDK_t the number of seals positively and probably killed each year by DFO staff for predator control, and PK_t the estimated proportion of the probable kills that were actually killed. The carcass recovery rate, R, was estimated by averaging recovery rates reported for harbour seals by experienced seal hunters and researchers (see Section 3.4 for details), and it was assumed that 0.75 of the probable predator control kills were actually killed.

A series of *Monte Carlo* simulations were run to assess how parameter uncertainty might affect the reconstruction. The estimated values for initial population size, N_{1973}, and finite multiplication rate, λ, were assumed to be normally distributed, $N(\mu,\sigma)$, with means and standard deviations as outlined Sections 3.3 and 3.4 respectively. However, the estimate of initial population size involved some subjective bias correction for missed sites, which was not factored into the confidence limits. We therefore added a component of variability that allowed the bias correction for missed sites to range uniformly from none to twice that used (i.e. anywhere from none of the new sites or 2/3's of the new sites had been missed in the early surveys), which nearly doubled the confidence limits for initial population size. Various estimates of carcass recovery rates, R, have been made by seal hunters and researchers, and this parameter was allowed to vary uniformly over the reported range. Seals were killed throughout the year, but information on the seasonal distribution of kills was only available for some years, and reflects when payments were claimed or pelts sold, rather than when seals were actually killed. However, the model was insensitive to the seasonal distribution of kills, so F was allowed to vary uniformly over its entire plausible range, 0 to 1, and the proportion of probable kills actually killed was allowed to vary uniformly from 0.5 to 1. A total of 500 sets of parameter estimates were drawn from the above distributions, and the population projected from 1973 backwards as far as 1879, the year in which the first commercial harvest was known to have been taken.

A second model developed for reconstructing whale populations (IWC 1999) was also fitted to the seal kill data for comparison. This simpler model projects the population forward through time:

$$[14]\quad N_{t+1} = N_t + \lambda \cdot N_t - C_t$$

It requires that a starting value (N_{1879}) be selected by trial-and-error until the projection produces an endpoint (N_{1970}) that is consistent with the earliest abundance estimate. While this makes it cumbersome to run *Monte Carlo* simulations to assess effects of parameter uncertainty, the model can easily be adapted to include potential density dependent effects:

$$[15]\quad N_{t+1} = N_t + \lambda \cdot N_t\, [1 - (Nt/K)^{\theta})] - C_t$$

where θ is the shape parameter of the generalized logistic model (equation [9]). I ran the density-dependent model with θ values of 2.5 (moderately skewed production curve) to 6.77 (sharply skewed production curve as observed in the Strait of Georgia survey time-series).

3. RESULTS

3.1 Absolute Abundance

Every effort was made to rigorously standardize the survey methods utilized during the study. Either the author or the late Dr. Michael A. Bigg served as the primary observer for all but 4 of the 197 (98%) survey flights (PFO on 76% and MAB on 22% of the flights respectively), and during 1982-88 we flew most of the surveys together (Appendix I). Variation attributable to differences in techniques among observers was thus probably negligible, and methodology can be regarded as consistent through the study period.

The majority of counts (95%) were made within the prescribed census window of 2.5 hours before to 1 hour after low tide, and most (97%) were made between 08:00 and 12:00 PDT (Figure 11). However, several of the inaugural survey flights made in early 1970s, which in retrospect it would seem the timing of censuses was still being developed, began as much as 5 hours before low tide (Figure 11) when water levels were still high and fewer animals would be expected to be hauled out (see Figure 8).

The majority of animals observed during surveys were subsequently counted from photographs. For example, in the 1996 survey, which was typical of surveys conducting using film cameras, 91.5% of seals were counted slides. For the remaining 8.5%, about one-third of animals were not photographed because they occurred in small groups that could be easily counted visually, or the photographs were of inadequate quality to count, and the remaining two-thirds of animals were counted in the water in small estuaries or on haulout sites comprised of boulder beaches where they were too scattered to photograph. As noted previously, in both cases we repetitively circled these sites until we were satisfied with their accuracy of our visual counts. With respect to the photographic counts, blind comparisons among different readers indicated that variability in interpretation of the photographic slides was negligible (Figure 12). During 2000-2006, when we were still using film and recorded both visual and photographic counts in the survey database, 89.3-94.5% of the total seals enumerated annually have been counted from photographic images. With the advent of digital photography, and larger buffers and faster memory cards that allow for longer and more rapid photo sequences, it is now possible to photograph even scattered animals, resulting in a shift away from visual counts. During the most recent surveys conducted in 2007-2008 surveys, only 1% (351 of 33,959) of the seals counted had not been documented in the digital images.

The *standardized* aerial counts appeared to provide a reliable and reproducible index of abundance. The coefficient of variation (*CV*; defined as the standard error of the mean expressed as a proportion of the mean) for surveys replicated within a few days or months of each other ranged from 0.01 to 0.16 (mean=0.064) (Table 2). This was similar to the *CV*s ranging from 0.01 to 0.10 (mean=0.042) reported by Huber (1995) for replicated surveys in Washington State, which were conducted by very experienced primary observers using essentially identical census methodology, which suggests that *CV*s of this magnitude reflect the inherent variability of surveys of this nature (Eberhardt et al. 1979). The overall mean *CV* of 0.064 was therefore applied to all adjusted counts where replicates were unavailable. It should be noted that these *CV*s were calculated based on the variability of the total counts for the entire area, as opposed to the average variation among individual haulout sites within the area. Although the latter generally provides much lower *CV*s, it requires independence of sites and hence implicitly assumes there are no day-to-day movements of animals between haulout sites, which is known not to be the case in the study area (Olesiuk, unpublished. data).

The estimated proportion of animals hauled out within subareas on survey flights ranged from 0.32 to 0.71 (mean=0.612), with corresponding correction factors thus ranging from 1.41 to 3.13 (mean=1.74) (Figure 13). The lowest proportions were associated with several flights made in the early 1970s that began very early in the tidal cycle while many animals had not yet hauled out (Figure 13). Several values in the mid 1980s were also atypically low, and represent surveys that were continued well beyond low tide when many animals had already begun vacating haulout sites. On an annual basis, the weighted mean proportions hauled out were less variable, ranging from 0.54 to 0.67 (mean=0.615). Corresponding annual correction values ranged from 1.49 to 1.85 (mean=1.63), with *CV*s ranging from 0.072 to 0.169 (mean=0.042). The proportion of animals hauled out during surveys tended to increase slightly over the course of the study (r^2=0.120; $F_{1,121}$=10.6; P<0.001), with the regression indicating that the average proportion hauled out increased from about 0.58 when the first censuses with correction factors were conducted in 1973 to 0.65 by 1998. This can likely be attributed to refinements in census techniques, most of which appears to have occurred prior to the mid-1980s (Figure 13). Since 2000, the correction factors have been fairly consistent (range 1.48 to 1.70) and show no temporal trend (r^2=0.0009; $F_{1,18}$=0.16; P=0.900).

The sequence of calculations used to estimate actual abundance from survey counts are illustrated here for one of the censuses of the Strait of Georgia conducted in 1996 (the example was formulated by Olesiuk (1999) before the 1998 data were available), since it shows the full spectrum of adjustments and corrections (see Appendix II). A total of 22,663 animals were actually observed during the survey, of which 1,926 visually counted and 20,737 were subsequently counted from photographs. The survey covered most of the Strait of Georgia study area, except for 15 haulout sites, several of which were fairly substantial, in the northern reaches of the *NEGULF* and one minor site in *HOWESD* (denoted as *ns* for not surveyed; see Appendix II). Judging from the most recent preceding and proceeding surveys in 1994 and 1998, about 4.6% of the total Strait of Georgia population would have occurred (the 95.4% coverage during the 1996 survey was below the overall average of 99.4%). The total count, adjusted for missed sites, was therefore 23,752. The first series of flights was conducted atypically early on a tidal cycle that occurred during 27-31 July, which was just past the midpoint of the pupping season. Based on the chronology of pupping in the Strait of Georgia (Figure 2), an estimated 1,990 pups would have been born subsequent to the survey. The total standardized count for the Strait of Georgia, adjusted to post-pupping levels, was therefore 25,742 animals. Since only one survey was conducted, the *CV* of the standardized count was assumed to be 0.064 based on the typical variability of replicates (Table 2).

Based on the haulout patterns for tides similar to those occurring on each of the 7 survey days (see example in Figure 10 for one of the flights), it was estimated that an average of 62.8% of animals would have been hauled and available for counting during the surveys, giving an overall correction factor of 1.59 (*CV*=0.064). This correction factor for this particular survey was typical in magnitude but somewhat more variable than the average *CV*=0.042 for the correction factors[3]. Total abundance in the Strait of Georgia study area at the end of the pupping season in 1996 was thus estimated to be about 41,000 (95% confidence interval of 29,400 to 52,500). The average abundance estimate for the Strait of Georgia in the 7 surveys conducted during 1994-2008 was 39,100 seals. Applying the calculated *CV* of 0.077 gives a 95% confidence interval of 33,200 to 45,000, whereas the 95% confidence interval for the 7 surveys was actually 35,100 to 42,900. This suggests that calculated CV is somewhat conservative, which might be expected since its unlikely variability in the counts and correction factor are independent on one

[3]The lower precision seems to have resulted because the first half of the survey was conducted during a series of extremely low tides that occurred during 27-31 July. Since such low tides were quite uncommon, the TDR database contained fewer of them such that the Standard Errors were inflated.

another. In comparison, analogous calculations indicate that the abundance of harbour seals in the Strait of Georgia when the first standardized surveys were conducted in 1973 was on the order of 3,570 (95% confidence interval of 2,480 to 4,650).

The formula used to calculate the overall variance of the abundance estimates (see equation [6]), indicated that about 50% of the imprecision in the 1996 abundance estimate was attributable to the inherent variability of replicate counts, and the remaining 50% to uncertainty in the proportion of animals hauled out during the survey. Overall, the average CV for the Strait of Georgia abundance estimates was 0.77 for the abundance estimates, and about 60% of the imprecision was attributable to the inherent variability in replicate counts and the remaining 40% to uncertainty in the proportion of animals hauled out. It should be noted that equation [6] implicitly assumes that the two sources of variation are independent, when in fact one might expect them to be inversely correlated. At least some, and perhaps most, of the inherent variability in the replicated counts may be attributable to variability in the proportion of animals hauled out during surveys, in which case the variability of the abundance estimates (which have been adjusted for differences in the estimated proportion of animals hauled out) would exhibit less variability than the underlying counts (see example in Discussion; see also Frost et al. 1999). Although not truly replicates, 6 most recent surveys for the Strait of Georgia during 1996-2008 give a general sense of the actual variability of the estimates if its assumed that population was stable over this period. The standardized counts had a CV=0.037 and the abundance estimates a CV=0.065, suggesting the calculated mean CV=0.077 that was applied to abundance estimates in other regions may be somewhat conservative.

3.2 Recent Trends in Abundance

During the study period, abundance of seals appears to have increased throughout the Strait of Georgia (Figure 14). Log-linear regressions indicated highly significant (P<0.001) increases in all subareas except *BBAY* (Table 3). During 1973-2008, mean annual finite rates of increase in subareas ranged from 2.1% to 12.9% per annum, but growth rates varied over the course of the study. Rates calculated over the entire study period were consistently lower than those calculated during the first half of the study (Table 3; Olesiuk et al. 1990a). Based on the Akaike's (1969) statistic, second-order polynomials enhanced regressions in all subareas, indicating growth rates had slowed over the course of the study. For example, abundance in *BBAY* and *FRASERR* increased at rates of 13.4% and 11.6% per annum respectively during 1973-82 (r^2=0.961; $F_{1,2}$=49.5; P=0.002 and r^2=0.991; $F_{1,2}$=228.8; P=0.004), but numbers appeared to have stabilized by the early 1980s, and there was no evidence of further growth during 1982-2008 (r^2=0.002; $F_{1,16}$=0.30; P=0.864). In contrast, the *NWGULF* and *NEGULF* sustained high growth rates well into the 1990s, averaging rates of 15.4% and 13.8% respectively until 1998. (r^2=0.896 and 0.913; $F_{1,9}$=77.5 and $F_{1,9}$=84.1; P<0.001; Olesiuk 1999). However, the most recent surveys indicate abundance has now stabilized throughout the Strait of Georgia (Figure 14).

As a result of the regional differences and temporal shifts in growth rates, there was a pronounced redistribution of seals within the Strait of Georgia over the course of the study (Figure 15). The combined abundance in the *NWGULF* and *NEGULF*, the two subareas exhibiting the highest growth rates and stabilizing last, more than doubled from 19% of the total in 1973 to 50-52% during 2000-2008. In contrast, the once predominant seal herds occupying the sandbars in *BBAY* and *FRASERR* dwindled in importance, from 25% in 1973 to 4-7% during 2003-2008. There was also evidence of a redistribution of seals within some subareas. For instance, although the overall proportion of seals in *GULFISL* remained relatively constant over the study period (range 23-33%), there was a pronounced shift in distribution from the haulout sites in the inside protected waters of the Gulf Islands toward more exposed sites along outer coast facing the open Strait of Georgia. The proportion of animals in the subarea on exposed sites increased from 9% in 1973 to 71-76% by 2000-2008.

Within the Strait of Georgia, there was an increase in both the mean size and total number of haulout sites (Table 4). Interestingly, however, there appears to have been a slight drop in the occupancy rate over the course of the study; 89% of all known haulout sites were occupied during the 1973-74, compared with 84% during the 1988 survey, 70% during 2003 survey, and only 62% during the most recent survey in 2008. This suggests that even though the population had been growing and colonizing new haulout sites, some older sites were also being abandoned (i.e. there is a turnover in haulout site utilization). Indeed, new sites have continued to be established even though the population has stabilized. In the most recent survey in the Strait of Georgia, 52 new sites were documented which combined accounted for 1,714 (7.8%) of the total count. In most cases the new sites represented small aggregations, but substantial numbers of seals sometimes occurred at new sites, particularly when new haulout platforms became available. For example, during the 2008 survey 147 seals were counted on a floating breakwater that had recently been installed, and 290 seals were counted on a logboom being towed. The tendency to abandon and colonize haulout sites warrants closer analysis, since it could have implications for index surveys that are designed to monitor a fixed set of haulout sites (as opposed to searching an entire survey area). Although haulout sites are widely distributed throughout the Strait of Georgia, making seals essentially ubiquitous, their importance varies widely (Appendix III). A few of the largest haulout sites were occupied by over a thousand animals, whereas some of the less significant sites were occupied by only a few seals. Data from the most recent surveys in 2003 and 2008 indicated that 10% of the most significant haulout sites supported almost half (44-49%) the total seal population, whereas 50% of the least significant sites supported about one-tenth (8.7-9.0%) the total seal population (Figure 19).

During 1973-2008 the overall Strait of Georgia population grew at a rate of 8.2% per annum, which was highly significant (r^2=0.861; $F_{1,18}$=98.9; P<0.001). However, as was the case for the subareas, the population trajectory for the entire Strait of Georgia was significantly improved by adding a second-order term (adjusted r^2=0.973; $F_{2,17}$=313.8; P<0.001), indicating the growth rate had slowed, presumably as a result of density dependent processes. The population trajectory was could be better described by a generalized logistic equation, which allowed for a slowing of exponential growth with increasing population size:

$$[16]\quad N_{t+1} = N_t + N_t \cdot 0.130\,[1-(N_t/39{,}190)^{6.77}] \qquad (N_0=2{,}372 \text{ in } 1970)$$

(Figure 16a) which indicated that during the 1970s and into the late 1980s the population had been increasing exponentially at a rate of about 13.0% per annum (bootstrapped 95% confidence interval 12.4-14.%), which presumably represents the maximum finite rate of increase (Rmax) that occurs in the absence of depensatory forces. However, the growth rate subsequently began slowing around 1990, and in recent years (1996-2008) the population appears to have stabilized at an average level of about 39,000 (95% confidence interval of 35,100 to 42,900), which is very close to the predicted carrying capacity for the Strait of Georgia (bootstrapped 95% confidence interval 37,600-41,300). The high θ value (bootstrapped 95% confidence interval 3.0 to 85.8) indicates that the population stabilized rather abruptly, with maximum net productivity level (MNPL) of about 11.3% occurring at approximately 75% (63-94% based on 95% confidence interval for θ) of carrying capacity, which for the Strait of Georgia equates to annual take of roughly 3,300 animals at a population level of 29,100. Fitting generalized logistic models individually to each of the 7 subareas (Figure 17) and summing their estimates gives a very similar result (never differing from equation [16] by more than 7%; Figure 16), with a combined carrying capacity of 39,800.

As noted by Olesiuk et al. (1990a) and Olesiuk (1999), the actual rate of population increase during the early part of the study may have been exaggerated due to the cumulative discovery of haulout sites that may have existed but been overlooked during the first surveys, but this bias was probably small. In our earlier assessment, the late Dr. Michael A. Bigg and I re-examined the flight paths of the earlier censuses and considered the location and visibility of haulout sites discovered in the late 1970s and early 1980s, and we subjectively estimated that perhaps one-third of the new sites may have been missed in previous censuses (and the remaining two-thirds colonized as a result of population expansion and redistribution). Since I have no basis for refining that assessment, the same correction is applied to the exponential phase of the Strait of Georgia growth curve, which suggests that the actual growth rate was about 11.5% per annum (95% confidence interval of 10.9-12.6%), which is considered to be a more realistic estimate of R_{max}. When adjusted for this bias, its estimated that abundance of harbour seals in the Strait of Georgia increased about ten-fold from 3,760 (95% confidence interval of 3,200 to 4,300) animals when the first standardized censuses were conducted in the early 1970s.

Surveys in index areas in other regions indicated that the Strait of Georgia trends were probably indicative of population trends throughout British Columbia. All 6 index areas exhibited growth, with annual finite rates ranging from 2.5% to 27.0% (Figure 14), but the paucity of the time-series precluded formal statistical analyses for most index areas. The exception was the lower Skeena River and surrounding area, which was surveyed 10 times between 1977 and 2005. Abundance in the Skeena River subarea increased at a mean finite rate of 7.0% per annum (r^2=0.830; $F_{1,5}$=48.8; P<0.001), but again growth has subsided in recent years (Figure 14), and the trend could better be described by second-order polynomial (adjusted r^2=0.986; $F_{2,9}$=306.8; P<0.001) (Figure 14). The generalized logistic model indicated the initial growth rate was 10.1% per annum when the population was at low levels in the 1970s, but abundance stabilized quite abruptly (θ=10.4) at a level of about 2,200 animals by the late 1980s (Figure 17).

A log-linear regression fitted to a composite of all index areas outside the Strait of Georgia combined indicated a mean rate of 6.7% during 1976-2008 (r^2=0.869; $F_{1,13}$=85.9; P<0.001), which was not significantly different from the mean rate within the Strait of Georgia (P>0.500). As was the case for the Strait of Georgia and Skeena River, growth rates slowed over the course of the study and the fit of the relationship could be significantly improved by incorporating a second-order term (adjusted r^2=0.983; $F_{2,12}$=411.7; P<0.001) (Figure 18). However, attempts to fit a generalized logistic equation to the composite index counts were unsuccessful, as the θ parameter was unbounded and could not be estimated, reducing the model to a standard logistic curve:

$$[17] \quad N_{t+1} = N_t + N_t \cdot 0.1674[1-(N_t/21{,}066)] \qquad (N_0=968 \text{ in } 1970)$$

(Figure 16). As discussed below, the problem in estimating θ was attributable to the paucity of surveys (only two flights) between 1994 and 2004, the period when growth slowed abruptly in the two areas surveyed frequently (the Strait of Georgia and lower Skeena River; see Figures 16 and 17). Data collected prior to 1994 indicate that abundance was increasing rapidly, so r could be estimated with some precision (bootstrapped 95% confidence interval of 12.2% to 18.1%). As was the case for the Strait of Georgia, the initial population growth rate during the first part of the study was probably exaggerated as a result of the cumulative discovery of haulout sites that existed but were overlooked in the earliest surveys, but in this case I am not familiar enough with the original surveys to ascertain the likely degree of any such bias. The recent surveys between 2004 and 2008 indicate the growth rate outside the Strait of Georgia has subsided or slowed, so *K* could also be estimated with some degree of precision (95% confidence interval of 19,300 to 20,800).

The most recent surveys during 2004-2008 indicate that most of the index areas exhibited *average* growth rates of -0.9% to 6.9% (mean 3.6% with 95% confidence interval of 1.6% to 5.3%) since they had been last surveyed in the late 1980s or early 1990s. Unfortunately, the time-series contains little information data on how the growth was temporally distributed during the long gap in trend surveys (Figure 18). Its possible the growth occurred at a constant rate during the gap in survey coverage and is still be occurring. However, areas that had been surveyed more frequently in the late 1980s and early 1990s, such as the Strait of Georgia and lower Skeena River, exhibited a dramatic slowing of the growth rate during this period (Figure 16). Its therefore more likely that most of the growth in the index areas occurred early in the gap in survey coverage and that abundance is currently growing more slowly or has stabilized.

3.3 Population Estimates

Although baseline seal surveys have never been conducted along 18% of the British Columbia coastline, reasonable inferences regarding total abundance in the province can be made from the density of seals observed along the 82% of coastline that has been surveyed. As noted by Olesiuk et al. (1990a) and Olesiuk (1999), the Strait of Georgia supports an unusually high concentration of harbour seals compared with other regions. The Strait of Georgia currently (1994-2008) supports an average of 13.1 seals per km of shoreline, with densities in the 7 subareas ranging from 4.1 to 25.2 seals·km^{-1} (Table 5). In comparison, the areas outside the Strait of Georgia that have been surveyed support an average 2.7 seals per km of shoreline, with densities in the 20 DFO Statistical Areas[4] ranging from 0.9 to 8.5 seals·km^{1}. In other words, the lowest densities within the Strait of Georgia are greater than the highest density observed outside the Strait of Georgia (Table 5), with the average density within the Strait about 5-times the density outside the Strait of Georgia (Table 6). A two-sample t-test allowing for unequal variances indicated the difference was highly significant ($t_{7,19}$=3.77; P<0.01), so abundance was estimated separately within and outside the Strait of Georgia.

In addition to the 39,000 seals in the Strait of Georgia in recent years, it was estimated that 52,400 seals occurred along the 19,225 kilometers of shoreline surveyed outside the Strait of Georgia (Table 6). We can infer the precision of this estimate based on the inherent variability of the abundance estimates for the Strait of Georgia, which were derived in the same manner. Applying the average CV=0.077 to both estimates, and given the variance of the sums is the sum of the variances (Snedecor and Cochran 1980), the combined abundance in all surveyed areas is estimated to be 91,400 with a 95% confidence interval of 76,200 to 103,200 seals. Extrapolating the average density observed in the surveyed portion of each DFO Statistical Area to the unsurveyed portion, its estimated there are an additional 14,900 seals along the 5,011 kilometers of coastline that have yet to be surveyed[5]. This estimate is subject to the same “within stratum” variability as the abundance in surveyed regions, but there is an additional component of imprecision due to uncertainty in the densities within areas that have never been surveyed. Assuming the variability in densities observed among the 20 DFO Statistical Areas (CV=0.118; Table 5) is representative of the variability in densities in

[4]This includes the portions of DFO Statistical Area 12 and 17 that fall outside the main Strait of Georgia survey area.
[5]If instead we calculate the abundance of seals in unsurveyed areas by applying the overall mean weighted density observed in surveyed areas outside the Strait of Georgia, we get a similar estimate of 13,300 seals.

unsurveyed areas, the 95% confidence interval for abundance in unsurveyed area of the coast is estimated to be 11,500 to 18,900 seals.

Summing the abundance estimates, total abundance of harbour seals on the B.C. coast is estimated to be 105,000 seals. Given that the variance of sums is the sum of their variances (Snedecor and Cochran 1980), the variance of the overall abundance estimate can be derived by adding the variances of estimates for the Strait of Georgia and surveyed and unsurveyed areas outside the Strait of Georgia, which gives an overall 95% confidence interval of 90,900 to 118,900. Assuming the Strait of Georgia time-series (Figure 16a) is indicative of trends throughout British Columbia, there were probably something on the order of 10,000 seals coast-wide when the first surveys were conducted in the early 1970s.

3.4 Historic Trends in Abundance

During 1879-1970, a total of 172,649 pelts were purchased and 114,903 bounties paid on snouts from harbour seals killed in British Columbia. There was no overlap between the two types of kills except for the early 1960s when a market for pelts re-emerged, and bounties were still being paid. Since bounty payments were claimed for virtually all pelts harvested, but pelts were not necessarily taken from all seals killed for bounty, duplication was avoided by tabulating only the bounty kills for the early 1960s until June 30, 1964, the date on which the bounty program was terminated. Another about 5,500 seals were known to have been killed by Departmental staff for predator control.

It is widely recognized many harbour seal carcasses sink when shot and are lost, so the bounty payments and pelts represent only a fraction of the seals actually killed. While few data exist, experienced seal hunters and researchers have made various estimates of recovery rates for harbour seals. The late Dr. Michael A. Bigg, who worked closely with seal hunters while collecting and sampling seals for graduate studies, and made specific inquiries about the struck-and-loss rate, estimated that only 50% of animals killed during the commercial harvest were recovered. Similarly, Fisher (1952), who worked with bounty hunters in the Skeena River in the 1940s and 1950s, estimated the bounty claims represent 60% of those actually killed. Bonnot (1928 p.20) estimated that not more than 60% of harbour seals killed off California were recovered, and Imler and Sarber (1947) reported that 60% of harbor seals did not sink when shot, and Boulva and McLaren (1973) presented data from a dozen hunters in New Brunswick and Nova Scotia that indicated about 65% (SE=6%) of non-pups were retrieved. In 1953, records kept by the McNaughton brothers, two well known seal hunters in British Columbia, indicated 95 noses were recovered out of 200 hit or killed, representing a recovery rate of 48%. Harkonen (1987) cited Boulva's estimate of 65% recovery, but considering that many of the animals taken in their area were pups, he conservatively estimated loss at 25%. Based on information from seal hunters in the Wadden Sea and Delta of Netherlands, and citing Harkonen's (1987) estimate, Reinders (1994) also estimated a minimum loss rate of 25% due to sinking. While most of these estimates are subjective, they nevertheless reflect a consensus among experienced seal researchers that almost half of seals killed are lost. The mean recovery rate was 61.6%, but varied from 48% to 75%. Applying this rate to the reported bounty payments and pelts suggests that roughly half a million seals were actually killed, although this figure could vary considerably due to uncertainty in the proportion of carcasses lost.

The simplified model used for the reconstruction model assumes kills were non-selective, or selection was too weak to affect the crude birth and death rates. Few data were available on the sex- and age-composition of the harvest to evaluate this assumption, but there tends to be little segregation by sex or age in harbour seal populations, and bounty payments were paid and pelts purchased from seals of either sex and any age. Nursing pups and weaners are likely the most vulnerable segment of the population, and pups may also be more buoyant so recovery rates tend to be higher. Boulva and McLaren (1979) reported that hunters indicated few pups were lost, whereas 35% of non-pups sank. A total of 350 teeth were collected from animals taken in the commercial harvest in British Columbia during the 1960s, and examination of the pulp cavities indicated 35% were from animals in their first year of life, whereas life table indicate the age-class should constitute only 23% of the population (Bigg 1969a; Olesiuk 1993), which could indicate either a real bias toward these younger animals, or merely reflect a higher recovery rate. The main fur buyers preferred post-moult animals, and actually encouraged the Department to close the fishery during the pupping season, as many pelts were oxidized or shedding (H. Hansen, Nanaimo, B.C., pers. comm.). No age information on bounty, but statistics by month were available for a few years that indicate seals were killed throughout the year, with seasonal peak in summer (Figure 20). Managers attributed this to movements of the fishing fleet, but it could reflect a bias toward taking pups during and following the pupping season. In southern B.C., it was calculated that 41% of the kills were made in the 6-months prior to pupping, and 59% in the 6 months following the onset of pupping; in northern B.C. 43% of kills were made before and 57% after the onset of pupping. Thus, there may have been a slight bias toward taking pups, but not likely to an extent that would drastically impact the sex- and age-structure, or affect crude birth and death rates.

Population reconstructions indicate that the relatively small populations that existed in the early 1970s could not have sustained anywhere near the levels of harvesting that had occurred in the 1960s, and it must have been severely depleted (Figure 21). At their lowest point in the late 1960s, total abundance was likely reduced to less than 10,000 seals. This is consistent with reports from seal hunters and researchers associated with the industry (H. D. Fisher, Vancouver, B.C.; B. and D. McNaughton, Pender harbour, B.C., and M.A. Bigg, Nanaimo, B.C., all deceased, pers. comm.) , all of whom noted that the seals had become very scarce in the late 1960s, and the fishery ended due to the lack of their availability. The sharp decline in harvest levels preceded protective legislation, which wasn't introduced until 1970.

Prior to populations being depleted by the commercial harvests, the population was controlled by bounty programs and predator control kills by Departmental staff. The first bounty payments were offered during 1914-17, apparently as a subsidy when pelagic fur sealing ended with the signing of the North Pacific Fur Seal Treaty. The bounty program was reinstituted in 1927, a various correspondence refers to a growing seal population, which the reconstruction indicates had been increasing exponentially for over a decade after the first era of commercial hunting ended. Bounty payments were subsequently offered for most years (35 of 38 years) between 1927-1964, but kill levels fluctuated, presumably as a result of economic conditions, World War II, and the Depression. The bounty kills never seem to have been large enough to deplete the population to the same extent as the commercial harvests, but kept it in check, and there were no extended periods of exponential growth as seem though the 1970s and 1980s.

The population also appeared to have been depleted by the first known period of commercial utilization during 1879-1914. Little information is available for this hunt, but apparently hair (harbour) seals were harvested in conjunction with the fur sealing industry operating out of Victoria, British Columbia. Large kills were reported as taken from Canadian waters, with just over 10,000 pelts taken when the harvest peaked in 1890 (and presumably an almost equal number of seals were killed but sank). The population must have been much larger to support that level of harvesting, or as the reconstruction indicated was quickly depleted. Harbour seal populations were likely at peak abundance during the 1880s and 1890s, and may have numbered something on the order of 65,000 to 110,000, similar to current levels. There are obviously considerable uncertainties associated with the reconstruction, but it is consistent with the hypothesis that the population growth seen through the 1970s and 80s and subsequent leveling-off in the 1990s represented the recovery of a population that had been depleted by over-harvesting.

The forward-projecting model without density dependence (equation [14]) gave results very similar to the back-projecting model (Figure 22), indicating that a historic population of about 80,000 would have been required to have sustained the large kills made during the late 1800s and early 1900s. An even larger historic population would be required if density dependent effects are included in the model (equation [15]). With θ set to 5.7, as observed in the Strait of Georgia time-series, the initial population would have had to been about 100,000. The value is higher with density dependence because the population would be less productive at high densities, and could not sustain as large of a kill. With θ set to 2.5, the initial population would have to be near 120,000. The initial abundance required is larger because in this case the population would be less productive even at moderate densities, so the kills would have a greater impact on the population.

4. DISCUSSION

This study reaffirms the finding in our earlier assessments that harbour seal populations in British Columbia had been increasing in recent years (Olesiuk et al. 1990a; Olesiuk 1999). Based on the more recent data and refined analysis presented in this report, it is estimated that populations in the Strait of Georgia were increasing at a rate of about 11.5% per annum during 1970s and 80s, but that growth rates subsequently slowed and has now stabilized. There is no basis for revising the rate of increase reported by Olesiuk (1999).

Recent assessments have indicated that harbour seal populations in neighbouring waters also appear to be increasing. In southeast Alaska, populations are monitored on several trend routes (a series of haulout sites that can be flown on a during low tide cycle). Seal numbers on a trend route just north of the Canadian border near Ketchikan increased at a rate of 7.4% during 1983-98, but the rate slowed to 5.6% during 1994-98 (Small et al. 2003). Populations showed no significant change on a trend route near Sitka in central SE Alaska during the same period (Small et al. 2003), but populations have declined in Glacier Bay in northern SE Alaska (Mathews et al. 2004). Comprehensive assessments have recently been published for the states of Washington and Oregon (Jeffries et al. 2003; Brown et al. 2005), and in both cases generalize logistic models indicated trends were very similar to those described here for British Columbia. In Washington (Jeffries et al. 2003), populations increased exponentially at 12.6% during the 1970s and 1980s, but the growth rate slowed through the 1990s. In Oregon (Brown et al. 2005), populations increased at 11.5% during the 1980s, but also stabilized in the early 1990s. Off California, harbour seal populations increased rapidly during 1972-1990, but have shown no increases since 1990 (Lowry et al. 2004; Carretta et al. 2008). The population trends observed in British Columbia thus appear to be representative of a broader pattern that occurred from California to southern SE Alaska. This is in sharp contrast with the Gulf of Alaska and Bering Sea, where harbour seal numbers have experienced severe declines, and are currently at depressed levels (Pitcher 1990; Lewis et al. 1996; Frost et al. 1997; Jemison et al. 2005; Mathews et al. 2005; Small et al. 2003, 2008). The geographic differences in the status of harbour seal populations is also reflected in the status of other pinniped species, such as Steller sea lions (*Eumetopias jubatus*), which are declining in the northern part of their range but generally flourishing in the southern part of their range (Calkins et al. 1999; Olesiuk et al. 2007; Pitcher et al. 2007; Carretta et al. 2008; Angliss and Allen 2009).

In support of the previous assessment (Olesiuk 1999), the present study also found evidence of density dependence in the population growth rates both within and outside the Strait of Georgia. Logistic models indicated exponential growth during sustained through the 1970s and 1980s began to slow in the late 1980s or early 1990s and that populations had stabilized by the mid 1990s. This would explain why density dependence was not detected by Olesiuk et al. (1990) in their original assessment based on survey data collected up until 1988. The Strait of Georgia time-series, for which surveys have been repeated every 2-3 years, shows the trajectory best, and indicates that populations stabilized quite abruptly. Three additional Strait of Georgia surveys have been conducted in 2000, 2003 and 2008, and they reaffirm the conclusion by Olesiuk (1999) that the population had stabilized. The logistic curve for index areas outside the Strait of Georgia also indicate a phase of exponential growth during the 1970s and 1980s, followed by stability in recent years, but due to the paucity of surveys during 1994-2004 its impossible to establish exactly when and how abruptly the population stabilized. As noted above, there is also evidence of slowing of growth rates and stabilization of harbour seal populations in Washington, Oregon and California (Huber and Laake 1998; Jeffries et al. 2003; Brown et al. 2005; Carretta et al. 2008). In all cases where there are sufficient data, it appears the stabilization was quite abrupt, indicating the productivity curve of harbour seals is skewed (i.e. maximum net productivity levels will occur when populations are close to carrying capacity). The high density of seals the now occur along the west coast of North America presumably increases the risk of massive die-offs, as recently experienced by European harbour seal populations (Dietz et al. 1989; Harkonen et al. 2006).

The detailed survey data available for subareas within the Strait of Georgia also revealed geographic differences in population trajectories (see Figure 17). In some subareas, such as Boundary Bay, populations appear to have stabilized by the early 1980s, and may actually have declined in recent years. Nevertheless, overall growth rates in the Strait of Georgia were sustained into the early 1990s, and it appears that the slowing in some areas was initially compensated by higher growth rates in other regions, such as the northeastern and northwestern sections of the Strait of Georgia. Population growth rates sustained in the latter areas are too high to be biologically realistic, and populations in them stabilized last and very abruptly. These patterns, as well as the resulting redistribution of animals that was observed over the course of the study (see Figure 15), suggest there was movement of seals among subareas, and implies that one of the earliest depensatory responses of animals was to immigrate from areas of higher density to areas supporting lower densities (as opposed to experiencing a decline in productivity levels).

In our previous assessment it was hypothesized that the recent increase in harbour seal abundance represented recovery from predator control kills and particularly commercial harvests that had depleted populations prior to the species being protected in 1970. Reconstructions in this report indicate that the level of kills during commercial harvests in 1879-1914 and 1962-1968 were in fact large enough to have depleted populations. While there is obviously considerable uncertainty in extrapolations that go back over a century, it seems quite clear that the large numbers of pelts taken during both fisheries could not have been sustained by the low abundance of seals observed during the first surveys in the 1970s, or for that matter even the large populations seen today. The peak historic population levels of 65,000 to 120,000 projected to have occurred in the 1880s is consistent with the conjecture that the recent trends represent the recovery of populations from over-hunting.

One of the most important advances in the previous assessment was the development of correction factors to account for animals at sea during surveys, based on haulout patterns as indicated by time-depth recorders. When Olesiuk et al. (1990) published their original assessment, there was virtually no quantitative data available on the haulout patterns of harbour seals in British Columbia or anywhere else. Time depth recorders (*n*=76) deployed in various habitat types and areas indicate a general pattern in which harbour seals haul out on most days (83.1% of days), but on average haulout bouts generally last only 5.0 hours on average, so seals spend only about 19.9% of the time on land (Olesiuk 1999b, 2003). This pattern seems to be an intrinsic to the species, regardless of area or habitat (Olesiuk 1999b; Simpkins et al. 2003). In most areas, haulout bouts tend to by synchronized with tides, such that at low tides up to 70-75% of seals might be on land at the same time. In this study, it was estimated that 54-67% (mean 61%) of animals were hauled out and counted during low-tide surveys, giving correction factors ranging from 1.49 to 1.85 (mean=1.63). Correction factors have also been derived in other areas based on the proportion of radio-tagged seals that were hauled out during survey flights, which are similar to those derived from time-depth recorders. Huber (1995) and Huber et al. (2001) estimated corrections ranged from 1.35 to 1.85 (mean=1.53) for various regions of the State of Washington. Interestingly, their study area included one of our subareas, *BBAY* in 1992, for which her correction factor was 1.51, which compares favorably with my correction factor of 1.49 for *BBAY* in the same year (Huber's 1992 mean count for *BBAY* of 787 animals also compares favorably with my standardized count of 723 in *BBAY* in the same year; H. R. Huber, National Marine Mammal Laboratory, Seattle, Washington, 98115, personal communication). Huber et al. (2001) found no significant geographic differences in correction factors between regions of Washington State, which included various substrate types on both the outer coast and inland waters. More recently, Withrow and Loughlin (1995b) used similar methods and reported a correction factor of 1.74 for rocky outcroppings in southeast Alaska under typical survey conditions, and Withrow and Loughlin (1997b) reported a correction factor of 1.90 for sandbars in Prince William Sound. Harvey and Goley (2005) derived a correction of 1.65 for harbour seals off California. Thus, correction factors appear to be quite consistent among areas and substrate types where haulout patterns are associated with low tide cycles. There will, however, be notable exceptions such as the small estuaries along the east side of Vancouver Island where seals haul out on logbooms (see Figure 6), and in fjords where seals haul out on glacial ice flows (D. E. Withrow, National Marine Mammal Laboratory, Seattle, Washington, 98115, personal comm.; Olesiuk 1999b; Boveng et al. 2003). In the Gulf of Alaska, where there is a range of habitat types including glacial ice, Boveng et al. (2003) developed co-variate models that predicted 54% of seals would be hauled out under ideal conditions, and Simpkins et al. (2004) estimated that 83% of seals would be hauled out under ideal conditions, giving an overall correction of 2.2, somewhat higher than the corrections reported for British Columbia to California.

The haulout response curves on which my census correction factors are based encompass two of the three factors identified by Frost et al. (1996, 1999), Boveng et al. (2003), and ver Hoef and Frost 2003 as being most important when standardizing survey counts, namely time-of-day and time relative to low tide. This was not by design, but instead dictated by the nature of haulout patterns as revealed by the TDRs. Originally, I had intended on basing my correction factors on the proportion of animals hauled out as a function of time-of-day and *tide height*. The TDR records verified that time-of-day had an important effect on haulout behaviour (especially at intermediate low tides), with a greater proportion of animals hauling out on low tides that occurred near midday than on equivalent tides that occurred at other times (see Figure 8b). However, the TDR records also indicated that haulout patterns were not dictated so much by tide height *per se*, but instead more by changes in relative water levels (i.e. time relative to low tide). Regardless of how low a low tide was falling, animals normally initiated haulout bouts several hours before the low tide and terminated bouts within several hours after the low tide. As a result, seals were hauling out and entering the water at higher water levels on higher low tides than on lower low tides. Tide height itself played a relatively minor role, and when low tides occurred near midday the proportion of seals hauling out on them was almost independent of the height of the low tide (Figure 8c). Interestingly, this suggests that haulout bouts were not necessarily limited by the availability of the tidal substrates used as haulout sites. Boveng et al. (2003) also noted that relative tide height was a better predictor than absolute tide height on terrestrial sites in the Gulf of Alaska.

Frost et al. (1996, 1999), Boveng et al. (2003), and ver Hoef and Frost (2003) all identified date as being an important factor in standardizing survey counts in Alaska, where surveys are generally conducted during the annual moult. In contrast, except for nursing females, the TDR records showed that the time animals spent ashore was quite constant over the period which surveys were conducted. Although nursing females spent more time ashore, most the extra time was during high tides and at night, such that the proportion of animals hauled out and presumably counted was quite insensitive to the date of the survey. Although I made minor adjustments to account for unborn pups based on the date of the survey, these would not have accounted for the seasonal effects reported in Alaska. One plausible explanation for the apparent difference may be that surveys in British Columbia were conducted at the end to the pupping season, whereas those in Alaska were conducted during the annual moult. The proportion of moulting animals ashore and hence counted during surveys can vary appreciably over relatively short periods (Jemison et al. 1998). It is also possible the seasonal effects reported by Frost et al. (1996, 1999) were due to movements of animals during the survey period. In Alaska, large concentrations of seals often occur in glacial fjords, and abundance in them and surrounding areas can fluctuate dramatically within a short time-frame (Mathews and Kelly 1996). Large reservoirs of seals whose movements could affect counts are not known to occur in British Columbia, and Boveng et al (2003) found the date effect over the entire Gulf of Alaska, an area presumably too large to be influenced by movements.

Frost et al. (1996, 1999) developed their standardization model primarily to enhance the statistical power for detecting trends from relatively short time-series of survey data. That was not my objective here. Given the long time-series of counts for the Strait of Georgia (1973-98) and the population growth sustained over much of that period, the resulting population trend (a ten-fold increase in abundance) greatly predominated any underlying variability due to slight differences in census conditions. Nevertheless, I would expect that application of the corrections derived from the haulout response curves would also enhance the power of detecting population trends were they not so overwhelming. This appeared to be evident for the two replicate censuses of the entire Strait of Georgia in 1988 conducted during 30 May -16 June, just prior to the pupping season, and again during 9-26 August, toward the end of the pupping season. The raw counts for the two surveys were 10,680 and 14,177 respectively, giving a *CV* of 0.141. Adjusted to post-pupping levels, the adjusted counts were 13,340 and 14,614, giving a *CV* of 0.046. Finally, when corrected for differences in the proportion of animals hauled out during the surveys, the estimated abundance was 23,432 and 23,126, giving a *CV* of 0.007. This implies that much of the variation in the adjusted counts was attributable to differences in the proportion of seals hauled out during surveys. Although this one example is tantalizing, too few replicates were available to evaluate how consistently and to what degree the TDR corrections might serve to standardize the survey counts.

One of the main drawbacks of my correction factors was that they were based on haulout patterns for similar tidal cycles, rather than the same tide cycles on which censuses were conducted. It would have been preferable to obtain correction factors during the actual survey, as did Huber et al. (2001), Harvey and Goley (2005). However, it is not feasible to deploy and subsequently monitor sufficiently large numbers of transmitters or TDRs during every survey, such that it will be necessary to extrapolate correction factors beyond the surveys during which they were developed. In fact, in recent years, the Huber et al. (2001) correction factor has been widely applied to harbour seal counts throughout the Pacific Northwest (Carretta et al. 2008). One of the advantages of TDRs is that they provide very detailed records of haulout patterns over extended periods, which allow correction factors to be developed based on fairly large numbers of tidal cycles similar to those under which surveys are conducted. This allows correction factors to be calculated for the specific tidal conditions of each survey flight, and hence provides a basis for retrospectively correcting counts from earlier censuses that might have been done under different tidal conditions. TDRs also circumvent some of the more serious problems associated with haulout patterns ascertained by radio telemetry, such as emigration of animals from the study area and loss or failure of transmitters (Boveng 1988).

There is potential for introducing bias in the census correction factors when the sex- and age-structure of the sample of animals on which they are based is not representative of the population being censused. The TDR records in this study were obtained from a fairly balanced sample of males and females as well as of juveniles and adults, but owing to the bulk of the TDR packages pups and yearling were not represented. In developing her correction factors, Huber (1995) found that pups spent about as much time ashore as adult females in June, but subsequently rarely hauled out in July, such that correction factors for pups can change quite markedly between months. Given the chronology of pupping in her study area, the seasonal changes she observed in pup behaviour were probably associated with weaning. Similarly, Harvey and Goley (2005) reported that a smaller proportion of radio-tagged weaners and yearlings were ashore during surveys off California, but details were not provided. Since most pups in the Strait of Georgia are born in late July and early August and typically nurse for about 5-6 weeks (Olesiuk 1993), few would have been weaned by August when most surveys were conducted.

It should be noted that the haulout response curves and corresponding census correction factors are only applicable to the period over which the TDR data were collected, in this case May through August. In the Strait of Georgia, this represents the period from about 6 weeks prior to the onset of the pupping season to the end of the pupping season. Unfortunately, since the TDRs were glued to the pelage and shed very early in the moult, it was not possible to evaluate how haulout patterns might have changed during the annual moult, the period during which most surveys have been conducted in Alaska. Several researchers have noted that the amount of time spent ashore declines dramatically during winter months when animals are not pupping or moulting (Harvey 1987; Swain et al. 1996). Withrow and Loughlin (1996b) also found that correction factors can vary quite markedly depending on the conditions under which surveys are flown. While I attempted to minimize these effects by excluding days with heavy precipitation, analysis of the TDR data could be further refined by accounting for other environmental factors[6].

There was one unexpected and important discrepancy between the haulout patterns indicated by the TDRs and observations made by the author during the past 25 years of conducting aerial surveys. When surveys were attempted too far in advance of low tide, many animals were seen swimming or milling in the water adjacent to the haulout site, and animals on shore were still wet indicating they had just recently hauled out. In such cases we usually landed for 30-45 minutes before beginning the survey. In most instances, censuses were initiated 2 to 2-1/2 hours before low tide, and very few animals were generally seen in the water during the survey. Surveys were usually terminated just before or after low tide when I began to see an increase in the number of animals milling in the water adjacent to haulout sites. It was assumed this indicated animals were terminating haulout bouts and dispersing from haulout

[6]Mean or maximum daily wind speeds did not appear to affect the proportion of time animals spent hauled out. Surprisingly, however, wind direction seemed to have an effect, with seals spending significantly more time ashore during north and west winds, and less time ashore during south and east winds. The prevailing winds in the study area are from the northwest (generally associated with high pressure systems and clear skies), and from southeast (generally associated with low pressure systems and low overcast conditions with precipitation).

sites, and that counts would be too low if the survey was continued. Surprisingly, however, the haulout response curves indicate quite clearly that the proportion of animals hauled out is quite symmetric around the low tide, where I would have expected to see a rather sharp decline around the time of the low tide. One possible explanation is that seals were more susceptible to being disturbed once they had been hauled out for awhile, so that more animals were frightened into the water when counts were made beyond the peak of the haulout response curve. Indeed, their original assessment, Olesiuk et al. (1990) noted:

> *...as censuses progressed, the pelage of seals dried which made seals more visible from the air. Few animals were observed in the water, except in small estuaries where seals often gathered in groups and rested on the ocean floor and in deep inlets where there were few suitable haulout sites. Toward the end of censuses the pelages of seals became distinctly drier and lighter, which indicated we were approaching the end of the census window. Within an hour or so, seals were easily frightened into the water by the approach of our aircraft or were milling in the water near the haulout when we arrived, perhaps having been frightened before coming within sighting range. At the end of a census, it was not unusual to frighten 3-4 haulouts in succession whereas seals were rarely frightened earlier in the census.*

and that general observation seems to have held. An alternative explanation is that seals may behave differently just prior to initiating a haulout bout than just after terminating a haulout bout. For example, one could imagine that seals arriving at a haulout site on an ebbing tide might haul out almost immediately, such that very few animals would be milling in the water prior to low tide. On the other hand, animals may linger adjacent to haulout sites after terminating bouts on flooding tides, such that an increasing number of animals would be milling adjacent to sites after a low tide. This is an important matter since the haulout response curves indicate that censuses could easily be extended another two hours or so, but one wants to be very cautious in modifying census protocol when it could jeopardize comparisons with all previous surveys.

The updated population estimate of 105,000 for British Columbia is very similar to the 99,400 derived by Olesiuk (2006) using the same methods, and the estimate of 101,000[7] extrapolated by Olesiuk (1999). The close agreement between the estimates is somewhat fortuitous. The recent baseline surveys on the central-northern mainland coast indicate that seals densities were about 1.9 seals per kilometer of shoreline, somewhat less than the average of 2.7 assumed by Olesiuk (1999). On the other hand, the logistic curve indicates that populations outside the Strait of Georgia have continued to increase – by about 3.6% per year - since the 1999 assessment, and baseline surveys in the Discovery Passage area indicate that seal densities were about 4.2 seals per kilometer of shoreline, somewhat higher than the average of 2.7 assumed by Olesiuk (1999). Since these two changes essentially cancel one another, there has been very little change in the total population estimate. Given the fairly broad coverage of baseline surveys – 82% of the total coastline, including a portion or all 29 DFO Statistical Areas has now been surveyed – reasonable bounds can be calculated for the estimate, giving a 95% confidence interval of 90,900 to 118,900. Based on the sources of variation that can be quantified, this confidence limit is considered to be conservative. Abundance estimates in surveyed areas were assumed to vary as the result of the imprecision of counts based on the observed variability of replicated counts and the imprecision of survey

[7]Olesiuk (1999) actually derived two province-wide population estimates. The first was based on an extrapolation of average densities observed outside the Strait of Georgia to unsurveyed areas, including the vast central-northern mainland coast, which gave an estimate of 101,000. The second estimate was based on the proportion of bounty kills and commercial harvests taken in surveyed areas, which gave an estimate of 115,700. The two estimates were averaged to get the final estimate of 108,000.

correction factors due to observed variability in haulout patterns. For unsurveyed areas, a third source of imprecision due to the observed variability of seal densities among areas. It was assumed the three sources of imprecision were independent of one another, such that the variances were additive (Goodman 1960). In reality, the three components are nested, and likely encompass one another. Some of the observed variability in counts is likely real, but some also attributable to variability in the proportion of animals hauled out, which is accounted for in the variance of the survey correction factor. Similarly, some of the observed variability in densities observed among areas is likely real, but some of it is also attributable to variability in the counts and correction factors. On the other hand, there are sources of bias that cannot be quantified that are not included in the confidence limits. Perhaps most importantly, its assumed that all hauled out seals are detected and counted. In reality, harbour seals are cryptic animals, and could easily be missed. This is unlikely a serious bias when survey conditions are favourable. If this were the case, one would expect counts to gradually increase due to the cumulative discovery of sites that had been missed. In the Strait of Georgia, where survey effort has been most intense, there is no evidence of this, and the rate of discovery of new sites has been the same as the rate of abandonment of existing sites, so overall numbers have not changed. The author is not so confident the bias is negligible in more challenging areas, where animals are widely scattered in smaller groups and fog and wind make counts more difficult. Evaluation of the bias cannot be made until surveys have been replicated, and the rate of discovery of new sites quantified.

In comparison with the estimated 105,000 harbour seals on the British Columbia coast in 2008, abundance was estimated to be about 43,449 seals off California as of 2004 (Harvey and Goley 2005; Lowry et al. 2005), 24,732 seals off outer coast of Oregon and Washington as of 1999 (Jeffries et al. 2003; Brown et al. 2004; Carretta et al. 2009), 14,612 seals in the inland waters of Washington as of 1999 (Jeffries et al. 2003; Carretta et al. 2009), 112,391 seals in southeast Alaska as of 1997-1998 (NMFS, unpublished data; Angliss and Allen 2009), 45,975 in the Gulf of Alaska as of 1996-1999 (Boveng et al. 2003; Simpkins et al. 2003; Angliss and Allen 2009), and 21,651 in the Bering Sea as of 2000 (NMFS unpublished data; Angliss and Allen 2009). Total range-wide abundance of *P. v. richardsi* is thus on the order of 370,000, of which about 29% occur in British Columbia.

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Table 1. Summary of the sex, body mass (kg) and maturity of animals instrumented with time-depth recorders and the dates and locations of deployments (for those instruments successfully recovered). Maturity status was inferred based on the mean body size at onset of maturation in each sex (48.6kg for females and 64.6kg for males; Olesiuk 1993).

Animal ID	Sex	Mass (kg)	Maturity	Deployment		Days of Data
				Date	Location	
01	F	68	A	01-Aug-90	Danger Reef	34
02	M	57	J	30-Jul-90	Danger Reef	16
03	F	43	J	03-Aug-90	NE Valdes Island	58
04	F	54	A	07-Aug-90	Miami Island	12
05	F	59	A	08-Aug-90	NE Valdes Island	30
06	F	73	A	10-May-91	Cowichan Bay	103
07	M	95	A	13-May-91	Cowichan Bay	105
08	M	95	A	30-May-91	Snake Island	81
09	M	64	J	30-May-91	Snake Island	82
10	M	43	J	12-Jun-91	Danger Reef	154
11	F	50	A	13-Jun-91	SE Orlebar Point	49
12	M	50	J	27-May-92	Ragged Island	94
13	M	64	J	19-May-92	Danger Reef	106
14	M	>91	A	28-May-92	Danger Reef	95
15	M	93	A	03-Jun-92	Danger Reef	106
16	M	57	J	29-Apr-92	Snake Island	95
17	F	41	J	02-May-92	Entrance Island	93
18	F	89	A	29-Apr-92	Snake Island	77
19	F	~95	A	03-May-92	NE Gabriola Island-B	137
20	F	75	A	01-May-92	Snake Island	105
21	M	61	J	28-Apr-93	Snake Island	98
22	M	57	J	28-Apr-93	Snake Island	106
23	M	93	A	30-Apr-93	Snake Island	121
24	M	84	A	22-Apr-93	Snake Island	125
25	M	68	A	23-Apr-93	Snake Island	124
26	M	98	A	29-Apr-94	NE Gabriola Island-C	110
27	F	96	A	05-May-94	NE Gabriola Island-C	101
28	F	55	A	03-May-94	NE Gabriola Island-C	108
29	F	45	A[a]	05-May-94	NE Gabriola Island-C	92
30	M	54	J	26-Apr-94	NE Gabriola Island-C	101
31	F	93	A	27-Apr-94	NE Gabriola Island-C	133
32	M	70	A	27-Apr-94	NE Gabriola Island-C	120
33	F	72	A	26-Apr-94	NE Gabriola Island-C	106
34	F	89	A	30-Apr-94	NE Gabriola Island-C	132

[a]classified as an under-sized adult on the basis that it was observed nursing a pup.

Table 2. Mean, standard error, and coefficient of variation of adjusted counts for replicated censuses (after Table 3 in Olesiuk et al. 1990a).

Subarea(s) Censused	Census period	Number replicates	Mean Count	Standard Error	Coefficient Variation
		Strait of Georgia			
BBAY – FRASERR	Aug. 84	2	1,627.9	60.9	0.037
BBAY – FRASERR	Aug. 85	2	1,538.1	53.8	0.035
SGULF	Aug. 86	2	1,868.9	74.8	0.040
Complete	May-Aug. 88	2	13,977.1	636.7	0.046
Partial[a]	May-Sept 88	3	6,284.4	211.4	0.034
		Skeena River			
Complete	Jun. 77	2	407.5	68.5	0.168
Complete	Jun. 83	2	712.0	63.6	0.089
Complete	Jun 87	2	1255.7	38.5	0.031
Complete	July 98	2	1093.4	101.1	0.092
Overall Mean					0.064

[a]Based on portion of region surveyed in September: *BBAY, FRASERR, HOWESD*, 46.3% of *SGULF*, 22.6% of *GULFISL*, and 47.6% of *NEGULF*.

Table 3. Mean annual finite population growth rates calculated from log-linear regressions fitted to June-August abundance estimates for the period 1973-2008. For comparison, the mean finite rates of increase for the period 1973-1998 (Olesiuk et al. 1990a) are shown in parentheses. Significance of time-series containing less than 6 surveys were not tested due to the lack of statistical power for detecting trends.

Region/ Subarea	Census period	Number of censuses	Correlation coefficient	Significance level	Finite rate of increase (%)	
			Strait of Georgia			
BBAY	1973-2008	22	0.006	0.740	0.3	(8.6)
FRASERR	1973-2008	22	0.510	<0.001	4.8	(9.4)
HOWESD	1973-2008	18	0.534	<0.001	6.2	(16.2)
SGULF	1973-2008	16	0.796	<0.001	5.9	(9.0)
GULFISL	1973-2008	14	0.828	<0.001	8.4	(15.4)
NWGULF	1974-2008	15	0.759	<0.001	10.6	(24.7)
NEGULF	1976-2008	13	0.788	<0.001	9.1	(20.9)
Total[a]	1973-2008	-	0.958	<0.001	8.3	(13.6)
			Lower Skeena River			
Total	1977-2003	10	0.620	0.011	7.0	(11.9)
			Southwest Vancouver Island			
SWVANISL	1976-2007	3	-	-	7.2	(17.2)
BARKLYSD	1976-2007	3	-	-	10.6	(26.5)
MWVANISL	1994-2007	2	-	-	4.5	-
			Queen Charlotte Islands			
SEQCI	1986-2008	3	-	-	4.9	-
SWQCI	1994-2008	2	-	-	2.7	-
NEQCI	1986-2008	2	-	-	0.9	-
			Queen Charlotte Strait			
SWQCSTR	1989-2004	2	-	-	2.7	-
BROUGHT	1989-2004	3	-	-	2.6	-

[a]Based on weighted regression.

Table 4. Observed changes in number and mean size of known haulout sites in the Strait of Georgia between 1973-74, 1988, 1996 and the most recent survey in 2003. Numbers in brackets indicate the number of known haulout sites occupied during censuses (updated from Table 1 in Olesiuk et al. 1990a).

	1973-74[a]		1988		1996		2003		2008	
Subarea	Number of Haulouts	Mean size	Number of Haulouts	Mean Size	Number of Haulouts	Mean Size	Number of Haulouts	Mean Size	Number of Haulouts	Mean Size
BBAY	8 (5)	66.3	10 (7)	125.7	11 (7)	127.0	11 (5)	74.2	11 (3)	119.0
FRASERR[b]	9 (7)	44.6	13 (7)	86.3	19 (8)	146.8	22 (10)	152.8	22 (15)	40.3
HOWESD	3 (3)	25.4	12 (8)	76.1	20 (13)	32.9	23 (12)	58.4	27 (14)	34.1
SGULF	34 (28)	28.6	63 (53)	62.3	81 (52)	96.6	87 (66)	62.7	99 (68)	57.3
GULFISL	46 (43)	12.4	91 (78)	46.6	131 (87)	67.2	146 (100)	76.2	161 (80)	69.8
NEGULF	19 (19)	18.6	64 (54)	59.8	114 (85)	67.7	137 (93)	67.1	158 (107)	71.1
NWGULF	8 (8)	9.3	32 (31)	57.1	37 (29)	122.5	42 (20)	161.6	46 (30)	111.2
Total	127 (113)	21.9	285 (238)	59.0	413 (281)	80.7	468 (306)	81.7	524 (317)	69.0

[a]1976 for the *NWGULF*

[b]May be some confusion over the exact location of animals and hence of the number of haulout sites in the earlier censuses.

Table 5. Mean estimated density of seals (seals·km^{-1}) in Strait of Georgia subareas for the 6 most recent surveys conducted during 1994-2008. Relative shoreline lengths were expressed in terms of a total British Columbia coastline of 27,200 km (M. Browning, Canadian Hydrographic Service, Victoria, British Columbia, pers. comm.).

Region / Subarea	Population size	Shoreline length (km)	Density of seals	Coefficient of Variation
	Strait of Georgia			
SGULF	6,253	330	19.0	-
BBAY	1,064	60	17.7	-
FRASERR	1,660	277	6.0	-
HOWESD	1,022	247	4.1	-
GULFISL	11,436	699	16.4	-
NEGULF	11,167	1,099	10.2	-
NWGULF	6,382	254	25.2	-
Overall (Strait of Georgia)	**38,984**	**2,965**	**13.1**	**0.24**

Table 6. Estimated density of seals (seals·km^{-1}) for DFO Statistical Areas outside the Strait of Georgia. Abundance estimates have been adjust to 2008 levels based on population trends observed in index areas outside the Strait of Georgia (see Equation 16 and Figure 16b). Relative shoreline lengths were expressed in terms of a total British Columbia coastline of 27,200 km (M. Browning, Canadian Hydrographic Service, Victoria, British Columbia, pers. comm.).

DFO Statistical Area	Abundance surveyed portion	Km of shoreline surveyed	Density of seals in surveyed portion	Total shoreline in DFO Area	Estimated Total Abundance
			Queen Charlotte Islands		
01	4,195	496	8.47	613	5,189
02	7,392	2,465	3.00	2,557	7,666
Mean			3.91		
			Northern Mainland Coast		
03	1,648	572	2.83	1,175	3,381
04	5,451	1,223	4.46	1,240	5,531
05	1,685	1,841	0.92	1,869	1,711
06	1,038	727	1.43	2,836	4,050
Mean			2.25		
			Central Mainland Coast		
07	4,727	2,753	1.72	2,785	4,783
08	2,453	1,195	2.05	1,195	2,453
09	840	848	0.99	848	840
10	1,088	431	2.52	431	1,088
Mean			1.74		
			Queen Charlotte Strait, Discovery Passage & Jervis Inlet		
11	1,388	201	6.92	759	5,253
12	5,294	1,624	3.26	2,533	8,258
13	4,131	637	6.48	898	5,823
16	785	484	1.62	596	967
Mean			3.94		
			West Coast Vancouver Island		
20&21	916	265	3.46	265	916
23	2,111	615	2.95	715	2,111
24	1,431	560	1.64	871	1,431
25	1,877	320	2.48	780	1,933
26	1,804	524	3.44	524	1,804
27	2,182	596	3.66	596	2,182
Mean			2.77		
Total					67,368
Wt. Mean	52,435	19,225	2.73	24,087	65,696

Table 7. Number of harbour seal pelts processed, bounties paid and Departmental kills in British Columbia during 1879-1970. Data were compiled from Fisher (1952), Bigg (1969), Annual Fisheries Reports, and unpublished archival files on the bounty program and commercial seal harvest, including semi-annual reports filed by fur buyers.

Year	Departmental Kills		Bounty Payments	Pelts Processed	Year	Departmental Kills		Bounty Payments	Pelts Processed
	Positive	Probable				Positive	Probable		
1970	12	0	0	0	1923	0	0	0	0
1969	30	0	0	0	1922	0	0	0	0
1968	171	0	0	249	1921	0	0	0	0
1967	33	0	0	185	1920	0	0	0	0
1966	15	0	0	2584	1919	0	0	0	0
1965	3	0	0	3531	1918	0	0	0	0
1964	42	0	5886	2456	1917	0	0	748	0
1963	334	0	4962	0	1916	0	0	785	0
1962	351	0	2118	0	1915	0	0	749	0
1961	274	0	2351	0	1914	0	0	1237	2050
1960	348	0	2878	0	1913	0	0	0	2520
1959	193	0	3431	0	1912	0	0	0	2275
1958	346	0	3741	0	1911	0	0	0	2125
1957	279	0	4053	0	1910	0	0	0	2590
1956	209	0	3426	0	1909	0	0	0	5100
1955	236	0	3987	0	1908	0	0	0	5220
1954	357	0	4333	0	1907	0	0	0	5160
1953	302	30	3257	0	1906	0	0	0	5600
1952	303	105	3397	0	1905	0	0	0	5684
1951	316	63	2791	0	1904	0	0	0	6000
1950	352	84	2289	0	1903	0	0	0	5950
1949	421	186	2556	0	1902	0	0	0	5600
1948	132	21	2693	0	1901	0	0	0	4100
1947	0	0	2740	0	1900	0	0	0	7825
1946	0	0	1949	0	1899	0	0	0	7600
1945	0	0	1978	0	1898	0	0	0	7600
1944	0	0	961	0	1897	0	0	0	5000
1943	0	0	1001	0	1896	0	0	0	3700
1942	0	0	1168	0	1895	0	0	0	3660
1941	0	0	2282	0	1894	0	0	0	3260
1940	0	0	0	0	1893	0	0	0	4150
1939	0	0	3547	0	1892	0	0	0	6700
1938	0	0	4569	0	1891	0	0	0	5175
1937	0	0	4295	0	1890	0	0	0	10200
1936	0	0	1933	0	1889	0	0	0	7000
1935	0	0	0	0	1888	0	0	0	3500
1934	0	0	0	0	1887	0	0	0	3500
1933	0	0	400	0	1886	0	0	0	3000
1932	0	0	4300	0	1885	0	0	0	2950
1931	0	0	6084	0	1884	0	0	0	2950
1930	0	0	6308	0	1883	0	0	0	2900
1929	0	0	5944	0	1882	0	0	0	3500
1928	0	0	3209	0	1881	0	0	0	3500
1927	0	0	567	0	1880	0	0	0	3000
1926	0	0	0	0	1879	0	0	0	3000
1925	0	0	0	0					
1924	0	0	0	0	**Total**	**5059**	**489**	**114903**	**172649**

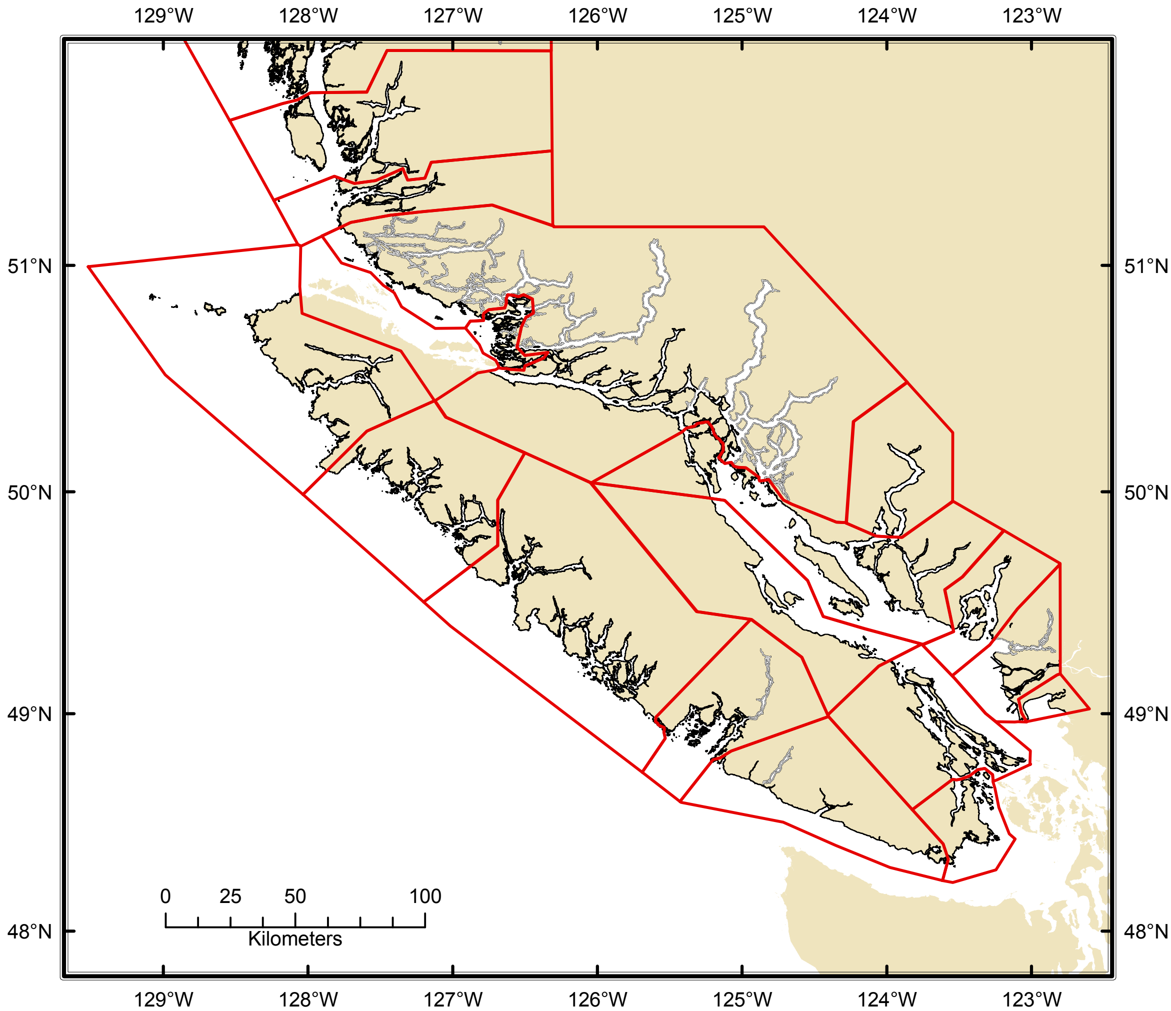


Figure 1a. Overview map showing coverage of harbour seal surveys in northern British Columbia. Grey coastline denotes areas where baseline surveys have not been conducted. Detailed maps showing the location of haulout sites are given in Appendix III.

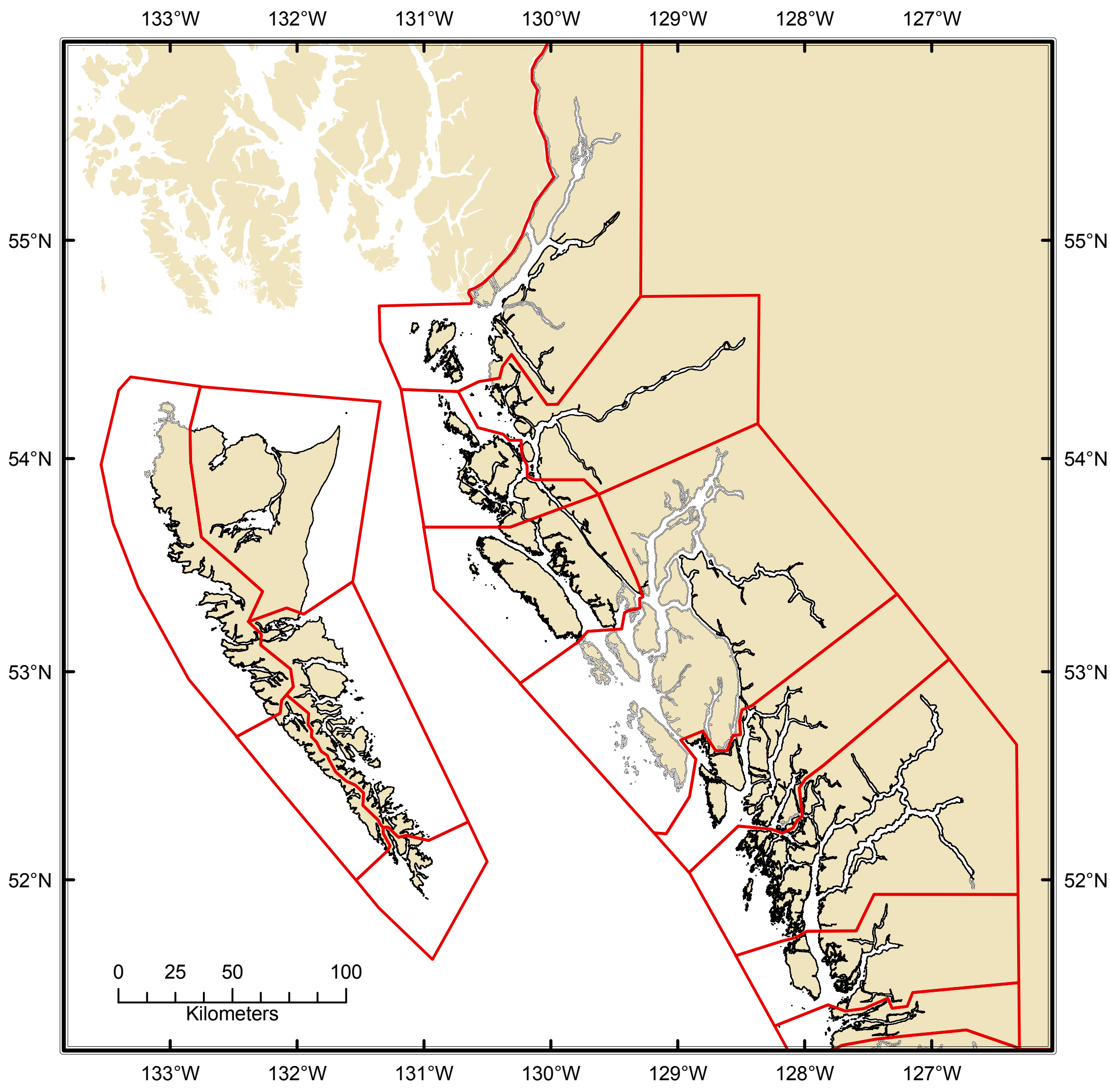


Figure 1b. Overview map showing coverage of harbour seal surveys in northern British Columbia. Grey coastline denotes areas where baseline surveys have not been conducted. Detailed maps showing the location of haulout sites are given in Appendix III.

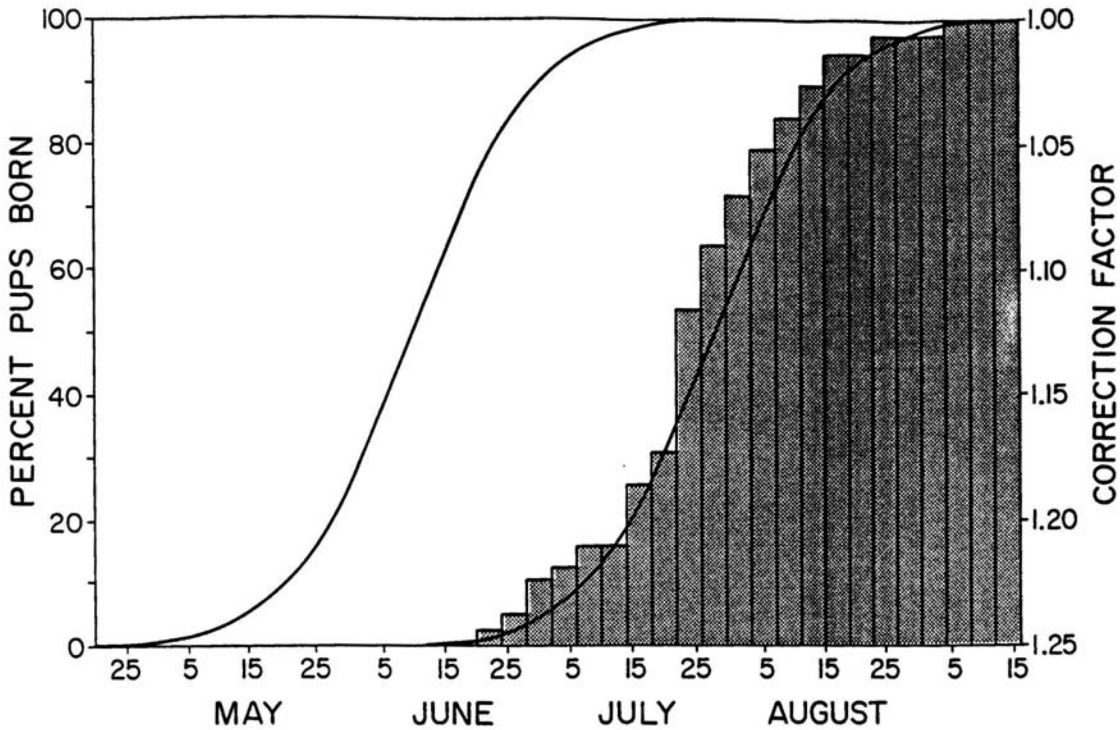


Figure 2. Pupping curves for the Strait of Georgia and southern British Columbia (right) and for the Skeena River and northern British Columbia (left). The shaded histogram indicates the cumulative number of neonates observed in 4-day intervals in the Strait of Georgia (from Olesiuk et al. 1990a; data from Bigg 1969a).

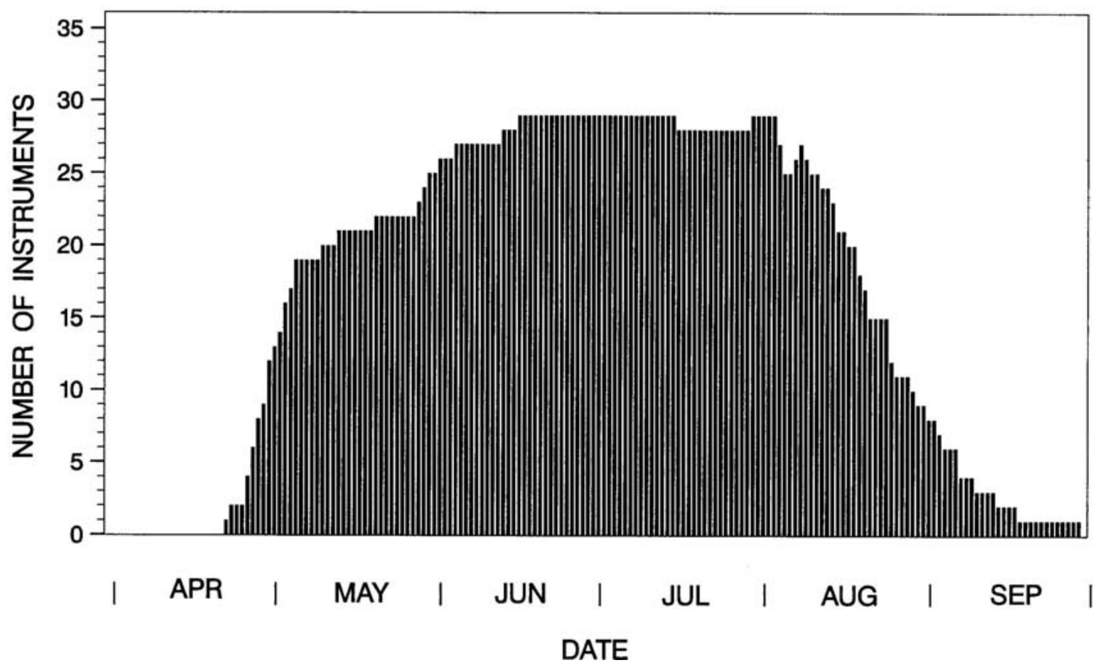


Figure 3. Seasonal distribution in time-depth recorder sampling effort. Bars show the number of instruments recovered that were actively recording by date.

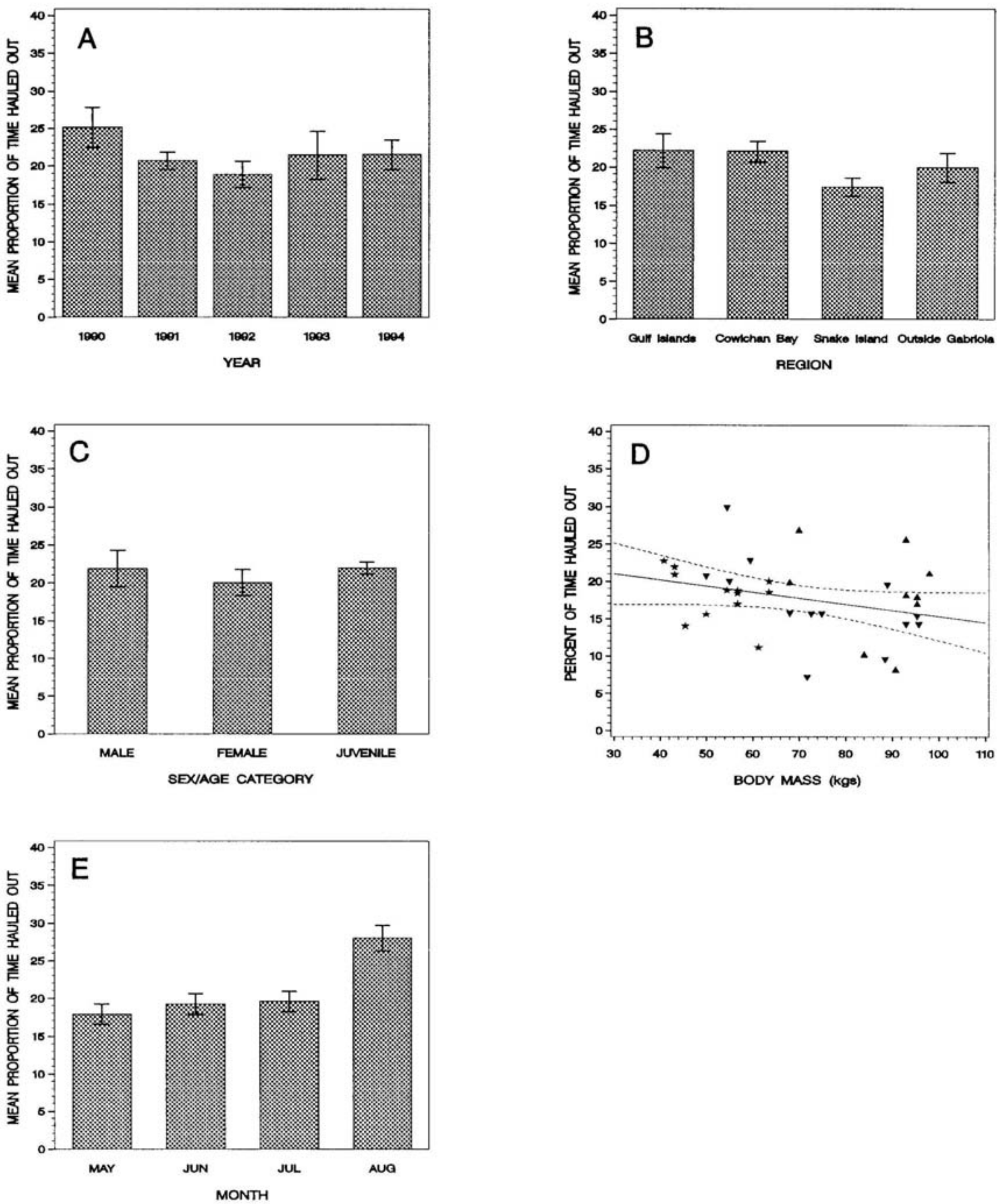


Figure 4. Mean proportion of time harbour seals spent hauled out as a function of: **a)** year; **b)** area; **c)** sex- and age-class; **d)** body mass; and **e)** month. Data were tabulated by animal and then averaged. Vertical bars denote standard errors of the animal means.

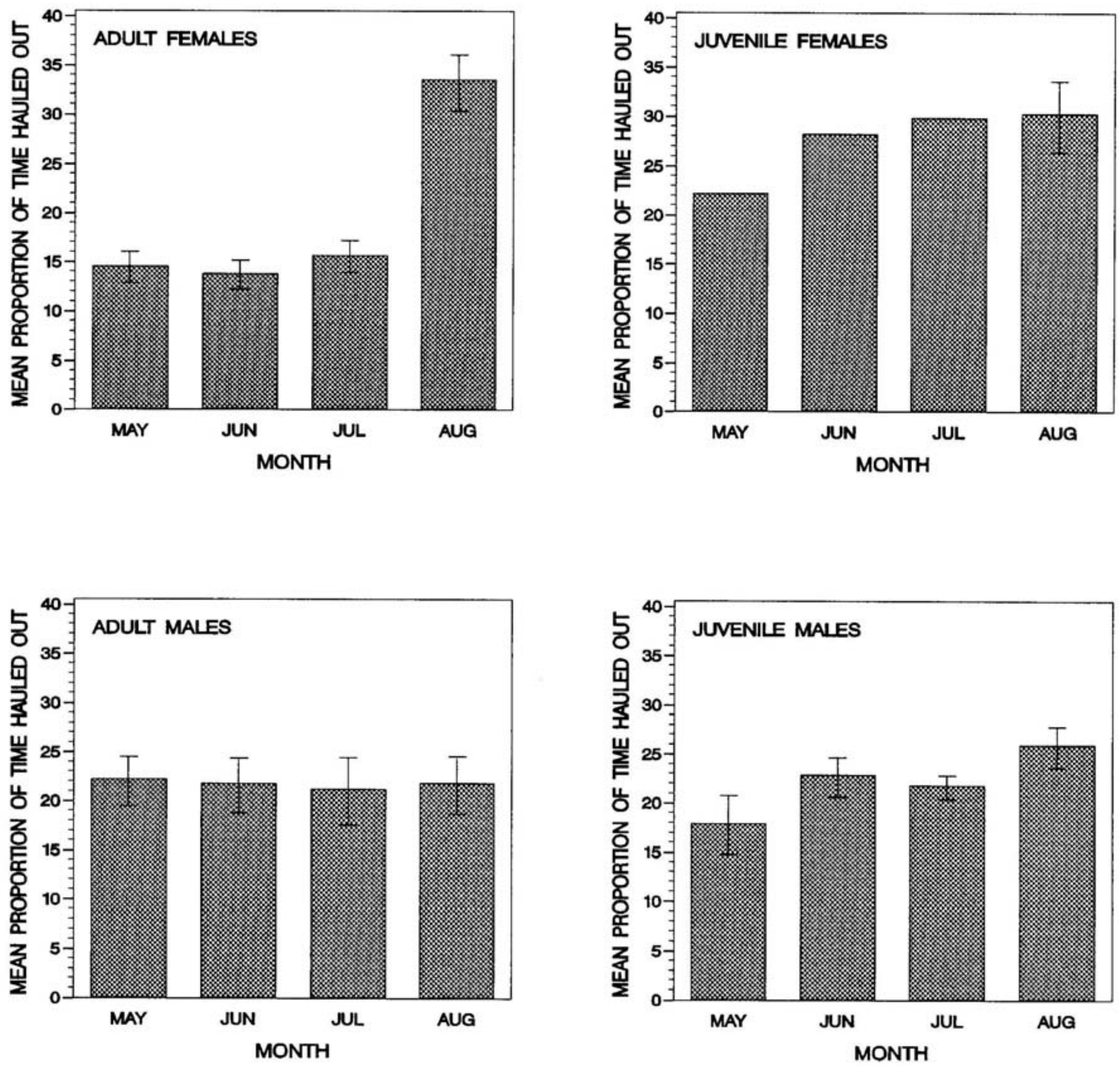


Figure 4f. Mean proportion of time harbour seals spent hauled out as a function of month for each sex- and age-class. Data were tabulated by animal and then averaged. Vertical bars denote standard errors of the animal means.

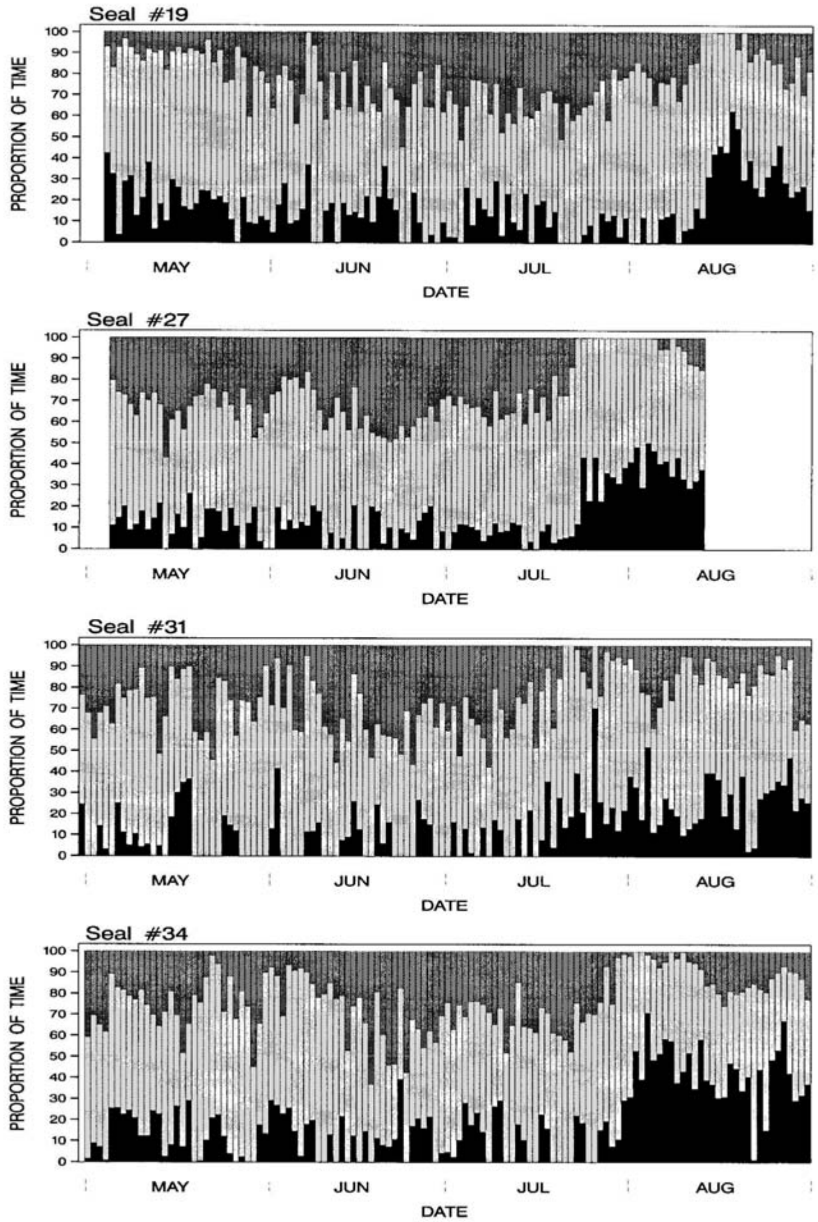


Figure 5a. Several examples showing seasonal changes in daily activity patterns for adult females that were seen nursing pups for which there was at least several weeks of data both preceding and proceeding the apparent date of parturition. The bars in each panel show, from bottom to top, the proportion of each day spent hauled out (black), in the water near the surface (<10 meters) (light grey) and diving (>10 meters) (dark grey). Each seal exhibited an abrupt change in behaviour sometime between mid-July and mid-August, which coincides with the pupping season (see Figure 2). These behavioural changes are characterized by: 1) hauling out every day rather than most days; 2) an increase in the proportion of time spent hauled out each day; and 3) a decline in the amount of time spent diving each day. The changes were

most dramatic for Seal #27, but were also exhibited to varying degrees by the other nursing females.

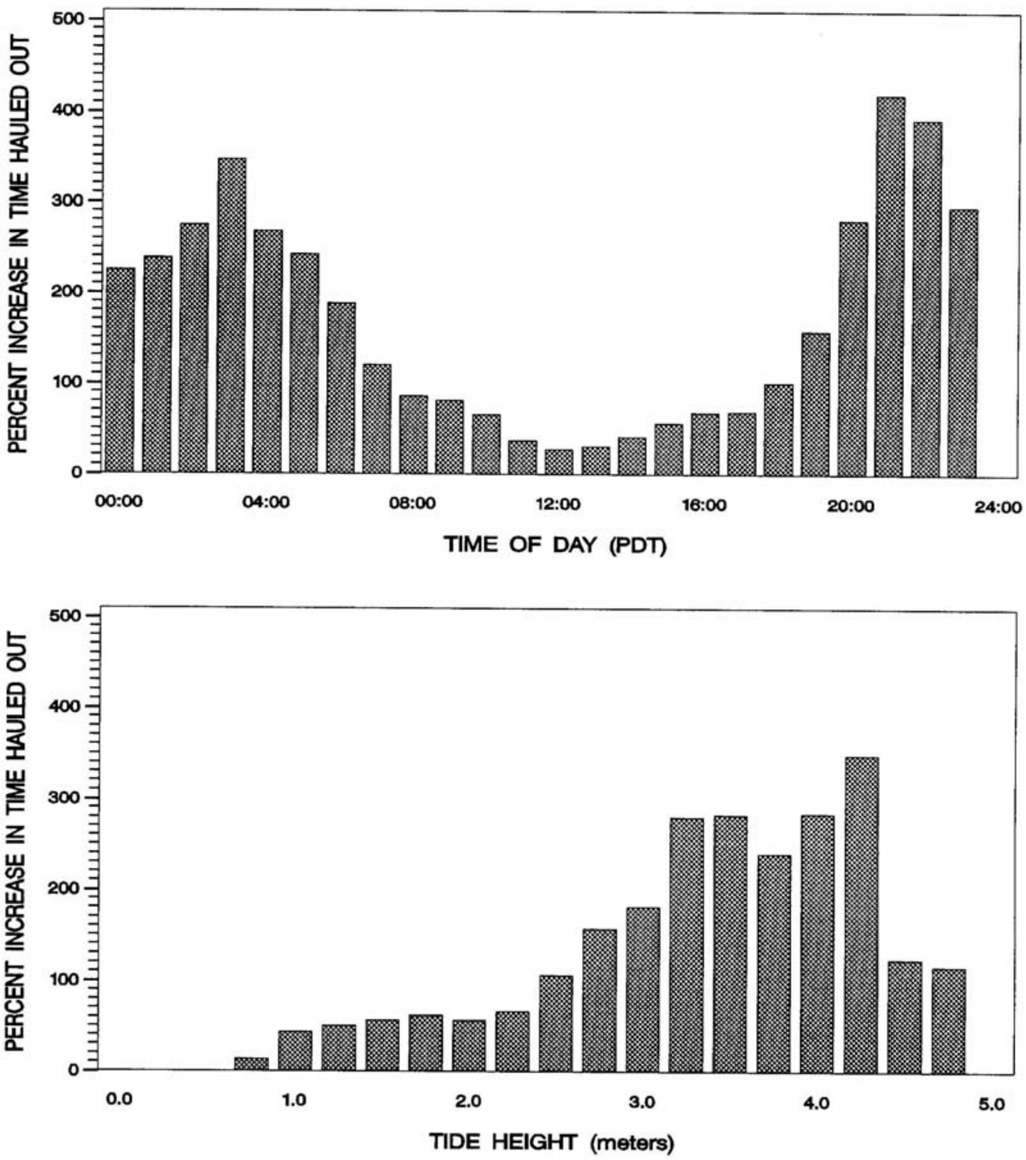
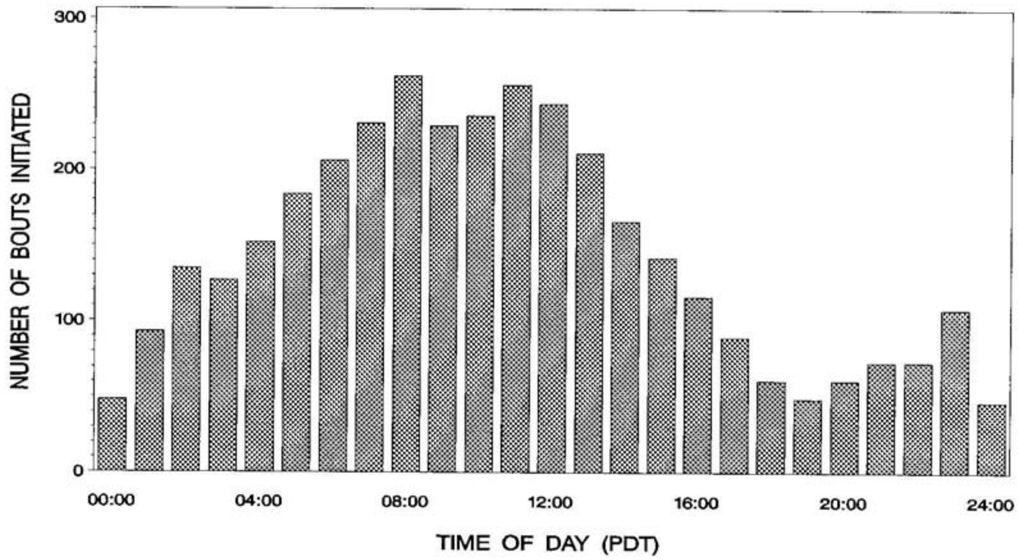


Figure 5b. Relative increase in amount of time spent ashore by adult females in August compared to May-July as a function of time of day (top panel) and tide height (bottom panel).



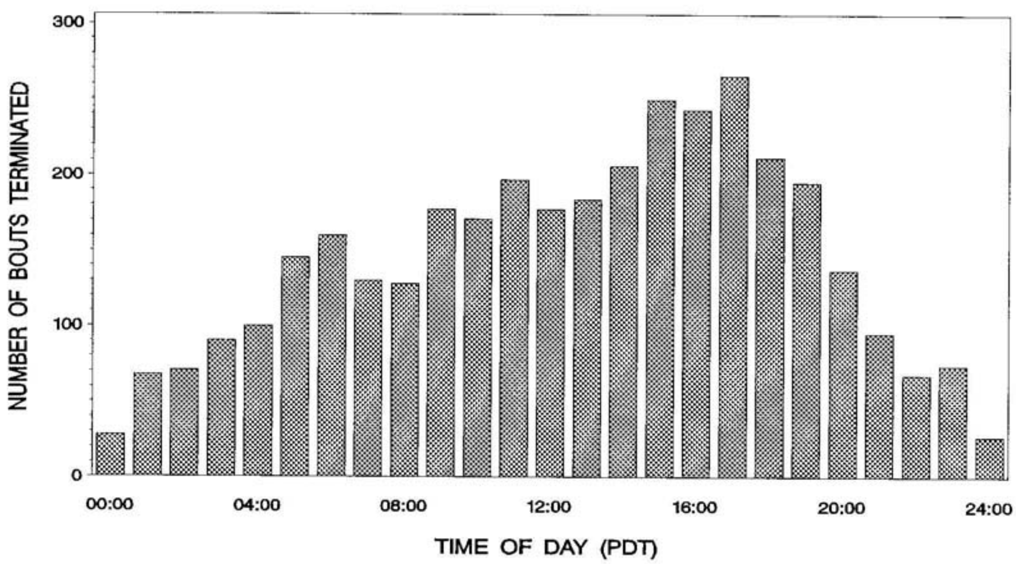


Figure 6a. Number of haulout bouts initiated (top panel) and terminated (bottom panel) as a function of time of day.

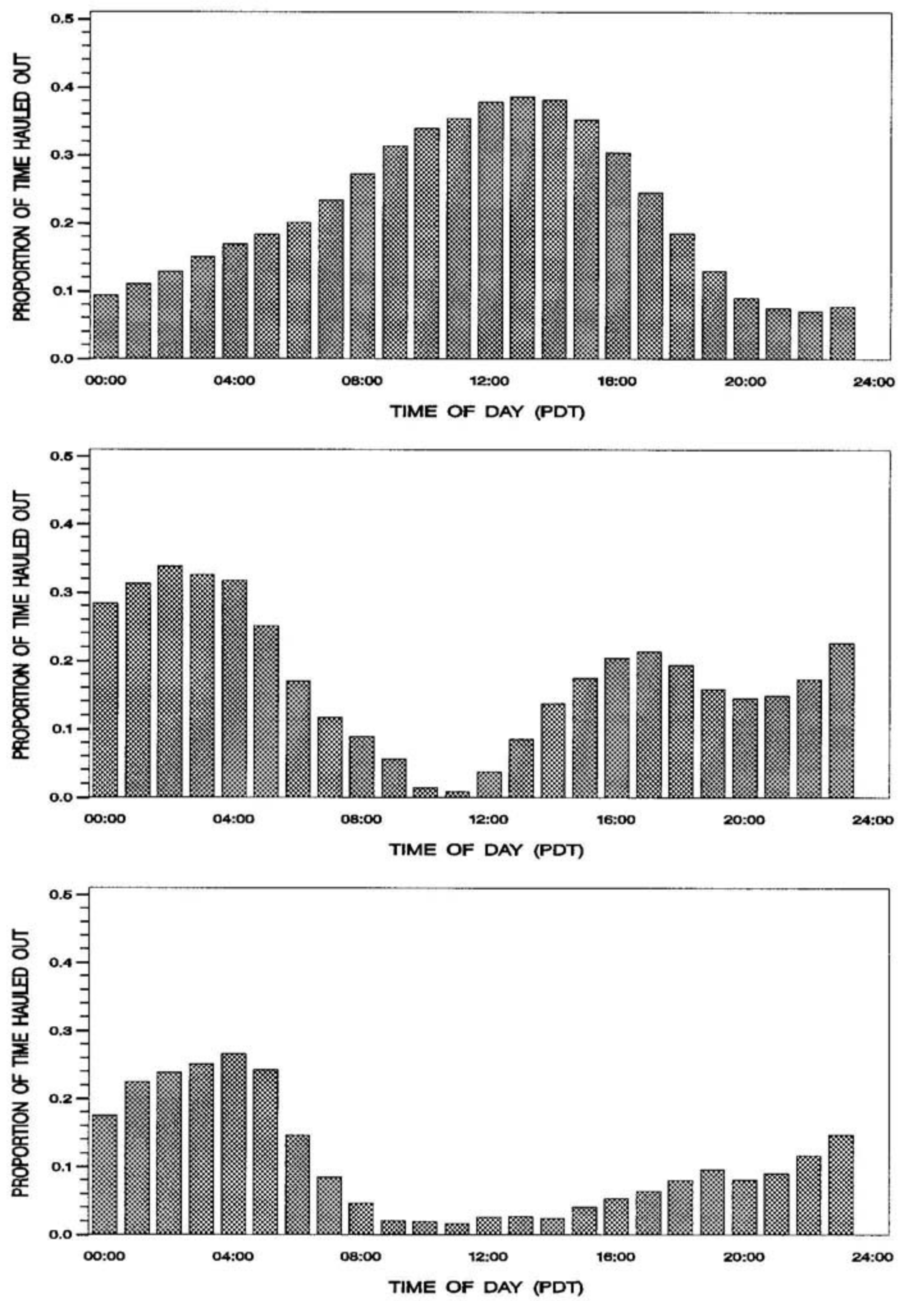


Figure 6b. Proportion of time spent hauled out as a function of time of day for the 31 time-depth records used to generate the haulout response curves on which the census correction factors are based (top panel), for the 2 time-depth records from instruments deployed in Cowichan Bay estuary (middle panel), and for the time-depth record of an animal captured at a tidal haulout but which frequented the Nanaimo River estuary on a regular basis (bottom panel).

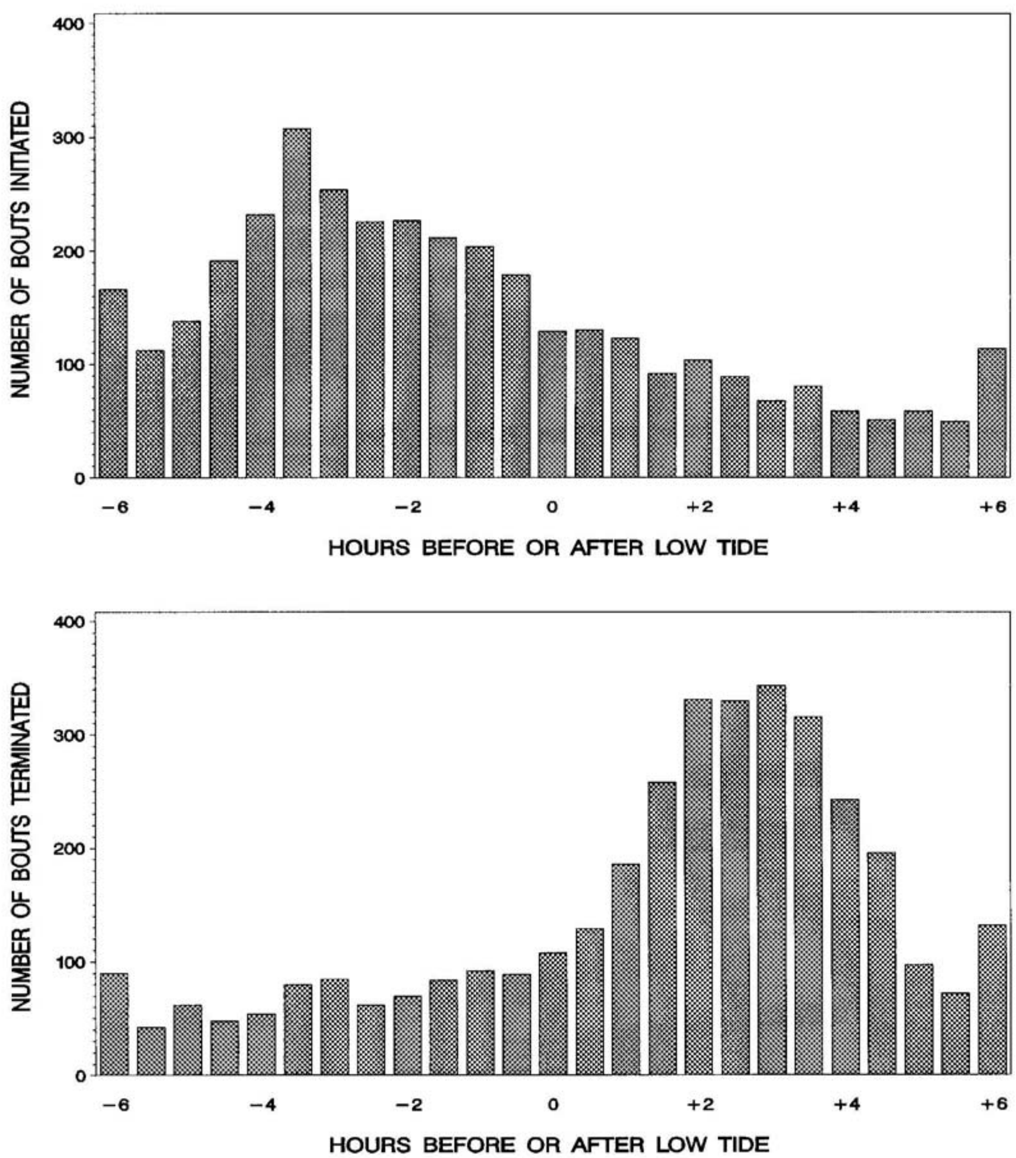


Figure 7a. Number of haulout bouts initiated (top panel) and terminated (bottom panel) as a function of time relative to low tide

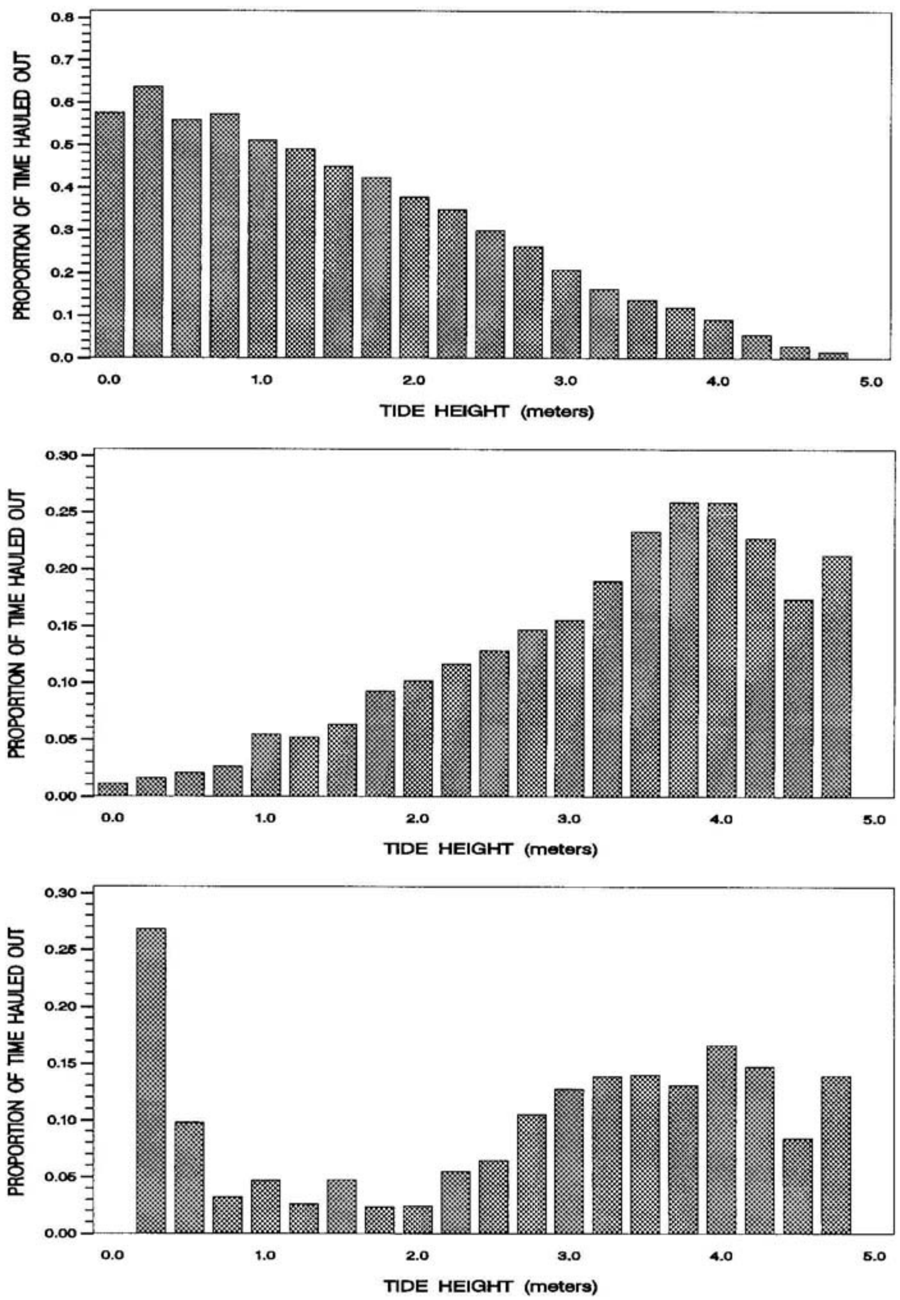


Figure7b. Proportion of time spent hauled out as a function of time relative to low tide for the 31 time-depth records used to generate haulout response curves on which the census correction factors area based (top panel), for the 2 time-depth records from instruments deployed in Cowichan Bay estuary (middle panel), and for a time-depth record of an animal captured at a tidal haulout but which frequented the Nanaimo River estuary on a regular basis (bottom panel).

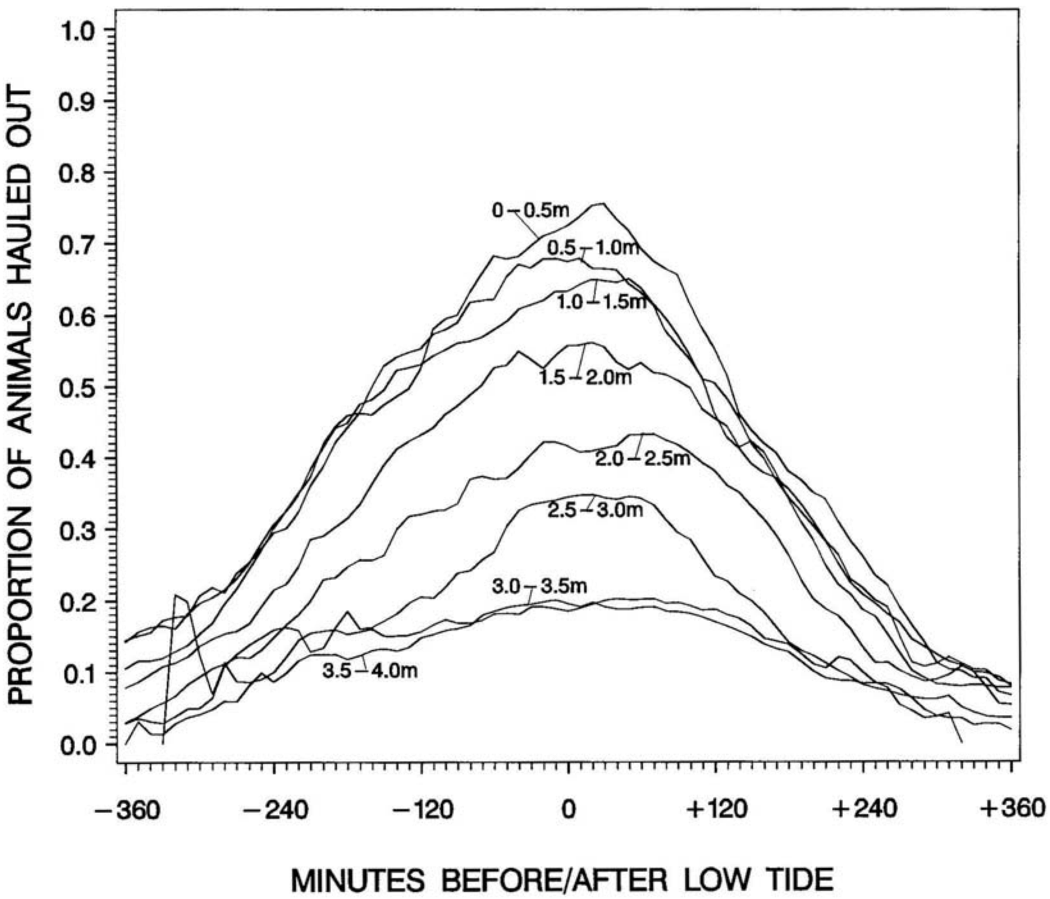


Figure 8a. Examples of haulout response curves showing the proportion of seals hauled out as a function of time relative to low tide for low tides of varying height irrespective of the time at which the low tide occurred, which shows that animals prefer to haul out on lower low tides. Note the consistent shape of the response curves irrespective of the time or height of the low tide.

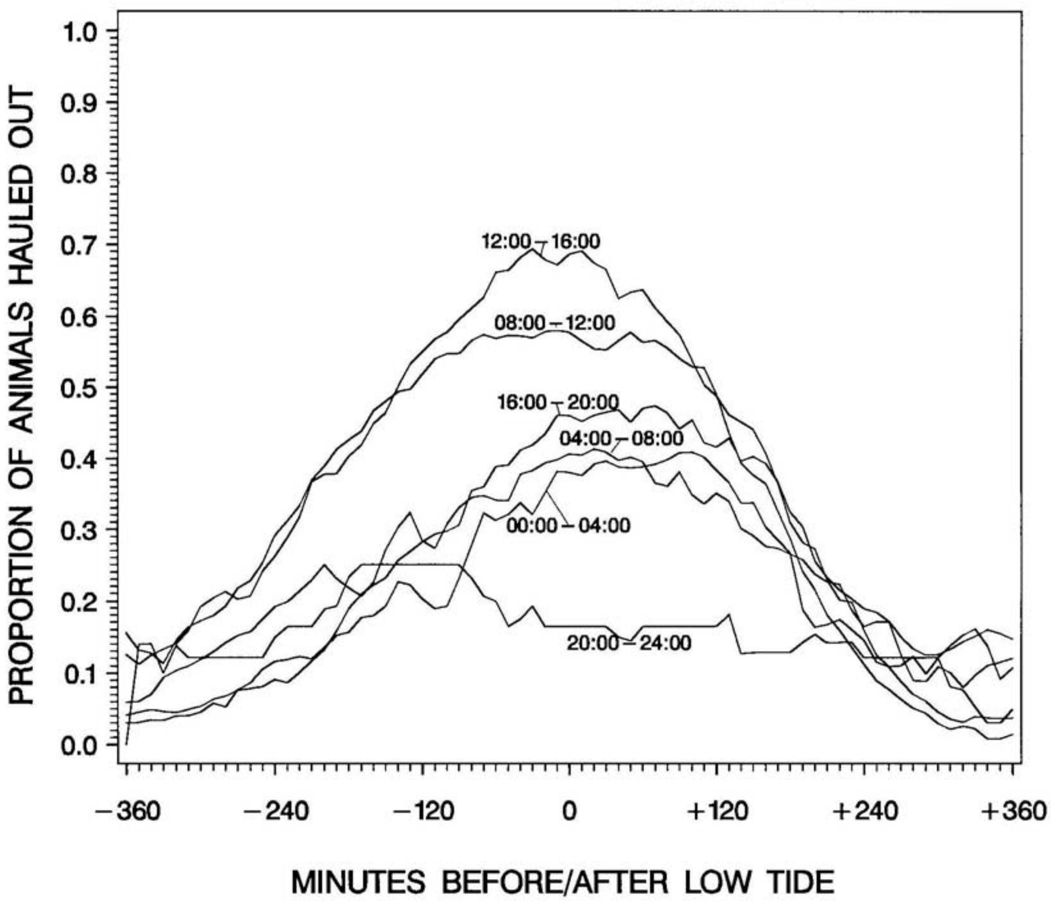


Figure 8b. Examples of haulout response curves showing the proportion of seals hauled out as a function of time relative to low tide for an intermediate low tide of 2.0-2.5 meters, which shows that for a tides of a fixed height animals prefer to haul out near mid-day as opposed to night-time. Note the consistent shape of the response curves irrespective of the time or height of the low tide.

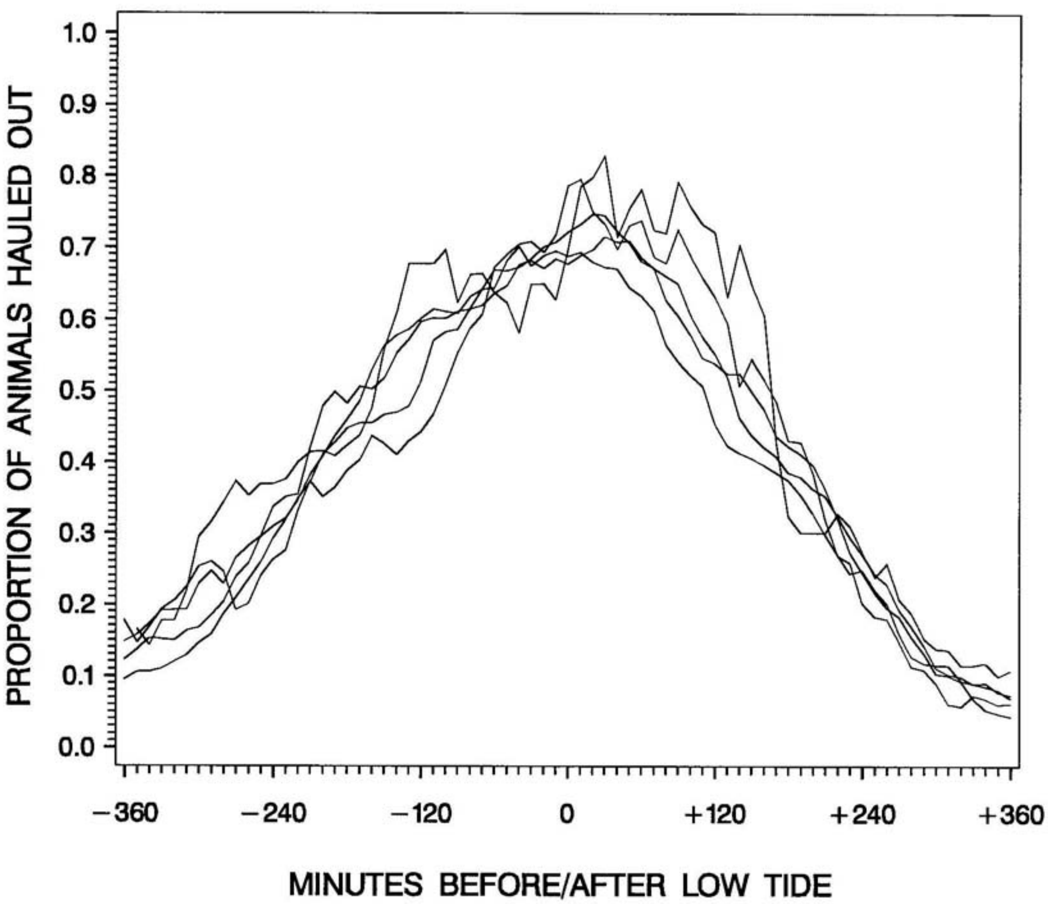


Figure 8c. Examples of haulout response curves showing the proportion of seals hauled out as a function of time relative to low tide for tides of varying heights that occur near mid-day (10:00-14:00), which shows that once the effects of time-of-day are removed, tide height has little effect on the proportion of animals hauled out (curves were too similar to label and represent tides of 0-0.5, 0.5-1.0, 1.0-1.5, 1.5-2.0, and 2.0-2.5m; low tides >2.5m never occur near mid-day during summer months).. Note the consistent shape of the response curves irrespective of the time or height of the low tide.

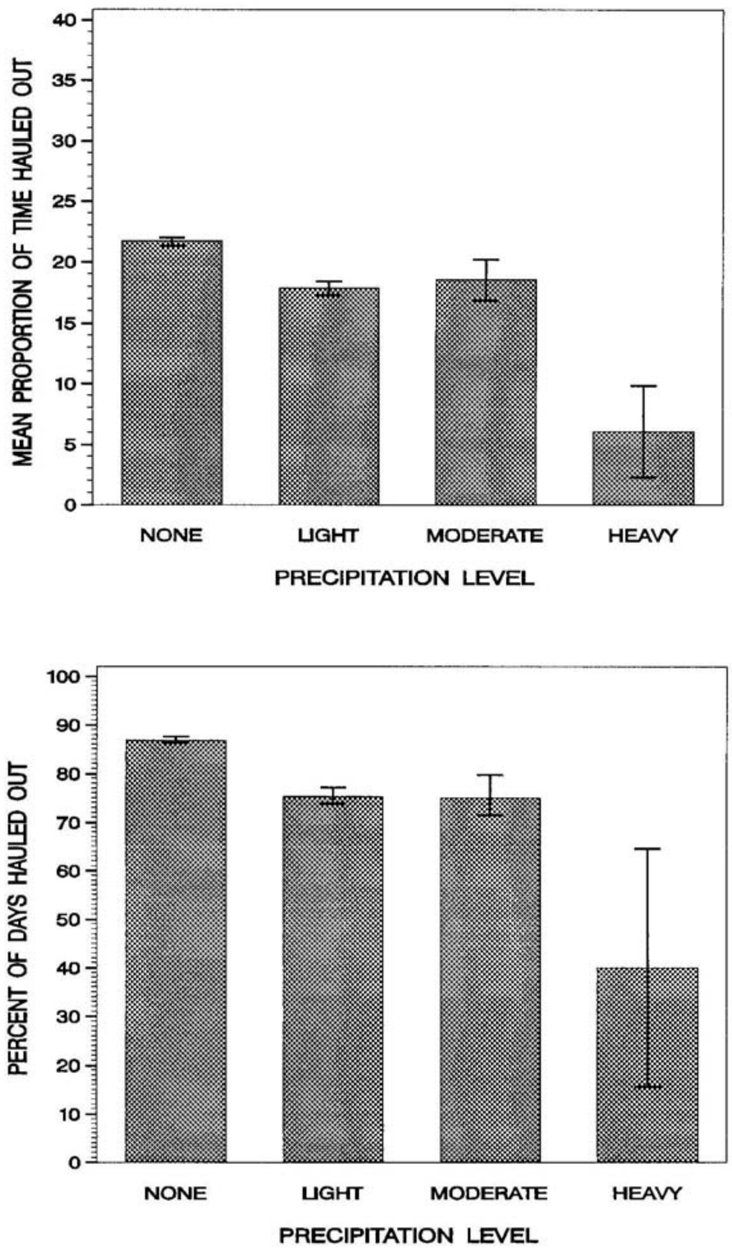


Figure 9. Effect of precipitation on the proportion of **a)** time spent hauled out; and **b)** days on which seals hauled out.. Light, moderate and heavy precipitation were defined days with 0-10mm, 10-20mm and >20mm of rain per day respectively as recorded at the Environment Canada station located on Gabriola Island near the centre of the study area. Data were tabulated by animal and then averaged. Vertical bars denote standard errors of the animal means.

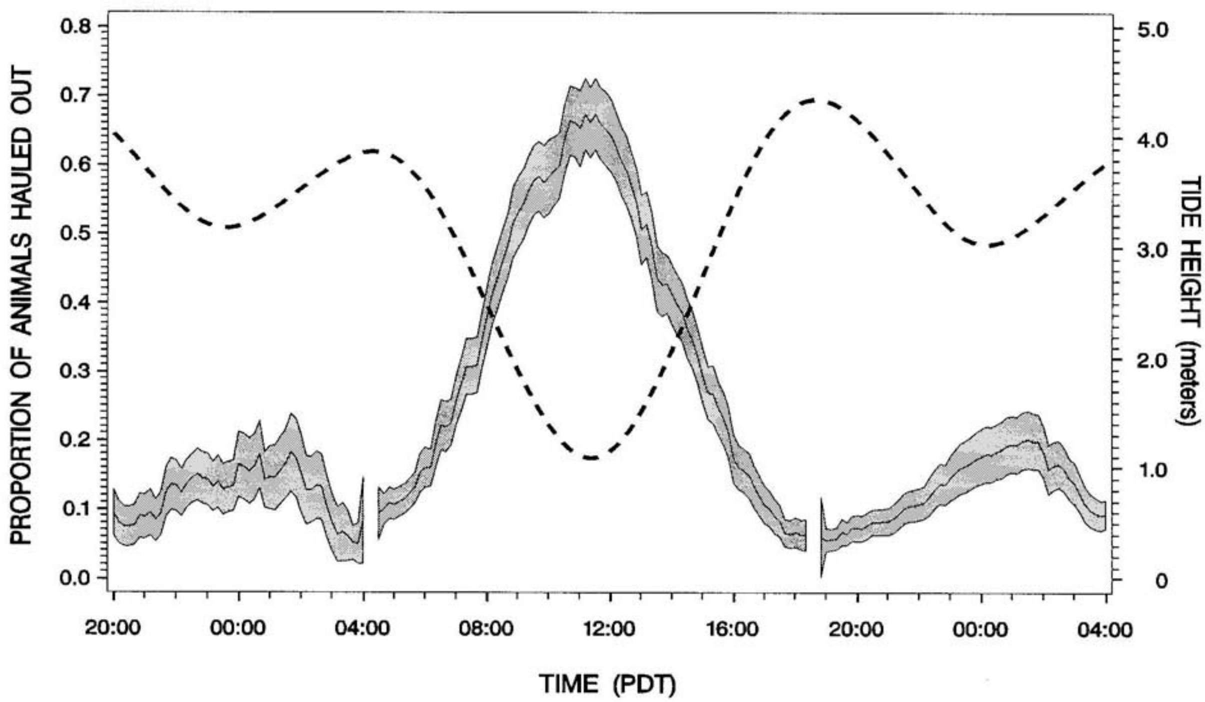


Figure 10a. Example illustrating calculation of correction factors for animals that were not hauled out and hence missed during surveys for one of the most recent flights (*NEGULF* on 14 August, 1996). This panel gives an overview of the day of the survey showing that the lower low tide of 1.09 meters occurred at 11:23 PDT and was preceded by a higher low tides of 3.87 meters that occurred at 23:35 PDT and proceeded by higher low of 3.03 meters that occurred at 00:10 PDT (dashed lines). The three haulout response curves (solid lines with ±SE shaded) corresponding to similar tides (in this case defined at tides of 3.37 to 4.37 meters between 22:35 and 00:35 PDT, 0.59 to 1.59 meters between 10:23 and 12:23 PDT, and 2.53 to 3.53 meters between 23:10 and 01:10 PDT respectively; 110, 520 and 629 of which had been monitored by the time-depth recorders) indicated that animals clearly preferred to haul out on the lower low tide that occurred during daylight as opposed to the higher low tides that occurred at night.

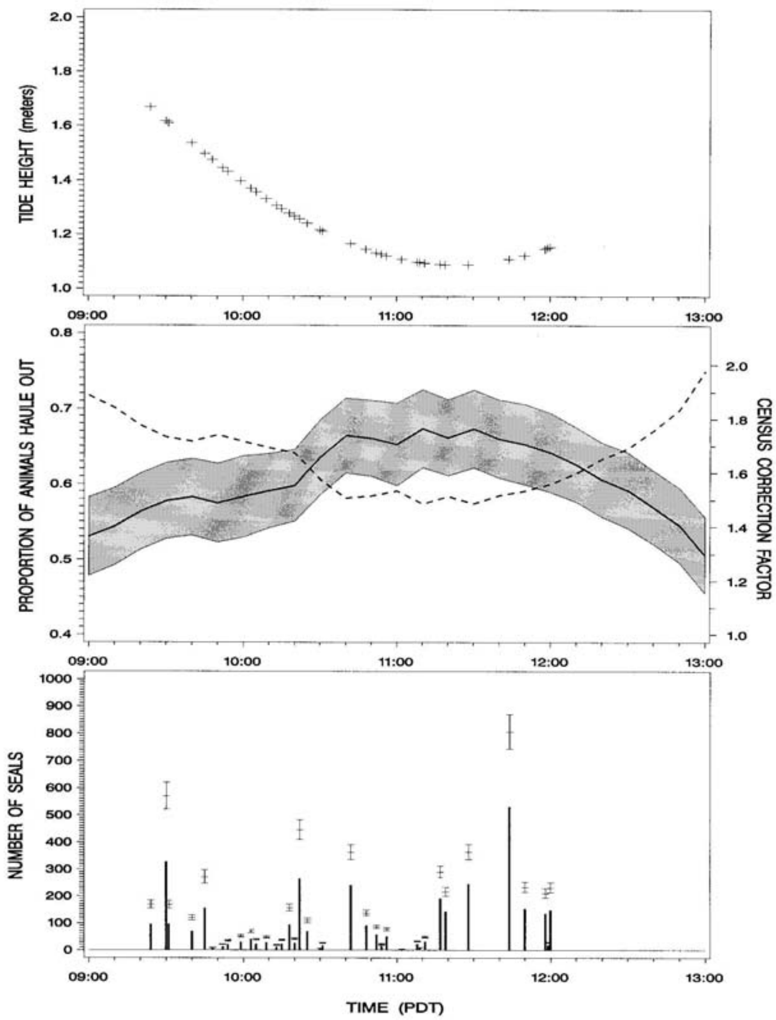


Figure10b. Example illustrating calculation of correction factors for animals that were not hauled out and hence missed during surveys for one of the most recent flights (*NEGULF* on 14 August, 1996). The first count was made about 110 minutes prior to low tide and the final count about 22 minutes after low tide (top panel), which generally coincided with the peak haulout period (middle panel). Based on TDR records for similar tides, the proportion (solid line with ±SE shaded / left scale) of animals hauled out increased from about 0.563 at the beginning of the survey, peaked at 0.673 about 11 minutes prior to low tide, and subsequently declined to 0.650 by the end of the survey, such that the corresponding census correction factors (dashed line / right scale) declined from 1.78 at the beginning to the census to a minimum of 1.49 about 11 minutes before low tide before increasing to 1.54 by the end of the survey. Bottom panel shows counts (solid bars) and estimated actual abundance (vertical lines with SE bars) for each haulout site based on the estimated proportion of animals hauled out when the site was surveyed. The overall weighted mean proportion of animals hauled out during the survey was 0.624 (SE=0.051), which corresponds with a census correction factor of 1.60.

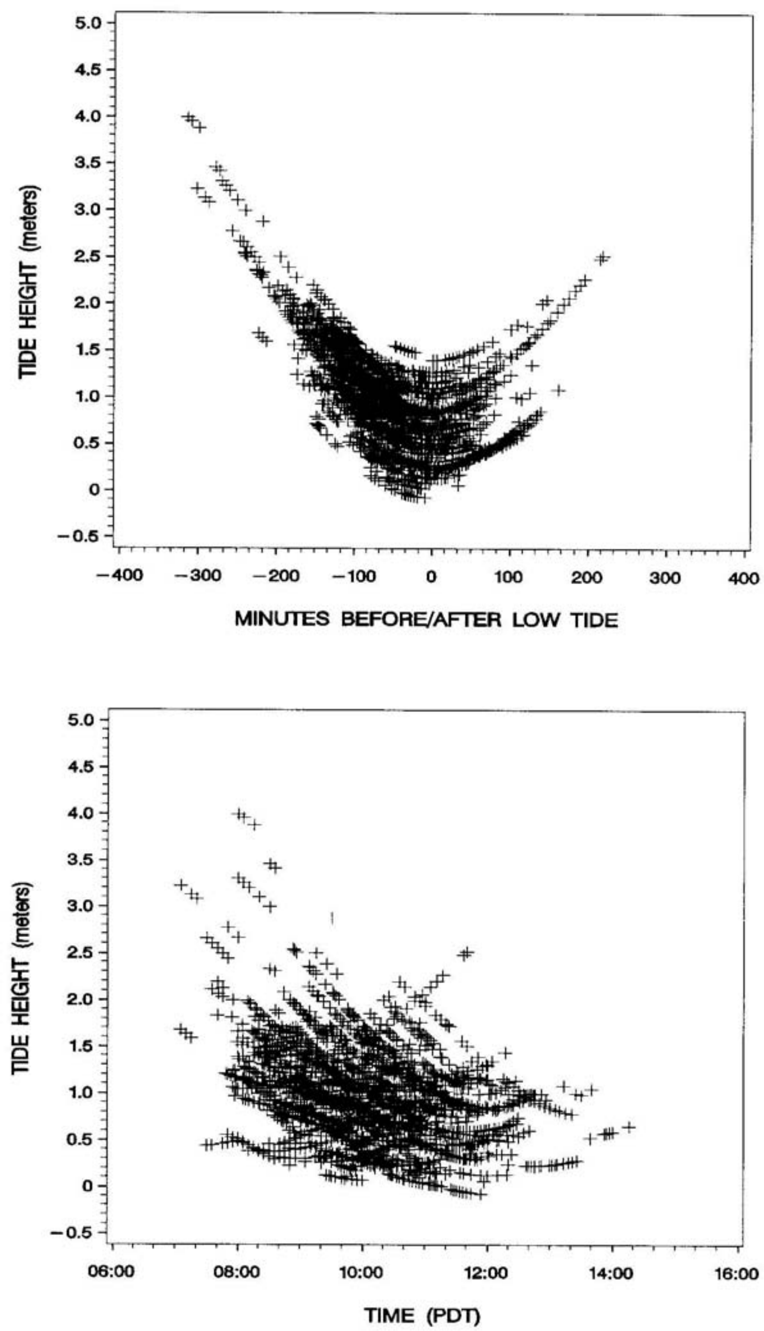


Figure 11. Scatterplots showing the time and tide height for all counts made in the Strait of Georgia during 1973-96 as a function of: **a)** time relative to low tide; and **b)** time of day. Each symbol represents one count, and the chains of symbols usually denote a sequence of counts made on the same survey flight. The outliers in the upper-left corner represent several survey flights in 1973 and 1974 that were initiated up to 5 hours before low tide while water levels were still high.

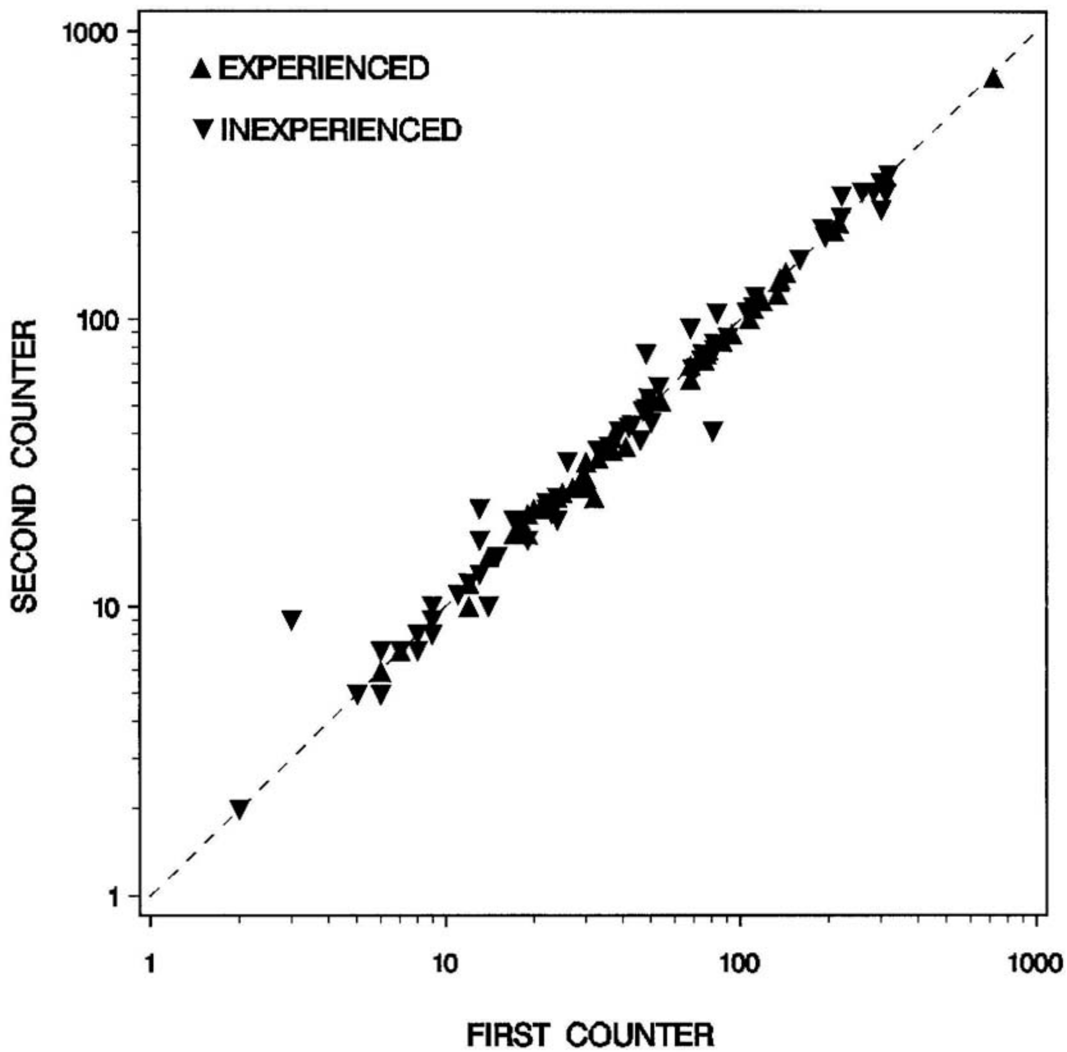


Figure 12. Blind comparisons of counts made from photographic slides by different readers. The dashed line denotes a 1:1 line indicating perfect agreement. The first counter in both cases was the author, who counted most slides from 1982-88 and about two-thirds of those from 1988-98. An experienced assistant counted most of the remaining one-third of slides from 1988-98. An inexperienced assistant also counted some of the more recent slides, but most were eventually recounted by either the author or the experienced assistant.

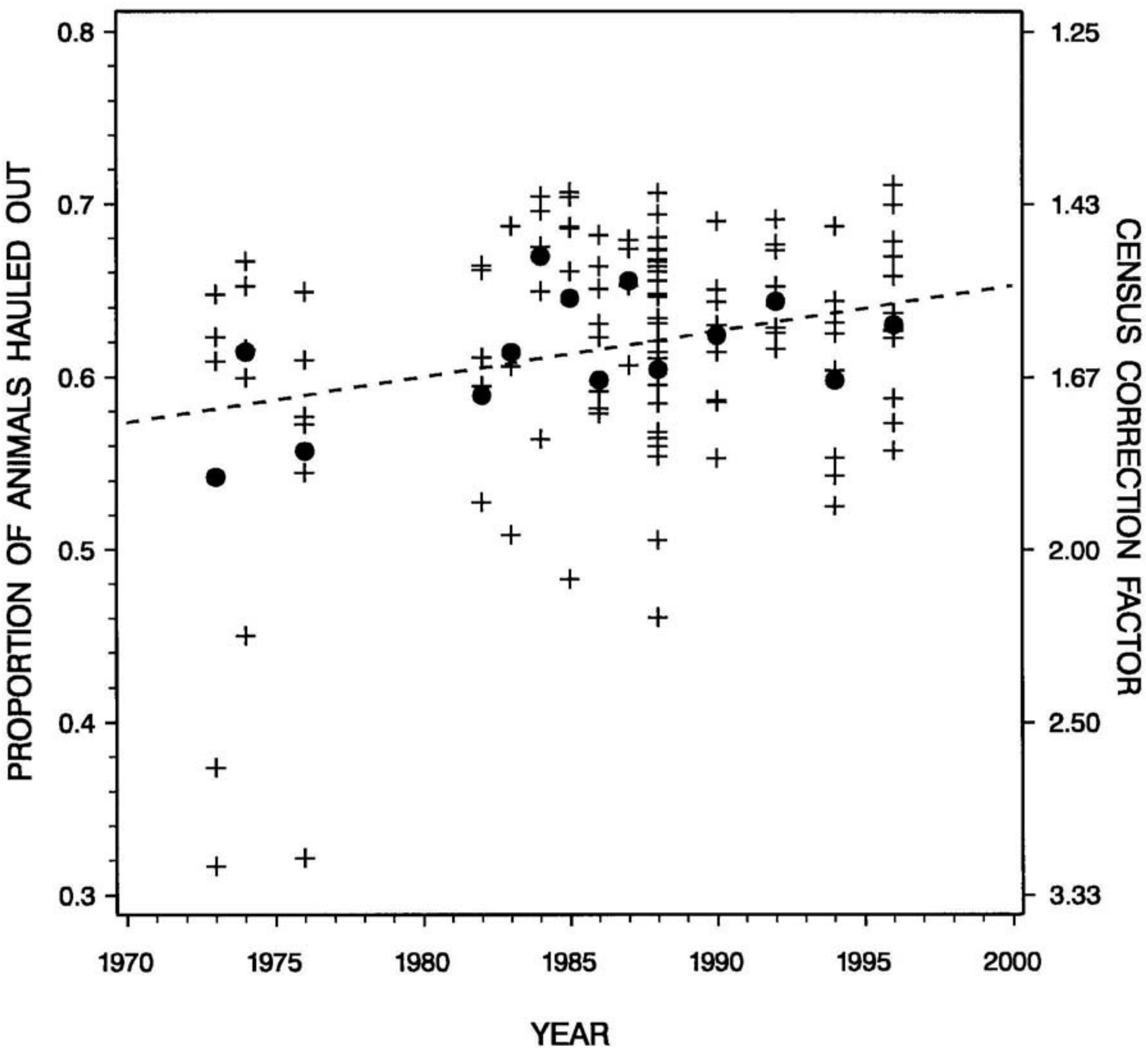


Figure 13. Census correction factors for the Strait of Georgia over the course of the study. Plus symbols denote correction factors for each subarea on each flight (i.e. there would be two symbols if the flight covered two subareas or if a subarea required two flights), circles represent the weighted annual means, and the dashed line a weighted least squares regression fitted to the annual means. The corresponding census correction factor is shown on the right-hand axis, but note that its scale is non-linear.

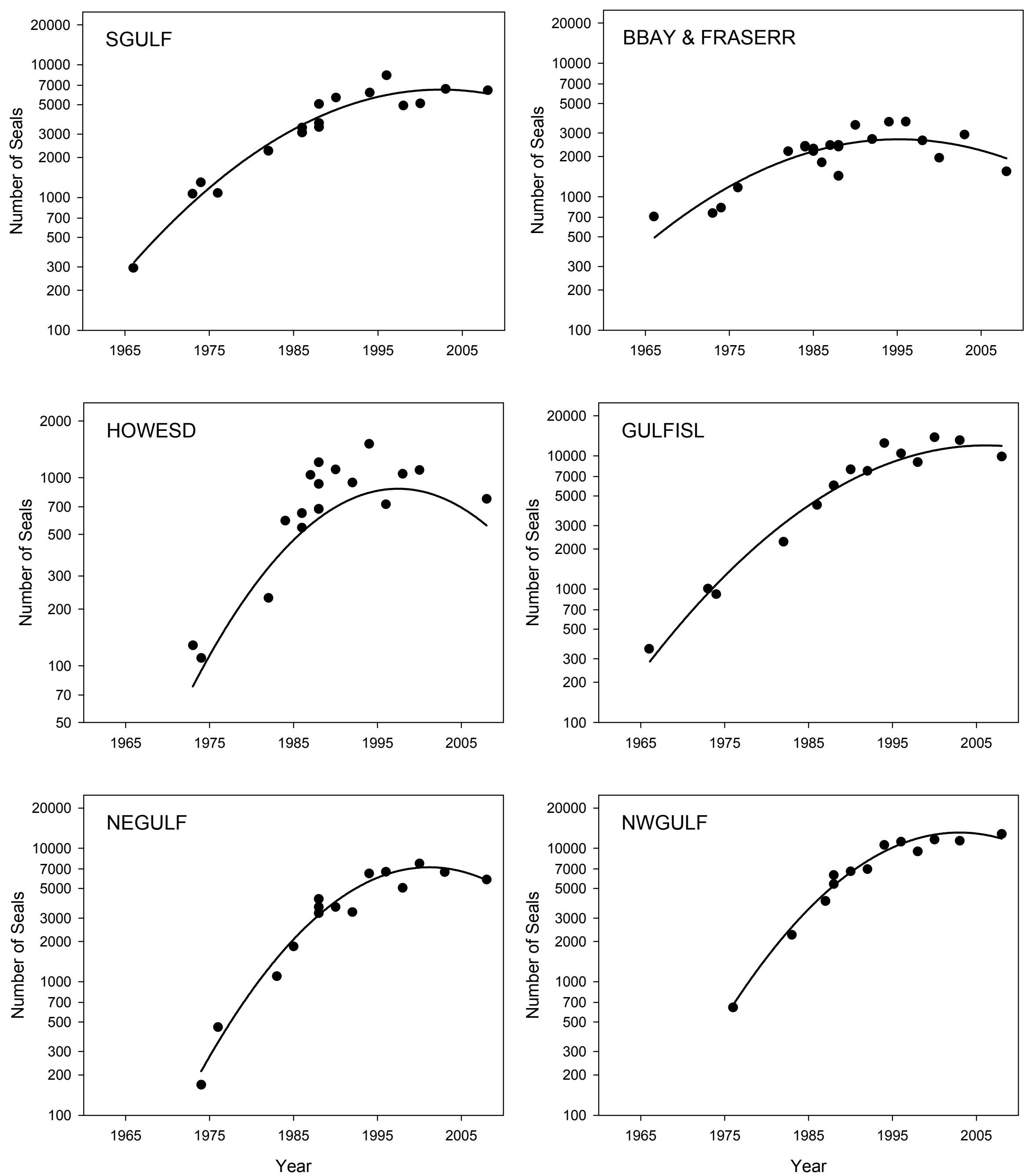


Figure 14. Trends in abundance of seals in subareas with time-series of counts. Solid lines represent second-order log-linear polynomials (4 or more surveys), dashed lines represent log-linear regression lines (3 surveys), and dotted lines join the point estimates where there were too few data to fit regressions (2 surveys).

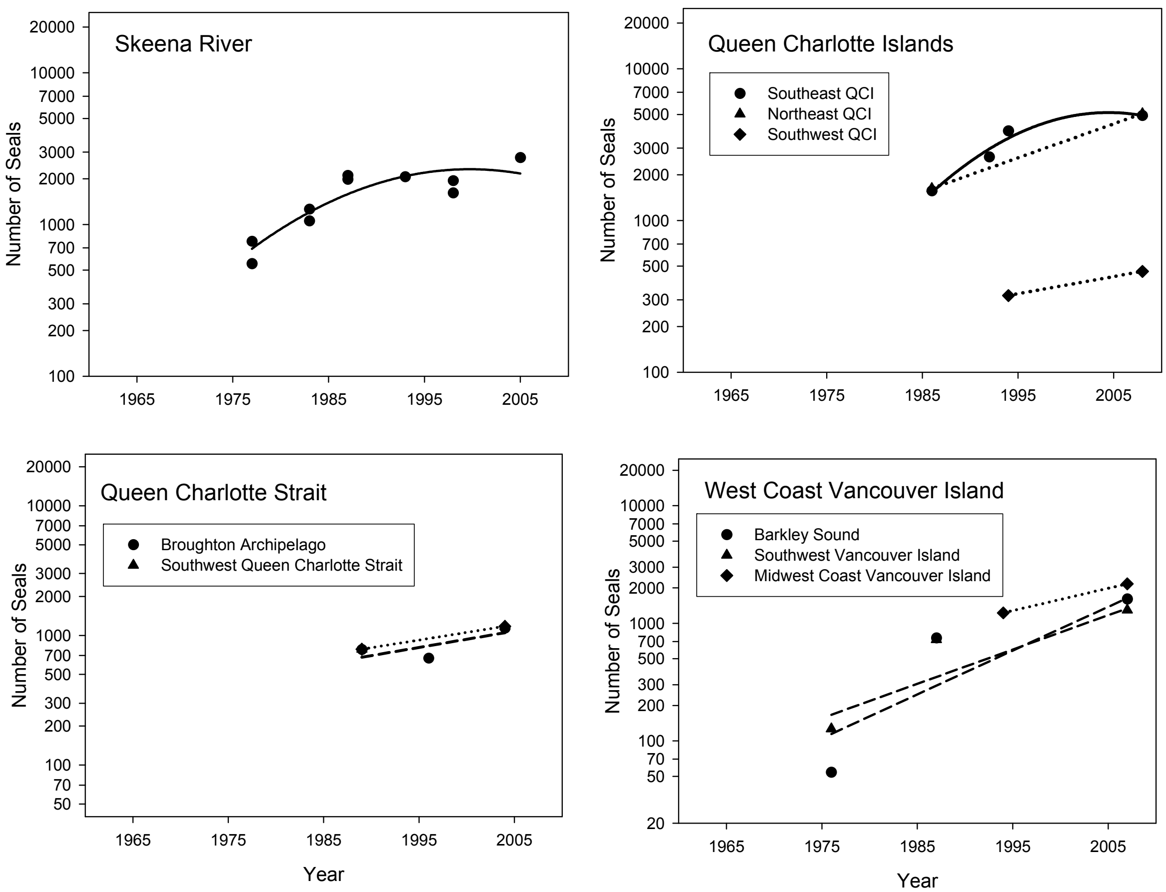


Figure 14 continued. Trends in abundance observed in subareas surveyed more than once over the course of the study. Dashed lines represented weighted least squares log-linear regressions and solid lines join the point estimates where there were too few data to fit regressions.

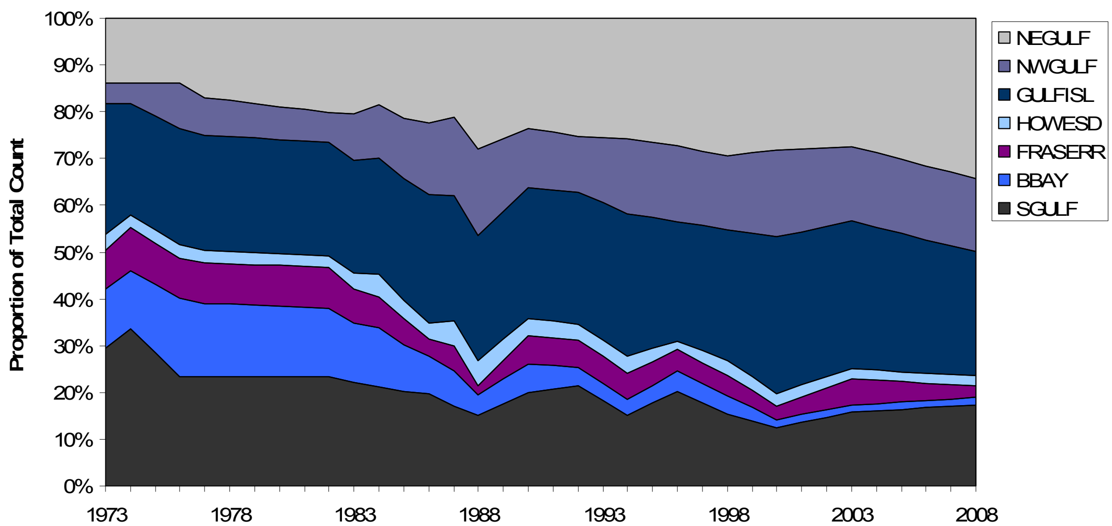


Figure 15. Shifts in the relative distribution of harbour seals among the Strait of Georgia subareas over the course of the study.

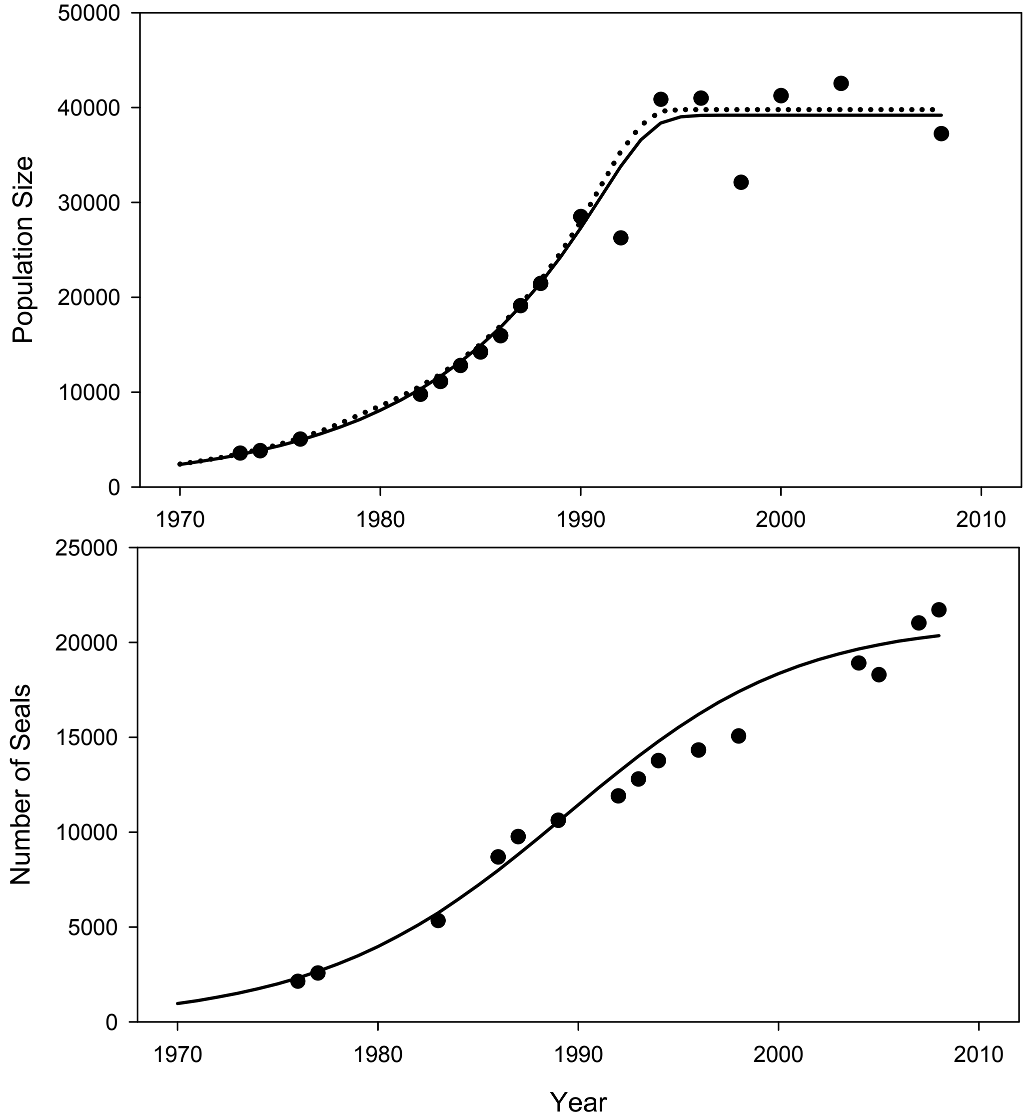


Figure 16. Population trends **a)** within the Strait of Georgia; and **b)** in a composite of all areas surveyed outside the Strait of Georgia. The solid line denotes a generalized logistic model fitted by least squares (weighted by the square root of the proportion of the region surveyed), and the dashed line in the first panel represents the sum of abundance estimates from generalized logistic models fitted individually to each of the seven subareas (see Figure 17).

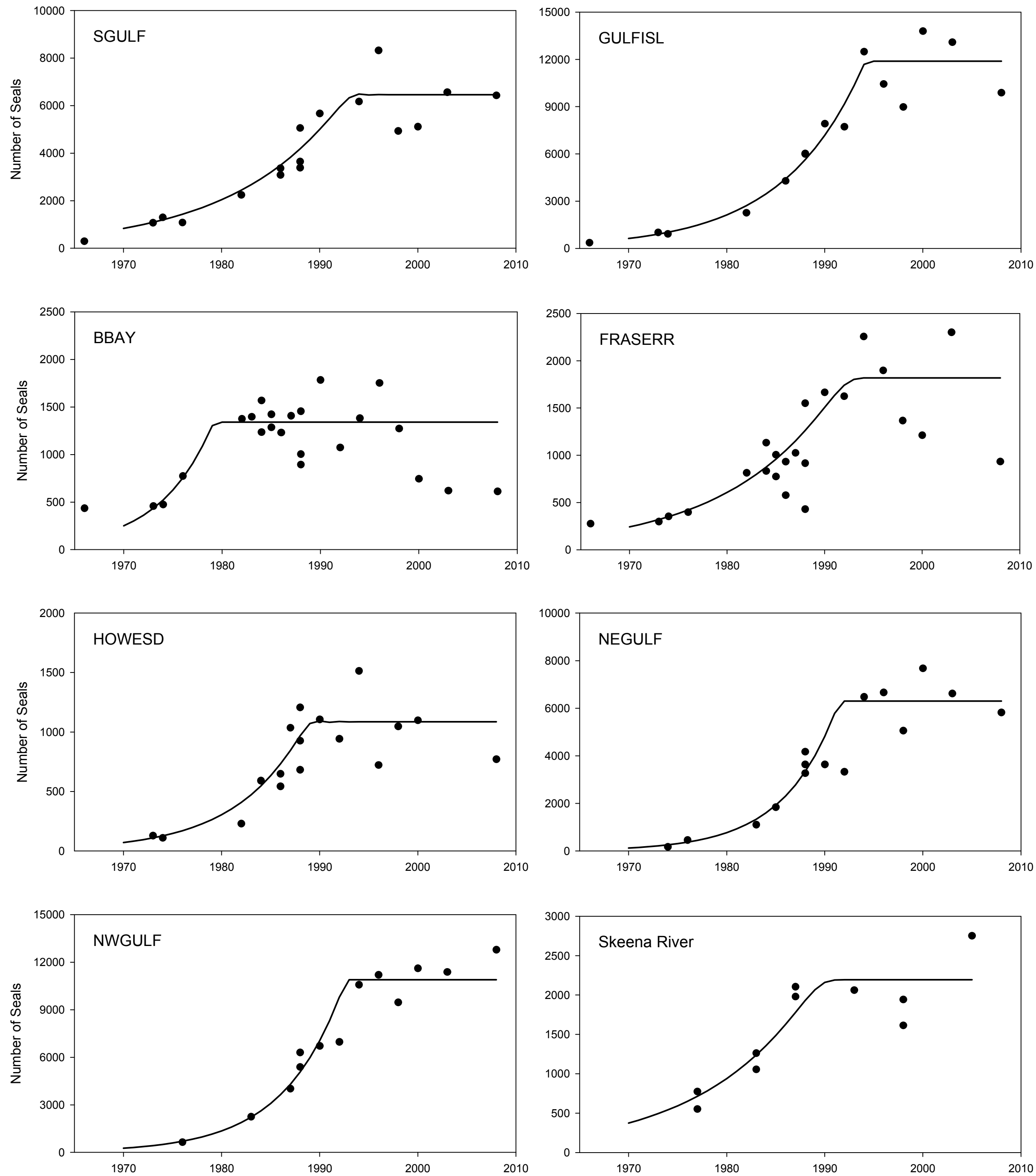


Figure 17. Population trends within each of the seven Strait of Georgia subareas and the lower Skeena River. The solid lines denote generalized logistic model fitted by least squares (weighted by the square root on the number of replicate counts).

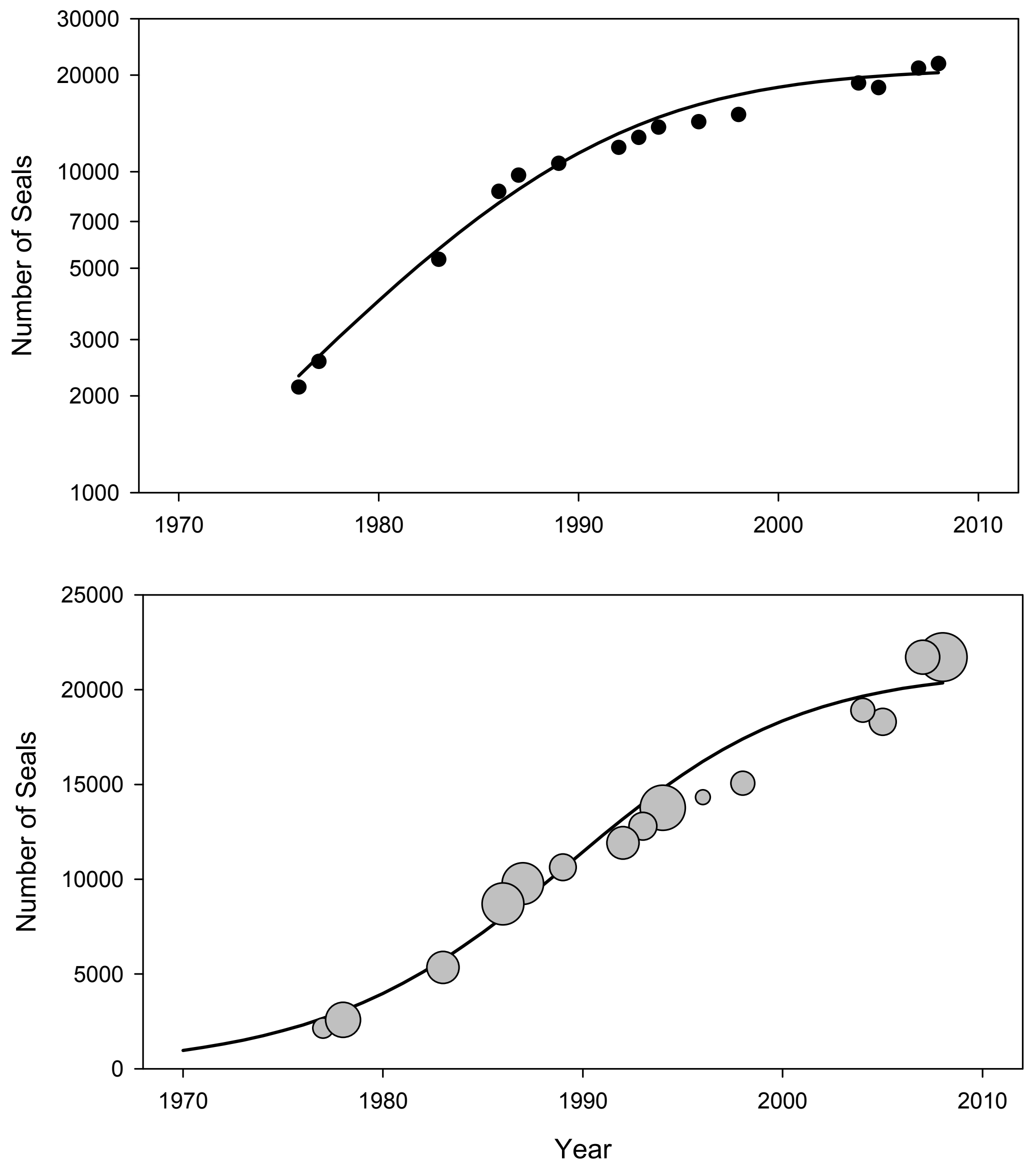


Figure 18. Second-order log-linear regression (top panel) and logistic model (bottom panel) fitted to counts in index trend areas. The size of points in the bottom panel are scaled show the relative proportion of the index areas surveyed each year, and indicate the relative weighting used in fitting the relationship.

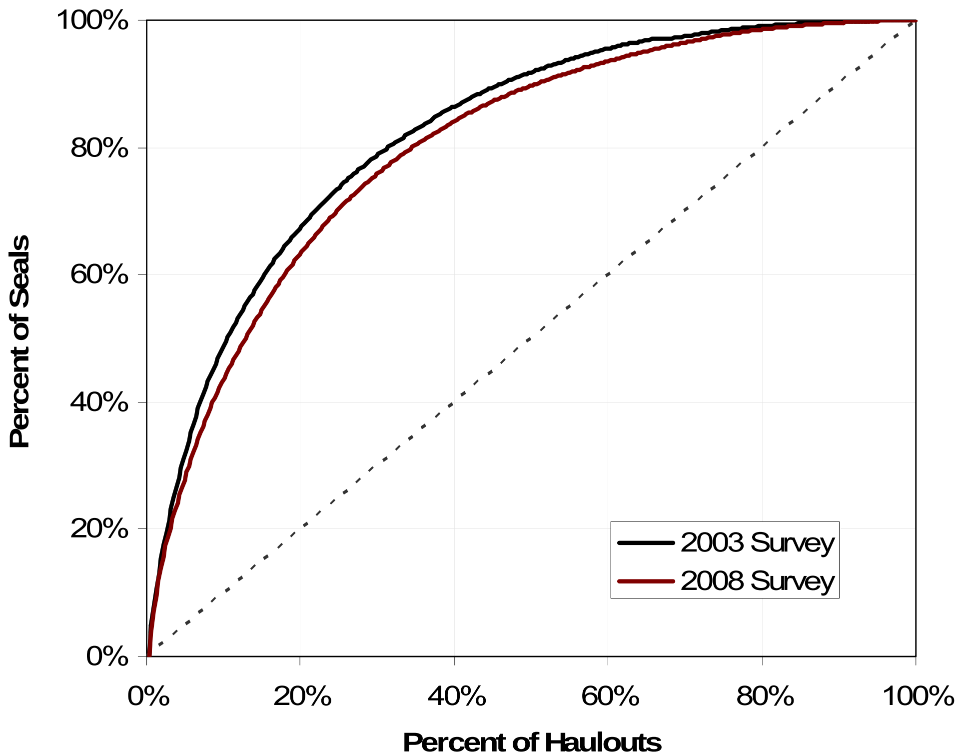


Figure 19. Relative importance of haulout sites in the Strait of Georgia based on the two most recent surveys in 2003 and 2008. Sites were ranked from largest to smallest and the cumulative total count plotted as a function of the cumulative number of sites occupied. The dashed line represents the 1:1 relationship that would result if all sites were equal in size.

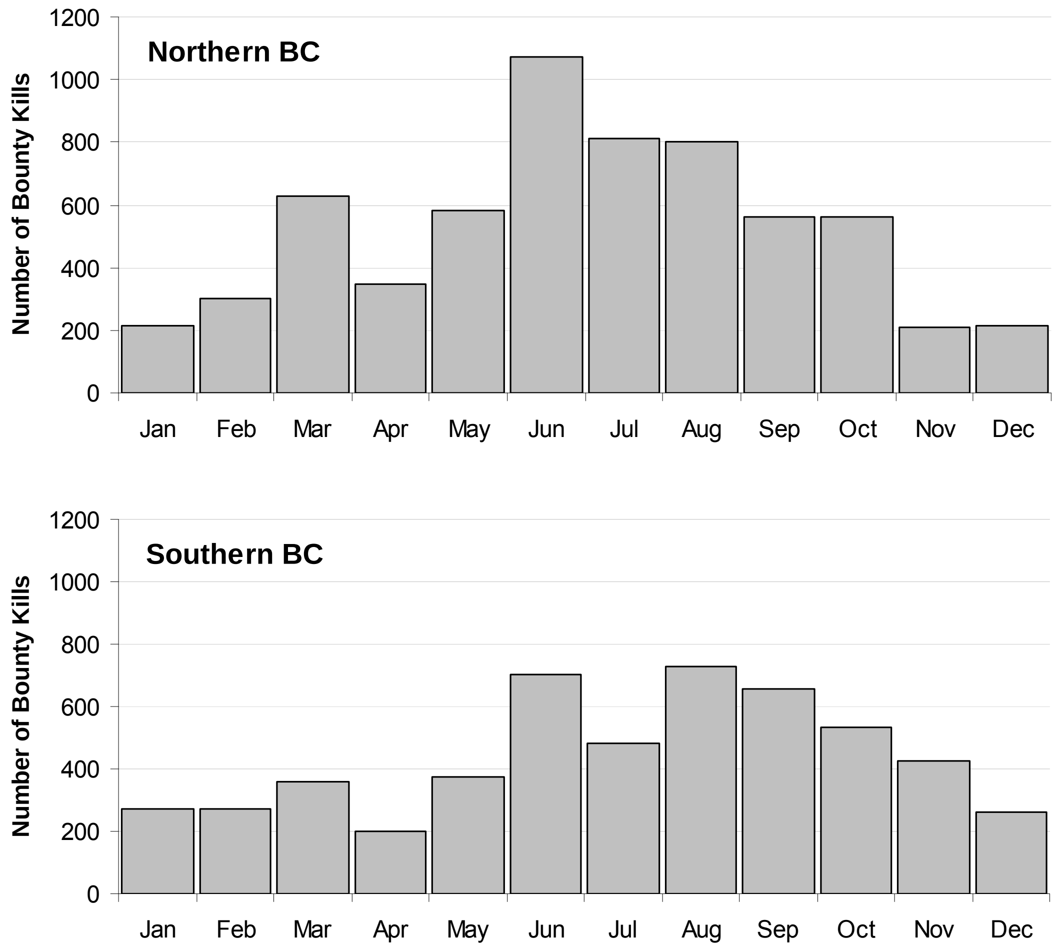


Figure 20. Seasonal distribution of total number of bounty kills in northern British Columbia (top panel) and southern British Columbia (bottom panel) over the period 1939-47. Vertical lines denote the beginning of pupping (date by which 5% of pups born) in each region as per Figure 2.

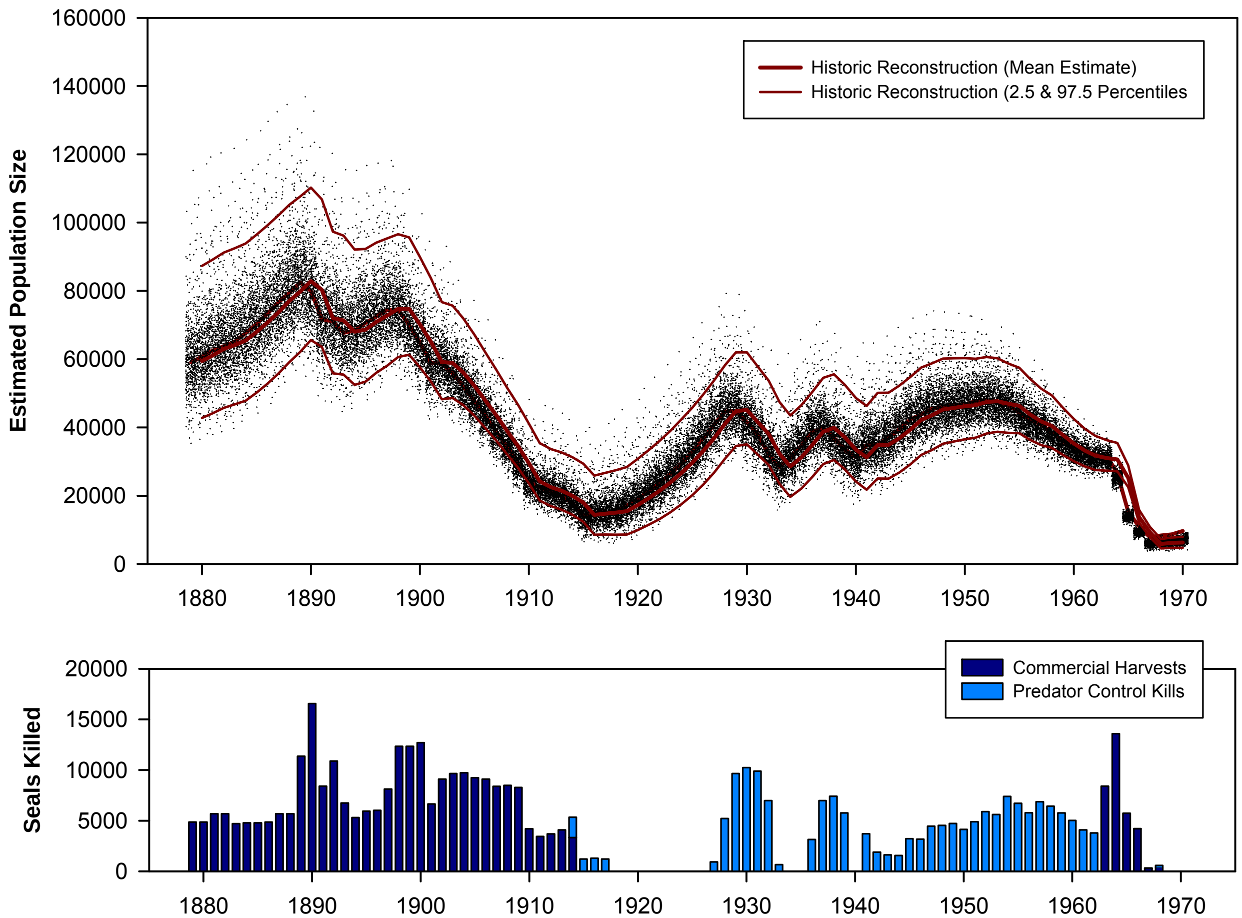


Figure 21. Historic reconstruction of harbour seal abundance in British Columbia from 1970 to 1897 (top panel) and estimated number of seals killed annually (bottom panel). Black dots represent 500 *Monte Carlo* simulations as described in the text. The thick red line indicates trajectory for the mean of all parameters, and the thin upper and lower red lines encompass the 2.5 and 97.5 percentiles of the simulations.

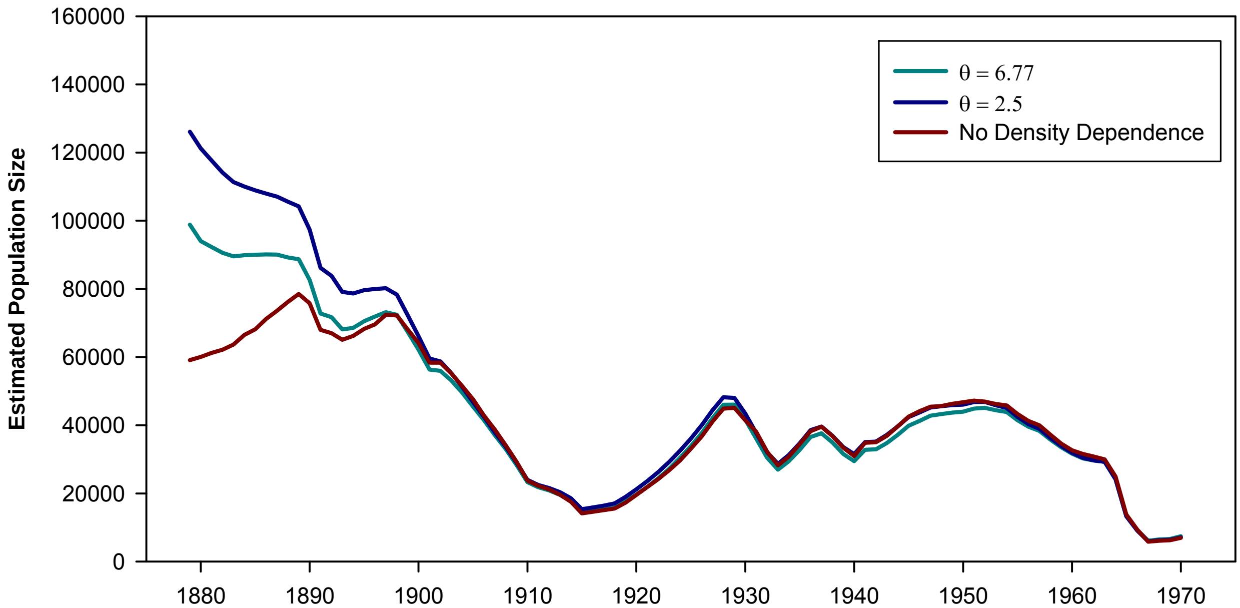


Figure 22. Historic reconstruction of harbour seal abundance in British Columbia from 1970 to 1897 using the forward-projecting model (equation [16]), showing potential density-dependent effects.

Appendix I

Summary of Survey Flights

Summary of survey flights (Panel 1 of 5 panels).

Survey Number	Survey Date:	Platform:	Primary Observer	Description of survey:	Conditions during survey:
31	19-Jul-1966	Aircraft	MAB	Aerial census: BBAY / FRASERR	Not recorded
32	27-Jul-1966	Aircraft	MAB	Aerial census: BBAY / FRASERR	Not recorded
33	28-Jul-1966	Aircraft	MAB	Aerial census: BBAY / FRASERR	Not recorded
28	13-Aug-1966	Aircraft	MAB	Aerial census: SGULF / GULFISL	Not recorded
29	14-Aug-1966	Aircraft	MAB	Aerial census: GULFISL	Scattered clouds, 10 knot wind
34	29-Aug-1966	Aircraft	MAB	Aerial census: BBAY / FRASERR	Not recorded
23	11-Jun-1973	Aircraft on wheels	MAB	Aerial census: HOWESD	Overcast, calm
24	13-Jun-1973	Aircraft on wheels	MAB	Aerial census: SGULF	Patchy cloud, calm
26	14-Jun-1973	Aircraft on wheels	MAB	Aerial census: GULFISL / FRASERR / BBAY	Overcast, calm, scattered rain
25	15-Jun-1973	Aircraft on wheels	MAB	Aerial census: GULFISL	Overcast, calm
19	14-Aug-1974	Cessna 180 on wheels	MAB	Aerial census: SGULF	Slight overcast, calm
20	15-Aug-1974	Cessna 180 on wheels	MAB	Aerial census: GULFISL	Slight overcast, calm
21	16-Aug-1974	Cessna 180 on wheels	MAB	Aerial census: NWGULF / BBAY / FRASERR	Not recorded
22	19-Aug-1974	Cessna 180 on wheels	MAB	Aerial census: NWGULF / NEGULF / HOWESD / FRASERR	Low ceiling, scattered drizzle
12	10-Aug-1976	Cessna 180 on wheels	MAB	Aerial census: NWGULF	Not recorded
13	11-Aug-1976	Cessna 180 on wheels	MAB	Aerial census: NEGULF	Not recorded
18	12-Aug-1976	Cessna 180 on wheels	MAB	Aerial census: SGULF / SWVANISL	High overcast, calm
14	22-Aug-1976	Cessna 180 on wheels	MAB	Aerial census: BBAY / FRASERR	Overcast, cool, light wind
15	23-Aug-1976	Cessna 180 on wheels	MAB	Aerial census: NEGULF	Overcast, light wind
16	24-Aug-1976	Cessna 180 on wheels	MAB	Aerial census: NEGULF	Overcast, no wind
17	25-Aug-1976	Cessna 180 floatplane	MAB	Aerial census: BARKLYSD / SWVANISL	400' ceiling, calm
10	15-Jun-1977	Cessna 185 floatplane	MAB	Aerial census: Lower Skeena River	Not recorded
11	16-Jun-1977	Cessna 185 floatplane	MAB	Aerial census: Lower Skeena River	Not recorded
5	16-Aug-1982	Cessna 172 on wheels	MAB	Aerial census: SGULF / GULFISL	High overcast, calm
6	17-Aug-1982	Cessna 172 on wheels	MAB	Aerial census: BBAY / FRASERR / HOWESD	Clear, calm
7	18-Aug-1982	Cessna 172 on wheels	MAB	Aerial census: GULFISL	Not recorded
8	13-Jun-1983	Cessna 185 floatplane	PFO	Aerial census: Lower Skeena River	Overcast, calm
9	14-Jun-1983	Cessna 185 floatplane	PFO	Aerial census: Lower Skeena River	Overcast, calm
2	17-Aug-1983	Aircraft	MAB	Aerial census: NWGULF / NEGULF	Clear, wind NW 20 knots
3	18-Aug-1983	Aircraft	MAB	Aerial census: NEGULF	Clear, wind NW 15 knots
4	19-Aug-1983	Aircraft	MAB	Aerial census: NEGULF / BBAY	Clear, water rippled
39	08-Aug-1984	Cessna 172 on wheels	MAB	Aerial census: BBAY / FRASERR	Overcast, calm
40	23-Aug-1984	Cessna 172 on wheels	PFO	Aerial census: BBAY / FRASERR / HOWESD	2/3 cloud cover, rippled
38	12-Aug-1985	Cessna 172 on wheels	MAB	Aerial census: BBAY / FRASERR	High overcast, 10-15 knots
37	14-Aug-1985	Cessna 172 on wheels	MAB	Aerial census: NWGULF	High overcast, 10-15 knot NWer
35	27-Aug-1985	Cessna 172 on wheels	MAB	Aerial census: BBAY / FRASERR / HOWESD	Not recorded
56	22-Jul-1986	DHC Beaver floatplane	PFO	Aerial census: SEQCI	Not recorded
57	23-Jul-1986	DHC Beaver floatplane	PFO	Aerial census: NEQCI / MASSET	Sea rippled
58	24-Jul-1986	DHC Beaver floatplane	PFO	Aerial census: SEQCI	Overcast, scattered drizzle, sea rippled
44	16-Aug-1986	Cessna 172 on wheels	MAB	Aerial census: SGULF	Clear
46	17-Aug-1986	Cessna 172 on wheels	MAB	Aerial census: HOWESD / FRASERR / BBAY	High light overcast, light wind
47	18-Aug-1986	Cessna 172 on wheels	MAB	Aerial census: BBAY / FRASERR / HOWESD	Scattered high overcast, calm
48	19-Aug-1986	Cessna 172 on wheels	MAB	Aerial census: GULFISL	Clear, light chop on water
45	20-Aug-1986	Cessna 172 on wheels	MAB	Aerial census: SGULF	Not recorded
52	14-Jun-1987	Cessna 180 floatplane	PFO	Aerial census: Lower Skeena River	Heavy overcast, scattered showers
53	15-Jun-1987	Cessna 180 floatplane	PFO	Aerial census: Lower Skeena River	7/10 cloud, scattered showers
51	11-Aug-1987	Cessna 172 on wheels	MAB	Aerial census: HOWESD / FRASERR / BBAY	High overcast, calm
49	21-Aug-1987	Cessna 172 on wheels	MAB	Aerial census: NEGULF	Not recorded

Summary of survey flights (Panel 2 of 5 panels).

Survey Number	Survey Date:	Platform:	Primary Observer	Description of survey:	Conditions during survey:
50	22-Aug-1987	Cessna 172 on wheels	MAB	Aerial census: NEGULF	Clear, 10 knot NEer
54	28-Aug-1987	Cessna 172 on wheels	PFO	Aerial census: BARKLYSD	Not recorded
55	29-Aug-1987	Cessna 172 on wheels	PFO	Aerial census: SWVANISL	Not recorded
94	20-Sep-1987	Cessna 172 floatplane	PFO	Aerial census: NEGULF / Jervis Inlet	Not recorded
59	30-May-1988	Cessna 172 on wheels	MAB	Aerial census: BBAY / FRASERR / HOWESD	High overcast, calm
60	31-May-1988	Cessna 172 on wheels	PFO	Aerial census: SGULF	Not recorded
61	01-Jun-1988	Cessna 172 on wheels	PFO	Aerial census: GULFISL	Low cloud, scattered (sometime heavy) showers
62	13-Jun-1988	Cessna 172 on wheels	PFO	Aerial census: NEGULF / NWGULF	Not recorded
63	14-Jun-1988	Cessna 172 on wheels	PFO	Aerial census: NEGULF / NWGULF	Not recorded
64	15-Jun-1988	Cessna 172 on wheels	PFO	Aerial census: GULFISL	Not recorded
65	16-Jun-1988	Cessna 172 on wheels	PFO	Aerial census: GULFISL / NWGULF	Not recorded
66	09-Aug-1988	Cessna 172 on wheels	PFO	Aerial census: NEGULF	Scattered cloud, light wind
67	10-Aug-1988	Cessna 172 on wheels	PFO	Aerial census: NEGULF / NWGULF	Mainly clear, NW 15-25 knot wind
68	11-Aug-1988	Cessna 172 on wheels	PFO	Aerial census: NWGULF	Clear, NW 15 knot wind
69	12-Aug-1988	Cessna 172 on wheels	PFO	Aerial census: SGULF	Clear, W 20 knot wind
70	24-Aug-1988	Cessna 172 on wheels	PFO	Aerial census: GULFISL / NWGULF	Clear, NW 5-10 knot wind
71	25-Aug-1988	Cessna 172 on wheels	PFO	Aerial census: BBAY / FRASERR / HOWESD	Scattered cloud, SE 5-10 knot wind
72	26-Aug-1988	Cessna 172 on wheels	PFO	Aerial census: GULFISL	Not recorded
76	29-Aug-1988	Cessna 185 floatplane	PFO	Aerial census: Queen Charlotte Strait	Not recorded
73	21-Sep-1988	Cessna 172 on wheels	PFO	Aerial census: NEGULF	Not recorded
74	22-Sep-1988	Cessna 172 on wheels	PFO	Aerial census: BBAY / FRASERR / HOWESD	Foggy, calm
75	24-Sep-1988	Cessna 172 on wheels	PFO	Aerial census: SGULF / BBAY / FRASERR	Not recorded
123	21-Jul-1989	Cessna 185 floatplane	GME	Aerial census: Queen Charlotte Strait	Not recorded
124	23-Jul-1989	Cessna 185 floatplane	GME	Aerial census: Queen Charlotte Strait	Not recorded
79	03-Aug-1990	Cessna 185 floatplane	PFO	Aerial census: HOWESD / NEGULF	Not recorded
80	04-Aug-1990	Cessna 185 floatplane	PFO	Aerial census: BBAY / FRASERR	Not recorded
81	05-Aug-1990	Cessna 185 floatplane	PFO	Aerial census: GULFISL	Not recorded
82	06-Aug-1990	Cessna 185 floatplane	PFO	Aerial census: SGULF / GULFISL	Not recorded
83	07-Aug-1990	Cessna 185 floatplane	PFO	Aerial census: SGULF	Not recorded
84	17-Aug-1990	Cessna 185 floatplane	PFO	Aerial census: NWGULF	Mainly overcast, very scattered showers, calm
85	18-Aug-1990	Cessna 185 floatplane	PFO	Aerial census: NEGULF	Overcast, scattered fog patches, sea rippled
86	20-Aug-1990	Cessna 185 floatplane	PFO	Aerial census: NEGULF	Not recorded
99	01-Jul-1992	DHC Beaver floatplane	PFO	Aerial census: NWQCI	Not recorded
100	03-Jul-1992	DHC Beaver floatplane	PFO	Aerial census: SEQCI	Not recorded
101	04-Jul-1992	DHC Beaver floatplane	PFO	Aerial census: SEQCI	Not recorded
154	30-Jul-1992	Cessna 185 floatplane	DXB	Aerial census: SEQCI	Not recorded
155	01-Aug-1992	Cessna 185 floatplane	DXB	Aerial census: SEQCI	Not recorded
87	24-Aug-1992	DHC Beaver floatplane	PFO	Aerial census: BBAY / FRASERR / HOWESD	Not recorded
88	25-Aug-1992	DHC Beaver floatplane	PFO	Aerial census: HOWESD / NEGULF	Clear, water rippled
89	26-Aug-1992	DHC Beaver floatplane	PFO	Aerial census: NEGULF	Clear, water rippled
90	27-Aug-1992	DHC Beaver floatplane	PFO	Aerial census: NEGULF / NWGULF	8/10 cloud cover, wind 10-15 kts
91	28-Aug-1992	DHC Beaver floatplane	PFO	Aerial census: NWGULF / GULFISL	Clear, wind 5-10 kts
92	08-Sep-1992	DHC Beaver floatplane	PFO	Aerial census: GULFISL	2/10 cloud cover, wind 5-10 kts
93	09-Sep-1992	DHC Beaver floatplane	PFO	Aerial census: GULFISL	Not recorded
78	04-Jul-1993	DHC Beaver floatplane	PFO	Aerial census: Lower Skeena River	Low ceiling, scattered showers, calm
114	19-Aug-1993	DHC Beaver floatplane	PFO	Aerial census: NWVANISL	Not recorded
115	20-Aug-1993	DHC Beaver floatplane	PFO	Aerial census: NWVANISL	Not recorded
102	11-Jul-1994	Cessna 185 floatplane	PFO	Aerial census: SEQCI	Not recorded

Summary of survey flights (Panel 3 of 5 panels).

Survey Number	Survey Date:	Platform:	Primary Observer	Description of survey:	Conditions during survey:
103	12-Jul-1994	Cessna 185 floatplane	PFO	Aerial census: SEQCI / SWQCI	Not recorded
104	13-Jul-1994	Cessna 185 floatplane	PFO	Aerial census: SWQCI	Not recorded
116	26-Jul-1994	DHC Beaver floatplane	PFO	Aerial census: NWVANSIL	Not recorded
117	29-Jul-1994	DHC Beaver floatplane	PFO	Aerial census: NWVANISL	Not recorded
126	04-Aug-1994	DHC Beaver floatplane	PFO	Aerial census: BBAY / FRASERR / HOWESD	Not recorded
127	05-Aug-1994	DHC Beaver floatplane	PFO	Aerial census: NEGULF	Not recorded
128	06-Aug-1994	DHC Beaver floatplane	PFO	Aerial census: NEGULF	Not recorded
129	07-Aug-1994	DHC Beaver floatplane	PFO	Aerial census: NEGULF / NWGULF	Not recorded
130	17-Aug-1994	DHC Beaver floatplane	PFO	Aerial census: NWGULF	1/10 cloud; wind NW at 5-10 knots
131	18-Aug-1994	DHC Beaver floatplane	PFO	Aerial census: GULFISL	Clear; wind NW at 5 knots
132	19-Aug-1994	DHC Beaver floatplane	PFO	Aerial census: GULFISL	2/10 high cloud; wind < 5 knots
133	20-Aug-1994	DHC Beaver floatplane	PFO	Aerial census: GULFISL / SGULF	7/10 high overcast; wind SE at 5 knots
134	21-Aug-1994	DHC Beaver floatplane	PFO	Aerial census: SGULF	8/10 high overcast; wind SE at 10 knots
118	13-Aug-1995	DHC Beaver floatplane	PFO	Aerial census: NWVANISL	Not recorded
119	15-Aug-1995	DHC Beaver floatplane	PFO	Aerial census: NWVANISL	2/10 Cloud cover; NW 10 kts
135	27-Jul-1996	DHC Beaver floatplane	PFO	Aerial census: BBAY / FRASERR / HOWESD	0/10 cloud; wind NW at 15 knots
136	28-Jul-1996	DHC Beaver floatplane	PFO	Aerial census: GULFISL	0/10 cloud; wind NE at 12 knots
137	29-Jul-1996	DHC Beaver floatplane	PFO	Aerial census: GULFISL	0/10 cloud; wind NE at 12 knots
138	30-Jul-1996	DHC Beaver floatplane	PFO	Aerial census: GULFISL	0/10 cloud; wind NE at 10 knots
139	31-Jul-1996	DHC Beaver floatplane	PFO	Aerial census: SGULF	2/10 cloud; wind NW at 10 knots
121	02-Aug-1996	DHC Beaver floatplane	PFO	Aerial census: Broughton Archipelago	10/10 Cloud cover at 2000 ft; scatterd drizzle
120	03-Aug-1996	DHC Beaver floatplane	PFO	Aerial census: NWVANISL	10/10 Cloud cover at 5000 ft; calm
122	04-Aug-1996	DHC Beaver floatplane	PFO	Aerial census: Broughton Archipelago	10/10 Cloud cover 700 ft; scattered fog; NW 10 kts
140	10-Aug-1996	DHC Beaver floatplane	PFO	Aerial census: HOWESD / NEGULF	3/10 cloud; wind NW at 15 knots (25 kt in Howe Sd)
141	11-Aug-1996	DHC Beaver floatplane	PFO	Aerial census: NEGULF / NWGULF	1/10 high cloud; wind SE at 5-10 knots
142	12-Aug-1996	DHC Beaver floatplane	PFO	Aerial census: NEGULF / NWGULF	5/10 scattered @ 1000 feet; wind NW at 10 knots
143	13-Aug-1996	DHC Beaver floatplane	PFO	Aerial census: NWGULF	0/10 cloud; wind NW at 10-15 knots
152	11-Jul-1998	DHC Beaver floatplane	PFO	Aerial census: Lower Skeena River	10/10 low overcast; wind less than 10 knots
153	12-Jul-1998	DHC Beaver floatplane	PFO	Aerial census: Lower Skeena River	10/10 high overcast; calm
144	05-Aug-1998	Cessna 180 floatplane	PFO	Aerial census: BBAY / FRASERR / HOWESD	clear; wind NW at 20 knots
145	06-Aug-1998	Cessna 180 floatplane	PFO	Aerial census: NEGULF	2/10 cloud; wind NW at 15-20 knots
146	07-Aug-1998	Cessna 180 floatplane	PFO	Aerial census: NEGULF	Not recorded
147	08-Aug-1998	Cessna 180 floatplane	PFO	Aerial census: NEGULF / NWGULF	3/10 cloud; wind NW at 10-15 knots
148	09-Aug-1998	Cessna 180 floatplane	PFO	Aerial census: NWGULF	2/10 high overcast; wind SE at 20 knots
149	04-Sep-1998	Cessna 180 floatplane	PFO	Aerial census: GULFISL	clear; wind NW at 20-25 knots
150	05-Sep-1998	Cessna 180 floatplane	PFO	Aerial census: GULFISL	clear; wind NW at 10 knots
151	06-Sep-1998	Cessna 180 floatplane	PFO	Aerial census: SGULF	2/10 high overcast; calm
156	16-Jul-1999	DHC Beaver floatplane	PFO	Aerial census: Nass River	0/10 patchy fog
157	25-Aug-2000	Cessna 180 floatplane	PFO	Aerial census: NWGULF	10/10 high overcast SE 10-15 kts
158	26-Aug-2000	Cessna 180 floatplane	PFO	Aerial census: NEGULF	Not recorded
159	27-Aug-2000	Cessna 180 floatplane	PFO	Aerial census: BBAY / FRASERR / HOWESD	3/10 high overcast; NW 15-20 kts
160	28-Aug-2000	Cessna 180 floatplane	PFO	Aerial census: NWGULF	clear; NW 10-15 kts
161	29-Aug-2000	Cessna 180 floatplane	PFO	Aerial census: GULFISL	10/10 low overcast; light drizzle; calm
162	30-Aug-2000	Cessna 180 floatplane	PFO	Aerial census: GULFISL	Not recorded
163	31-Aug-2000	Cessna 180 floatplane	PFO	Aerial census: SGULF	Not recorded
164	17-Sep-2000	DHC Beaver floatplane	PFO	Aerial census: Rivers Inlet	10/10 low overcast, scattered drizzle and fog; NE at 10-20 kts
165	10-Aug-2003	Cessna 180 floatplane	PFO	Aerial census: NEGULF / NWGULF	7/10 high overcast; wind NW 5 kts
166	11-Aug-2003	Cessna 180 floatplane	PFO	Aerial census: NEGULF	10/10 high overcast; scattered light showers; W 5 kts

Summary of survey flights (Panel 4 of 5 panels).

Survey Number	Survey Date:	Platform:	Primary Observer	Description of survey:	Conditions during survey:
167	12-Aug-2003	Cessna 180 floatplane	PFO	Aerial census: Discovery Passage	10/10 high overcast; wind < 5 kts
168	13-Aug-2003	Cessna 180 floatplane	PFO	Aerial census: Discovery Passage	10/10 high overcast; wind W 10 kts
169	14-Aug-2003	Cessna 180 floatplane	PFO	Aerial census: Broughton Archipelago	4/10 high overcast; calm
170	24-Aug-2003	Cessna 180 floatplane	PFO	Aerial census: BBAY / FRASERR	Not recorded
171	25-Aug-2003	Cessna 180 floatplane	PFO	Aerial census: GULFISL	10/10 high overcast; wind < 5 kts
172	26-Aug-2003	Cessna 180 floatplane	PFO	Aerial census: SGULF	Not recorded
173	29-Aug-2003	Cessna 180 floatplane	PFO	Aerial census: GULFISL / SGULF	Clear; NW 15 kts
174	30-Aug-2003	Cessna 180 floatplane	PFO	Aerial census: GULFISL	Clear; SE 5 kts
175	31-Aug-2003	Cessna 180 floatplane	PFO	Aerial census: BROUGHT / Discovery Passage	Clear; NW 15 kts
176	04-Jul-2004	Cessna 180 floatplane	PFO	Aerial census: Broughton Archipelago	Low overcast; SE 5-10 kts
177	05-Jul-2004	Cessna 180 floatplane	PFO	Aerial census: NQCSTR / Rivers Inlet	Low overcast and scattered fog; calm
178	06-Jul-2004	Cessna 180 floatplane	PFO	Aerial census: Rivers Inlet	Low overcast and scattered fog; SE 5-10 kts
179	07-Jul-2004	Cessna 180 floatplane	PFO	Aerial census: Rivers Inlet	Low overcast; SE 5-10 kts
180	08-Jul-2004	Cessna 180 floatplane	PFO	Aerial census: Rivers Inlet	Low overcast; SE 10 kts
181	09-Jul-2004	Cessna 180 floatplane	PFO	Aerial census: Rivers Inlet	6/10 high overcast; NE 10-15 kts
182	07-Jun-2005	Cessna 180 floatplane	PFO	Aerial census: SKEENAR	Clear; calm
183	08-Jun-2005	Cessna 180 floatplane	PFO	Aerial census: DUNDAS-NASS	Clear; NW 5-10 kts
184	09-Jun-2005	Cessna 180 floatplane	PFO	Aerial census: DUNDAS-NASS	Clear; NW 10-20 kts
185	10-Jun-2005	Cessna 180 floatplane	PFO	Aerial census: PORCHER	Clear; NW 5-10 kts
186	11-Jun-2005	Cessna 180 floatplane	PFO	Aerial census: PORCHER	High overcast; SE 5-15 kts
187	12-Jun-2005	Cessna 180 floatplane	PFO	Aerial census: BANKS	High overcast; SE 10-20 kts
188	13-Jun-2005	Cessna 180 floatplane	PFO	Aerial census: BANKS	High overcast; NE 5-10 kts
189	23-Jun-2005	Cessna 180 floatplane	PFO	Aerial census: Millbank Sound	Clear; <10 kts
190	25-Jun-2005	Cessna 180 floatplane	PFO	Aerial census: Millbank Sound	Clear; NW 10-20 kts
191	26-Jun-2005	Cessna 180 floatplane	PFO	Aerial census: Millbank Sound	Clear; NW 10-25 kts
192	27-Jun-2005	Cessna 180 floatplane	PFO	Aerial census: Millbank Sound	5/10 high overcast; SW 5-15 kts
193	28-Jun-2005	Cessna 180 floatplane	PFO	Aerial census: Millbank Sound	Clear; SW 5-10 kts
194	28-Jun-2006	Cessna 180 floatplane	PFO	Aerial census: Burke and Dean Channels	Not recorded
195	29-Jun-2006	Cessna 180 floatplane	PFO	Aerial census: Queens Sound	3/10 cloud; wind NW at 10-15 knots
196	30-Jun-2006	Cessna 180 floatplane	PFO	Aerial census: Central Coast Inlets	2/10 high overcast; wind SE at 20 knots
197	01-Aug-2007	Cessna 180 floatplane	PFO	Aerial census: MWVANISL	10/10 low overcast, scattered drizzle and fog; SE at 5-10 kts
198	02-Aug-2007	Cessna 180 floatplane	PFO	Aerial census: MWVANISL	10/10 low overcast, scattered fog; SE at 10-20 kts
199	03-Aug-2007	Cessna 180 floatplane	PFO	Aerial census: BARKLYSD	5/10 high overcast; SE 10-15 kts
200	04-Aug-2007	Cessna 180 floatplane	PFO	Aerial census: BARKYSD / SWVANISL	Clear; NW 10-25 kts
201	15-Aug-2007	Cessna 180 floatplane	PFO	Aerial census: MWVANISL	Low overcast, patches of fog; SE at 10-20 kts
202	16-Aug-2007	Cessna 180 floatplane	PFO	Aerial census: MWVANISL	Low overcast, patches of fog; SE 5-10 kts
203	18-Aug-2007	Cessna 180 floatplane	PFO	Aerial census: MWVANISL / NMWVANISL	Low overcast; SW 10-20 kts
204	01-Sep-2007	Cessna 180 floatplane	PFO	Aerial census: NWVANISL	Clear; NW 20 kts
205	04-Jul-2008	Cessna 180 floatplane	PFO	Aerial census: NWQCI / SEQCI	Low overcast, scattered drizzle and fog; calm
206	05-Jul-2008	Cessna 180 floatplane	PFO	Aerial census: SEQCI	Low overcast, scattered drizzle and fog; <10 kts
207	06-Jul-2008	Cessna 180 floatplane	PFO	Aerial census: SEQCI / NEQCI	6/10 High overcast; SE 10-20 kts
208	07-Jul-2008	Cessna 180 floatplane	PFO	Aerial census: SEQCI	Clean; SE 5-10 kts
209	08-Jul-2008	Cessna 180 floatplane	PFO	Aerial census: SEQCI	High overcast; NW 10-20 kts
210	05-Aug-2008	Cessna 180 floatplane	PFO	Aerial census: SQCI / SEQCI	Low overcast, scattered fog; SE at 10-20 kts
211	06-Aug-2008	Cessna 180 floatplane	PFO	Aerial census: SWQCI / NWQCI	Low overcast, patches of fog; SE 5-10 kts
212	13-Aug-2008	Cessna 180 floatplane	PFO	Aerial census: BBAY, FRASERR and HOWESD	10/10 high overcast; SE 10-15 kts
213	14-Aug-2008	Cessna 180 floatplane	PFO	Aerial census: NEGULF	Clear; NW 10-15 kts
214	15-Aug-2008	Cessna 180 floatplane	PFO	Aerial census: NEGULF	Clear; NW 10-20 kts

Summary of survey flights (Panel 5 of 5 panels).

Survey Number	Survey Date:	Platform:	Primary Observer	Description of survey:	Conditions during survey:
215	16-Aug-2008	Cessna 180 floatplane	PFO	Aerial census: NWGULF	Clear; NW 10-25 kts
216	28-Aug-2008	Cessna 180 floatplane	PFO	Aerial census: GULFISL	Clear; calm
217	29-Aug-2008	Cessna 180 floatplane	PFO	Aerial census: GULFISL	3/10 overcast; NW 5-10 kts
218	30-Aug-2008	Cessna 180 floatplane	PFO	Aerial census: SGULF & GULFISL	Clear; NW 10-15 kts
219	31-Aug-2008	Cessna 206 floatplane	PFO	Aerial census: SGULF	Clear; NW 5-10 kts

Appendix II

Summary of Survey Counts

Note: counts denoted by a ‘0’ indicate the site was specifically checked during the survey and no animals were present; counts denoted with a ‘-‘ indicate the area was surveyed but the site was not specifically checked and no seals were present (i.e. the survey was made before seals were ever observed using the site); counts denoted with ‘ns’ indicate the site was not surveyed or occasionally that the count was deemed unusable (e.g. poor visual and no useful photographs or the site was known to have been disturbed prior to the count).

Subarea 11 (SGULF). Panel 1 of 4 panels.

Site Name and Number:		13 August 1966	13-15 June 1973	14-15 August 1974	12 August 1976	16 August 1982	16 August 1986	20 August 1986	31 May 1 June 1988	12-26 August 1988
H0222	E CHADS ISL	-	-	-	ns	-	10	0	0	8
H0462	CANOE ROCK	-	-	-	ns	-	-	-	-	-
H0338	PARKIN PT	-	-	-	ns	-	-	-	3	0
H0180	REYNARD PT RF	-	1	13	ns	0	51	52		90
H0223	PELLOW ITS	-	-	-	ns	-	40	44	81	58
H0224	PELORUS PT	-	-	-	ns	-	24	42	0	26
H1454	SE MORESBY ISL	-	-	-	-	-	-	-	-	-
H0226	S BRACKMAN ISL	-	-	-	ns	-	-	68	0	55
H0179	TORTOISE ITS	-	1	24	ns	0	13	13	0	0
H0365	ARBUTUS ISL	-	-	-	ns	-	-	-	-	2
H0463	W POINT FAIRFAX	-	-	-	ns	-	-	-	-	-
H0411	N KNAPP ISL	-	-	-	ns	-	-	-	-	-
H0221	CLIVE ISL	-	-	-	ns	-	22	36	52	47
H0366	PYM ISL	-	-	-	ns	-	-	-	-	2
H0378	POINT FAIRFAX	-	-	-	ns	-	-	-	-	5
H0161	IMRIE ISL	6	0	0	ns	0	54	20	0	15
H0360	HATCH PT	-	-	-	ns	-	-	-	-	16
H0023	N GOUDGE ISL RF	-	1	0	ns	43	4	7	67	17
H0536	WAIN ROCK	-	-	-	ns	-	-	-	-	-
H0841	ARACHNE REEF	-	-	-	-	-	-	-	-	-
H0554	SE SWARTZ HEAD RF	-	-	-	ns	-	-	-	-	-
H0018	REAY ISL	-	1	0	ns	28	3	1	0	6
H0025	E FERNIE ISL	-	-	-	ns	13	26	66	0	0
H0017	NW BRETHOUR ISL	-	-	9	ns	59	38	21		79
H0020	S COAL ISL RF	-	-	22	ns	41	21	7	11	82
H0019	GREIG ISL	-	14	9	ns	13	53	41	31	0
H0537	SW COAL ISLAND RF	-	-	-	ns	-	-	-	-	-
H0016	E BRETHOUR ISL RF	-	15	80	ns	91	61	66	96	136
H0022	TSEHUM HRBR RF	30	84	35	ns	16	17	32	26	15
H0844	NE LITTLE GRP RK	-	-	-	-	-	-	-	-	-
H0323	DOCK ISL	-	-	-	ns	-	-	-	17	2
H0015	COOPER REEF	4	21	0	ns	72	100	45	86	223
H0363	W DOMVILLE ISL	-	-	-	ns	-	-	-	-	4
H0413	S COMET ISL	-	-	-	ns	-	-	-	-	-
H0021	S KER ISL RF	-	-	-	ns	38	10	7	0	52
H0158	N GOOCH ISL	4	0	0	ns	0	0	6	0	0
H0412	RUBLY ISL	-	-	-	ns	-	-	-	-	-
H0324	NE PATRICIA BAY	-	-	-	ns	-	-	-	40	15
H0219	TOM PT	-	-	-	ns	-	29	0	0	26
H0220	SE FORREST ISL RFS	-	-	-	ns	-	33	61	41	76
H0218	NORTH COD REEF	-	-	-	ns	-	9	7	17	39
H0024	MILL BAY	ns	12	7	ns	0	ns	24	36	72
H0014	NW MANDARTE ISL RK	-	-	2	ns	6	6	9	1	20
H0225	S MANDARTE ISL RF	-	-	-	ns	-	-	5	4	7
H0552	TANNER ROCK	-	-	-	ns	-	-	-	-	-
H0367	DYER ROCKS	-	-	-	ns	-	-	-	-	22
H0013	E SIDNEY ISL RF	2	30	35	ns	38	26	27	44	33
H0157	HALIBUT ISL	3	0	0	ns	0	18	31	20	31
H0461	TOZIER ROCK	-	-	-	ns	-	-	-	-	-
H0362	E JAMES ISL	-	-	-	ns	-	-	-	-	1
H0156	CORDOVA SPIT	3	0	0	ns	0	0	0	0	0
H0011	MUNROE ROCK	30	35	0	ns	33	34	40	1	35
H0318	N BAMBERTON	-	-	-	ns	-	-	-	48	64
H0010	S JAMES ISL RF	-	5	2	ns	7	1	0	0	2
H0009	SALLAS ROCKS	2	3	40	ns	124	152	107	126	223
H0008	NW LITTLE D'ARCY ISL RK	-	4	5	ns	46	13	5	17	22
H0012	COWICHAN HD	ns	13	4	ns	10	12	25	49	30
H0319	SHEPPARD PT	-	-	-	ns	-	-	-	6	0
H0469	E D'ARCY ISL	-	-	-	ns	-	-	-	-	-
H0007	UNIT ROCKS	-	20	15	ns	58	65	46	19	20

Subarea 11 (SGULF). Panel 2 of 4 panels.

Site Name and Number:		13 August 1966	13-15 June 1973	14-15 August 1974	12 August 1976	16 August 1982	16 August 1986	20 August 1986	31 May 1 June 1988	12-26 August 1988
H0006	S D'ARCY ISL RF	2	0	0	ns	5	6	0	0	55
H0842	KELP REEFS	-	-	-	-	-	-	-	-	-
H0361	ELBOW PT	ns	-	-	ns	-	-	-	-	23
H0542	LITTLE ZERO ROCK	-	-	-	ns	-	-	-	-	-
H0005	ZERO ROCK	3	28	19	ns	18	55	65	0	71
H0538	CORDOVA BAY RF	ns	-	-	ns	-	-	-	-	-
H0843	E CHRISTMAS PT	ns								
H0177	GORDON ROCK	ns	-	5	ns	0	0	10	13	1
H0320	GOLDSTREAM ESTUARY	ns	-	-	ns	-	-	-	1	0
H0594	S FINNERTY COVE REEF	ns	-	-	ns	-	-	-	-	-
H0539	CADBORO POINT	ns	-	-	ns	-	-	-	-	-
H0468	S FLOWER ISL RK	ns	-	-	ns	-	-	-	-	-
H0212	CHATHAM ISLS	ns	-	2	ns	0	32	77	57	156
H0321	BROTHERS ISLS	ns	-	-	ns	-	-	-	33	47
H0540	MAYOR CHANNEL RF	ns	-	-	ns	-	-	-	-	-
H0004	CHAIN ITS	ns	57	87	ns	180	216	231	240	309
H0322	GREAT CHAIN ISL	ns	-	-	ns	-	-	-	9	14
H0840	GILLINGHAM ISL	ns	-	-	-	-	-	-	-	-
H1444	MCLOUGHLIN PT	ns	-	-	-	-	-	-	-	-
H0541	MOUAT REEF	ns	-	-	ns	-	-	-	-	-
H0171	GLIMPSE REEFS	ns	6	5	ns	0	8	24	0	0
H0178	TRIAL ISLS	ns	-	29	ns	0	60	89	10	132
H0217	ALBERT HD	ns	-	-	-	-	5	17	0	41
H0003	HAYSTOCK ITS	ns	43	52	40	49	63	91	71	161
H0467	PARKER BAY	ns	-	-	-	-	-	-	-	-
H0216	ANCHOR RK	ns	-	-	-	-	26	26	1	44
H1445	MANOR PT	ns	-	-	-	-	-	-	-	-
H0466	ROCKY PT	ns	-	-	-	-	-	-	-	-
H0001	W BENTINCK ISL RFS	ns	1	13	35	54	94	ns	100	189
H0002	RACE ROCKS	ns	158	304	195	290	209	223	245	383
Total number counted		**89**	**553**	**818**	**270**	**1,332**	**1,719**	**1,814**	**1,719**	**3,304**
Correction for unborn pups		**1.0397**	**1.2494**	**1.0362**	**1.0438**	**1.0293**	**1.0293**	**1.0187**	**1.2499**	**1.0414**
Proportion of area covered		**0.4756**	**1.0000**	**1.0000**	**0.4511**	**1.0000**	**0.9862**	**0.9507**	**1.0000**	**1.0000**
Adjusted count		**194.6**	**690.9**	**847.6**	**624.8**	**1371.0**	**1794.1**	**1943.7**	**2148.6**	**3440.9**
Estimated proportion hauled out		**0.660**	**0.648**	**0.653**	**0.577**	**0.611**	**0.582**	**0.579**	**0.634**	**0.680**
Correction for missed animals		**1.516**	**1.544**	**1.532**	**1.732**	**1.636**	**1.718**	**1.728**	**1.577**	**1.470**
Estimated abundance		**295**	**1,067**	**1,299**	**1,082**	**2,243**	**3,082**	**3,359**	**3,388**	**5,058**

Subarea 11 (SGULF). Panel 3 of 4 panels.

Site Name and Number:		24 Sept. 1988	6-7 August 1990	20-21 August 1994	30-31 July 1996	5-6 Sept. 1998	26-31 August 2000	25-29 August 2003	30-31 August 2008
H0222	E CHADS ISL	21	4	25	0	42	25	35	29
H0462	CANOE ROCK	-	76	219	339	106	59	0	61
H0338	PARKIN PT	0	4	0	0	0	4	0	0
H0180	REYNARD PT RF	40	47	87	84	91	62	155	87
H0223	PELLOW ITS	39	125	50	65	0	4	70	29
H0224	PELORUS PT	38	0	19	0	0	0	1	0
H1454	SE MORESBY ISL	-	-	-	-	-	-	-	6
H0226	S BRACKMAN ISL	26	37	20	0	0	0	3	0
H0179	TORTOISE ITS	1	1	0	0	0	0	0	3
H0365	ARBUTUS ISL	12	1	4	0	30	36	30	6
H0463	W POINT FAIRFAX	-	-	7	7	0	0	4	3
H0411	N KNAPP ISL	14	0	0	0	0	0	0	0
H0221	CLIVE ISL	1	22	50	45	28	45	60	25
H0366	PYM ISL	10	0	0	0	0	0	0	0
H0378	POINT FAIRFAX	37	0	3	0	14	2	75	43
H0161	IMRIE ISL	1	0	87	64	80	84	80	132
H0360	HATCH PT	ns	29	36	6	ns	ns	0	ns
H0023	N GOUDGE ISL RF	3	2	49	34	7	23	15	10
H0536	WAIN ROCK	ns	-	46	33	ns	ns	40	68
H0841	ARACHNE REEF	-	-	-	-	-	-	5	ns
H0554	SE SWARTZ HEAD RF	-	-	-	22	20	19	7	18
H0018	REAY ISL	3	3	1	12	0	1	0	8
H0025	E FERNIE ISL	0	82	4	0	0	0	16	0
H0017	NW BRETHOUR ISL	39	61	49	109	29	10	30	46
H0020	S COAL ISL RF	67	31	6	0	0	0	40	7
H0019	GREIG ISL	33	65	40	135	10	77	0	6
H0537	SW COAL ISLAND RF	-	-	76	46	47	66	0	22
H0016	E BRETHOUR ISL RF	75	129	92	217	42	3	25	22
H0022	TSEHUM HRBR RF	0	0	24	23	0	28	20	15
H0844	NE LITTLE GRP RK	-	-	-	-	-	-	25	2
H0323	DOCK ISL	1	68	7	0	6	39	25	38
H0015	COOPER REEF	102	198	162	0	159	77	45	38
H0363	W DOMVILLE ISL	0	2	0	24	0	0	0	0
H0413	S COMET ISL	13	0	9	7	5	0	0	3
H0021	S KER ISL RF	30	56	58	49	116	67	73	92
H0158	N GOOCH ISL	0	0	0	0	0	0	0	0
H0412	RUBLY ISL	6	4	21	0	13	22	25	8
H0324	NE PATRICIA BAY	0	1	0	3	ns	ns	3	4
H0219	TOM PT	66	31	71	48	28	79	55	68
H0220	SE FORREST ISL RFS	66	59	51	80	57	64	60	33
H0218	NORTH COD REEF	0	55	17	49	0	5	55	22
H0024	MILL BAY	ns	17	11	5	ns	ns	18	ns
H0014	NW MANDARTE ISL RK	6	12	32	44	57	50	41	73
H0225	S MANDARTE ISL RF	7	36	23	117	33	38	87	70
H0552	TANNER ROCK	ns	-	-	38	ns	ns	0	ns
H0367	DYER ROCKS	ns	34	19	0	ns	ns	55	ns
H0013	E SIDNEY ISL RF	9	48	30	37	3	4	0	0
H0157	HALIBUT ISL	28	13	34	14	39	47	33	22
H0461	TOZIER ROCK	ns	10	10	2	ns	ns	21	ns
H0362	E JAMES ISL	1	0	0	0	1	0	0	0
H0156	CORDOVA SPIT	0	0	0	0	0	0	0	0
H0011	MUNROE ROCK	39	5	21	12	46	48	30	19
H0318	N BAMBERTON	ns	0	2	0	ns	ns	24	ns
H0010	S JAMES ISL RF	0	0	0	10	0	0	0	0
H0009	SALLAS ROCKS	148	274	265	289	149	259	115	157
H0008	NW LITTLE D'ARCY ISL RK	38	17	50	64	0	29	25	68
H0012	COWICHAN HD	24	0	2	15	0	14	0	0
H0319	SHEPPARD PT	ns	39	3	9	ns	ns	2	ns
H0469	E D'ARCY ISL	-	15	19	121	28	30	0	90
H0007	UNIT ROCKS	69	31	100	21	91	75	60	7

Subarea 11 (SGULF). Panel 4 of 4 panels.

Site Name and Number:		24 Sept. 1988	6-7 August 1990	20-21 August 1994	30-31 July 1996	5-6 Sept. 1998	26-31 August 2000	25-29 August 2003	30-31 August 2008
H0006	S D'ARCY ISL RF	0	49	0	95	56	0	15	17
H0842	KELP REEFS	-	-	-	-	-	-	5	ns
H0361	ELBOW PT	ns	44	19	0	ns	ns	28	ns
H0542	LITTLE ZERO ROCK	-	-	4	10	0	7	6	18
H0005	ZERO ROCK	52	83	109	155	111	47	125	141
H0538	CORDOVA BAY RF	ns	-	42	8	36	0	35	33
H0843	E CHRISTMAS PT							2	ns
H0177	GORDON ROCK	ns	8	0	0	0	0	0	0
H0320	GOLDSTREAM ESTUARY	ns	ns	ns	ns	ns	ns	5	ns
H0594	S FINNERTY COVE REEF	ns	-	-	-	8	3	0	17
H0539	CADBORO POINT	ns	-	7	0	0	0	1	0
H0468	S FLOWER ISL RK	ns	6	0	0	0	0	3	0
H0212	CHATHAM ISLS	ns	134	237	236	232	273	413	363
H0321	BROTHERS ISLS	ns	7	0	29	10	17	25	29
H0540	MAYOR CHANNEL RF	ns	-	29	59	39	35	52	13
H0004	CHAIN ITS	ns	193	290	401	144	470	352	325
H0322	GREAT CHAIN ISL	ns	23	47	103	185	109	100	211
H0840	GILLINGHAM ISL	-	-	-	-	-	-	4	0
H1444	MCLOUGHLIN PT	-	-	-	-	-	-	-	9
H0541	MOUAT REEF	ns	-	3	0	0	2	24	4
H0171	GLIMPSE REEFS	ns	2	0	0	3	0	1	0
H0178	TRIAL ISLS	ns	79	100	119	105	51	95	152
H0217	ALBERT HD	ns	55	80	0	153	58	50	110
H0003	HAYSTOCK ITS	ns	182	179	193	129	71	120	205
H0467	PARKER BAY	ns	7	20	0	10	0	16	0
H0216	ANCHOR RK	ns	50	58	48	109	61	73	116
H1445	MANOR PT	-	-	-	-	-	-	-	13
H0466	ROCKY PT	ns	14	8	0	37	0	50	43
H0001	W BENTINCK ISL RFS	ns	174	76	412	173	90	380	145
H0002	RACE ROCKS	ns	617	485	858	359	387	570	306
Total number counted		**1,165**	**3,471**	**3,804**	**5,025**	**3,276**	**3,176**	**4,138**	**3,730**
Correction for unborn pups		**1.0001**	**1.0617**	**1.0145**	**1.1067**	**1.0010**	**1.0037**	**1.0077**	**1.0041**
Proportion of area covered		**0.4933**	**1.0000**	**1.0000**	**1.0000**	**0.9809**	**0.9809**	**1.0000**	**0.9579**
Adjusted count		**2361.9**	**3685.2**	**3859.0**	**5561.2**	**3343.1**	**3249.9**	**4169.9**	**3909.9**
Estimated proportion hauled out		**0.648**	**0.651**	**0.625**	**0.668**	**0.678**	**0.633**	**0.643**	**0.638**
Correction for missed animals		**1.543**	**1.537**	**1.599**	**1.496**	**1.474**	**1.580**	**1.555**	**1.567**
Estimated abundance		**3,643**	**5,664**	**6,170**	**8,320**	**4,929**	**5,134**	**6,485**	**6,128**

Subarea 12 (BBAY). Panel 1 of 2 panels.

Site Name and Number:		27 July 1966	11 June 1973	16 August 1974	23 August 1976	17 August 1982	19 August 1983	9 August 1984	24 August 1984	12 August 1985	27 August 1985	18 August 1986	11 August 1987
H0030	E BOUNDARY BAY SITE B	-	0	0	19	8	10	10	0	9	4	0	27
H0029	E BOUNDARY BAY SITE A	0	15	0	34	24	37	22	28	25	42	52	21
H0031	E BOUNDARY BAY SITE C	13	0	0	35	18	51	13	38	50	38	24	42
H0032	E BOUNDARY BAY SITE D	50	76	56	29	38	37	0	31	0	0	31	18
H0033	C BOUNDARY BAY SITE E	-	-	-	-	77	0	46	24	39	0	0	102
H0449	W BOUNDARY BAY SITE I	-	-	-	-	-	-	-	-	-	-	-	-
H0034	W BOUNDARY BAY SITE F	118	116	247	304	593	740	827	677	746	755	610	643
H0155	C BOUNDARY BAY SITE H	-	-	-	-	-	44	67	0	22	31	44	0
H0035	W BOUNDARY BAY SITE G	40	0	0	41	38	20	59	21	4	0	24	52
H0172	KWOMAIS PT	-	8	0	0	0	0	0	0	0	0	0	0
H0170	SE POINT ROBERTS RFS	15	8	4	2	1	0	0	0	5	5	0	7
Total number counted		**236**	**223**	**307**	**464**	**797**	**939**	**1,044**	**819**	**900**	**875**	**785**	**912**
Correction for unborn pups		**1.1320**	**1.2496**	**1.0293**	**1.0167**	**1.0264**	**1.0213**	**1.0149**	**1.0621**	**1.0438**	**1.0075**	**1.0238**	**1.0480**
Proportion of area covered		**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**
Adjusted count		**267.2**	**278.7**	**316.0**	**471.7**	**818.0**	**959.0**	**1059.6**	**869.9**	**939.4**	**881.6**	**803.7**	**955.8**
Estimated proportion hauled out		**0.615**	**0.609**	**0.667**	**0.610**	**0.595**	**0.687**	**0.676**	**0.704**	**0.661**	**0.686**	**0.623**	**0.679**
Correction for missed animals		**1.626**	**1.641**	**1.499**	**1.640**	**1.681**	**1.456**	**1.480**	**1.420**	**1.513**	**1.458**	**1.605**	**1.472**
Estimated abundance		**434**	**457**	**474**	**774**	**1,375**	**1,396**	**1,568**	**1,235**	**1,421**	**1,285**	**1,290**	**1,407**

Subarea 12 (BBAY). Panel 2 of 2 panels.

Site Name and Number:		31 May 1988	26 August 1988	24 Sept. 1988	5 August 1990	24 August 1992	5 August 1994	27 July 1996	5 August 1998	27 August 2000	24 August 2003	13 August 2008
H0030	E BOUNDARY BAY SITE B	0	0	0	23	0	0	80	86	0	0	0
H0029	E BOUNDARY BAY SITE A	39	50	73	78	23	0	0	0	56	0	0
H0031	E BOUNDARY BAY SITE C	1	55	22	64	68	64	90	121	81	101	140
H0032	E BOUNDARY BAY SITE D	0	13	0	4	0	0	0	0	0	0	0
H0033	C BOUNDARY BAY SITE E	87	7	0	14	12	54	28	34	0	11	0
H0449	W BOUNDARY BAY SITE I	-	-	-	28	9	33	0	16	0	0	0
H0034	W BOUNDARY BAY SITE F	303	694	525	714	594	604	631	284	305	250	212
H0155	C BOUNDARY BAY SITE H	0	0	10	77	5	12	48	118	0	0	0
H0035	W BOUNDARY BAY SITE G	0	57	0	27	3	0	0	0	0	8	0
H0172	KWOMAIS PT	0	0	0	0	0	0	1	1	0	0	ns
H0170	SE POINT ROBERTS RFS	24	4	2	14	1	7	11	1	5	1	5
Total number counted		**454**	**880**	**632**	**1,043**	**715**	**774**	**889**	**661**	**447**	**371**	**357**
Correction for unborn pups		**1.2500**	**1.0100**	**1.0000**	**1.0770**	**1.0110**	**1.0770**	**1.1310**	**1.0720**	**1.0068**	**1.0103**	**1.0364**
Proportion of area covered		**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**
Adjusted count		**567.5**	**888.8**	**632.0**	**1123.3**	**722.9**	**833.6**	**1005.5**	**708.6**	**450.0**	**374.8**	**370.0**
Estimated proportion hauled out		**0.565**	**0.611**	**0.707**	**0.630**	**0.673**	**0.603**	**0.574**	**0.557**	**0.605**	**0.611**	**0.602**
Correction for missed animals		**1.769**	**1.637**	**1.415**	**1.587**	**1.485**	**1.658**	**1.743**	**1.796**	**1.653**	**1.637**	**1.661**
Estimated abundance		**1,004**	**1,455**	**894**	**1,783**	**1,073**	**1,382**	**1,753**	**1,273**	**744**	**613**	**615**

Subarea 13 (FRASERR). Panel 1 of 2 panels.

Site Name and Number:		28 July 1966	196608	14 June 1973	16 August 1974	22 August 1976	17 August 1982	8 August 1984	23 August 1984	12 August 1985	27 August 1985	17 August 1986	18 August 1986	11 August 1987	30 May 1988	25 August 1988
H0042	C STURGEON BANK SITE C	46	25	71	17	35	13	0	124	0	178	0	64	97	0	158
H0071	C STURGEON BANK SITE B	-		-	71	52	193	266	118	219	72	101	60	176	0	58
H0199	SWISHWASH ISL	25	0	0	0	0	0	0	0	0	12	0	0	0	0	6
H0573	STURGEON BANK - SITE G	-		-	-	-	-	-	-	-	-	-	-	-	-	-
H0451	C STURGEON BANK SITE E	-		-	-	-	-	-	-	-	-	-	-	-	-	-
H0231	S STURGEON BANK SITE D	-		-	-	-	-	-	-	-	-	-	7	0	50	0
H0564	STURGEON BANK - SITE F	-		-	-	-	-	-	-	-	-	-	-	-	-	-
H0070	S STURGEON BANK SITE A	66	31	0	53	3	20	33	11	0	3	8	8	29	0	10
H0481	GARRY PT	-		-	-	-	-	-	-	-	-	-	-	-	-	-
H0206	N ROBERTS BANK SITE G	-		-	-	-	-	-	135	0	0	0	0	0	0	0
H0038	N ROBERTS BANK SITE C	-		1	0	30	47	0	47	20	17	0	7	0	0	0
H0565	ROBERTS BANK - SITE K	-		-	-	-	-	-	-	-	-	-	-	-	-	-
H0543	N ROBERTS BANK SITE J	-		-	-	-	-	-	-	-	-	-	-	-	-	-
H0041	N ROBERTS BANK SITE E	-		-	-	-	154	10	38	83	57	179	185	203	163	177
H0040	N ROBERTS BANK SITE F	13	7	0	41	125	69	193	252	193	354	0	189	123	0	194
H0039	N ROBERTS BANK SITE D	-			29	0	10	35	0	0	9	0	0	11	0	0
H0201	N ROBERTS BANK SITE H	-		74	0	0	0	0	0	0	0	-	14	0	0	0
H0408	S WESTHAM ISL	-		-	-	-	-	-	-	-	-	-	-	-	-	-
H0036	C ROBERTS BANK SITE A	-		-	-	9	0	0	0	0	0	84	0	0	0	
H0450	C ROBERTS BANK SITE I	-		-	-	-	-	-	-	-	-	-	-	-	-	-
H0037	C ROBERTS BANK SITE B	0	0	0	0	0	20	9	0	7	3	11	10	20	0	1
H0480	TSWASSEN BREAKWATER	-		-	-	-	-	-	-	-	-	-	-	-	-	-
Total number counted		**150**	**63**	**146**	**211**	**254**	**526**	**546**	**725**	**522**	**705**	**383**	**544**	**659**	**213**	**604**
Correction for unborn pups		**1.1260**	**1.0213**	**1.2492**	**1.0293**	**1.0167**	**1.0264**	**1.0621**	**1.0149**	**1.0438**	**1.0076**	**1.0264**	**1.0238**	**1.0480**	**1.2500**	**1.0100**
Proportion of area covered		**1.0000**	**1**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**
Adjusted count		**168.9**	**959**	**182.4**	**217.2**	**258.2**	**539.9**	**579.9**	**735.8**	**544.9**	**710.3**	**393.1**	**556.9**	**690.6**	**266.3**	**610.0**
Estimated proportion hauled out		**0.615**	**0.687**	**0.615**	**0.616**	**0.649**	**0.664**	**0.696**	**0.649**	**0.704**	**0.707**	**0.682**	**0.598**	**0.674**	**0.621**	**0.667**
Correction for missed animals		**1.626**		**1.626**	**1.623**	**1.540**	**1.506**	**1.437**	**1.540**	**1.421**	**1.415**	**1.467**	**1.673**	**1.483**	**1.611**	**1.500**
Estimated abundance		**275**	**1,396**	**297**	**352**	**398**	**813**	**833**	**1,133**	**774**	**1,005**	**577**	**932**	**1,024**	**429**	**915**

Subarea 13 (FRASERR). Panel 2 of 2 panels.

Site Name and Number:		22 Sept. 1988	4 August 1990	24 August 1992	4 August 1994	27 July 1996	5 August 1998	27 August 2000	24 August 2003	13 August 2008
H0042	C STURGEON BANK SITE C	140	0	279	163	0	0	0	35	0
H0071	C STURGEON BANK SITE B	185	139	78		0	0	98	90	0
H0199	SWISHWASH ISL	0	0	0	51	6	190	195	215	0
H0573	STURGEON BANK - SITE G	-	-	-	-	-	111	0	0	ns
H0451	C STURGEON BANK SITE E	-	314	0	312	598	156	0	0	231
H0231	S STURGEON BANK SITE D	0	0	0	0	0	0	0	0	0
H0564	STURGEON BANK - SITE F	-	-	-	71	0	0	0	0	0
H0070	S STURGEON BANK SITE A	0	36	4	4	0	0	0	0	0
H0481	GARRY PT	-	-	63	0	0	0	0	ns	0
H0206	N ROBERTS BANK SITE G	35	0	75	0	172	79	0	0	20
H0038	N ROBERTS BANK SITE C	0	106	0	239	0	0	126	90	0
H0565	ROBERTS BANK - SITE K	-	-	-	257	0	13	126	450	254
H0543	N ROBERTS BANK SITE J	-	-	-	-	103	0	143	140	47
H0041	N ROBERTS BANK SITE E	363	142	161	34	184	103	54	350	0
H0040	N ROBERTS BANK SITE F	328	217	418	122	81	69	29	0	29
H0039	N ROBERTS BANK SITE D	0	5	0	0	0	26	19	0	0
H0201	N ROBERTS BANK SITE H	0	73	23	63	0	0	0	55	0
H0408	S WESTHAM ISL	15	0	0	0	0	0	0	0	0
H0036	C ROBERTS BANK SITE A	9	0	0	4	10	0	0	8	0
H0450	C ROBERTS BANK SITE I	-	24	0	0	0	110	0	0	0
H0037	C ROBERTS BANK SITE B	0	11	0	1	0	0	0	0	0
H0480	TSWASSEN BREAKWATER	-	-	10	2	20	18	17	95	23
Total number counted		**1,075**	**1,067**	**1,111**	**1,323**	**1,174**	**875**	**807**	**1,528**	**604**
Correction for unborn pups		**1.0000**	**1.0770**	**1.0110**	**1.0770**	**1.1310**	**1.0777**	**1.0068**	**1.0103**	**1.0364**
Proportion of area covered		**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**
Adjusted count		**1,075.0**	**1,149.2**	**1,123.2**	**1,424.9**	**1,327.8**	**943.0**	**812.5**	**1,543.7**	**626.0**
Estimated proportion hauled out		**0.694**	**0.690**	**0.692**	**0.632**	**0.700**	**0.691**	**0.674**	**0.671**	**0.666**
Correction for missed animals		**1.441**	**1.449**	**1.446**	**1.583**	**1.429**	**1.448**	**1.484**	**1.490**	**1.502**
Estimated abundance		**1,549**	**1,665**	**1,624**	**2,256**	**1,897**	**1,365**	**1,205**	**2,301**	**940**

Subarea 14 (HOWESD). Panel 1 of 1 panels.

Site Name and Number:		11 June 1973	19 August 1974	17 August 1982	23 August 1984	27 August 1985	18 August 1986	11 August 1987	30 May 1988	25 August 1988	22 Sept. 1988	3 August 1990	25 August 1992	4 August 1994	10 August 1996	5 August 1998	27 August 2000	13 August 2008
H0317	SQUAMISH ESTUARY	-	-	-	-	-	-	-	-	-	2	ns	ns	ns	ns	ns	ns	ns
H0316	N IRBY PT RKS	-	-	-	-	-	-	-	3	0	0	0	2	0	0	0	0	0
H0445	CHRISTIE IT	-	-	-	-	-	-	-	-	-	-	33		24	14	24	41	40
H0043	PAM ROCKS	37	38	65	195	180	126	251	191	219	139	204	180	288	187	214	323	224
H0410	PORT GRAVES	-	-	-	-	-	-	-	-	-	3	0	0	0	ns	ns	ns	0
H0446	N HALKETT PT	-	-	-	-	-	-	-	-	-	-	6	0	4	0	0	2	0
H0252	HALKETT PT	-	-	-	-	-	-	2				0	4	0	0	0	0	0
H0230	E BOWYER ISL	-	-	-	-	-	35	64	75	80	70	38	51	0	32	14	34	22
H0315	W HUTT ISL	-	-	-	-	-	-	-	3	0	21	1	4	1	0	0	7	0
H0372	NW BOWEN ISL	-	-	-	-	-	-	-	-	21	26	40	21	38	2	7	0	0
H0200	RAGGED ISL	-	-	-	-	10	8	12	11	18	7	26	0	0	9	0	8	1
H0253	N HERMIT ISL RK	-	-	-	-	-	-	2	51	7	0	1	14	1	16	0	16	4
H0484	MICKEY ISL	-	-	-	-	-	-	0	0	0	0	5	2	22	3	0	0	0
H0232	WHYTE IT	-	-	-	-	-	4	0	0	5	1	0	0	42	0	6	0	1
H0507	S HERMIT ISL REEF	-	-	-	-	-	-	-	-	-	-	-	-	22	11	0	0	8
H0044	N POPHAM ISL RFS	-	24	52	99	112	170	190	207	182	71	151	110	224	52	138	53	57
H0506	BOWEN BAY ROCK	-	-	-	-	-	-	-	-	-	-	-	-	20	0	0	0	0
H0229	S PASLEY ISL RK	-	-	-	-	-	0	0	9	0	35	36	42	11	28	67	46	0
H0482	EAGLE ISL	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0
H0574	N WORLCOMBE ISL RF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20	0	0
H0045	NW WORLCOMBE ISL RFS	27	1	31	34	68	77	73	88	77	50	84	122	244	63	187	81	10
H1455	NE ANVIL ISL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	22
H1456	WEST BAY LOGBOOMS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	22
H1457	SE TWIN CREEKS LOGBOOMS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9
H1458	PRESTON ISL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	17
H0483	GREBE ITS	-	-	-	-	-	-	-	-	-	-	-	21	20	10	2	46	41
H0409	E CAPE ROGER CURTIS	-	-	-	-	-	-	-	-	-	5	0	8	0	1	0	44	0
Total number counted		**64**	**63**	**148**	**328**	**370**	**420**	**594**	**638**	**609**	**430**	**625**	**581**	**961**	**428**	**679**	**701**	**478**
Correction for unborn pups		**1.2496**	**1.0213**	**1.0264**	**1.0149**	**1.0075**	**1.0238**	**1.0480**	**1.2500**	**1.0100**	**1.0000**	**1.0820**	**1.0100**	**1.0770**	**1.0520**	**1.0777**	**1.0068**	**1.0364**
Proportion of area covered		**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**0.9905**	**1.0000**	**1.0000**	**1.0000**	**0.9953**	**0.9953**	**0.9953**	**0.9953**	**0.9953**	**0.9953**	**0.9953**
Adjusted count		**80.0**	**64.3**	**151.9**	**332.9**	**372.8**	**430.0**	**628.5**	**797.5**	**615.1**	**430.0**	**679.4**	**589.6**	**1039.9**	**452.4**	**735.2**	**709.1**	**497.7**
Estimated proportion hauled out		**0.623**	**0.585**	**0.662**	**0.564**	**0.687**	**0.664**	**0.607**	**0.661**	**0.664**	**0.631**	**0.615**	**0.626**	**0.687**	**0.627**	**0.702**	**0.646**	**0.622**
Correction for missed animals		**1.605**	**1.709**	**1.511**	**1.773**	**1.456**	**1.506**	**1.647**	**1.513**	**1.506**	**1.585**	**1.627**	**1.598**	**1.455**	**1.596**	**1.424**	**1.548**	**1.608**
Estimated abundance		**128**	**110**	**230**	**590**	**543**	**648**	**1,035**	**1,207**	**926**	**682**	**1,105**	**942**	**1,513**	**722**	**1,047**	**1,098**	**800**

Subarea 15 (GULFISL). Panel 1 of 4 panels.

Site Name and Number:		13-14 August 1966	14-15 June 1973	14-16 August 1974	16-18 August 1982	19-20 August 1986	1-17 June 1988	12-26 August 1988	5-6 August 1990	28 Aug 9 Sept 1992	18-20 August 1994	28-30 July 1996	9 Aug 5 Sept 1998	28-30 August 2000	25-30 August 2003	28-30 August 2008
H0589	HORSWELL BLUFF RF	-	-	-	-	-	-	-	-	-	-	-	13	34	20	8
H0370	NECK PT	-	-	-	-	-	-	8	0	0	2	0	0	0	0	0
H0053	FIVE FINGER ISL	ns	-	-	1	4	1	12	2	30	15	45	44	113	90	119
H0335	HUDSON ROCKS	ns	-	-	-	-	20	27	71	43	75	54	38	0	140	121
H0054	SNAKE ISL	ns	6	15	61	139	127	156	149	216	236	407	187	275	140	249
H0233	NW ENTRANCE ISL RFS	ns	-	-	-	38	62	34	37	99	162	130	123	211	150	138
H0052	INSKIP ROCK	ns	-	-	-	24	15	1	34	43	42	39	56	71	57	54
H0055	SE ORLEBAR PT RK	ns	7	0	5	7	7	12	29	45	131	55	117	189	110	133
H0056	NE GABRIOLA ISL RF A	ns	-	6	10	27	62	85	74	69	27	20	33	37	35	43
H0057	NE GABRIOLA ISL RF B	ns	-	9	8	15	51	9	32	5	0	50	0	0	0	0
H0527	S DESCANSO BAY PT	ns	-	-	-	-	-	-	-	-	-	1	0	5	0	2
H0452	W PROTECTION ISL	ns	-	-	-	-	-	-	2	0	0	0	2	0	0	0
H0058	NE GABRIOLA ISL RF C	ns	6	10	22	51	20	36	67	11	8	20	0	28	30	16
H0061	NE GABRIOLA ISL RF D	ns	-	-	6	17	5	7	15	14	53	2	0	9	5	14
H0523	CARLOS ISLAND	-	-	-	-	-	-	-	-	-	49	26	39	13	80	64
H0059	BRANT REEF	-	12	32	72	74	125	113	218	98	124	107	309	781	425	198
H0545	S ACORN ISLAND RF	-	-	-	-	-	-	-	-	-	-	37	0	167	0	13
H0060	SE ACORN ISL RF	11	0	0	44	69	12	124	17	225	182	0	232	415	225	113
H0051	NANAIMO RIVER FLATS	-	-	8	4	10	29	52	47	0	16	37	ns	ns	ns	46
H0544	SE TUGBOAT ISLAND RF	-	-	-	-	-	-	-	-	-	-	17	15	0	0	61
H0371	W BATH ISL	-	-	-	-	-	-	47	34	49	164	235	59	65	55	23
H0167	GABRIOLA REEFS	4	0	0	0	23	29	37	82	27	152	131	58	362	310	31
H0342	BREAKWATER ISL	-	-	-	-	-	5	30	51	1	0	21	0	2	2	0
H0526	DEGNEN BAY RF	-	-	-	-	-	-	-	-	-	7	0	ns	0	0	0
H0343	SE FALSE NARROWS	-	-	-	-	-	6	4	15	4	0	0	0	1	0	0
H0464	DIBUXANTE PT	-	-	-	-	-	-	-	21	0	0	0	0	10	12	0
H0524	N KENDRICK ISLAND RF	-	-	-	-	-	-	-	-	-	5	0	0	0	2	0
H0062	E KENDRICK ISL RK	1	9	0	6	10	95	18	64	19	0	46	18	34	13	9
H0050	NE LINK ISL RK	-	-	-	44	0	0	2	0	0	0	0	0	0	0	0
H0373	S ROUND ISL RF	-	-	-	-	-	-	6	15	12	15	26	33	29	16	2
H0228	S DIBUXANTE PT	-	-	-	-	7	0	3	0	0	2	0	0	3	3	0
H0049	NE DE COURCY ISL RF	-	22	27	6	17	132	0	0	6	0	61	0	0	16	0
H0063	NE VALDES ISL RK	-	-	-	16	142	5	183	157	300	512	236	284	382	160	204
H0072	E DE COURCY ISL RF	-	-	-	3	0	0	4	0	0	11	25	0	13	0	19
H0344	NE REYNOLDS PT RF	-	-	-	-	-	55	77	92	40	48	63	31	33	40	1
H0234	SE FLEWETTE PT RF	-	-	-	-	55	0	0	3	12	38	43	31	50	65	10
H0227	N BLACKBERRY PT	-	-	-	-	4	0	28	58	3	10	4	0	0	3	0
H1464	ME VALDEZ ISL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4
H0028	DANGER REEFS	-	1	26	148	72	124	173	194	235	111	130	99	68	140	132
H0833	NW PYLADES ISL														12	0
H0591	NICHOLSON COVE REEF	-	-	-	-	-	-	-	-	-	-	-	4	0	0	2
H0064	E NOEL BAY RK	-	-	-	8	5	0	9	14	27	60	48	81	117	105	65
H0027	MIAMI IT	-	-	-	21	38	1	14	127	193	154	13	192	182	285	127
H0525	S SHINGLE POINT	-	-	-	-	-	-	-	-	-	2	2	0	0	0	0
H0243	CANOE IT	-	-	-	-	43	10	51	74	179	214	146	208	435	500	189

Subarea 15 (GULFISL). Panel 2 of 4 panels.

Site Name and Number:		13-14 August 1966	14-15 June 1973	14-16 August 1974	16-18 August 1982	19-20 August 1986	1-17 June 1988	12-26 August 1988	5-6 August 1990	28 Aug 9 Sept 1992	18-20 August 1994	28-30 July 1996	9 Aug 5 Sept 1998	28-30 August 2000	25-30 August 2003	28-30 August 2008
H0048	RAGGED ITS	-	1	13	2		1	1	0		13	29	0	0	0	0
H0590	S SHAH PT RF	-	-	-	-	-	-	-	-	-	-	-	14	0	70	0
H0174	CARDALE PT	-	3	1	0	0	1	0	12	9	0	0	2	2	0	0
H0047	ROSE ITS	32	0	17	45	41	102	63	75	78	104	121	64	46	130	148
H1460	BLACK RK	-	-	-	-	-	-	-	-	-	-	-	-	-	-	67
H1465	NE GALIANO ISL B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18
H0213	LADYSMITH HRBR	ns	12	ns	0	0	0	15	0	0	0	0	0	0	0	0
H0453	NE GALIANO ISL A	-	-	-	-	-	-	-	19	0	51	16	0	16	1	2
H0346	S REID ISL RF	-	-	-	-	-	41	1	0	4	0	0	1	0	0	0
H0546	N HALL ISLAND	-	-	-	-	-	-	-	-	-	-	4	0	6	8	4
H0374	E HALL ISL	-	-	-	-	-	-	25	0	34	69	0	52	14	50	0
H1466	NE GALIANO ISL C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	30
H0529	SW HALL ISLAND	-	-	-	-	-	-	-	-	-	10	0	3	12	15	0
H0181	S NORWAY ISL RF	-	-	23	0	9	7	16	19	26	23	63	42	33	32	22
H0236	MOWGLI ISL	-	-	-	-	22	0	3	0	1	37	7	13	5	21	30
H0547	NE SECRETARY ISLANDS	-	-	-	-	-	-	-	-	-	-	9	0	0	0	0
H0182	HUDSON ISL	-	2	6	0	26	16	96	0	76	51	0	54	91	90	1
H0086	S MOWGLI ISL RK	-	1	2	16	14	60	28	25	4	2	16	2	6	30	0
H0528	E HUDSON ISLAND	-	-	-	-	-	-	-	-	-	22	0	22	30	20	27
H1467	NE GALIANO ISL D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6
H1462	ALARM RK	-	-	-	-	-	-	-	-	-	-	-	-	-	-	63
H0336	MW GALIANO ISL RF D	-	-	-	-	-	-	6	0	0	0	0	0	0	1	0
H0454	NME GALIANO ISL A	-	-	-	-	-	-	-	9	0	6	26	0	17	0	11
H0085	S SECRETARY ISLS RK	-	-	-	29	0	51	0	12	11	16	12	27	41	45	0
H0465	S CHIVERS PT RF	-	-	-	-	-	-	-	40	0	2	49	30	2	10	39
H0083	S JACKSCREW ISL RF	-	-	9	32	23	0	34	2	0	23	16	15	13	45	8
H0832	ME WALLACE ISL														4	5
H0084	MW WALLACE ISL	-	-	33	9	49	30	57	49	42	29	21	0	6	8	8
H0065	ME GALIANO ISL RF A	-	1	9	15	41	13	42	42	81	40	0	156	244	15	148
H1468	ME GALIANO ISL RF B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	65
H1461	SW WALLACE RF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
H0235	ESCAPE REEF	-	-	-	-	25	7	1	0	2	4	63	83	58	60	62
H0349	GRAPPLER ROCK	-	-	-	-	-	1	2	0	0	0	0	0	0	0	0
H0348	CONOVER COVE RFS	-	-	-	-	-	70	1	82	0	8	46	2	6	15	0
H0762	SE WALLACE ISL													13	0	25
H0082	MW GALIANO ISL RF C	2	2	0	3	15	0	3	0	0	2	0	11	12	0	0
H0347	PANTHER PT	-	-	-	-	-	10	47	25	20	31	19	44	0	30	0
H0530	NW COOK COVE	-	-	-	-	-	-	-	-	-	260	152	0	191	320	1
H0836	MW GALIANO ISL RF E														5	0
H0046	SANDSTONE ROCKS	-	-	-	2	60	0	0	0	13	12	0	0	0	0	52
H0066	S COOK COVE	-	-	6	11	46	70	55	0	0	0	0	0	47	0	1
H0081	MW GALIANO ISL RF B	-	8	7	13	30	0	8	0	5	0	0	1	1	0	0
H0501	IDOL ISL	-	-	-	-	-	-	-	-	10	0	0	0	0	0	0
H0345	NORTH REEF	-	-	-	-	-	27	45	46	38	60	0	59	46	10	86
H0080	MW GALIANO ISL RF A	2	12	9	21	0	31	0	25	3	0	4	0	0	0	2

Subarea 15 (GULFISL). Panel 3 of 4 panels.

Site Name and Number:		13-14 August 1966	14-15 June 1973	14-16 August 1974	16-18 August 1982	19-20 August 1986	1-17 June 1988	12-26 August 1988	5-6 August 1990	28 Aug 9 Sept 1992	18-20 August 1994	28-30 July 1996	9 Aug 5 Sept 1998	28-30 August 2000	25-30 August 2003	28-30 August 2008
H0364	BALLINGALL ITS	-	-	-	-	-	-	8	15	14	85	0	99	111	200	162
H0169	WISE ISL	5	15	2	0	0	1	1	1	0	0	2	0	8	4	0
H0498	CHARLES ISL	-	-	-	-	-	-	-	3	4	0	0	1	ns	0	0
H0026	SHOAL ISLS FLATS	7	12	1	38	40	135	121	223	79	7	28	16	0	2	28
H0531	LION ISLETS	-	-	-	-	-	-	-	-	-	4	0	69	70	0	96
H0837	TWISS PT														15	0
H0350	YORK ROCKS	-	-	-	-	-	-	27	54	59	66	17	11	13	0	17
H0067	SE GOSSIP ISL RFS	-	-	-	9	31	33	15	25	75	192	104	59	129	83	40
H0548	NW RIP POINT	-	-	-	-	-	-	-	-	-	-	13	16	24	15	28
H0592	CROFTON REEF	-	-	-	-	-	-	-	-	-	-	-	80	0	2	56
H0168	ATKINS REEF	12	7	4	0	23	10	23	49	34	0	98	52	39	21	46
H0846	GEORGINA PT														4	36
H1459	PHILLIMORE PT															3
H0376	E DAVID COVE RF	-	-	-	-	-	-	15	0	32	29	23	28	32	35	43
H0497	W MARY ANNE PT	-	-	-	-	-	-	-	-	5	17	0	6	5	0	0
H0549	W GEORGESON BAY RF	-	-	-	-	-	-	-	-	-	-	43	27	125	0	75
H1469	HELEN PT															19
H0241	SE EDITH PT RFS	-	-	-	-	17	0	7	24	36	19	31	14	12	30	0
H0835	POWDER IT														12	0
H0375	NE NOSE PT	-	-	-	-	-	-	7	5	12	20	0	0	0	2	0
H0166	S PEILE PT	3	0	1	0	0	0	2	31	0	0	0	5	0	1	0
H0379	CHAIN ISLS	-	1	6	0	0	108	42	0	24	59	17	0	8	4	0
H1470	N GEORGESON PT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18
H0079	CHARLES ROCKS	1	33	14	63	20	119	81	3	15	23	123	14	21	15	53
H0502	HAWKINS ISL	-	-	-	-	-	-	-	-	53	21	0	0	0	1	0
H1463	SE THIRD SISTER ISL RF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6
H0457	DINNER PT	-	-	-	-	-	-	-	9	16	21	0	27	34	100	57
H0069	BELLE CHAIN ITS	7	14	106	140	471	240	753	573	800	0	755	458	608	1,175	438
H0068	E SAMUEL ISL RF	-	55	20	34	22	123	0	103	96	1,034	281	0	1	20	19
H0503	E STANLEY PT	-	-	-	-	-	-	-	-	29	5	0	0	1	0	0
H0078	NE STANLEY PT	1	0	12	5	14	0	34	6	0	19	18	6	11	7	0
H0337	LIZARD ISL	-	-	-	-	-	8	0	0	0	0	2	0	1	1	0
H0550	E ELLEN BAY	-	-	-	-	-	-	-	-	-	-	18	0	2	0	0
H1451	SW ARBUTUS PT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	39
H0173	NW ACLAND ISLS RFS	1	1	0	0	9	1	52	0	0	0	0	3	35	0	12
H0237	RED ITS	-	-	-	-	6	0	0	15	15	0	0	0	0	0	0
H0551	BOAT ISLET	-	-	-	-	-	-	-	-	-	-	8	2	6	5	22
H0460	SE ACLAND ISLS	-	-	-	-	-	-	-	7	0	0	4	0	0	0	0
H0240	KING ITS	-	-	-	-	52	40	41	65	66	6	105	26	25	30	42
H1452	BIRDS EYE COVE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11
H0238	FANE ISL	-	-	-	-	7	19	13	0	12	4	35	5	4	0	0
H0073	W TUMBO ISL RF	2	0	10	20	0	121	45	106	21	205	5	108	152	200	139
H0165	CHANNEL ISLS	11	27	0	0	68	61	51	114	63	135	169	66	82	45	70
H0074	PINE IT	11	10	6	26	103	0	107	157	247	355	236	185	132	175	144
H0242	TUMBO REEF	-	-	-	-	44	0	0	0	0	0	0	0	0	0	0

Subarea 15 (GULFISL). Panel 4 of 4 panels.

Site Name and Number:		13-14 August 1966	14-15 June 1973	14-16 August 1974	16-18 August 1982	19-20 August 1986	1-17 June 1988	12-26 August 1988	5-6 August 1990	28 Aug 9 Sept 1992	18-20 August 1994	28-30 July 1996	9 Aug 5 Sept 1998	28-30 August 2000	25-30 August 2003	28-30 August 2008
H1453	CHISHOLM ISL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11
H0532	TUMBO POINT	-	-	-	-	-	-	-	-	-	19	26	0	41	20	0
H0164	E NORTH PENDER ISL	18	2	4	0	24	5	26	13	48	17	11	5	12	4	0
H0505	S OTTER BAY RK	-	-	-	-	-	-	-	-	14	0	0	7	7	30	20
H0075	BOILING REEF	-	-	-	78	39	37	64	84	210	450	207	223	648	650	236
H0500	BOLD BLUFF PT	-	-	-	-	-	-	-	-	5	0	0	0	0	5	ns
H0845	PORT BROWNING RKS	-	-	-	-	-	-	-	-	-	-	-	-	-	5	8
H0455	NARVAEZ BAY RK	-	-	-	-	-	-	-	16	2	0	0	0	0	1	5
H0163	CROAKER PT	5	1	0	0	0	0	0	0	0	0	0	0	0	0	18
H0377	RAZOR PT	-	-	-	-	-	7	30	7	0	0	11	3	0	0	0
H0499	BURIAL IT	-	-	-	-	-	-	-	-	17	7	4	19	0	8	15
H0456	W MONARCH HD	-	-	-	-	-	-	-	17	0	0	0	0	0	0	0
H0077	BEDDIS ROCK	21	14	10	3	30	0	27	0	15	12	29	42	13	18	21
H0162	MURDER PT	11	2	4	0	10	1	23	30	11	3	0	12	5	2	0
H1471	S BOAT NOOK	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16
H0076	JAVA ITS	10	1	42	64	112	38	67	223	316	109	224	294	340	225	259
H0458	N SOUTH PENDER ISL	-	-	-	-	-	-	-	9	6	4	0	0	1	2	0
H0593	N MUSGRAVE PT REEF	-	-	-	-	-	-	-	-	-	-	-	12	0	0	ns
H0535	ELEANOR POINT	-	-	-	-	-	-	-	-	-	11	0	0	0	6	0
H0459	S NORTH PENDER ISL	-	-	-	-	-	-	-	10	9	21	5	21	12	6	2
H0159	NE SOUTH PENDER ISL	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H0175	COWICHAN BAY	-	4	1	ns	9	31	18	32		40	38	ns	ns	82	95
H1450	OAKS BLUFF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14
H0239	BLUNDEN IT	-	-	-	-	37	9	30	31	96	73	112	74	63	30	66
H1473	HAY PT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6
H0534	SE HAY POINT	-	-	-	-	-	-	-	-	-	5	8	9	5	1	0
H0533	N GOWLLAND POINT RF	-	-	-	-	-	-	-	-	-	31	48	34	0	0	0
H0504	N WALLACE PT RK	-	-	-	-	-	-	-	-	15	25	33	48	19	25	ns
H1472	E TILLY PT ISL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16
H0553	PATEY ROCK	-	-	-	-	-	-	-	-	-	-	2	0	0	0	ns
Total number counted		**181**	**302**	**511**	**1,162**	**2,480**	**2,671**	**3,641**	**4,337**	**5,033**	**6,655**	**5,843**	**5,189**	**7,949**	**7,605**	**5,662**
Correction for unborn pups		**1.0380**	**1.2490**	**1.0329**	**1.0238**	**1.0213**	**1.2491**	**1.0110**	**1.0696**	**1.0003**	**1.0190**	**1.1204**	**1.0040**	**1.0046**	**1.0053**	**1.0061**
Proportion of area covered		**0.8974**	**1.0000**	**0.9603**	**0.9963**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**0.9830**	**0.9830**	**0.9937**	**0.9661**
Adjusted count		**209.4**	**377.2**	**549.6**	**1194.1**	**2532.8**	**3336.8**	**3681.1**	**4638.9**	**5034.5**	**6781.4**	**6546.5**	**5299.8**	**8123.8**	**7694.0**	**5896.8**
Estimated proportion hauled out		**0.589**	**0.374**	**0.600**	**0.528**	**0.592**	**0.555**	**0.615**	**0.587**	**0.652**	**0.543**	**0.627**	**0.592**	**0.589**	**0.601**	**0.593**
Correction for missed animals		**1.699**	**2.673**	**1.668**	**1.894**	**1.690**	**1.803**	**1.626**	**1.705**	**1.533**	**1.841**	**1.594**	**1.689**	**1.698**	**1.664**	**1.686**
Estimated abundance		**356**	**1,008**	**917**	**2,262**	**4,280**	**6,016**	**5,985**	**7,909**	**7,718**	**12,485**	**10,435**	**8,954**	**13,792**	**12,802**	**9,944**

Subarea 16 (NWGULF). Panel 1 of 2 panels.

Site Name and Number:		16-19 August 1974	10-11 August 1976	17-18 August 1983	14 August 1985	13-16 June 1988	10-24 August 1988	17-18 August 1990	27-28 August 1992	7-17 August 1994	11-13 August 1996	8-9 August 1998	26-29 August 2000	10-28 August 2003	14-16 August 2008
H0356	SHELTER PT RF	-	-	-	-	ns	32	56	36	44	0	83	75	ns	144
H0588	OYSTER BAY RF	-	-	-	-	-	-	-	-	-	-	3	0	ns	0
H0329	S WILLIAMS BEACH	-	-	-	-	103	92	163	119	87	151	93	49	ns	25
H0330	N LITTLE RIVER RF	-	-	-	-	153	65	117	138	103	134	192	187	ns	100
H0522	LITTLE RIVER RF	-	-	-	-	-	-	-	-	-	18	11	40	ns	9
H0126	E CAPE LAZO RF	24	16	12	65	111	94	138	111	126	147	92	105	ns	27
H0104	COMOX HRBR	1	7	15	75	168	169	0	0	318	241	262	182	ns	17
H0102	E SEAL ITS RF	3	6	7	10	55	44	60	60	45	28	16	78	18	3
H1474	UNION PT	-	-	-	-	-	-	-	-	-	-	-	-	-	54
H0414	S UNION PT	-	-	-	-	-	-	19	26	2	0	0	ns	0	0
H1475	KOMAS BLUFF	-	-	-	-	-	-	-	-	-	-	-	-	-	6
H0204	S KOMAS BLUFF	-	-	-	5	4	12	51	46	15	19	15	0	44	6
H0103	COLLISHAW PT	16	14	32	65	25	165	126	226	220	262	144	434	300	163
H0357	TRALEE PT	-	-	-	-	-	12	0	0	30	0	0	0	ns	0
H0491	CAPE GURNEY	-	-	-	-	-	-	-	3	5	1	0	34	55	69
H0099	FLORA IT	-	-	65	106	164	186	219	251	505	559	356	847	575	777
H0332	NASH BANK RF	-	-	-	-	73	18	0	0	15	27	0	0	35	0
H0101	S FANNY BAY		3	32	10	0	14	37	2	11	43	17	6	ns	0
H0490	MAUDE REEF	-	-	-	-	-	-	-	-	28	18	21	66	45	46
H0203	E NORMAN PT	1	0	0	49	51	77	116	103	199	123	123	89	100	111
H0470	NORRIS ROCKS	-	-	-	-	-	-	60	136	229	266	350	571	450	519
H0202	E REPULSE PT	-	-	-	6	4	21	25	48	67	43	59	0	30	54
H0100	MUD BAY	2	28	25	67	17	81	98	50	51	81	15	3	ns	21
H0760	EAGLE RK	-	-	-	-	-	-	-	-	-	-	-	4	0	0
H0778	S REPULSE PT	-	-	-	-	-	-	-	-	-	-	-	-	15	0
H0358	N QUALICUM BAY RF A	-	-	-	-	-	5	28	2	2	2	0	0	0	0
H1476	N QUALICUM BAY RF B	-	-	-	-	-	-	-	-	-	-	-	-	-	3
H0331	S QUALICUM BAY RF	-	-	-	-	65	57	114	67	154	126	157	8	208	151
H0761	LITTLE QUALICUM RIVER	-	-	-	-	-	-	-	-	-	-	-	118	0	0
H0093	S BALLENAS ISLS RFS	3	1	10	17	56	77	88	65	111	132	107	156	199	100
H0094	NE MISTAKEN ISL RFS		12	85	94	65	85	28	173	275	245	221	282	326	221
H0359	COTTAM REEF	-	-	-	-	-	1	7	4	8	13	0	0	30	17
H0340	GERALD ISL	-	-	-	-	3	19	50	7	3	51	91	22	68	41
H0339	DOUGLAS ISL	-	-	-	-	51	34	25	35	13	0	12	70	100	48
H0092	YEO ISLS	-	-	59	65	96	53	73	71	321	187	187	267	155	99
H0368	AMELIA ISL	-	-	-	-	-	11	0	0	0	0	0	41	6	18
H0091	N SCHOONER REEF	-	-	5	0	10	18	25	12	38	21	18	103	20	44
H0369	WINCHELSEA ISLS	-	-	-	-	-	49	10	95	37	20	173	149	64	11
H0087	ADA ISLS	-	-	79	120	123	181	245	38	274	502	307	308	305	272

Subarea 16 (NWGULF). Panel 2 of 2 panels.

Site Name and Number:		16-19 August 1974	10-11 August 1976	17-18 August 1983	14 August 1985	13-16 June 1988	10-24 August 1988	17-18 August 1990	27-28 August 1992	7-17 August 1994	11-13 August 1996	8-9 August 1998	26-29 August 2000	10-28 August 2003	14-16 August 2008
H0759	RUTH ISL	-	-	-	-	-	-	-	-	-	-	-	16	15	21
H0088	SOUTHEY ISL	24	50	78	67	95	73	76	70	41	72	24	132	50	113
H0496	N WALLIS PT RKS	-	-	-	-	-	-	-	12	20	8	0	3	2	0
H0089	E WALLIS PT RK	-	-	7	0	0	0	9	0	9	0	0	13	0	0
H0090	MAUDE ISL	-	3	35	36	17	24	18	30	43	30	2	34	17	27
H0341	NANOOSE BAY	-	-	-	-	2	1	0	0	0	0	0	ns	0	0
Total number counted		**74**	**140**	**546**	**857**	**1,511**	**1,770**	**2,081**	**2,036**	**3,449**	**3,570**	**3,151**	**4,492**	**3,232**	**3,337**
Correction for unborn pups		**1.0293**	**1.0502**	**1.0264**	**1.0362**	**1.2490**	**1.0337**	**1.0225**	**1.0067**	**1.0385**	**1.0399**	**1.0580**	**1.0063**	**1.0316**	**1.0268**
Proportion of area covered		**1.0000**	**1.0000**	**1.0000**	**1.0000**	**0.9820**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**0.8560**	**1.0000**
Adjusted count		**76.2**	**147.0**	**560.4**	**888.0**	**1921.8**	**1829.1**	**2127.9**	**2049.6**	**3581.6**	**3712.4**	**3333.8**	**4520.1**	**3895.3**	**3426.3**
Estimated proportion hauled out		**0.450**	**0.322**	**0.509**	**0.483**	**0.461**	**0.560**	**0.585**	**0.617**	**0.553**	**0.558**	**0.660**	**0.589**	**0.587**	**0.604**
Correction for missed animals		**2.221**	**3.107**	**1.965**	**2.070**	**2.169**	**1.785**	**1.708**	**1.622**	**1.807**	**1.793**	**1.515**	**1.698**	**1.704**	**1.656**
Estimated abundance		**169**	**457**	**1,101**	**1,838**	**4,168**	**3,265**	**3,634**	**3,324**	**6,472**	**6,656**	**5,052**	**7,676**	**6,636**	**5,673**

Subarea 17 (NEGULF). Panel 1 of 6 panels.

Site Name and Number:		11-24 August 1976	17-19 August 1983	21-22 August 1987	13-14 June 1988	9-10 August 1988	3-20 August 1990	25-27 August 1992	5-7 August 1994	10-12 August 1996
H0127	SE WAIATT BAY RF	-	24	ns	ns	ns	ns	ns	ns	ns
H0797	CYRUS RKS									
H0128	M CHAINED ISLS	-	1	ns	ns	ns	ns	ns	ns	ns
H0494	DUNSTERVILLE IT	-	-	-	-	-	-	31	26	ns
H0822	READ PT									
H0493	NW VINER PT RK	-	-	-	-	-	-	6	7	ns
H0821	VINER PT									
H0520	N BRETON ISLANDS IT	-	-	-	-	-	-	-	29	ns
H0580	NE BRETON ISL	-	-	-	-		-	-	-	ns
H1496	N SUBTLE ISLS									
H0519	CENTRE ISLET	-	-	-	-	-	-	-	35	ns
H0125	S BRETON ISLS	39	29	10	ns	ns	ns	199	253	ns
H0581	SW HYACINTHE PT RF	-	-	-	-	-	-	-	-	ns
H0521	HYACINTHE BAY RF	-	-	-	-	-	-	-	7	ns
H0579	SE SUBTLE ISLS	-	-	-	-	-	-	-	-	ns
H0796	MAY ISL									
H0415	GOWLLAND HRBR									
H0334	NW MARINA ISL RF	-	-	-	16	1	52	12	18	ns
H1495	GUIDE ITS									
H0839	S MANSON BAY									
H0124	SW MARINA ISL RF	-	8	53		14	70	25	38	ns
H1493	S GROUSE ISL									
H1492	W POWELL IT									
H0120	POWELL ITS	11	123	190	141	177	288	226	164	191
H0123	MARINA REEF	73	266	468	474	491	495	310	594	ns
H0794	N YACULTA RF									
H0518	TOWNLEY ISLAND	-	-	-	-	-	-	-	23	22
H0492	IRON PT	-	-	-	-	-	-	9	0	0
H1491	N COPELAND ISL									
H0492	IRON PT									
H0578	S TWIN ISLS	-	-	-	-	-	-	-	-	-
H0122	SW SUTIL PT RF	11	89	149	202	161	141	50	204	244
H0758	FRANCISCO PT									
H0495	CAPE MUDGE	-	-	-	-	-	-	11	24	ns
H0119	S COPELAND ISLS	-	48	1	0	1	0	0	0	6
H0188	MAJOR IT	37	0	0	3	97	6	0	121	32
H0117	ME HERNANDO ISL RK	-	19	18	20	0	31	28	28	0
H0118	SW H0ERNANDO ISL	32	51	50	211	98	132	85	195	142
H0116	KEEFER ROCK	-	22	36	0	85	68	190	37	50
H1494	ASHWORTH PT									
H0489	INDIAN PT	-	-	-	-	-	-	22	0	0
H0121	MITLENATCH ISL	-	59	50	118	173	153	216	319	529
H0471	DINNER ROCK	-	-	-	-	-	2	0	0	2
H0115	SW SAVARY ISL	5	23	34	0	37	48	0	4	15
H0187	SE SAVARY ISL RFS	9	0	95	100	85	85	119	85	90
H0517	S BEACON POINT RF	-	-	-	-	-	-	-	52	56
H0114	STRADIOTTI REEF	-	25	3	115	60	50	61	28	13
H0113	MYSTERY REEF	2	10	90	90	85	105	95	98	240
H0186	NW HARWOOD ISL	7	0	5	1	2	8	6	20	13
H0577	SE HARWOOD ISL	-	-	-	-	-	-	-	-	-
H0112	VIVIAN ISL	-	7	16	0	55	41	228	44	453
H0559	SW HARWOOD ISLAND	-	-	-	-	-	-	-	-	21
H1487	NE SYDNEY ISL RF									
H0111	REBECCA ROCK	-	10	47	50	118	198	122	206	289
H0576	CYRIL RK	-	-	-	-	-	-	-	-	-

Subarea 17 (NEGULF). Panel 2 of 6 panels.

Site Name and Number:		11-24 August 1976	17-19 August 1983	21-22 August 1987	13-14 June 1988	9-10 August 1988	3-20 August 1990	25-27 August 1992	5-7 August 1994	10-12 August 1996
H0754	S GRILSE PT A									
H0575	KIDDIE PT	-	-	-	-	-	-	-	-	-
H1479	S GRILSE PT B									
H0354	MYRTLE ROCKS	-	-	-	-	26	0	0	67	34
H0132	MILLER IT	15	22	18	2	6	41	0	0	0
H0110	N MARSHALL PT		2	7	10	15	10	2	29	22
H1480	HODGSON PT									
H0327	ALBION PT	-	-	-	3	0	1	0	0	0
H0508	CRESCENT BAY IT	-	-	-	-	-	-	-	5	0
H1484	SUTTON ITS									
H1481	E VANANDA									
H0133	MCRAE IT	20	34	71	108	113	129	100	280	143
H0558	SW SCOTCH FIR PT IT	-	-	-	-	-	-	-	-	87
H0250	N FAVADA PT RK	-	-	12	1	26	0	13	10	14
H1490	DAVIS BAY									
H0516	NOCTURNE ISLAND	-	-	-	-	-	-	-	12	12
H0185	NW KELLY ISL RK	24	7	11		35	30	21	82	17
H0184	NORTHEAST PT	5		13	13	42	51	85	50	60
H0563	SE DAVIS BAY IT	-	-	-	-	-	-	-	-	17
H0515	S KELLY ISLAND	-	-	-	-	-	-	-	7	0
H1489	SE WELCOME BAY									
H0473	SW BILLINGS BAY	-	-	-	-	-	20	0	17	0
H0353	STRAWBERRY IT	-	-	-	-	14	1	16	50	42
H0326	NW HIGHLAND PT RF	-	-	-	68	125	117	0	0	0
H0488	N GILES BAY	-	-	-	-	-	-	7	0	4
H1478	E COCKBURN BAY									
H0134	E CAPE COCKBURN RK	-	-	8	0	4	21	1	0	35
H0135	W QUARRY BAY RF	-	1	2	0	0	0	0	42	0
H0205	MERMAID PT	-	-	7	0	1	0	0	15	0
H0249	S DICK ISL	-	-	48	6	39	31	49	68	69
H0472	NELSON ROCK	-	-	-	-	-	17	0	199	0
H1488	N MOUAT ISL									
H0131	W HODGSON ISLS	20	79	151	93	87	100	86	11	159
H0109	MOUAT ISLS	2	53	114	136	132	146	159	267	265
H0557	NARES ROCK	-	-	-	-	-	-	-	-	18
H1486	E KUNECHIN PT									
H0781	MARTIN ISLAND									
H0248	MW TEXADA ISL	-	-	4	0	2	0	4	0	25
H1485	KUNECHIN ITS									
H0784	DAVIE BAY IT									
H0556	S EDGECOMBE ISLAND IT	-	-	-	-	-	-	-	-	20
H0448	N WHITESTONE ISLS	-	-	-	-	-	19	31	75	0
H0108	SE DAVIE BAY RFS	-	10	40	32	25	70	30	76	93
H0487	MSW TEXADA ISL	-	-	-	-	-	-	8	22	22
H0244	SE TEXADA ISL	-	-	9	11	9	72	40	32	45
H0783	W COOK BAY RKS									
H0107	SW COOK BAY RK	-	9	0	24	24	10	0	24	11
H1483	N PARTINGTON PT									
H0098	FEGAN ITS	38	104	155	268	257	276	129	310	327
H0477	SE BOAT COVE RK	-	-	-	-	-	35	0	48	0
H0474	PARTINGTON PT	-	-	-	-	-	40	26	9	0
H0475	NE LASQUETI ISL RK	-	-	-	-	-	7		13	0
H0560	S FEGAN ITS	-	-	-	-	-	-	-	-	96
H0209	NW JERVIS ISL IT	-	-	-	-	-	-	-	194	155
H0245	NE JERVIS ISL	-	-	44	43	86	135	139	0	0

Subarea 17 (NEGULF). Panel 3 of 6 panels.

Site Name and Number:		11-24 August 1976	17-19 August 1983	21-22 August 1987	13-14 June 1988	9-10 August 1988	3-20 August 1990	25-27 August 1992	5-7 August 1994	10-12 August 1996
H0782	ANDERSON BAY IT									
H0105	E JERVIS ISL RF	-	65	87	146	0	143	27	83	69
H0757	N JEDEDIAH ISL									
H0176	N PAUL ISL RK	-	-	-	-	87	0	0	0	0
H0352	DERBY PT	-	-	-	-	11	0	31	3	0
H0756	TUCKER BAY RK									
H0247	FINNERTY ISLS	-	-	23	0	15	16	21	93	94
H0562	E JEDEDIAH ISLAND	-	-	-	-	-	-	-	-	30
H0183	SE JEDDAH PT RKS	-	-	19	0	4	34	17	21	48
H0486	SW TEXADA ISL	-	-	-	-	-	-	9	17	36
H0755	N UPWOOD PT									
H0405	BOHO ISL	-	-	-	-	-	3	4	0	0
H0333	W JEDEDIAH ISL RF	-	-	-	59	11	2	0	0	0
H0476	E JEDEDIAH ISL RK	-	-	-	-	-	14	45	41	0
H0561	S BOHO BAY IT	-	-	-	-	-	-	-	-	5
H0512	S JEDEDIAH ISLAND	-	-	-	-	-	-	-	3	0
H1482	SW UPWOOD PT									
H0251	SISTERS ITS	-	-	5	0	0	44	90	226	37
H0555	EGERTON ROCK	-	-	-	-	-	-	-	-	20
H0106	SHEER ISL	-	10	34	9	32	13	14	76	40
H0779	E THORMANBY ISL RK									
H0130	MW SOUTH THORMANBY ISL	-	8	3	86	45	0	12	106	38
H0513	SE BULL ISLAND RF	-	-	-	-	-	-	-	22	0
H0511	S BULL ISLAND IT	-	-	-	-	-	-	-	3	0
H0510	S RABBIT ISLAND	-	-	-	-	-	-	-	5	23
H0355	HEATH IT	-	-	-	-	3	0	0	0	0
H0215	ME SOUTH THORMANBY ISL	-	-	0	37	20	26	0	21	4
H0479	SW LASQUETI ISL	-	-	-	-	-	2	6	0	0
H0129	SW SOUTH THORMANBY ISL	1	31	31		15	12	50	12	136
H0447	S SOUTH THORMANBY ISL RF	-	-	-	-	-	53	0	23	0
H0160	MERRY ISL	-	-	12	2	27	33	157	59	111
H0325	PIRATE ROCK	-	-	-	12	13	35	0	23	53
H0406	E LASQUETI RK	-	-	-	-	-	0	0	0	12
H0351	BERTHA ISL	-	-	-	-	4	28	22	5	57
H0096	BOAT COVE RFS	-	16	53	111	85	0	23	2	2
H0136	W TRAIL ISLS	3	1	105	2	27	93	126	14	174
H0154	M TRAIL ISLS	-	-	15	62		18	43	32	1
H0514	E TRAIL ISLANDS	-	-	-	-	-	-	-	7	0
H0097	SEA EGG ROCKS	-	7	33	43	64	77	171	161	126
H0485	SE LASQUETI ISL	-	-	-	-	-	-	4	0	0
H0509	SW JENKINS ISLAND	-	-	-	-	-	-	-	8	5
H0478	E JENKINS ISL RK	-	-	-	-	-	15	14	72	38
H0246	E YOUNG PT RK	-	-	15	1	0	14	0	1	20
H0328	SEAL REEF	-	-	-	4	21	0	17	111	0
H0095	SANGSTER ISL	-	37	54	36	61	86	240	299	288
H0153	WHITE ITS	-	-	16	0	0	7	102	49	67
H1477	NW CHASTER									
Total number counted		**354**	**1,310**	**2,534**	**2,969**	**3,353**	**4,120**	**4,242**	**6,271**	**5,734**
Correction for unborn pups		**1.0187**	**1.0238**	**1.0163**	**1.2490**	**1.0539**	**1.0243**	**1.0086**	**1.0662**	**1.0461**
Proportion of area covered		**0.9814**	**0.9861**	**0.9812**	**1.0002**	**1.0151**	**0.9773**	**0.9773**	**0.9812**	**0.8406**
Adjusted count		**367.4**	**1360.1**	**2624.8**	**3707.5**	**3481.3**	**4318.0**	**4377.9**	**6814.3**	**7136.0**
Estimated proportion hauled out		**0.573**	**0.606**	**0.653**	**0.588**	**0.646**	**0.644**	**0.629**	**0.644**	**0.637**
Correction for missed animals		**1.746**	**1.650**	**1.531**	**1.700**	**1.547**	**1.554**	**1.591**	**1.552**	**1.569**
Estimated abundance		**642**	**2,244**	**4,019**	**6,303**	**5,386**	**6,710**	**6,965**	**10,576**	**11,196**

Subarea 17 (NEGULF). Panel 4 of 6 panels.

Site Name and Number:		6-8 August 1998	25-28 August 2000	30-31 August 2003	14-16 August 2008
H0127	SE WAIATT BAY RF	ns	ns	0	0
H0797	CYRUS RKS		ns	12	7
H0128	M CHAINED ISLS	ns	ns	0	26
H0494	DUNSTERVILLE IT	15	ns	75	18
H0822	READ PT		ns	32	0
H0493	NW VINER PT RK	53	ns	0	53
H0821	VINER PT		ns	39	0
H0520	N BRETON ISLANDS IT	5	ns	60	25
H0580	NE BRETON ISL	136	ns	23	166
H1496	N SUBTLE ISLS				27
H0519	CENTRE ISLET	30	ns	75	67
H0125	S BRETON ISLS	57	ns	146	22
H0581	SW HYACINTHE PT RF	20	ns	3	49
H0521	HYACINTHE BAY RF	0	ns	0	0
H0579	SE SUBTLE ISLS	5	ns	0	0
H0796	MAY ISL		ns	11	0
H0415	GOWLLAND HRBR		ns	125	19
H0334	NW MARINA ISL RF	6	0	0	0
H1495	GUIDE ITS				91
H0839	S MANSON BAY			20	31
H0124	SW MARINA ISL RF	57	0	1	0
H1493	S GROUSE ISL				57
H1492	W POWELL IT				19
H0120	POWELL ITS	112	147	ns	150
H0123	MARINA REEF	517	346	102	507
H0794	N YACULTA RF			2	23
H0518	TOWNLEY ISLAND	2	3	ns	0
H0492	IRON PT	0	0	0	0
H1491	N COPELAND ISL				22
H0492	IRON PT		ns	7	0
H0578	S TWIN ISLS	8	7	7	0
H0122	SW SUTIL PT RF	20	163	20	305
H0758	FRANCISCO PT		18	0	0
H0495	CAPE MUDGE	0	36	32	109
H0119	S COPELAND ISLS	0	0	ns	0
H0188	MAJOR IT	129	96	ns	124
H0117	ME HERNANDO ISL RK	0	104	ns	0
H0118	SW H0ERNANDO ISL	150	55	ns	29
H0116	KEEFER ROCK	136	163	0	107
H1494	ASHWORTH PT				89
H0489	INDIAN PT	0	8	0	0
H0121	MITLENATCH ISL	201	ns	ns	784
H0471	DINNER ROCK	0	13	ns	27
H0115	SW SAVARY ISL	0	15	21	12
H0187	SE SAVARY ISL RFS	44	54	49	48
H0517	S BEACON POINT RF	32	28	8	1
H0114	STRADIOTTI REEF	27	0	53	0
H0113	MYSTERY REEF	141	19	160	ns
H0186	NW HARWOOD ISL	0	7	14	0
H0577	SE HARWOOD ISL	6	9	36	93
H0112	VIVIAN ISL	122	504	375	176
H0559	SW HARWOOD ISLAND	17	64	13	71
H1487	NE SYDNEY ISL RF				147
H0111	REBECCA ROCK	442	516	700	398
H0576	CYRIL RK	17	3	65	69

Subarea 17 (NEGULF). Panel 5 of 6 panels.

Site Name and Number:		6-8 August 1998	25-28 August 2000	30-31 August 2003	14-16 August 2008
H0754	S GRILSE PT A		61	2	15
H0575	KIDDIE PT	4	0	0	0
H1479	S GRILSE PT B				27
H0354	MYRTLE ROCKS	8	0	1	0
H0132	MILLER IT	ns	ns	ns	34
H0110	N MARSHALL PT	14	0	22	53
H1480	HODGSON PT				16
H0327	ALBION PT	0	0	0	0
H0508	CRESCENT BAY IT	0	0	75	8
H1484	SUTTON ITS				21
H1481	E VANANDA				28
H0133	MCRAE IT	68	3	40	16
H0558	SW SCOTCH FIR PT IT	101	140	150	71
H0250	N FAVADA PT RK	20	25	27	150
H1490	DAVIS BAY				99
H0516	NOCTURNE ISLAND	0	0	15	0
H0185	NW KELLY ISL RK	0	45	37	0
H0184	NORTHEAST PT	58	76	111	74
H0563	SE DAVIS BAY IT	45	47	50	111
H0515	S KELLY ISLAND	0	0	5	15
H1489	SE WELCOME BAY				7
H0473	SW BILLINGS BAY	0	0	0	6
H0353	STRAWBERRY IT	32	31	60	4
H0326	NW HIGHLAND PT RF	ns	ns	ns	99
H0488	N GILES BAY	0	8	11	0
H1478	E COCKBURN BAY				9
H0134	E CAPE COCKBURN RK	19	95	56	51
H0135	W QUARRY BAY RF	0	0	0	0
H0205	MERMAID PT	0	0	2	0
H0249	S DICK ISL	78	68	65	11
H0472	NELSON ROCK	0	0	9	4
H1488	N MOUAT ISL				71
H0131	W HODGSON ISLS	95	59	99	37
H0109	MOUAT ISLS	165	237	205	90
H0557	NARES ROCK	18	0	0	11
H1486	E KUNECHIN PT				22
H0781	MARTIN ISLAND			4	0
H0248	MW TEXADA ISL	8	52	120	49
H1485	KUNECHIN ITS				48
H0784	DAVIE BAY IT			16	18
H0556	S EDGECOMBE ISLAND IT	0	0	7	0
H0448	N WHITESTONE ISLS	15	8	50	28
H0108	SE DAVIE BAY RFS	55	147	150	57
H0487	MSW TEXADA ISL	0	6	0	0
H0244	SE TEXADA ISL	10	24	86	47
H0783	W COOK BAY RKS			32	34
H0107	SW COOK BAY RK	0	0	0	23
H1483	N PARTINGTON PT				10
H0098	FEGAN ITS	291	321	150	155
H0477	SE BOAT COVE RK	18	26	10	0
H0474	PARTINGTON PT	0	58	0	15
H0475	NE LASQUETI ISL RK	0	0	0	0
H0560	S FEGAN ITS	37	283	60	70
H0209	NW JERVIS ISL IT	352	184	150	84
H0245	NE JERVIS ISL	0	152	25	0

Subarea 17 (NEGULF). Panel 6 of 6 panels.

Site Name and Number:		6-8 August 1998	25-28 August 2000	30-31 August 2003	14-16 August 2008
H0782	ANDERSON BAY IT			6	10
H0105	E JERVIS ISL RF	58	80	60	34
H0757	N JEDEDIAH ISL		4	0	22
H0176	N PAUL ISL RK	0	0	0	0
H0352	DERBY PT	0	0	0	1
H0756	TUCKER BAY RK		6	2	0
H0247	FINNERTY ISLS	70	172	60	55
H0562	E JEDEDIAH ISLAND	30	20	0	0
H0183	SE JEDDAH PT RKS	3	4	62	32
H0486	SW TEXADA ISL	6	7	0	0
H0755	N UPWOOD PT		15	22	0
H0405	BOHO ISL	0	0	0	0
H0333	W JEDEDIAH ISL RF	0	0	ns	0
H0476	E JEDEDIAH ISL RK	0	0	0	0
H0561	S BOHO BAY IT	0	9	ns	13
H0512	S JEDEDIAH ISLAND	0	0	0	0
H1482	SW UPWOOD PT				8
H0251	SISTERS ITS	258	320	160	241
H0555	EGERTON ROCK	0	0	0	0
H0106	SHEER ISL	103	19	54	22
H0779	E THORMANBY ISL RK		0	10	12
H0130	MW SOUTH THORMANBY ISL	21	0	106	0
H0513	SE BULL ISLAND RF	0	0	60	27
H0511	S BULL ISLAND IT	0	0	0	4
H0510	S RABBIT ISLAND	0	0	20	0
H0355	HEATH IT	0	0	0	0
H0215	ME SOUTH THORMANBY ISL	19	4	35	0
H0479	SW LASQUETI ISL	0	27	16	3
H0129	SW SOUTH THORMANBY ISL	97	0	30	27
H0447	S SOUTH THORMANBY ISL RF	0	20	27	36
H0160	MERRY ISL	72	61	260	89
H0325	PIRATE ROCK	52	0	18	0
H0406	E LASQUETI RK	47	49	25	0
H0351	BERTHA ISL	0	53	85	5
H0096	BOAT COVE RFS	0	0	7	28
H0136	W TRAIL ISLS	126	81	115	17
H0154	M TRAIL ISLS	24	2	20	28
H0514	E TRAIL ISLANDS	0	16	0	0
H0097	SEA EGG ROCKS	126	208	180	214
H0485	SE LASQUETI ISL	0	8	0	2
H0509	SW JENKINS ISLAND	28	10	70	91
H0478	E JENKINS ISL RK	46	160	80	115
H0246	E YOUNG PT RK	0	39	25	39
H0328	SEAL REEF	196	127	160	ns
H0095	SANGSTER ISL	191	333	180	277
H0153	WHITE ITS	119	208	101	102
H1477	NW CHASTER				290
Total number counted		**5,709**	**6,596**	**6,244**	**7,610**
Correction for unborn pups		**1.0670**	**1.0086**	**1.0430**	**1.0307**
Proportion of area covered		**0.9812**	**0.8915**	**0.8902**	**0.9544**
Adjusted count		**6208.3**	**7461.6**	**7316.0**	**8218.4**
Estimated proportion hauled out		**0.656**	**0.643**	**0.624**	**0.635**
Correction for missed animals		**1.524**	**1.555**	**1.603**	**1.575**
Estimated abundance		**9,463**	**11,604**	**11,724**	**12,942**

Subarea 21 (SWVANISL). Panel 1 of 1 panels.

Site Name and Number:		12-25 August 1976	29 August 1987	04 August 2007
H1314	W KEEHA BAY	-	-	7
H0278	S DEADMAN COVE RK	-	35	31
H1312	NE CLUTUS PT	-	-	8
H1313	E KEEHA BAY	-	-	28
H0192	SEABIRD ROCKS	29	133	152
H1311	E SEABIRD RKS	-	-	14
H1310	E PACHENA PT B	-	-	4
H0277	E PACHENA PT A	-	23	26
H1309	W KLANAWA R	-	-	3
H1308	SE TSUSIAT R	-	-	23
H0276	W TSUQUANAH PT	-	12	16
H1307	CLO-OOSE	-	-	11
H0207	W DARE PT RF	1	11	28
H1306	SE CHEEWHAT R	-	-	10
H1305	NW CARMANAH PT	-	-	9
H1304	CARMANAH PT	-	-	4
H1303	NW BONILLA PT	-	-	66
H0194	SE BONILLA PT	40	107	50
H0380	E CULLITE CRK	-	-	32
H0275	OWEN PT	-	34	131
H1302	HAMMOND RKS	-	-	15
H0193	N SOMBRIO PT	4	46	17
H0274	E SAN SIMON PT RF	-	2	0
H1301	E SHERINGHAM PT	-	-	17
H0208	SOOKE HRBR	2	1	9
H0273	MUIR PT	-	2	11
H0211	OTTER PT	1	0	1
H1449	O'BRIEN PT	-	-	22
H1448	HOSKYN PT	-	-	15
H1447	JOHN PARKER ISLS	-	-	19
H0272	SW FRAZER ISL RK	-	30	7
H0271	SOUTH BEDFORD ISL	-	8	17
H1446	LITTLE CHURCH ISL	-	-	36
Total number counted		**77**	**444**	**839**
Correction for unborn pups		**1.0111**	**1.0056**	**1.0774**
Proportion of area covered		**1.0000**	**1.0000**	**1.0000**
Adjusted count		**77.9**	**446.5**	**903.9**
Estimated proportion hauled out		**0.615**	**0.615**	**0.615**
Correction for missed animals		**1.626**	**1.626**	**1.626**
Estimated abundance		**127**	**726**	**1,470**
Abundance adjusted to 2008		**-**	**-**	**1,518**

Subarea 22 (BARKLYSD). Panel 1 of 1 panels.

Site Name and Number:		25 August 1976	28-29 August 1987	03-04 August 2007
H1328	SE DALLER PT	-	-	25
H1337	SHEARS ISLS	-	-	6
H1334	NW ALLEN PT	-	-	37
H0260	MILHUS ROCK	-	18	92
H1336	GEORGE IT	-	-	25
H1335	RUTLEY ISLS	-	-	9
H1329	BOYSON ISLS	-	-	23
H1338	N DAVID ISL	-	-	40
H0259	NE LINK ISL RK	-	6	0
H0270	NE BRYANT ISLS	-	16	13
H0189	BAERIA ROCKS	15	19	2
H0383	STUD ISLETS	-	-	5
H1322	PAGER ISL	-	-	41
H0258	MEADE ITS	-	58	21
H0382	GEER ITS	-	-	26
H1320	PINDER ROCK	-	-	7
H1321	HANKIN ISL	-	-	2
H1339	FOOD ITS	-	-	31
H1323	SW DODD ISL REEF	-	-	7
H1327	HOSIE ISLS	-	-	36
H1326	JAN JOSE ITS	-	-	14
H0266	NW ELBOW IT RKS	-	18	55
H1315	SE GEORGE FRASER RFS	-	-	76
H1319	W NANTES REEF	-	-	11
H1316	ALLEY ROCK	-	-	3
H1324	SE WIEBE ISL	-	-	20
H0265	FABER ITS	-	4	44
H0268	GREAT BEAR ROCK	-	72	58
H1317	N BENSON ISL	-	-	11
H0269	STARLIGHT REEF	-	89	54
H1318	VERBEKE RF	-	-	1
H0191	NW WOUWER ISL RFS	13	0	0
H1330	S SANDFORD ISL RF	-	-	5
H0261	WIZARD IT	-	13	29
H1325	SW HOWELL ISL	-	-	10
H1333	OHIAT IT	-	-	17
H0190	S HOWELL ISL	5	8	4
H0267	SE CREE ISL	-	47	0
H1332	NW EDWARD KING ISL	-	-	6
H0263	N LEACH IT RK	-	21	0
H0264	N FOLGER ISL	-	19	3
H1331	TAYLOR IT	-	-	6
H0262	BORDELAIS ITS	-	41	15
H0279	NW CAPE BEALE RK	-	9	22
Total number counted		**33**	**458**	**912**
Correction for unborn pups		**1.0087**	**1.0066**	**1.0823**
Proportion of area covered		**1.0000**	**1.0000**	**1.0000**
Adjusted count		**33.3**	**461.0**	**987.1**
Estimated proportion hauled out		**0.615**	**0.615**	**0.615**
Correction for missed animals		**1.626**	**1.626**	**1.626**
Estimated abundance		**54**	**750**	**1,605**
Abundance adjusted to 2008		**-**	**-**	**1,658**

Subarea 23 (MWVANISL). Panel 1 of 1 panels.

Site Name and Number:		26-27 July 1994	01-18 Aug 2007
H1383	TLUPANA ESTUARY	ns	1
H1382	W ATREVIDA PT	ns	2
H1379	S VILLAVERDE ISLS REEFS	ns	1
H1377	SW BLIGH ISL REEF	ns	2
H1381	E GORE ISL	ns	2
H1376	E VERNACI ISL REEF	ns	47
H1378	S BLIGH ISL REEF	ns	1
H1380	MOOYAH BAY	ns	2
H1501	W BAJO PT	ns	40
H1375	SW CLOTCHMAN ISL REEF	ns	8
H1500	SE BAJO PT	ns	74
H1499	NW MAQUINNA PT REEFS	ns	28
H1374	N ESCALANTE RCKS	ns	10
H1373	ESCALANTE ROCKS	ns	105
H1372	SPLIT CAPE REEFS	ns	18
H1371	NORTH PEREZ RKS	ns	55
H1366	W OBSTRUCTION ISL	-	8
H1367	SULPHUR PASSAGE REEFS	-	1
H1370	SOUTH PEREZ RKS	ns	96
H1368	SW HESQUIAT PT REEF	ns	107
H1369	ESTEVAN PT	ns	75
H1360	MILLER CHANNEL ISLS	-	1
H0659	W FLORES ISL REEFS	14	40
H1365	NW WHITEPINE BAY REEFS	-	8
H0658	N RAFAEL PT REEF	33	38
H0657	SE SIWISH COVE REEF	31	0
H1359	SW KUTCOUS PT REEFS	-	5
H1358	GARRARD GROUP	-	1
H0644	MALTBY ITS	23	2
H0655	TIBBS IT	13	31
H0656	W BARTLETT ISL REEFS	21	13
H0643	BLACKBERRY ITS	3	0
H0650	SE HANSEN ISL REEF	51	0
H0651	N LAGOON ISL REEF	15	2
H0646	S CORNING PT REEF	4	0
H0642	DARK ISL	51	2
H0647	W MCCAW PENINSULA REEF	43	58
H0648	RANKIN RKS	42	63
H1363	SW MCCAW PENINSULA REEF	-	13
H1362	SE MCCAW PENINSULA REEFS	-	10
H0654	S CLELAND ISL	40	38
H0653	LACROIX GROUP	42	45
H0649	GUNNER INLET REEF	36	18
H1364	RIDOUT ITS	-	6
H0652	NW WILF RK REEF	7	41
H0645	BROWNING PASS REEF	9	37
H0641	SW LENNARD ISL REEF	38	51
H1361	GRICE BAY	-	6
H1357	GOWLLAND ROCKS	ns	93
H1356	BOX ISL REEFS	ns	9
H1355	WICKANINNISH BAY REEFS	ns	6
H1354	N QUITIS PT REEFS	ns	10
H1351	FLORENCIA BAY REEFS	ns	4
H1353	QUISITIS PT	ns	24
H1352	FLORENCIA IT	ns	8
H1350	S WYA PT	ns	13
H1349	S UCLUTH PENINSULA REEFS	ns	3
Total number counted		**516**	**1,382**
Correction for unborn pups		**1.1385**	**1.0584**
Proportion of area covered		**1.0000**	**1.0000**
Adjusted count		**587.5**	**1462.7**
Estimated proportion hauled out		**0.615**	**0.615**
Correction for missed animals		**1.626**	**1.626**
Estimated abundance		**955**	**2,378**
Abundance adjusted to 2008		**-**	**2,457**

Subarea 24 (NMWVANISL). Panel 1 of 1 panels.

Site Name and Number:		19-20 August 1993	13-15 August 1995	16 Aug 01 Sep 2007
H1386	KASHUTL ESTUARY	-	ns	8
H0582	NW TASHISH INLET REEF	8	ns	16
H1390	MALKSOPE INLET ISLS	ns	-	39
H0661	SW JACKOBSON PT REEF	ns	2	0
H1385	EXPEDITION ITS	-	ns	8
H1391	SW ACOUS PENINSULA	ns	-	26
H0660	SE O'LEARY ITS REEF	ns	25	1
H0662	W CLERKE PT REEF	ns	7	36
H1387	CHAMISS BAY	-	ns	1
H0416	GULL IT	62	31	105
H0583	WARREN RK	4	ns	9
H0638	S CLARA IT REEF	16	0	8
H0639	E THOMAS ISL REEF	1	4	0
H0640	COLE RK	18	17	47
H0587	NW LOOKOUT ISL ISLET	36	14	34
H1388	MINX ROCKS	-	-	41
H1389	BARRIER ISLS	-	-	3
H0586	SW SPRING ISL REEF	3	4	0
H0584	N MOOS IT	16	ns	52
H0637	THORNTON ISLS	9	ns	0
H0585	MUNSIE RKS	45	ns	136
H1384	EAST ENTRANCE REEF	-	ns	22
H0636	GRASSY ISLS	179	ns	179
H0635	MCQUARRIE ITS	130	ns	245
H0634	TATCHU RKS	18	ns	40
H0633	JURASSIC PT REEF	62	ns	0
H1347	FAIRWAY ISL	-	-	29
H0632	HIGH RKS	139	ns	284
H1348	DOUBLE ISL	-	-	30
H1340	GARDEN PT REEFS	-	-	19
H0631	SW CATALA ISL ISLET	3	0	0
H0630	W TWIN ISL REEF	3	1	1
H1346	S ROSA ISL REEFS	-	-	41
H1345	COLWOOD ROCKS	-	-	23
H1343	S LORD ISL REEFS	-	-	7
H1344	FITZ ISL	-	-	54
H1342	SW FLORENCE PT REEFS	-	-	27
H0629	NE FERRER PT REEF	2	0	0
H1341	TONGUE PT REEFS	-	-	2
Total number counted		**753**	**105**	**1,573**
Correction for unborn pups		**1.0173**	**1.0358**	**1.0167**
Proportion of area covered		**0.9380**	**0.3943**	**1.0000**
Adjusted count		**816.6**	**275.8**	**1599.2**
Estimated proportion hauled out		**0.615**	**0.615**	**0.615**
Correction for missed animals		**1.626**	**1.626**	**1.626**
Estimated abundance		**1,328**	**449**	**2,600**
Abundance adjusted to 2008		**-**	**-**	**2,686**

Subarea 25 (NWVANISL). Panel 1 of 1 panels.

Site Name and Number:		15 August 1995	3 August 1996
H0685	W SHUTTLEWORTH BIGHT RF	ns	16
H0681	NE LANZ ISL	ns	11
H0680	W LANZ ISL	ns	36
H0683	N COX ISL	ns	19
H0682	NW COX ISL	ns	3
H0684	NE COX ISL	ns	11
H0679	SW COX ISL	ns	5
H0678	WINIFRED ISL	ns	45
H0677	SAN JOSEPH BAY REEF	ns	12
H0676	NW CAPE PALMERSTON	ns	7
H0673	STRAGGLING ISLS	ns	45
H0675	SE TOPKNOT PT REEF	ns	15
H0688	FARMER ITS	6	11
H0672	KULTUS COVE REEFS	15	31
H0686	PINNACLE ISL	ns	13
H0687	N GILLAM ISLS	36	ns
H0674	NW CAPE PARKINS REEF	ns	32
H0670	S GILLAM ISLS	38	ns
H0669	NE ROWLEY RFS	34	ns
H0668	RESTLESS BIGHT REEF	15	ns
H0667	S KWAKIUTL PT REEF	131	ns
H0666	LAWN PT	24	ns
H0665	RUGGED ISLS	12	ns
H1393	S MCDOUGAL ISL REEF	-	ns
H0664	CLERKE RFS	12	ns
H1392	GUILLIAMS ISL	-	ns
H0663	NE CAPE COOK REEF	9	ns
Total number counted		**332**	**312**
Correction for unborn pups		**1.0297**	**1.0830**
Proportion of area covered		**1.0000**	**1.0000**
Adjusted count		**341.9**	**337.9**
Estimated proportion hauled out		**0.615**	**0.615**
Correction for missed animals		**1.626**	**1.626**
Estimated abundance		**556**	**549**
Abundance adjusted to 2008		**1,693**	

Subarea 31 (SWQCSTR). Panel 1 of 1 panels.

Site Name and Number:		29 August 1988	23-24 July 1989
H0404	TREE ITS	24	40
H0700	ASHBY/SECRETARY PTS	-	8
H0707	BUCKLE GRP	-	5
H0400	RAGGED ROCK	20	0
H0701	PLOVER/RASON ISLS	-	18
H0395	NICHOLAS ISLS	112	82
H0214	NE TOMMY PT RF	4	15
H0398	N HEDLEY ISLS RK	23	12
H0702	SE MEXICANA PT	-	4
H0397	JANE ROCK	5	2
H0399	SE HEDLEY ISLS RK	7	0
H0396	SUSSEX REEFS	43	41
H0401	N MCLEOD ISL	17	3
H0692	E DESERTERS ISL	-	10
H0391	CARDIGAN ROCKS	11	2
H0403	S WISHART ISL RK	20	8
H0402	S ECHO ISLS RF	19	3
H0691	NW CASTLE PT	-	3
H0393	N HUSSAR PT RF	12	0
H0394	S LOQUILLILLA COVE RK	1	8
H0390	W BALAKLAVA ISL RKS	2	0
H0699	BOYLE ISL	-	13
H0392	JEROME ISL	4	0
H0389	S DUNCAN ISL	27	0
H0388	ROUND ISL	30	5
H0671	NW DEER ISL ROCKS	-	34
H0387	N FALSE HD	11	65
H0386	SINGLE TREE PT RFS	67	75
H0741	SE MALCOLM ISL	ns	2
H0708	SE PEARSE ISL REEFS	ns	3
H0709	NW STEPHENSON ITS	ns	3
H0711	SE STEPHENSON ITS	ns	7
H0710	NW WEYNTON ISL REEF	ns	22
H0407	NIMPKISH BANK	ns	17
Total number counted		**459**	**510**
Correction for unborn pups		**1.005**	**1.1543**
Proportion of area covered		**0.8941**	**1.0000**
Adjusted count		**515.9**	**588.7**
Estimated proportion hauled out		**0.615**	**0.615**
Correction for missed animals		**1.626**	**1.626**
Estimated abundance		**839**	**957**
Abundance adjusted to 2008		**-**	**1,957**

Subarea 32 (NEQCSTR). Panel 1 of 1 panels.

Site Name and Number:		21-23 July 1989	05 July 2004
H0892	BREMNER IT	ns	51
H0890	S E FOX ILS REEF	ns	22
H0889	S W FOX ISL REEF	ns	13
H0891	DALKEITH PT	ns	7
H0887	SKULL COVE ISL	ns	6
H0888	MAYOR ISL	ns	88
H0886	E DELORAINE ISLS	ns	14
H0885	W DELORAINE ISLS	ns	16
H0883	FREDERICK ITS	ns	16
H0706	W STORM ISLS	30	10
H0882	EMILY GROUP	ns	11
H0703	NAIAD ITS	24	10
H0705	SE STORM ILS	15	34
H0704	REID ITS	12	0
H0884	ELIZABETH RKS	ns	31
H0881	ROGERS ISLS	ns	30
H0879	N SOUTHGATE ISL	ns	33
H0880	HARRIS ISL	ns	3
H0878	SIMPSON RK	ns	1
H0873	N JEANNETTE ISLS	ns	9
H0872	E JEANNETTE ISLS	ns	5
H0876	NW MILLER GROUP	-	110
H0690	M MILLER GROUP	50	ns
H0875	S MILLER GROUP	-	22
H0877	SE MILLER GROUP	-	10
H0693	SNELL IT	25	39
H0689	MARY RK	11	2
H0871	S BROWNING ISLS	-	5
H0694	NW RAYNOR GROUP	35	0
H0695	S RAYNOR GROUP	46	129
H0861	SW DICKSON ISL ITS	ns	16
H0866	OMMANEY IT	ns	4
H0860	N DREW IT	ns	9
H0868	LEWIS RKS	ns	28
H0867	SW BOYLES PT REEFS	ns	3
H0862	N POLKINGHORNE ISLS	ns	26
H0863	BRIG RK	ns	36
H0865	FANTOME PT REEF	ns	1
H0864	S POLKINGHORNE ISL REEF	ns	9
H0698	W NUMAS ISL	41	5
H0697	N NUMAS ISL	9	0
H0696	SE NUMAS ISL	9	2
Total number counted		**307**	**866**
Correction for unborn pups		**1.1582**	**1.2285**
Proportion of area covered		**0.4075**	**0.9336**
Adjusted count		**872.5**	**1139.5**
Estimated proportion hauled out		**0.615**	**0.615**
Correction for missed animals		**1.626**	**1.626**
Estimated abundance		**1,419**	**1,853**
Abundance adjusted to 2008		**-**	**2,128**

Subarea 33 (BROUGHT). Panel 1 of 1 panels.

Site Name and Number:		24 July 1989	02-04 August 1996	14-31 August 2003	04-05 July 2004
H0858	WALKER IT	ns	ns	ns	15
H0854	PYM RKS	ns	ns	ns	28
H0859	GORE RK	ns	ns	ns	2
H0853	STEEP IT	ns	ns	ns	26
H0857	TRAINER PASSAGE ISLS	ns	ns	ns	2
H0726	HOLFORD ITS	29	91	ns	42
H0722	FOX GRP	27	31	ns	0
H0739	SOLITARY IT	-	17	ns	0
H0740	HUSTON IT	-	6	ns	17
H0856	LISKA IT	-	-	ns	7
H0725	COACH ITS	9	43	ns	59
H0852	N RETREAT PASSAGE REEF	-	-	ns	26
H0855	SW HUDSON ISL	-	-	ns	4
H0716	FOSTER ISL	76	89	ns	122
H0724	FOG ITS	56	0	0	28
H0723	TRAP RK	11	8	0	2
H0736	N LEDGE RK	-	8	45	53
H0385	PENFOLD IT	4	46	75	56
H0735	SW SEDGE ISLS	-	20	17	2
H0737	S SEABREEZE ISL	-	6	3	19
H0731	GREEN RK	-	6	20	38
H0719	CANOE ITS	26	8	15	21
H0718	W CEDAR ISL ISLETS	5	0	0	1
H0738	NE MIDSUMMER ISL REEFS	-	1	0	9
H0717	FIRE ISL	2	3	4	8
H0733	WHITE CLIFF ITS	-	28	20	100
H0848	SPRING PASSAGE REEF		-	3	0
H0721	RIDGE RKS	66	6	30	ns
H0734	WHALE RK	-	3	0	0
H0732	PASSAGE IT	-	23	8	0
H0720	S RIDGE ITS	10	36	8	0
H0384	SURGE ISLS	25	0	40	0
H0713	PERING ITS	4	9	24	15
H0847	CHICK RF	-	-	5	16
H0714	N TWIST ISL	28	0		0
H0715	PUZZLE/MIST ISLS	25	0	0	0
H0712	NW ALDER ISL REEF	2	0	0	ns
H0829	SE TURNOUR ISL REEFS	ns	-	3	ns
H0728	NEGRO RK	ns	33	31	ns
H0727	E MOUND ISL REEF	-	2	0	ns
H0730	NW PARSON ISL REEF	ns	30	8	ns
H0729	BELL RKS	ns	45	63	ns
Total number counted		**405**	**598**	**422**	**718**
Correction for unborn pups		**1.1435**	**1.0865**	**1.010**	**1.2309**
Proportion of area covered		**0.7361**	**0.8983**	**0.5827**	**0.8561**
Adjusted count		**629.2**	**723.3**	**731.7**	**1032.3**
Estimated proportion hauled out		**0.615**	**0.615**	**0.615**	**0.615**
Correction for missed animals		**1.626**	**1.626**	**1.626**	**1.626**
Estimated abundance		**1,023**	**1,176**	**1,190**	**1,678**
Abundance adjusted to 2008		**-**	**-**	**1,420**	**1,927**

Subarea 41 (DISCOVPASS). Panel 1 of 1.

Site Name and Number:		12-31 August 2003
H0800	FRASER BAY REEF	26
H0799	PAN PT REEF	50
H0849	LORD IT	35
H0826	HEAD CALL INLET ROCKS	67
H0825	NE SQUIRE PT REEF	33
H0827	BOWER ISLS	18
H0801	SW COSBY PT REEF	63
H0804	TERMAGANT PT ROCKS	10
H0802	POYNTZ ISL	24
H0803	SEYMOUR ISL	88
H0824	MILLY ISL	2
H0805	FANNY ISL	16
H0791	N LYALL ISL	23
H0792	S LYALL ISL	155
H0806	ARTILLERY ITS	27
H0785	EDSALL ITS	66
H0790	ROWLAND ISL	9
H0811	E LITTLE DENT ISL	23
H0810	E DENT ISL	244
H0808	SW HELMCKEN ISL	6
H0807	NE HELMCKEN ISL	272
H0812	GILLARD ISLS	217
H0809	SE CAMP PT IT	10
H0789	W WALKEM ISL	47
H0786	SE WALKEM ISL A	43
H0788	S WALEM ISL	22
H0787	SE WALKEM ISL B	29
H0814	W WALTERS PT REEF	18
H0813	SW GRANT ISL REEF	73
H0815	RONDEZVOUS ISLS	15
H0798	NW STURT ISL	63
H0819	NW FREDERIC PT REEF	107
H0818	SW PENN ISLS A	3
H0816	E PENN ISLS	32
H0817	SW PENN ISLS B	107
H0820	BURDWOOD BAY REEF	18
H0494	HOSKYN RK	75
H0850	NE MARY PT ISL A	11
H0838	NE MARY PT ISL B	8
Total number counted		**2,155**
Correction for unborn pups		**1.0361**
Proportion of area covered		**1.0000**
Adjusted count		**2232.9**
Estimated proportion hauled out		**0.615**
Correction for missed animals		**1.626**
Estimated abundance		**3,631**
Abundance adjusted to 2008		**4,334**

Subarea 51 (DFO Area 07). Panel 1 of 1 panels.

Site Name and Number:		09 July 2004	23-28 June 2005	30 June 2006
H1189	THOMAS IT	ns	40	ns
H1192	SW MATHIESON PT A	ns	20	ns
H1191	SW MATHIESON PT B	ns	4	ns
H1176	N RODERICK ISL	ns	18	ns
H1190	SW MATHIESON PT C	ns	8	ns
H1177	E RODERICK ISL	ns	12	ns
H1197	SE SPLIT HEAD	ns	49	ns
H1198	SE SPLIT HEAD	ns	26	ns
H1178	GRIFFIN PASSAGE	ns	96	ns
H1179	MIALL IT	ns	54	ns
H1174	DODD ITS	ns	117	ns
H1167	HIGGONS LAGOON	ns	15	ns
H1152	S ELLERSLIE BAY REEF	ns	23	ns
H1186	DE FREITAS ISLS A	ns	74	ns
H1187	DE FREITAS ISLS B	ns	22	ns
H1188	DE FREITAS ISLS C	ns	93	ns
H1172	S ARTHUR ISL	ns	7	ns
H1193	PIDWELL RF	ns	121	ns
H1151	W COLDWELL PENINSULA	ns	80	ns
H1185	NO NAME C	ns	1	ns
H1184	NO NAME B	ns	3	ns
H1183	NO NAME A	ns	19	ns
H1168	E PRICE ISL	ns	1	ns
H1171	NE FACTOR ITS	ns	17	ns
H1170	SW FACTOR ITS	ns	38	ns
H1173	SW JERMAINE PT	ns	3	ns
H1155	DON PENINSULA INLET C	ns	3	ns
H1429	EMILY BAY REEFS	ns	ns	75
H1181	GAUDIN ISL B	ns	43	ns
H1153	DON PENINSULA INLET A	ns	40	ns
H1180	GAUDIN ISL A	ns	60	ns
H1182	GAUDIN ISL C	ns	29	ns
H1154	DON PENINSULA INLET B	ns	12	ns
H1162	N OKE IT	ns	36	ns
H1161	OKE IT	ns	86	ns
H1427	ROSCOE RK	ns	ns	8
H1428	ROCHESTER ISL	ns	ns	50
H1163	CROSS LEDGE	ns	40	ns
H1149	YEO COVE REEF A	ns	8	ns
H1150	YEO COVE REEF B	ns	8	ns
H1160	RANKIN PT	ns	15	ns
H1169	MUIR COVE REEFS	ns	20	ns
H1165	N MCINNES ISL REEFS	ns	5	ns
H1146	S LORNE IT	ns	27	ns
H1159	W BRANKS IT	ns	29	ns
H1133	N TROUP PASSAGE REEF A	ns	22	ns
H1134	N TROUP PASSAGE REEF B	ns	11	ns
H1157	IMAGE ISL	ns	29	ns
H1145	MOREHOUSE BAY REEFS	ns	6	ns
H1158	WOOTTON IT	ns	45	ns
H1156	FOOTE ITS	ns	20	ns
H1164	SE MCINNES ISL REEFS	ns	34	ns
H1144	BEAK ISL	ns	19	ns
H1143	W BEASLEY ISL	ns	25	ns
H1132	E TROUP PASSAGE INLET REE	ns	15	ns
H1131	RUDGE RK	ns	47	ns
H1128	RITHET ISL	ns	53	ns
H1127	NORMAN MORRISON BAY REE	ns	2	ns
H1142	E ATHLONE ISL INLET	ns	12	ns

Subarea 51 (DFO Area 07) Continued. Panel 1 of 1 panels.

Site Name and Number:		09 July 2004	23-28 June 2005	30 June 2006
H1140	E ATHLONE ISL INLET	ns	11	ns
H1130	BLOW RF	ns	5	ns
H1147	LEILA ISL	ns	8	ns
H1129	W ANTHONY PT REEF	ns	7	ns
H1136	QUINOOT PT	ns	8	ns
H1135	S CUNDALL BAY REEFS	ns	39	ns
H1141	NW GODFREY RK	ns	29	ns
H1137	BODDY NARROWS ISL	ns	15	ns
H1148	ALARM COVE REEFS	ns	5	ns
H1126	PETER BAY REEFS	ns	13	ns
H1138	E TUFT ISLS	ns	7	ns
H0944	HARBOURMASTER PT	5	ns	ns
H1139	MCMULLIN GROUP	ns	10	ns
H1125	PULLEN ISL	ns	40	ns
H1123	SW IROQUOIS ISL REEFS	ns	15	ns
H1124	NW DODWELL ISL REEFS	ns	1	ns
H1117	NE SIMONDS GROUP A	ns	34	ns
H1118	NE SIMONDS GROUP B	ns	18	ns
H0962	W HART GROUP	15	ns	ns
H0961	S HART GROUP	1	ns	ns
H1122	W GOOSE ISL	ns	61	ns
H1115	SE SIMONDS GROUP A	ns	15	ns
H1116	SE SIMONDS GROUP B	ns	32	ns
H0960	KILDIDT NARROWS REEF	15	ns	ns
H0963	STEWART INLET REEFS	4	ns	ns
H1121	NE GOSLING RKS	ns	29	ns
H1119	NW GOSLING RKS	ns	6	ns
H1120	CURRIE IT	ns	2	ns
H0964	SE HURRICANE ISL REEF	6	ns	ns
H0965	N MOSQUITO ITS	42	ns	ns
H0966	S MOSQUITO ITS	33	ns	ns
H1113	SW EDNA ISLS	ns	27	ns
H1114	E TRIQUET ISL REEFS	ns	6	ns
H1112	S SERPENT GROUP	ns	10	ns
H1109	SW STIRLING ISL C	ns	2	ns
H0959	SW STIRLING ISL B	37	ns	ns
H0958	SW STIRLING ISL A	9	ns	ns
H1108	S STIRLING ISL	ns	26	ns
Total number counted		**167**	**2,243**	**133**
Correction for unborn pups		**1.009**	**1.0403**	**1.0268**
Proportion of area covered		**1.0000**	**1.0000**	**1.0000**
Adjusted count		**168.5**	**2333.4**	**136.6**
Estimated proportion hauled out		**0.615**	**0.615**	**0.615**
Correction for missed animals		**1.626**	**1.626**	**1.626**
Estimated abundance		**274**	**3,794**	**222**
Abundance adjusted to 2008		**293**	**4,194**	**237**

Subarea 52 (DFO Area 08). Panel 1 of 1 panels.

Site Name and Number:		08-09 July 2004	23 June 2005	30 June 2006
H1401	HEAD DEAN CHANNEL A	ns	ns	1
H1402	HEAD DEAN CHANNEL B	ns	ns	1
H1400	S ENGERBRIGHTSON PT	ns	ns	1
H1396	N CASCADE INLET	ns	ns	3
H1399	NASCALL ISL	ns	ns	4
H1398	NASCALL RKS	ns	ns	218
H1397	S CASCADE INLET	ns	ns	32
H1406	E BACHELOR BAY	ns	ns	1
H1407	BACHELOR BAY	ns	ns	1
H1408	BIG BAY	ns	ns	0
H1403	CROYDEN BAY	ns	ns	40
H1498	JACOBSEN BAY	ns	ns	11
H1422	SW LABOUCHERE PT	ns	ns	3
H1417	ODEGAARD RKS	ns	ns	81
H1395	MARK RK	ns	ns	43
H1421	KWATNA RKS	ns	ns	58
H1420	S KWATNA BAY	ns	ns	51
H1394	S BREND PT	ns	ns	1
H1418	KWATNA INLET A	ns	ns	3
H1405	S BENTINK ARM B	ns	ns	1
H1419	KWATNA INLET B	ns	ns	5
H1426	CODVILLE LAGOON REEFS	ns	ns	18
H1404	S BENTINK ARM A	ns	ns	51
H0945	WHITE TOP RK	16	ns	ns
H1104	N CLAYTON ISL	ns	37	ns
H0946	CLAYTON ISL	18	ns	ns
H1425	FOG RKS	ns	ns	111
H1424	E KISAMEET ISLS	ns	ns	8
H1423	NE KIPLING ISL	ns	ns	9
H1416	NOOTSUM RIVER ESTUARY	ns	ns	65
H1415	FOUGNER BAY REEFS	ns	ns	40
H0948	MUSTANG BAY	8	ns	ns
H0947	TARGET BAY	2	ns	ns
H0953	E NALAU ISL	8	ns	ns
H0955	SE UNDERHILL ISL	13	ns	ns
H0956	S UNDERHILL ISL	10	ns	ns
H0954	E STIRLING ISL REEFS	25	ns	ns
H0949	SE STIRLING ISL	7	ns	ns
H0957	SE STIRLING ISL	5	ns	ns
H1107	N BREAKER GROUP	ns	61	ns
H0952	E BREAKER GROUP	6	ns	ns
H0950	SW BREAKER GROUP	28	ns	ns
H0951	S BREAKER GROUP	38	ns	ns
H1414	KWAKUME INLET REEF	ns	ns	3
H0936	FOSTER RKS	15	ns	ns
H0935	SW STARFISH ISL	28	ns	ns
H0933	W LOWER ISL	5	ns	ns
H0934	S LOWER ISL	4	ns	ns
H0932	NW CALVERT ISL	2	ns	ns
H0937	PRUTH BAY REEFS	9	ns	ns
H0931	N DUBLIN PT B	14	ns	ns
H0930	N DUBLIN PT A	7	ns	ns
H0928	CARRINGTON RF	51	ns	ns
H0929	SE BLAKNEY ISL	31	ns	ns
H0927	N HERBERT PT	42	ns	ns
Total number counted		**392**	**98**	**864**
Correction for unborn pups		**1.0096**	**1.052**	**1.0312**
Proportion of area covered		**1.0000**	**1.0000**	**1.0000**
Adjusted count		**395.8**	**103.1**	**891.0**
Estimated proportion hauled out		**0.615**	**0.615**	**0.615**
Correction for missed animals		**1.626**	**1.626**	**1.626**
Estimated abundance		**644**	**168**	**1,449**
Abundance adjusted to 2008		**739**	**185**	**1,548**

Subarea 53 (DFO Area 09). Panel 1 of 1.

Site Name and Number:		17 Sept 2000	06-07 June 2004	29 June 2006
H0919	W EBERTS COVE	-	1	ns
H0918	PENELOPE PT	-	5	ns
H0920	NELSON NARROWS	-	10	ns
H0775	MOSES INLET	25	ns	ns
H0774	N HARDY INLET	35	4	ns
H0922	S HARDY INLET	-	44	ns
H0776	MOUTH WANNOCK RIVER	40	86	ns
H0943	OWIKEENO LAKE B	ns	38	ns
H0942	OWIKEENO LAKE A	ns	0	ns
H0916	SCANDINAVIA BAY	-	4	ns
H1413	MCCLUSKY BAY REEFS	ns	ns	9
H1411	N GILDERSLEEVE BAY	ns	ns	ns
H1412	S OYSTER BAY	ns	ns	3
H1410	SW BLAIR ISL	ns	ns	17
H0769	W EDNA MATHEWS ISL A	8	ns	ns
H1409	SW BLAIR ISL	ns	ns	6
H0768	W EDNA MATHEWS ISL b	15	ns	ns
H0777	S EDNA MATHEWS ISL	12	92	ns
H0940	NUCLAUS RF	ns	71	ns
H0767	S ETHEL ISL	22	4	ns
H0770	N THE HAYTACK	6	ns	ns
H0766	S GOOD HOPE	2	ns	ns
H0765	FLORENCE ISL	8	ns	ns
H0771	TAYLOR BAY	7	ns	ns
H0773	KLAQUAEK CHANNEL	12	7	ns
H0772	E RIPON ISL	3	ns	ns
H0764	E DRANEY NARROWS	7	ns	ns
H0763	MAJOR BROWN RK	5	ns	ns
H0913	SE DRANEY INLET		46	ns
Total number counted		**207**	**412**	**35**
Correction for unborn pups		**1.000**	**1.011**	**1.030**
Proportion of area covered		**1.0000**	**1.0000**	**1.0000**
Adjusted count		**207.0**	**416.5**	**36.0**
Estimated proportion hauled out		**0.615**	**0.615**	**0.615**
Correction for missed animals		**1.626**	**1.626**	**1.626**
Estimated abundance		**337**	**677**	**59**
Abundance adjusted to 2008		**-**	**778**	**63**

Subarea 54 (DFO Area 10). Panel 1 of 2 panels.

Site Name and Number:		06-08 July 2004
H0926	HERBERT PT	14
H0925	E STRAFFORD PT	46
H0924	CHIC CHIC BAY	5
H0912	FALSE EGG ISL	11
H0906	BURNT ISLAND HARBOUR	8
H0907	FRANK RK	38
H0908	CENTRAL ISL	90
H0909	E CATHCART ISL	3
H0903	N GEAVES ISL	1
H0911	RUBY RKS	26
H0910	N SHOWER ISL	19
H0905	QUACILLA BAY	67
H0902	ANCHOR ITS	35
H0904	AHCLAKERHO ISLS	30
H0901	WATCHER ISL	21
H0899	ARMSTRONG RK	95
H0900	CHEST ISL	10
H0898	HOOP BAY REEF	15
H0897	HOOP RF	41
Total number counted		**575**
Correction for unborn pups		**1.013**
Proportion of area covered		**1.0000**
Adjusted count		**582.4**
Estimated proportion hauled out		**0.615**
Correction for missed animals		**1.626**
Estimated abundance		**947**
Abundance adjusted to 2008		**1,088**

Subarea 62 (DFO Area 03). Panel 1 of 2 panels.

Site Name and Number:		16 July 1999	08 June 2005
H0753	NASS RIVER BAR E	75	ns
H0749	NASS RIVER BAR A	210	ns
H0750	NASS RIVER BAR B	10	ns
H0752	NASS RIVER BAR D	14	ns
H0751	NASS RIVER BAR C	20	ns
H0747	NASOGA GULF REEF	12	ns
H0748	RANGER IT	120	ns
H0991	E GNARLED ISLS	ns	6
H0992	W GNARLED ISLS	ns	60
H0746	SW HOGAN ISL	27	ns
H0990	SE WHITE ITS	ns	7
H0988	N ZAYAS ISL	ns	15
H0987	ARANZAZU PT	ns	12
H0993	NE DUNDAS ISL REEFS	ns	8
H0989	E ZAYAS ISL B	ns	9
H0986	W ZAYAS ISL	ns	17
H0984	E ZAYAS ISL A	ns	24
H0985	SE ZAYAS ISL	ns	14
H0994	GREY IT	ns	21
H0744	HARBOUR REEFS	35	ns
H0995	GREEN ISL	ns	3
H0983	SW DUNDAS ISL	ns	17
H0745	QUOTTOON NARROWS	12	ns
Total number counted		**535**	**213**
Correction for unborn pups		**1.0032**	**1.1374**
Proportion of area covered		**1.0000**	**1.0000**
Adjusted count		**536.7**	**242.3**
Estimated proportion hauled out		**0.615**	**0.615**
Correction for missed animals		**1.626**	**1.626**
Estimated abundance		**873**	**394**
Abundance adjusted to 2008		**1,212**	**435**

Subarea 61 (SKEENAR). Panel 1 of 1 panels.

Site Name and Number:		15 June 1977	16 June 1977	13 June 1983	14 June 1983	14 June 1987	15 June 1987	4 July 1993	11 July 1998	12 July 1998	7-13 June 2005
H0256	W TUGWELL ISL RF	-	-	-	-	-	4	25	5	12	54
H0255	PIKE ISL	-	-	-	-	-	17	8	6	0	0
H0443	STRAITH PT	-	-	-	-	-	-	3	0	24	0
H0967	MIDGE RK	-	-	-	-	-	-	-	-	-	23
H0566	LUCY ISL	ns	ns	ns	ns	ns	ns	ns	149	147	82
H0442	CRIDGE ISL	-	-	-	-	-	-	55	0	31	76
H0151	SOUTH MORSE BASIN ROCK	-	-	-	30	34	53	65	40	44	0
H0441	SNIDER ROCK	-	-	-	-	-	-	11	43	18	0
H0197	N MARTINI ISL RF	-	4	0	0	0	0	3	0	0	5
H0570	SPIRE ISL	-	-	-	-	-	-	-	-	6	0
H0440	S MILLER PT RK	-	-	-	-	-	-	27	0	10	0
H0254	W LIMA PT	-	-	-	-	-	8	0	1	0	1
H0143	E ABERDEEN PT BAR	-	5	28	26	40	36	0	0	0	0
H0144	E WINDSOR PT BAR	0	98	254	233	278	363	158	0	0	55
H0569	SW KWINITSA PT	-	-	-	-	-	-	-	35	69	0
H0567	RACHEL ISLS	ns	ns	ns	ns	ns	ns	ns	43	51	26
H0150	E AYTON ISL BAR	-	-	-	6	0	10	0	0	0	0
H0444	SW KINAHAN ISLS	-	-	-	-	-	-	17	15	27	29
H0145	W AYTON ISL BAR	74	6	9	0	7	0		225	193	121
H0198	E CARNATION ISL BAR	-	22	6	1	1	0	147	0	0	161
H0568	GREENTOP IT	-	-	-	-	-	-	-	7	55	9
H0142	RASPBERRY ISLS	15	42	5	0	13	17	0	0	0	2
H0146	ECSTALL ISL	-	-	30	13	84	92	83	71	129	129
H0149	N MCDONALD CRK BAR	2	0	20	28	13	0	0	0	0	0
H0968	N LAWYER ISLS	-	-	-	-	-	-	-	-	-	1
H0141	ROBERTSON BANKS BAR	4	0	2	8	0	0	2	0	0	0
H0147	W MCDONALD CRK BAR	-	-	5	2	0	0	10	0	0	0
H0140	E DE HORSEY ISL BAR	46	56	6	55	0	60	28	1	0	44
H0138	N GENN ISLS	2	0	0	9	0	0	1	6	6	32
H0137	LITTLE GENN ISL	0	0	0	5	0	0	13	12	0	0
H0139	BASE SAND BAR	139	168	147	255	543	442	315	404	382	721
H0210	ECSTALL RIVER ISL	-	-	2	0	0	42		0	0	0
H0969	TELEGRAPH PASS REEF	-	-	-	-	-	-	-	-	-	18
H0148	ECSTALL SEAL BAR	0	1	49	37	44	15	83	41	37	0
H0572	NW MARRACK ISL	-	-	-	-	-	-	-	-	7	ns
H0257	CECIL PT	-	-	-	-	-	24	134	80	118	ns
H0571	SW BEDFORD ISL	-	-	-	-	-	-	-	-	20	ns
H0195	S LAMB ISL RK	-	15	0	0	0	0	59	0	0	ns
H0196	E GIBSON ISL RK	0	3	0	0	0	0	0	0	0	ns
H1100	SE BUCKLEY PT	-	-	-	-	-	-	-	-	-	8
Total number counted		**282**	**420**	**563**	**708**	**1,057**	**1,183**	**1,247**	**1,184**	**1,386**	**1,597**
Correction for unborn pups		**1.0941**	**1.0882**	**1.1063**	**1.1002**	**1.1002**	**1.0940**	**1.0164**	**1.0064**	**1.0055**	**1.1430**
Proportion of area covered		**0.9100**	**0.9600**	**0.9600**	**1.0000**	**0.9554**	**1.0000**	**1.0000**	**1.1947**	**1.1667**	**1.0788**
Adjusted count		**339.1**	**476.1**	**648.8**	**778.9**	**1217.2**	**1294.2**	**1267.4**	**997.4**	**1194.5**	**1692.0**
Estimated proportion hauled out		**0.615**	**0.615**	**0.615**	**0.615**	**0.615**	**0.615**	**0.615**	**0.615**	**0.615**	**0.615**
Correction for missed animals		**1.626**	**1.626**	**1.626**	**1.626**	**1.626**	**1.626**	**1.626**	**1.626**	**1.626**	**1.626**
Estimated abundance		**551**	**774**	**1,055**	**1,267**	**1,979**	**2,104**	**2,061**	**1,622**	**1,942**	**2,751**
Abundance adjusted to 2008		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3,041**

Subarea 63 (DFO Area 04). Panel 1 of 1 panels.

Site Name and Number:		08-12 June 2005
H0996	NE DUCIE ISL	5
H0997	E RANDALL ISL REEFS	33
H1000	NE DUNDAS ISLS A	49
H1001	NE DUNDAS ISLS B	31
H0975	N DUNIRA ISL A	51
H0999	N DUNIRA ISL B	41
H0998	N MOFFAT ISLS	15
H1002	E MOFFAT ISLS	1
H0979	NE CONNEL ISLS A	12
H0973	SE FARWEST PT	25
H0981	NE CONNEL ISLS C	10
H0980	NE CONNEL ISLS B	21
H0974	SW FARWEST PT B	13
H0972	SW FARWEST PT A	12
H0978	NW CONNEL ISLS	1
H0977	E CONNEL ISLS	13
H0976	N MELVILLE ISL	6
H0971	SIMPSON RK	30
H1003	HAMMER RKS	1
H1004	TRIPLE ISL	51
H1005	S TRIPLE ISL A	47
H1010	S TRIPLE ISL B	15
H1013	N RUSHTON ISL B	5
H1009	N TREE KNOB GROUP A	13
H1012	N RUSHTON ISL A	19
H1011	N TREE KNOB GROUP B	29
H1015	SE RUSHTON ISL A	1
H1014	S RUSHTON ISL	8
H1016	SE RUSHTON ISL B	27
H1008	S TREE KNOB GROUP C	41
H1007	S TREE KNOB GROUP B	21
H1006	S TREE KNOB GROUP A	11
H1017	NE ARCHIBALD ISL	13
H1018	SE AVERY ISL	4
H1025	ROLAND RKS	5
H1022	SKIAKL BAY REEF	6
H1023	S PHILIP ISL REEF	6
H1020	NW SKIAKL ISL	17
H1021	NE SKIAKL PT REEFS	3
H1019	NE PRESCOTT ISL	1
H1026	ALICE ISL	8
H1028	GRACE ISL	5
H1027	NW ISLAND PT	27
H1044	CREAK ISLS	12
H1052	WARRIOR RKS	36
H1041	NW WILLIAM ISL REEFS	14
H1042	S TRUSCOT RK	15
H1039	NW HENRY ISL	32
H1043	SW EDWIN PT REEFS	9
H1040	N FOG ISLS	5
H1053	SEAL ROCKS	97
H1037	S OVAL BAY REEFS A	46
H1038	S OVAL BAY REEFS B	9
H1036	OVAL RK	6
H1035	N FAN PT	3
H1034	FAN ISL	41
Total number counted		**1,078**
Correction for unborn pups		**1.1279**
Proportion of area covered		**1.0000**
Adjusted count		**1215.9**
Estimated proportion hauled out		**0.615**
Correction for missed animals		**1.626**
Estimated abundance		**1,977**
Abundance adjusted to 2008		**2,185**

Subarea 64 (DFO Area 05). Panel 1 of 1 panels.

Site Name and Number:		06-13 June 2005
H1030	N PORCHER INLET	7
H1032	WILCOX GROUP	44
H1033	WINTER RK	40
H1031	S PHOENIX ISL	12
H1101	KUMALEON INLET REEFS	21
H1072	BONWICK PT	20
H1029	SE CHIEF PT REEFS	1
H1047	JOACHIM SPIT	6
H1046	GOSCHEN SPIT	15
H1045	W DOLPHIN ISL REEFS	10
H1049	CONNIS COVE REEFS	21
H1048	FRIDAY ISL	1
H1102	EAST INLET REEFS	51
H1055	NW DEADMAN IT	5
H1054	E WHITE RKS	12
H1056	NE BANKS ISL REEFS	4
H1098	N TANGENT ISL REEFS	33
H1051	STEPHEN RKS	20
H1099	MARKLE ISL	10
H1050	SE SQUALL ISL REEFS	0
H1094	NW COSINE ISL REEF	6
H1070	N NORTHWEST RKS	20
H1093	S COSINE ISL REEF	2
H1069	S NORTHWEST RKS	52
H1092	WRIGHT INLET REEFS	1
H1091	NW WRIGHT NARROWS REEFS	15
H1090	W WRIGHT NARROWS REEFS	7
H1097	NW ANGER ISL REEFS	25
H1096	W ANGER ISL REEFS	42
H1068	SE BONILLA ISL REEFS	2
H1066	S BONILLA ISL REEFS A	22
H1067	S BONILLA ISL REEFS B	2
H1089	S RALSTON ISL A	1
H1095	S RALSTON ISL B	13
H1088	W PITT ISL REEFS	30
H1087	NESBITT RK	31
H1065	SOUTH RKS	1
H1064	NW HALIBUT RKS	2
H1086	LUNDY COVE REEFS	12
H1063	SE HALIBUT RKS A	1
H1062	SE HALIBUT RKS B	61
H1085	SE OAR PT REEFS	13
H1084	SE TWEEDSMUIR PT REEFS	8
H1083	SE ETTERSHANK ISL REEFS	68
H1082	PRINCIPE ITS	5
H1061	SE GRIEF PT REEFS B	7
H1060	SE GRIEF PT REEFS A	5
H1081	N RING PT REEF	34
H1059	SPEARER PT REEFS	15
Total number counted		**836**
Correction for unborn pups		**1.1108**
Proportion of area covered		**1.0000**
Adjusted count		**928.6**
Estimated proportion hauled out		**0.615**
Correction for missed animals		**1.626**
Estimated abundance		**1,510**
Abundance adjusted to 2008		**1,669**

Subarea 65 (DFO Area 06). Panel 1 of 1 panels.

Site Name and Number:		06-13 June 2005
H1433	OCHWE BAY	0
H1436	SE CORNWALL PT	11
H1442	SALIENT PT	6
H1437	BARRIE REACH	11
H1443	NE BARE PT	9
H1435	ENTRANCE KILTUISH INLET RE	18
H1432	GOAT HARBOUR	8
H1074	EDWARD IT	52
H1434	KILTUISH INLET	7
H1073	HALE PT	43
H1076	TUWARTZ INLET REEFS	24
H1075	LEGGEAT PT RKS	12
H1077	WILLMAN PT RKS	17
H1079	N BETTON RKS	19
H1078	S BETTON RKS	5
H1080	CHERRY ITS	21
H1057	SISTERS ISL	22
H1058	TERROR PT REEFS	18
H1431	KHUTZE RIVER ESTUARY	57
H1430	GREEN INLET REEF	2
H1202	RAMBS\OTHAM ISL	44
H1199	N JESSOP ISL	1
H1200	W JESSOP ISL	24
H1201	SW HAGUE PT REEFS	6
H1196	GAUDIN RK	25
H1195	CANN INLET	12
H1194	KITASU BAY REEFS	37
H1166	NW RUDOLF BAY REEFS	48
Total number counted		**559**
Correction for unborn pups		**1.0639**
Proportion of area covered		**1.0000**
Adjusted count		**594.7**
Estimated proportion hauled out		**0.615**
Correction for missed animals		**1.626**
Estimated abundance		**967**
Abundance adjusted to 2008		**1,069**

Subarea 72 (NEQCI). Panel 1 of 1 panels.

Site Name and Number:		23 July 1986	06 July 2008
H0285	ROSE SPIT	381	688
H0280	NE NANKIVELL PT	64	ns
H0281	CAPE NADEN	8	147
H0282	WIAH PT	78	95
H1257	NE CAPE EDENSHAW	-	34
H1256	NE HIDDEN ISL B	-	133
H1249	NE HIDDEN ISL A	-	9
H1258	CAPE EDENSHAW	-	20
H0284	TROUP BANK BAR	90	0
H0283	N STURGESS BAY RF	55	0
H1259	WADSWORTH LEDGE	-	131
H1260	COOK PT	-	23
H0286	SLOOP IT	103	224
H1261	W KWAIKANS ISL	-	37
H0287	E DAWSON ISLS RK	32	152
H1262	GRAY ISL	-	16
H0292	E COWLEY ISLS	61	55
H0288	NW MUTUS ISL RK	13	0
H0289	SE MUTUS ISL RFS	57	129
H1264	W MAKAI PT	-	120
H0291	NW SMYTH ISL	3	56
H1263	NE AWUN BAY	-	23
H1265	S DEASY ISL	-	20
H0290	W SHANNON BAY	14	0
H1266	OHALA ITS	-	3
H1267	N STEILTA ITS	-	51
H1270	E HARRISON ISLS REEF	-	33
H1272	NW MAMIN BAY	-	6
H1271	S HARRISON ISL	-	39
H1268	N MODEETS ISLS REEF	-	10
H0294	SW SEEGAY ITS RF	23	59
H0293	SW MODEETS ISLS	16	46
Total number counted		**998**	**2,359**
Correction for unborn pups		**1.0009**	**1.0133**
Proportion of area covered		**1.0000**	**0.9359**
Adjusted count		**998.8**	**2554.1**
Estimated proportion hauled out		**0.615**	**0.615**
Correction for missed animals		**1.626**	**1.626**
Estimated abundance		**1,624**	**4,153**
Abundance adjusted to 2008		**-**	**4,153**

Subarea 71 (SEQCI). Panel 1 of 1 panels.

Site Name and Number:		22-24 July 1986	1-4 July 1992	30 July 1 Aug 1992	11-13 July 1994	04-08 July 2008
H0417	GILLATT ISL	-	15	ns	ns	20
H1203	DYER PT	ns	ns	ns	ns	2
H1205	S GUST IST REEF	ns	ns	ns	ns	2
H1204	E SANDILANDS ISL REEFS	ns	ns	ns	ns	2
H1206	N DOGFISH BAY REEFS	-	-	ns	ns	1
H0295	NW DUVAL ROCK RKS	12	0	ns	ns	0
H0296	CUMSHEWA ISL	234	27	ns	ns	52
H0297	KINGUI ISL	77	156	ns	ns	144
H0418	CUMSHEWA ROCKS	-	114	ns	ns	36
H0419	S SKEDANS PT RK	-	19	ns	ns	38
H0298	SKEDANS ISLS	15	59	ns	ns	238
H0420	LOW ISL	-	33	ns	ns	33
H0299	SOUTH LOW ISL	48	47	ns	ns	89
H0422	N NELSON PT RF	-	11	ns	ns	7
H0424	SEWELL INLET RF	-	16	ns	ns	6
H0421	E REEF ISL RKS	-	51	ns	ns	87
H0423	SW ALFRED PT RK	-	83	ns	ns	0
H0300	PROCTER ROCKS	13	13	ns	ns	29
H1207	ALFORD PT	-	-	ns	ns	29
H0425	DWIGHT ROCK	-	51	ns	ns	18
H0432	E LOST ISLS	-	0	74	ns	147
H0430	FLOWER POT ISL	-	0	30	ns	83
H1210	TITUL ISL	-	-	-	ns	21
H0302	NOB ROCK	12	32	34	ns	28
H0301	MN TANU ISL RK	35	21	2	ns	49
H0431	W KUNGA ISL RF	-	7	0	ns	2
H0429	S STALKUNGI COVE RF	-	14	0	ns	0
H1209	KELO RKS	-	-	-	ns	12
H1229	W KLUE PT REEF	-	-	-	ns	9
H0433	KUL ROCKS	-	0	23	ns	63
H0303	STANSUNG ITS	35	71	88	ns	20
H1234	SE DODGE PT	-	-	-	ns	18
H1231	E BENT TREE PT	-	-	-	ns	27
H1228	ATLI INLET	-	-	-	ns	36
H1211	TUFT ITS	-	-	-	ns	4
H1233	SHUTTLE RF	-	-	-	ns	2
H0308	N SHUTTLE ISL RF	91	44	19	ns	30
H1235	SE GOGIT PT	-	-	-	ns	19
H0435	TAR ISLS	-	37	62	ns	179
H1232	N HOYA PASSAGE REEF	-	-	-	ns	5
H0428	TOPPING ISLS	-	85	51	ns	122
H1226	NW LYALL BAY REEF	-	-	-	ns	41
H0427	S HOYA PASSAGE RK	-	1	0	ns	0
H0426	S SHUTTLE ISL	-	22	0	ns	0
H1212	KAWAS ISLS	-	-	-	ns	12
H1241	SEDGWICK BAY ISLAND	-	-	-	ns	19
H0434	AGGLOMERATE ISL	-	0	39	ns	36
H1243	BERESFORD INLET REEF	-	-	-	ns	19
H0304	E MURCHISON ISL	33	14	0	ns	14
H1242	SW SEDGWICK PT REEF	-	-	-	ns	6
H1213	SE MURCHISON ISL REEFS	-	-	-	ns	38

Subarea 71 (SEQCI) Continued. Panel 1 of 1 panels.

Site Name and Number:		22-24 July 1986	1-4 July 1992	30 July 1 Aug 1992	11-13 July 1994	04-08 July 2008
H1239	SE KLOO RK	-	-	-	ns	12
H0307	BISCHOF ISLS	14	ns	0	ns	71
H1215	SE ANDREW PT REEFS	-		-	ns	23
H1214	SW ANDREW PT REEFS	-		-	ns	27
H0436	RAMSAY ROCKS	-	22	79	ns	10
H0305	S YADUS PT RF	30	75	0	ns	84
H1225	DE LA BECHE INLET	-	ns	-	ns	10
H0306	TATSUNG ROCK	40	26	261	ns	19
H0437	E DE LA BECHE INLET RK	-	ns	7	ns	6
H0438	HOSKINS ITS	-	ns	16	ns	124
H1230	MARCO ISL	-	ns	-	ns	12
H0309	MARCO ROCK	41	ns	37	ns	19
H1223	MARSHALL INLET REEF	-	ns	-	-	42
H1216	MONUMENT RK	-	ns	-	-	31
H1224	SE ABRAHAM PT	-	ns	-	-	9
H0595	NW HUXLEY ISL REEF	-	ns	-	18	29
H0311	N ALDER ISL RK	4	ns	0	19	10
H0596	E HUXLEY ISL REEF	-	ns	-	3	33
H0597	SAW RF	-	ns	-	62	30
H1217	SCUDDER PT	-	ns	-	-	26
H1222	PARK ISL	-	ns	-	-	3
H0310	SELS IT	69	ns	11	39	30
H0601	N KAT ISL REEF	-	ns	-	14	0
H0598	HOWAY ISL	-	ns	-	53	10
H0439	S SKAAT HRBR RK	-	ns	68	17	26
H1219	NE REBECCA PT REEF	-	ns	-	-	19
H1221	W DOLOMITE PT REEFS	-	ns	-	-	27
H1218	POOLE INLET REEFS	-	ns	-	-	11
H1220	ISLAND BAY REEFS	-	ns	-	-	6
H0312	E EAST COPPER ISL RFS	25	ns	0	69	26
H0605	S SKINCUTTLE ISL REEF	-	ns	-	145	163
H0599	S PELICAN PT REEF	-	ns	-	4	8
H0313	JOYCE ROCKS	67	ns	0	121	36
H0600	E SWAN ISL REEF	-	ns	ns	14	55
H0602	SE GEORGE BAY REEF	-	ns	ns	40	34
H0603	N BOULDER ISL REEF	-	ns	ns	61	24
H0607	E RANKINE ISL	-	ns	ns	32	49
H0604	HUSTON INLET REEF	-	ns	ns	14	21
H0606	SAMUEL RK	-	ns	ns	20	0
H0314	N HANCOCK PT	68	ns	ns	0	0
H1247	Check Waypoint?	-	ns	ns	-	16
H1246	N SOUTH COVE REEFS	-	ns	ns	-	54
H0608	GARCIN RKS	ns	ns	ns	82	0
Total number counted		**963**	**1,166**	**901**	**827**	**3,138**
Correction for unborn pups		**1.0009**	**1.0208**	**1.0000**	**1.0064**	**1.0124**
Proportion of area covered		**0.9719**	**0.8370**	**0.5288**	**0.2639**	**1.0000**
Adjusted count		**991.7**	**1422.0**	**1703.0**	**3154.3**	**3176.4**
Estimated proportion hauled out		**0.615**	**0.615**	**0.615**	**0.615**	**0.615**
Correction for missed animals		**1.626**	**1.626**	**1.626**	**1.626**	**1.626**
Estimated abundance		**1,612**	**2,312**	**2,769**	**5,129**	**5,165**
Abundance adjusted to 2008		**-**	**-**	**-**	**-**	**5,165**

Subarea 73 (SQCI). Panel 1 of 1 panels.

Site Name and Number:		12-13 July 1994	05 August 2008
H1237	HEAD RK	-	5
H0609	S MOORE HEAD	11	11
H0619	NW LOUSCOONE PT	12	ns
H0610	N HIGH ISL REEF	11	6
H0611	RAINY ISLS	37	15
H0618	ADAM RKS	70	ns
H1236	GULL IT	-	36
H0617	S ANTHONY ISL REEFS	30	ns
H0613	NW LUXANA BAY REEF	20	14
H0612	SE LUXANA BAY REEF	9	0
H0614	HOWE BAY REEF	21	0
H0616	S BARBER PT REEF	18	ns
H0615	BALLARD PT REEF	10	11
Total number counted		**249**	**98**
Correction for unborn pups		**1.0055**	**1.0001**
Proportion of area covered		**1.0000**	**0.4779**
Adjusted count		**250.4**	**205.1**
Estimated proportion hauled out		**0.615**	**0.615**
Correction for missed animals		**1.626**	**1.626**
Estimated abundance		**407**	**333**
Abundance adjusted to 2008		**-**	**333**

Subarea 74 (SWQCI). Panel 1 of 1 panels.

Site Name and Number:		13 July 1994	05 August 2008
H0626	ARIEL RK	30	45
H0627	LOMGON ITS	34	21
H0628	HORN RK	44	124
H0624	S REID PT	14	0
H0625	WILSON BAY REEF	6	0
H0623	S TASU HEAD	14	0
H0622	S KWOON COVE	9	0
H1245	SW GOWGAIA PT	-	28
H0621	NW WELLS COVE	31	19
H1240	BETWEEN VICTORIA LAKE OUT	-	0
H1238	BILLINGTON RKS	-	9
H0620	CAPE FREEMAN	2	ns
Total number counted		**184**	**246**
Correction for unborn pups		**1.0047**	**1.0001**
Proportion of area covered		**1.0000**	**0.9891**
Adjusted count		**184.9**	**248.7**
Estimated proportion hauled out		**0.615**	**0.615**
Correction for missed animals		**1.626**	**1.626**
Estimated abundance		**301**	**404**
Abundance adjusted to 2008		**-**	**404**

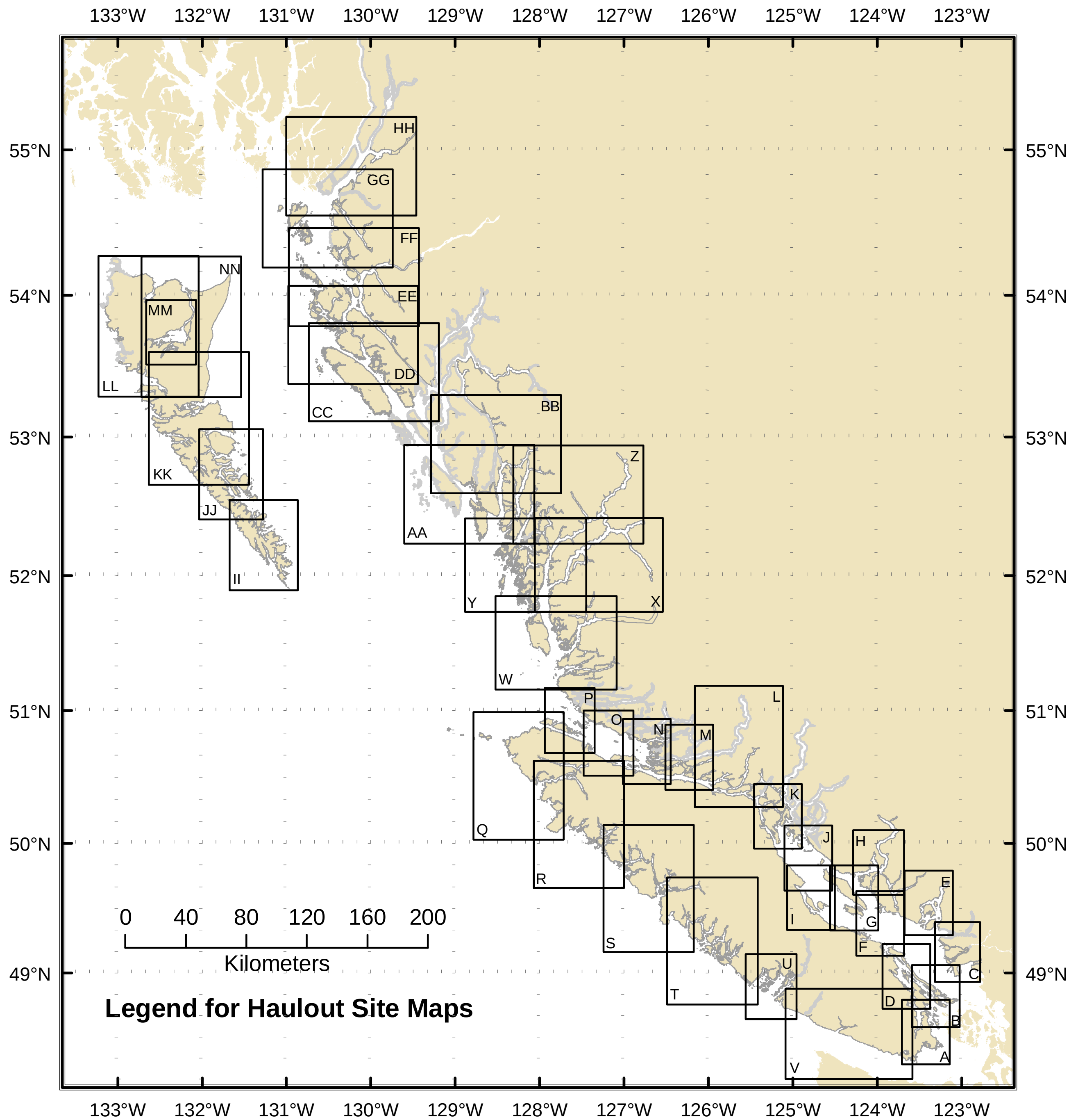
Subarea 75 (NWQCI). Panel 1 of 1 panels.

Site Name and Number:		04 July 06 Aug 2008
H1299	TIAN HEAD	33
H1298	N TIAN IST	28
H1297	S TIAN IT	66
H1296	SE THOMAS RK	13
H1295	SOLIDE ISLS	45
H1300	SW HIPPA ISL	140
H1293	SEAL INLET REEFS	2
H1294	SADLER ISL	60
H1291	SE SEAL PT	14
H1288	GOSPEL ISL	48
H1285	E CONE HD A	3
H1287	E CONE HD C	6
H1286	E CONE HD B	15
H1284	N KINDAKUN PT B	26
H1283	N KINDAKUN PT A	5
H1289	S SHIELDS ISL A	21
H1290	S SHIELDS ISL B	27
H1281	NW KANO PT	0
H1282	E KINDAKUN PT	26
H1280	CADMAN ISL	2
H1279	N HUNTER PT	6
H1292	E HUNTER PT	92
H1278	NW VAN PT	5
H1275	SE STIU PT	4
H1276	GAGI RK	15
H1277	MARBLE ISL	20
H1274	TANA BAY REEF	12
H1273	N MERCER PT	29
H1254	SAUNDERS ISL	3
H1255	LIHOU ISL	66
H1253	RECOVERY PT REEF	97
H1252	SANSUM ISL	33
H1251	DENHAM PT REEFS	16
H1250	NW BOTTLE INLET	16
H1244	S KOOTENAY PT REEFS	25
Total number counted		**1,019**
Correction for unborn pups		**1.0047**
Proportion of area covered		**1.0000**
Adjusted count		**1023.8**
Estimated proportion hauled out		**0.615**
Correction for missed animals		**1.626**
Estimated abundance		**1,665**
Abundance adjusted to 2008		**1,665**

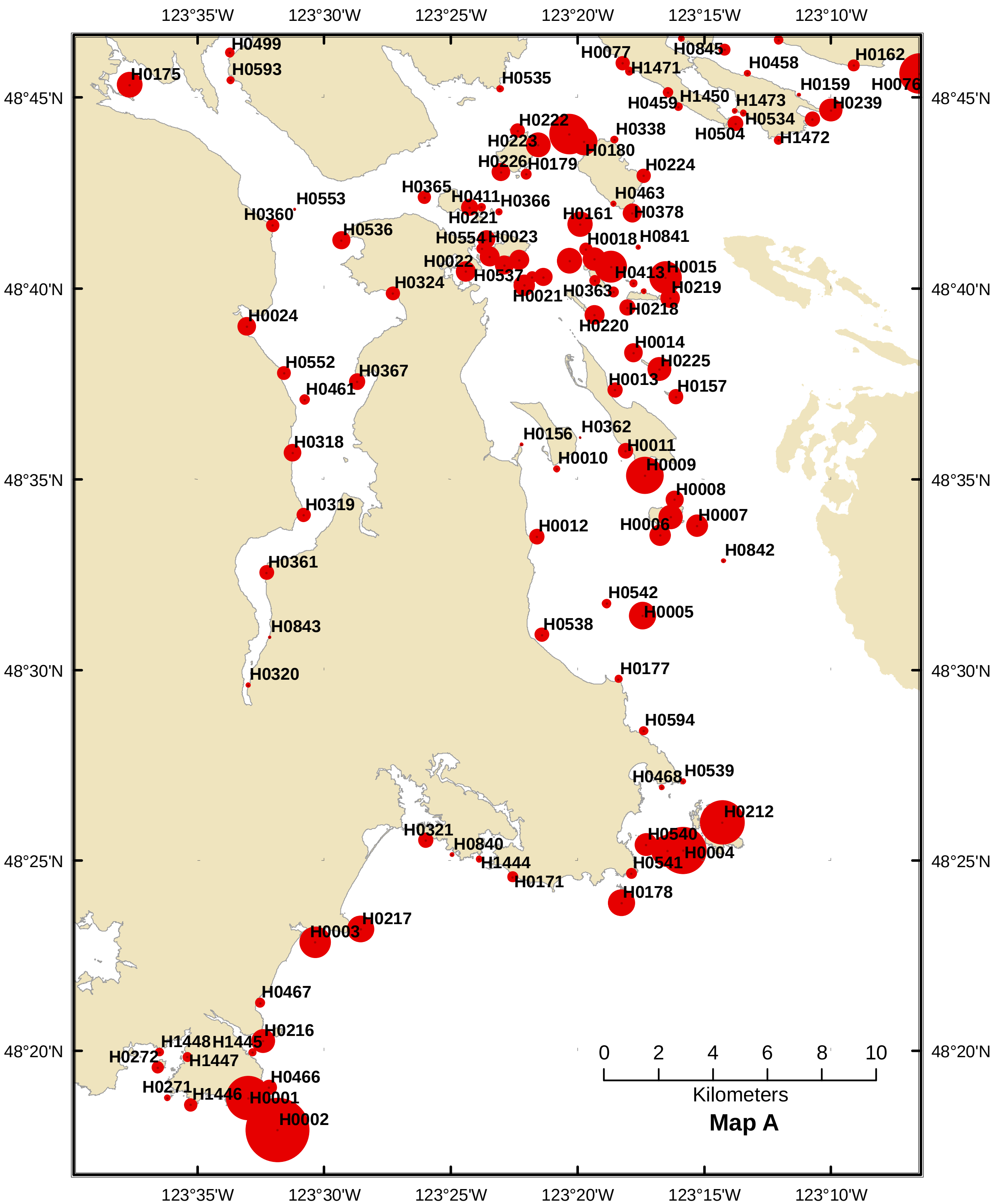
Appendix III

Haulout Site Maps

Note: the first overview map shows the boundaries of the following 55 detailed maps that show the location of haulout sites (needs to be updated). Adjacent maps overlap by about 10-20%, so some haulout sites may appear on more than one map. Red symbols are drawn proportional in area to the maximum count at the site.



133°W
132°W
131°W
130°W
129°W
128°W
127°W
126°W
125°W
124°W
123°W
55°N
54°N
53°N
52°N
51°N
50°N
49°N
HH
GG
FF
EE
DD
CC
BB
AA
Z
Y
X
W
P
O
N
M
L
K
J
H
E
I
G
F
C
D
B
A
U
V
T
S
R
Q
NN
MM
LL
KK
JJ
II
0
40
80
120
160
200
Kilometers
Legend for Haulout Site Maps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123°15'W
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48°40'N
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48°30'N
48°25'N
48°20'N
H0499
H0593
H0175
H0535
H0077
H1471
H0845
H0458
H0162
H0159
H0076
H0459
H1450
H1473
H0239
H0534
H0504
H1472
H0222
H0338
H0223
H0180
H0226
H0179
H0224
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H0411
H0366
H0463
H0553
H0360
H0221
H0161
H0378
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H0554
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H0018
H0841
H0022
H0413
H0015
H0537
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H0321
H0540
H0840
H0004
H1444
H0541
H0171
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H0217
H0003
H0467
H0216
H1448
H1445
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H0002
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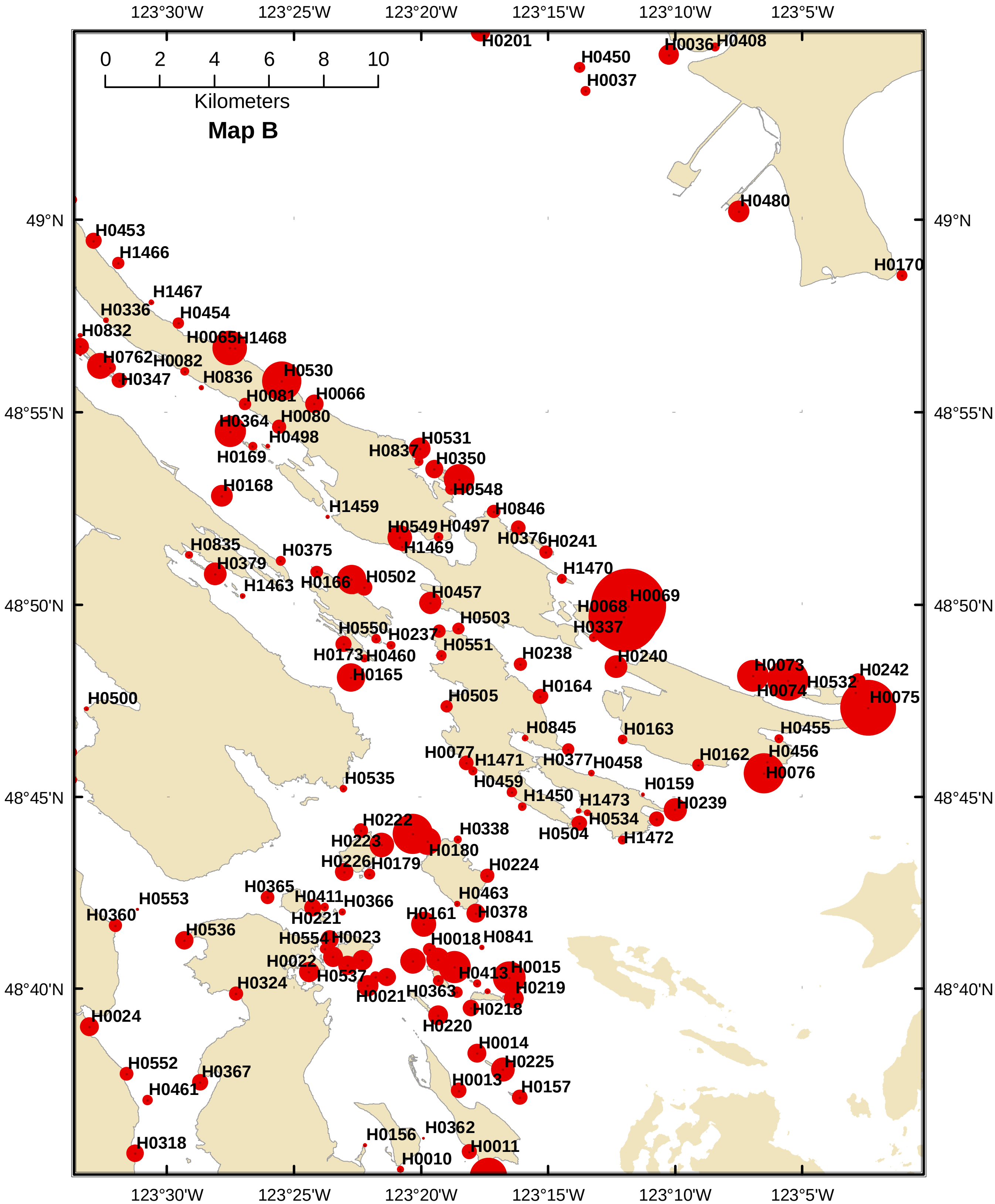
2
4
6
8
10
Kilometers
Map A


Map B
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123°10'W
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48°50'N
48°45'N
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H0450
H0037
H0036
H0408
H0480
H0170
H0453
H1466
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H0832
H0065
H1468
H0762
H0082
H0347
H0836
H0530
H0081
H0066
H0364
H0080
H0498
H0169
H0531
H0837
H0350
H0168
H0548
H1459
H0846
H0549
H0497
H1469
H0376
H0241
H0835
H0375
H0379
H1463
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H0164
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H0179
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H0463
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H0360
H0221
H0161
H0378
H0536
H0554
H0023
H0018
H0841
H0022
H0015
H0537
H0413
H0324
H0021
H0363
H0219
H0218
H0024
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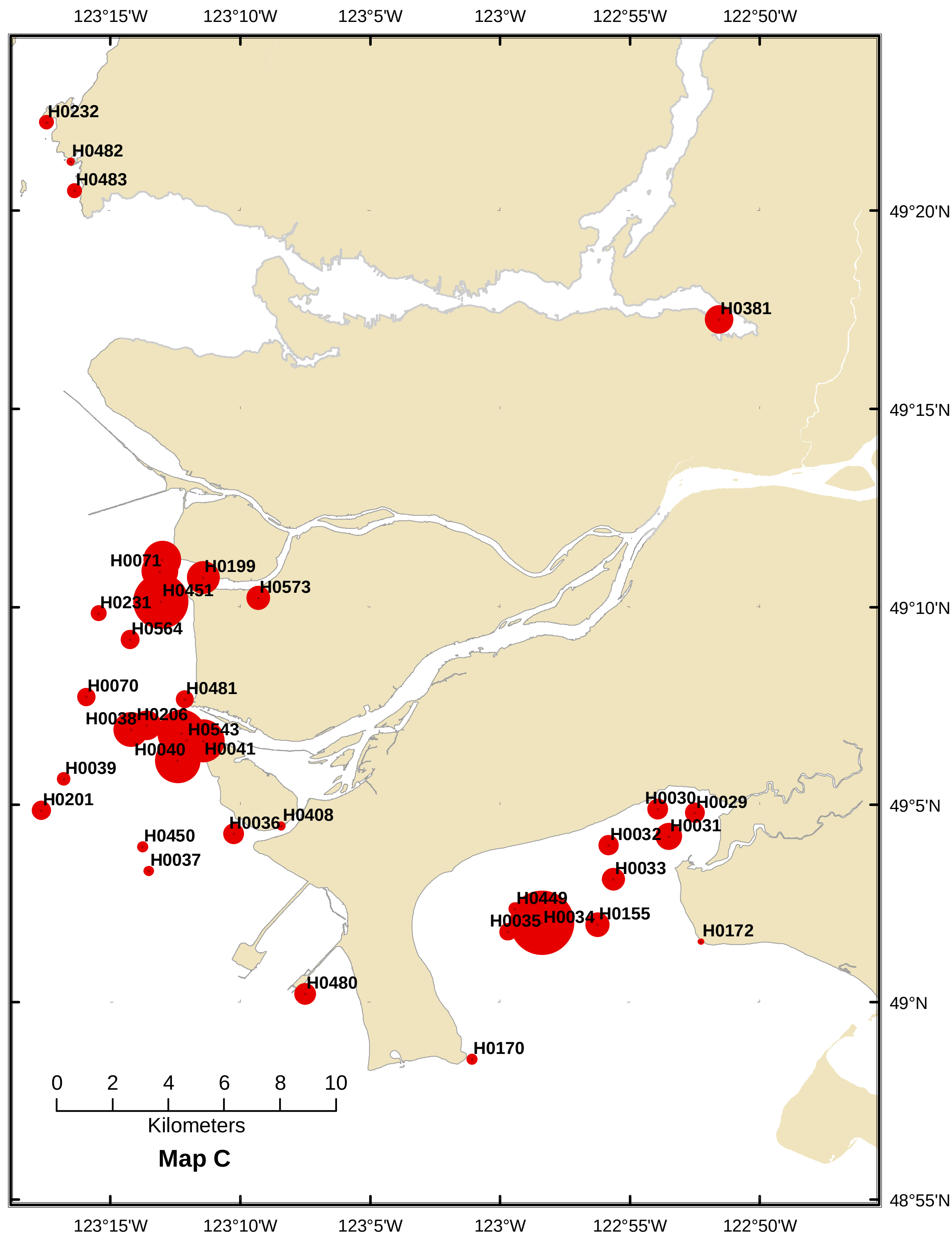
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122°50'W
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49°5'N
49°N
48°55'N
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H0482
H0483
H0381
H0071
H0199
H0451
H0573
H0231
H0564
H0070
H0481
H0038
H0206
H0543
H0040
H0041
H0039
H0201
H0036
H0408
H0450
H0037
H0030
H0029
H0031
H0032
H0033
H0449
H0035
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H0155
H0172
H0480
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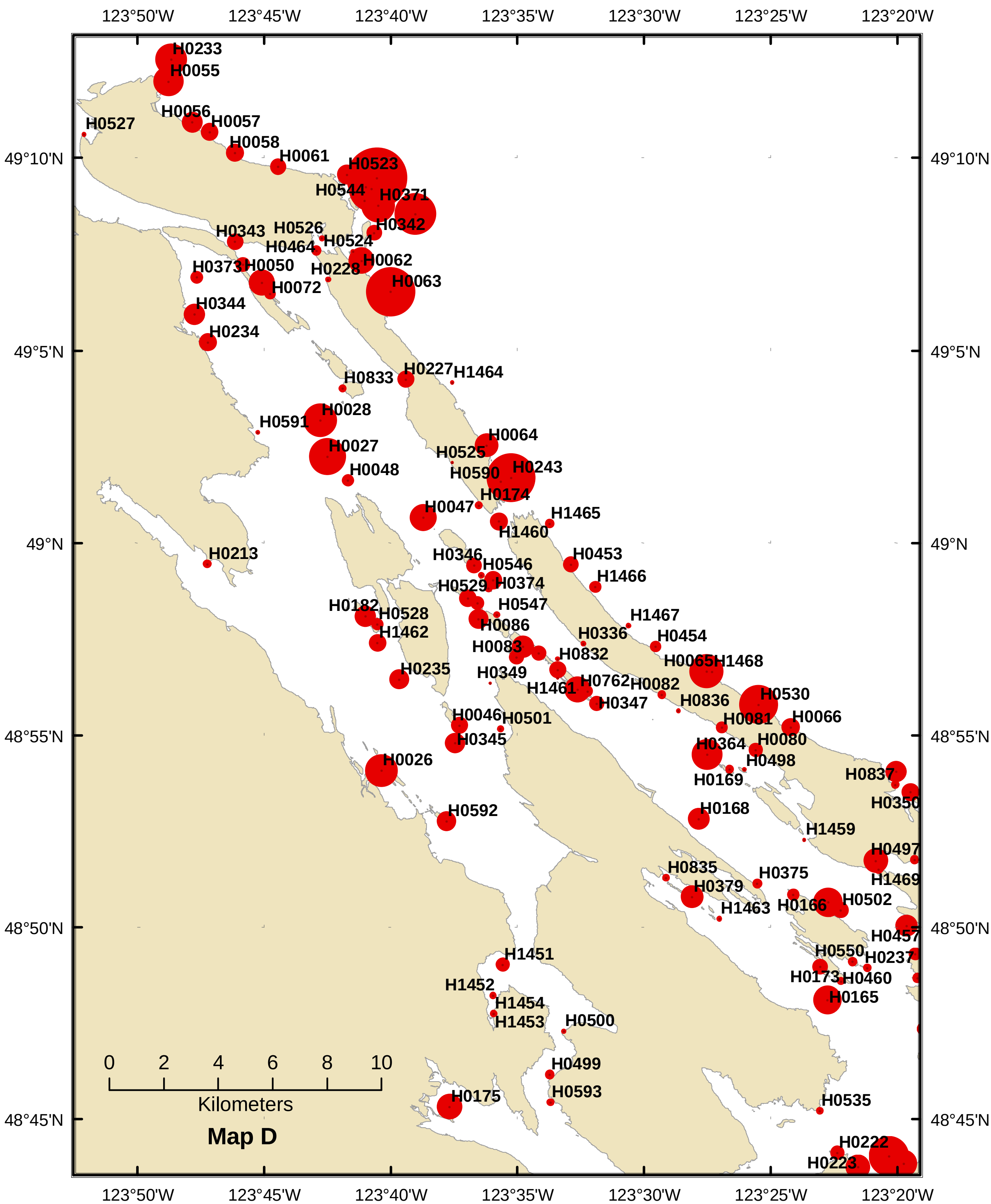
2
4
6
8
10
Kilometers
Map C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123°30'W
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123°20'W
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49°N
48°55'N
48°50'N
48°45'N
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H0055
H0527
H0056
H0057
H0058
H0061
H0523
H0544
H0371
H0343
H0526
H0342
H0464
H0524
H0373
H0050
H0228
H0062
H0072
H0063
H0344
H0234
H0227
H1464
H0833
H0028
H0591
H0064
H0027
H0525
H0243
H0048
H0590
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H0047
H1465
H1460
H0213
H0346
H0453
H0546
H1466
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H0350
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H0497
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H1469
H0379
H1463
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H1452
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H1454
H1453
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6
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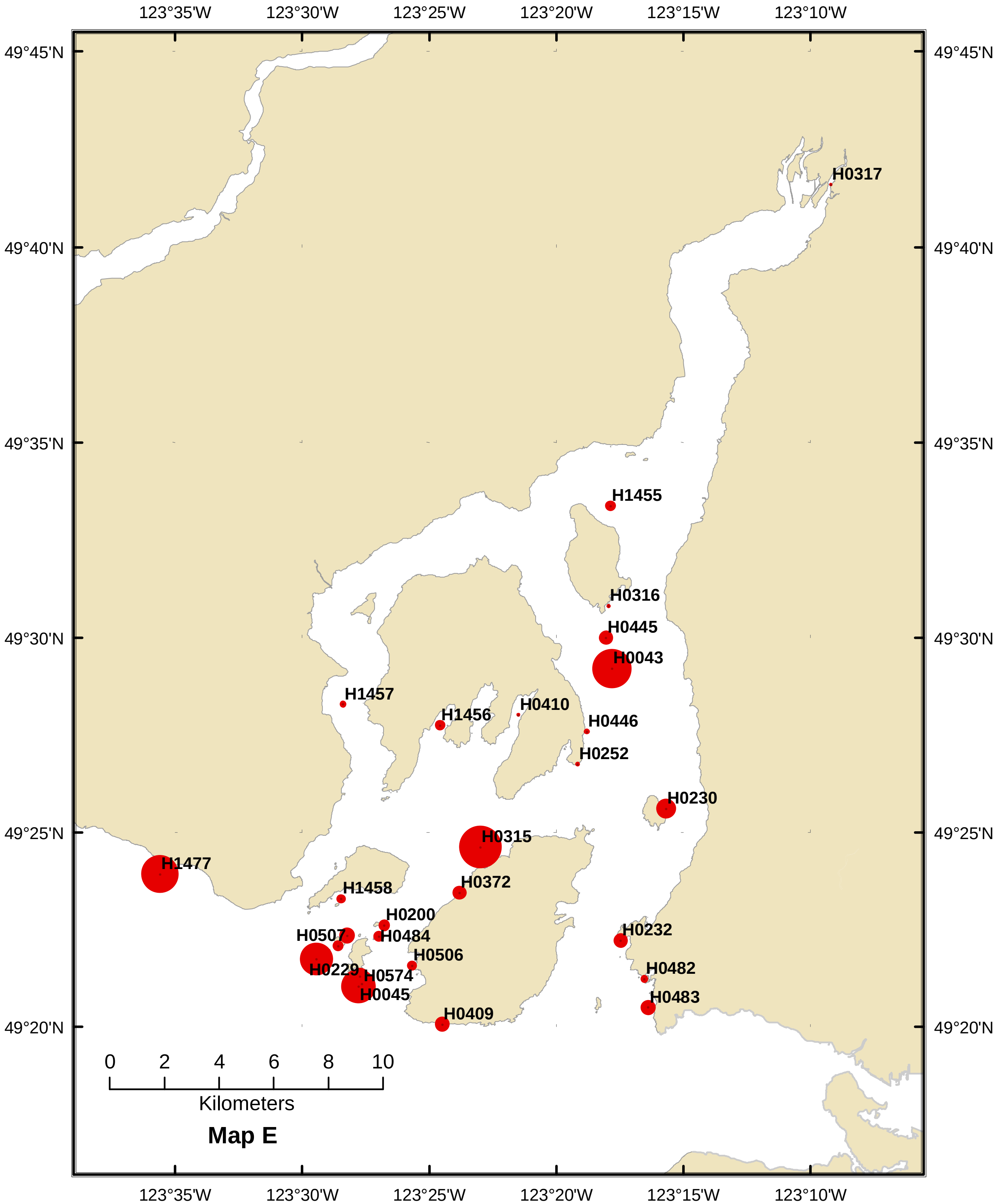
10
Kilometers
Map D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49°25'N
49°20'N
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H1455
H0316
H0445
H0043
H1457
H0410
H1456
H0446
H0252
H0230
H0315
H1477
H1458
H0372
H0200
H0507
H0484
H0232
H0506
H0229
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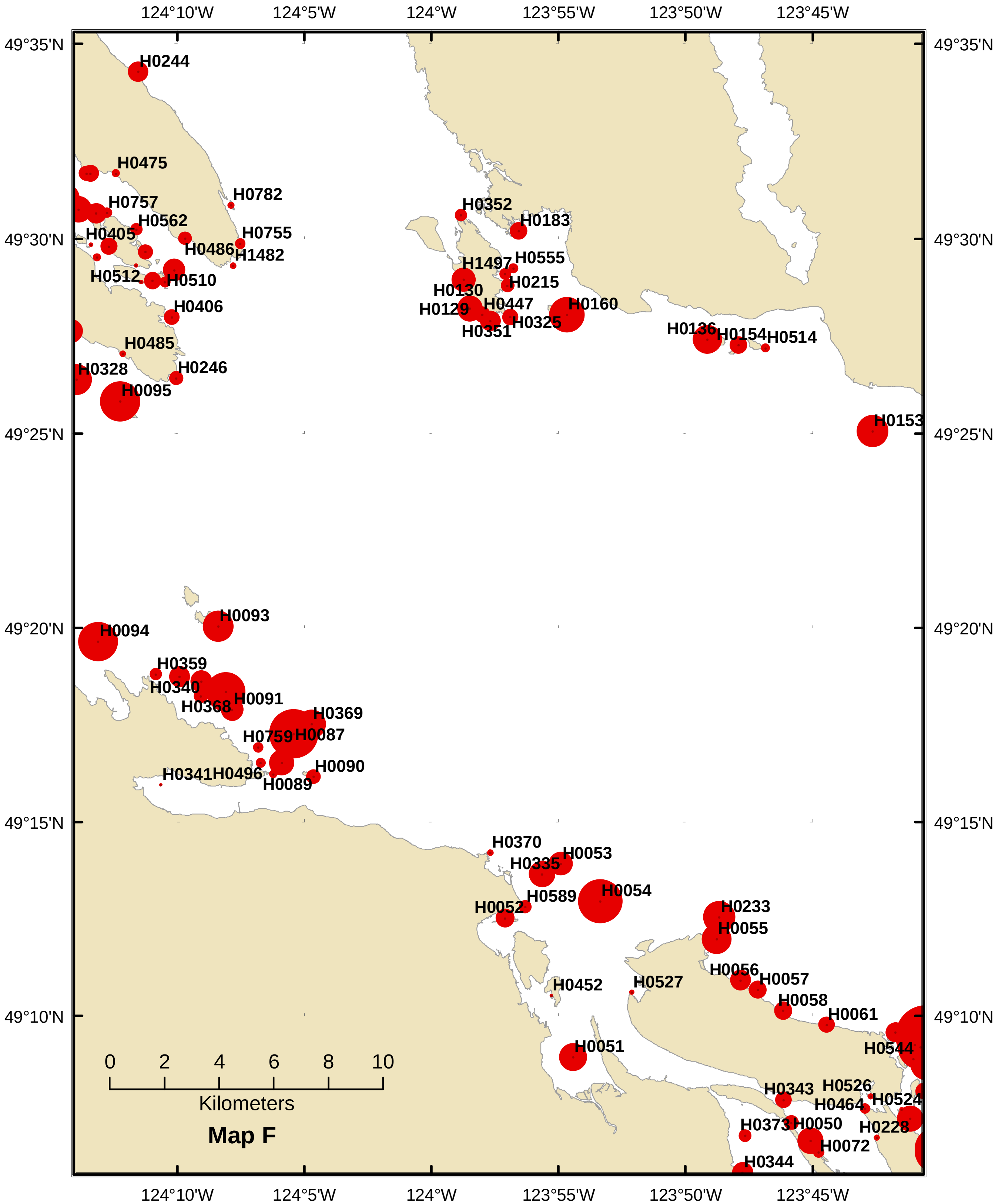
Kilometers
Map E



124°10'W
124°5'W
124°W
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123°50'W
123°45'W
49°35'N
49°30'N
49°25'N
49°20'N
49°15'N
49°10'N
H0244
H0475
H0782
H0757
H0562
H0405
H0755
H0486
H1482
H0512
H0510
H0406
H0485
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H0246
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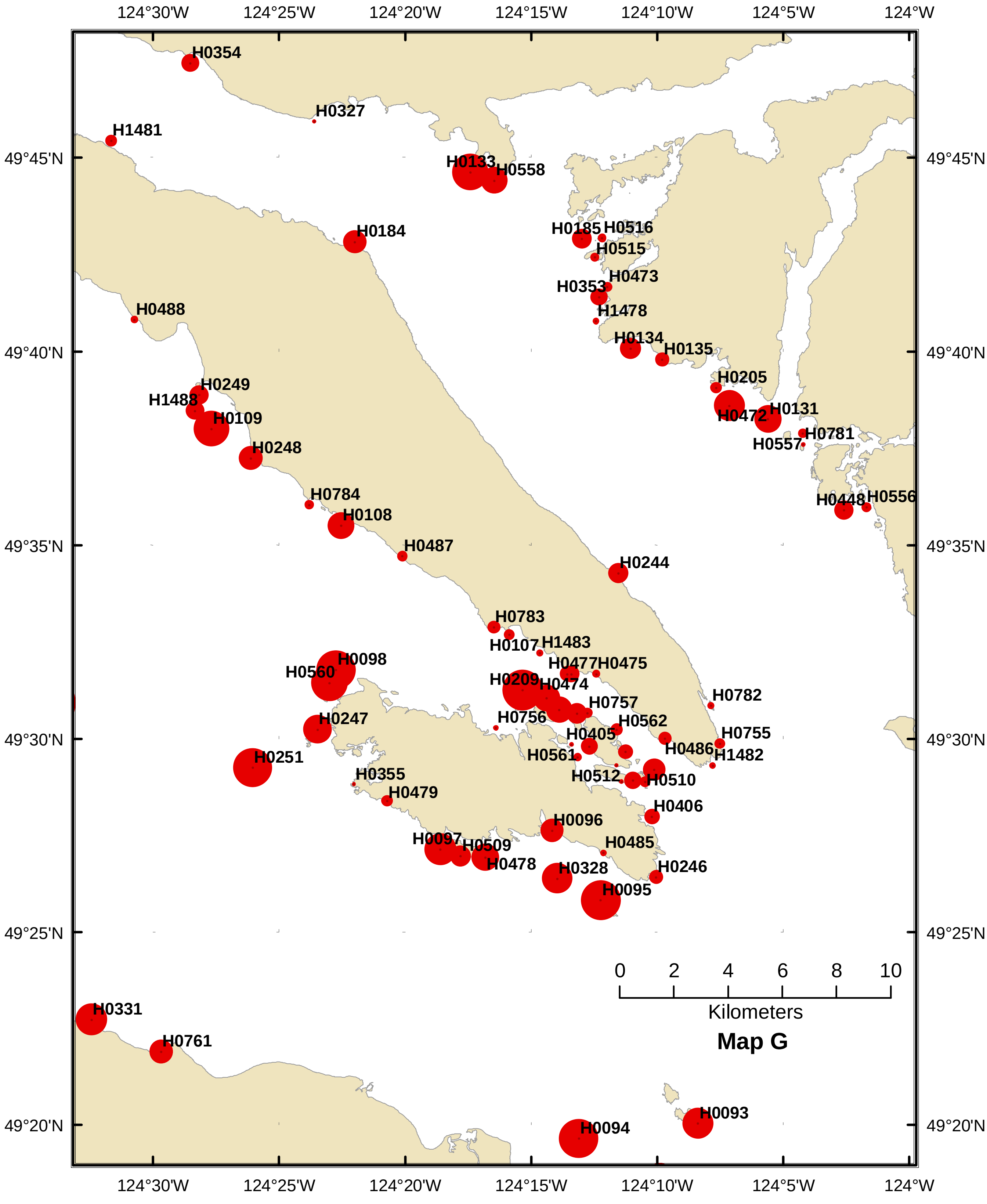
Kilometers
Map F



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49°35'N
49°30'N
49°25'N
49°20'N
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10
Kilometers
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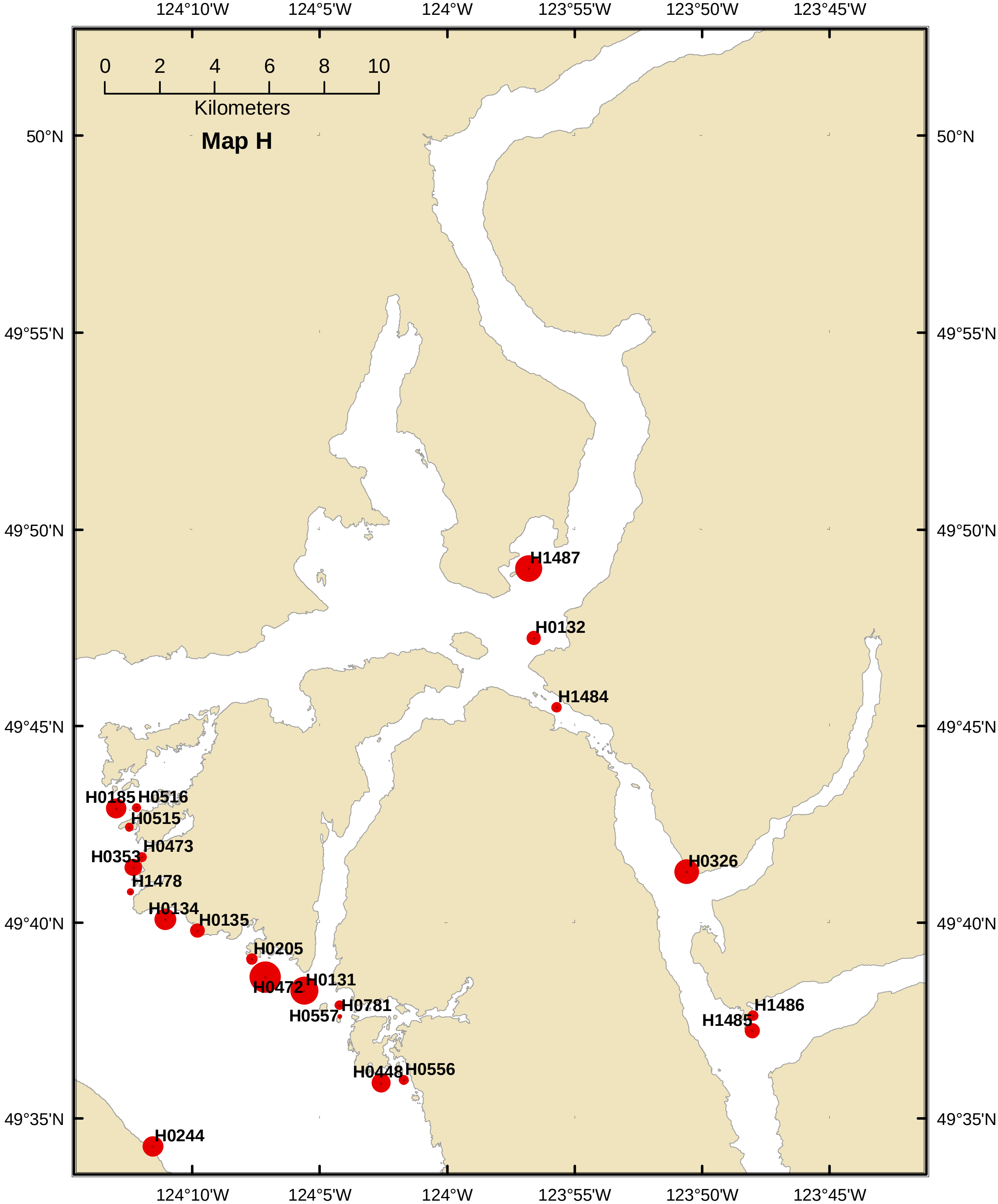
H0094


124°10'W
124°5'W
124°W
123°55'W
123°50'W
123°45'W
50°N
49°55'N
49°50'N
49°45'N
49°40'N
49°35'N
0 2 4 6 8 10
Kilometers
Map H
H1487
H0132
H1484
H0185
H0516
H0515
H0473
H0353
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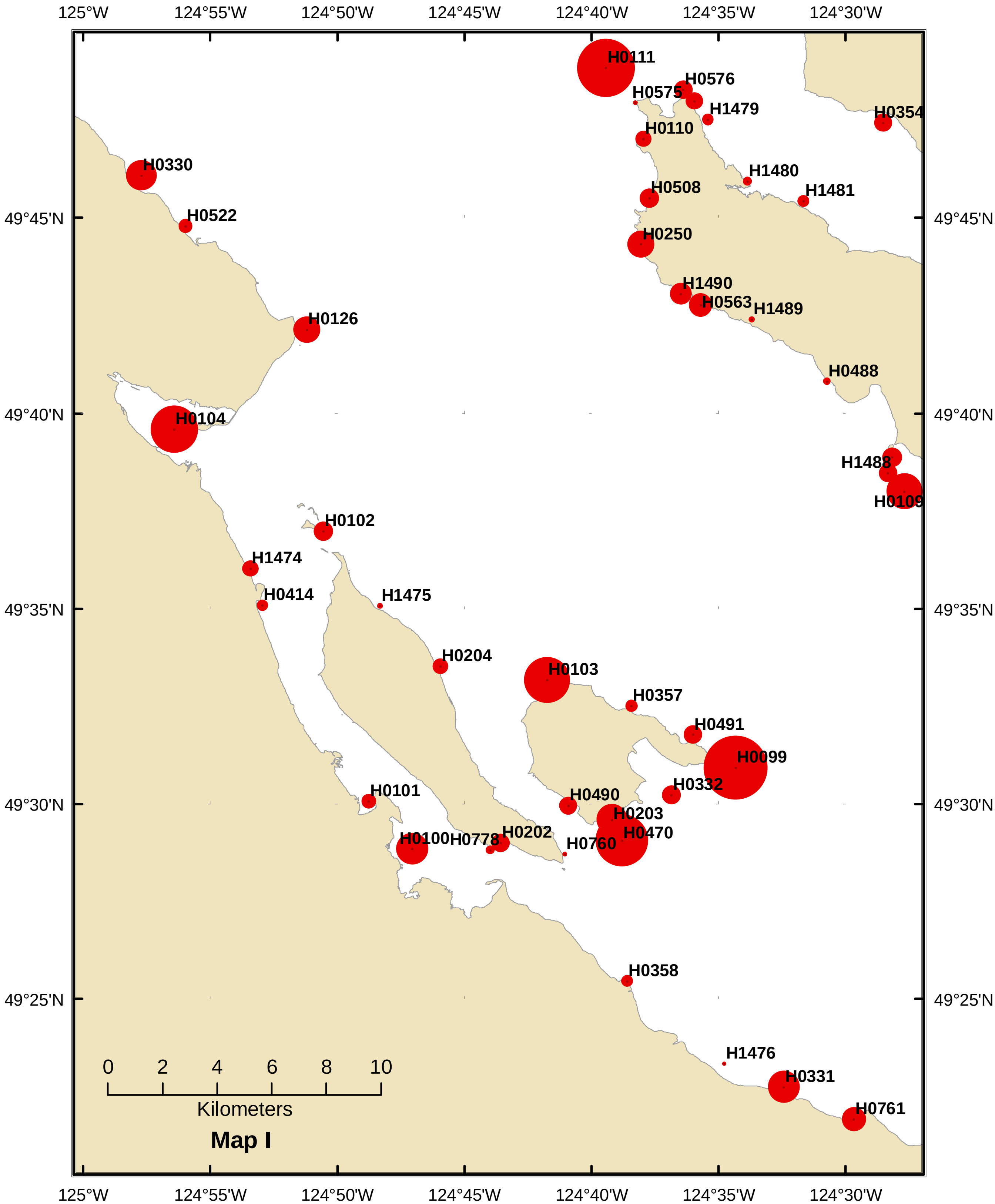
H0244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124°55'W
124°50'W
124°45'W
124°40'W
124°35'W
124°30'W
49°45'N
49°40'N
49°35'N
49°30'N
49°25'N
H0111
H0576
H0575
H1479
H0354
H0110
H0330
H1480
H0508
H1481
H0522
H0250
H1490
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H0102
H1474
H0414
H1475
H0204
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H0357
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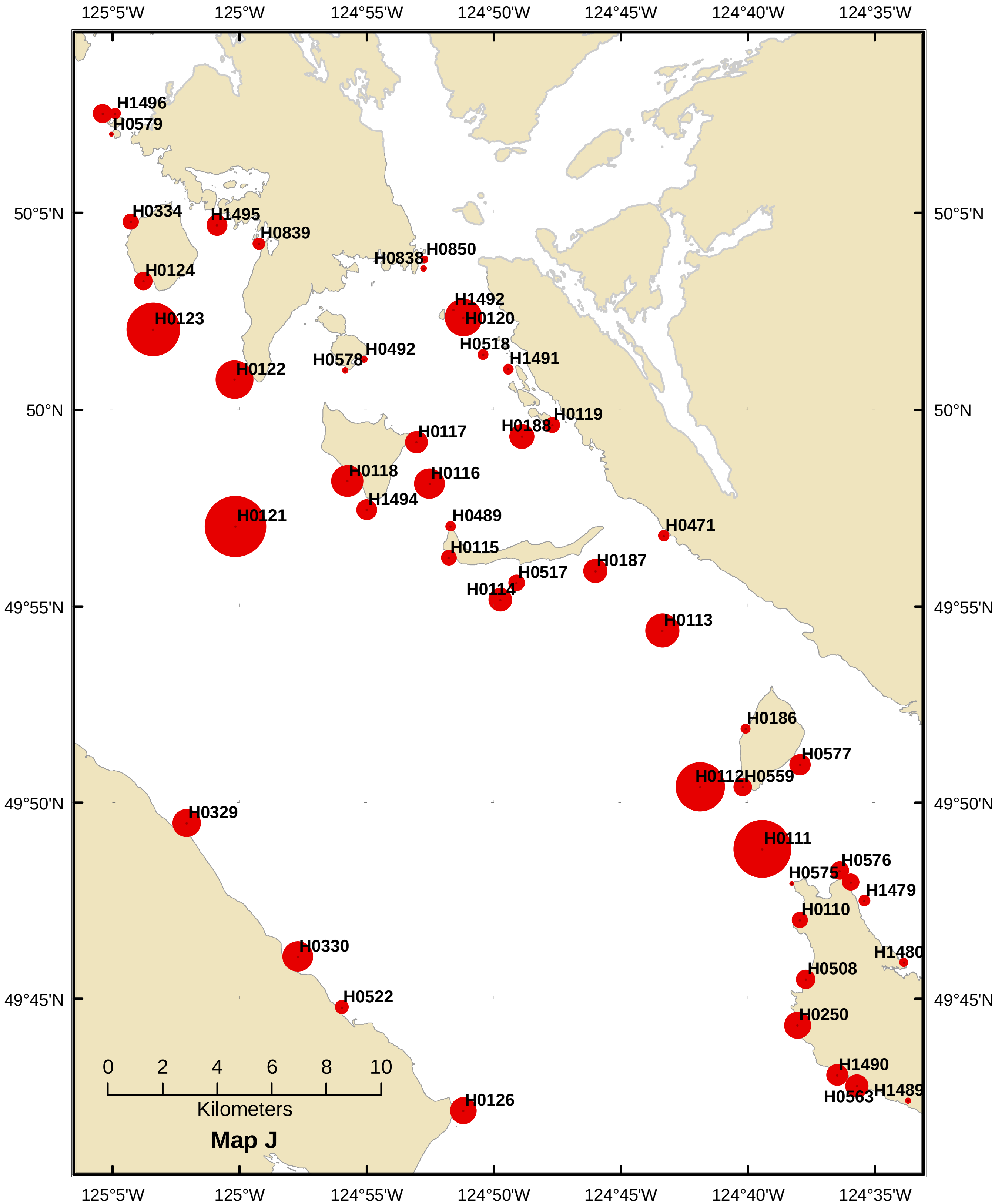
H0101
H0490
H0203
H0470
H0100
H0778
H0202
H0760
H0358
H1476
H0331
H0761
0
2
4
6
8
10
Kilometers

Map I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125°W
124°55'W
124°50'W
124°45'W
124°40'W
124°35'W
50°5'N
50°N
49°55'N
49°50'N
49°45'N
H1496
H0579
H0334
H1495
H0839
H0838
H0850
H0124
H0123
H1492
H0120
H0518
H0492
H0578
H1491
H0122
H0119
H0188
H0117
H0118
H0116
H1494
H0121
H0489
H0471
H0115
H0187
H0517
H0114
H0113
H0186
H0577
H0112
H0559
H0329
H0111
H0576
H0575
H1479
H0110
H1480
H0330
H0508
H0522
H0250
H1490
H0563
H1489
H0126
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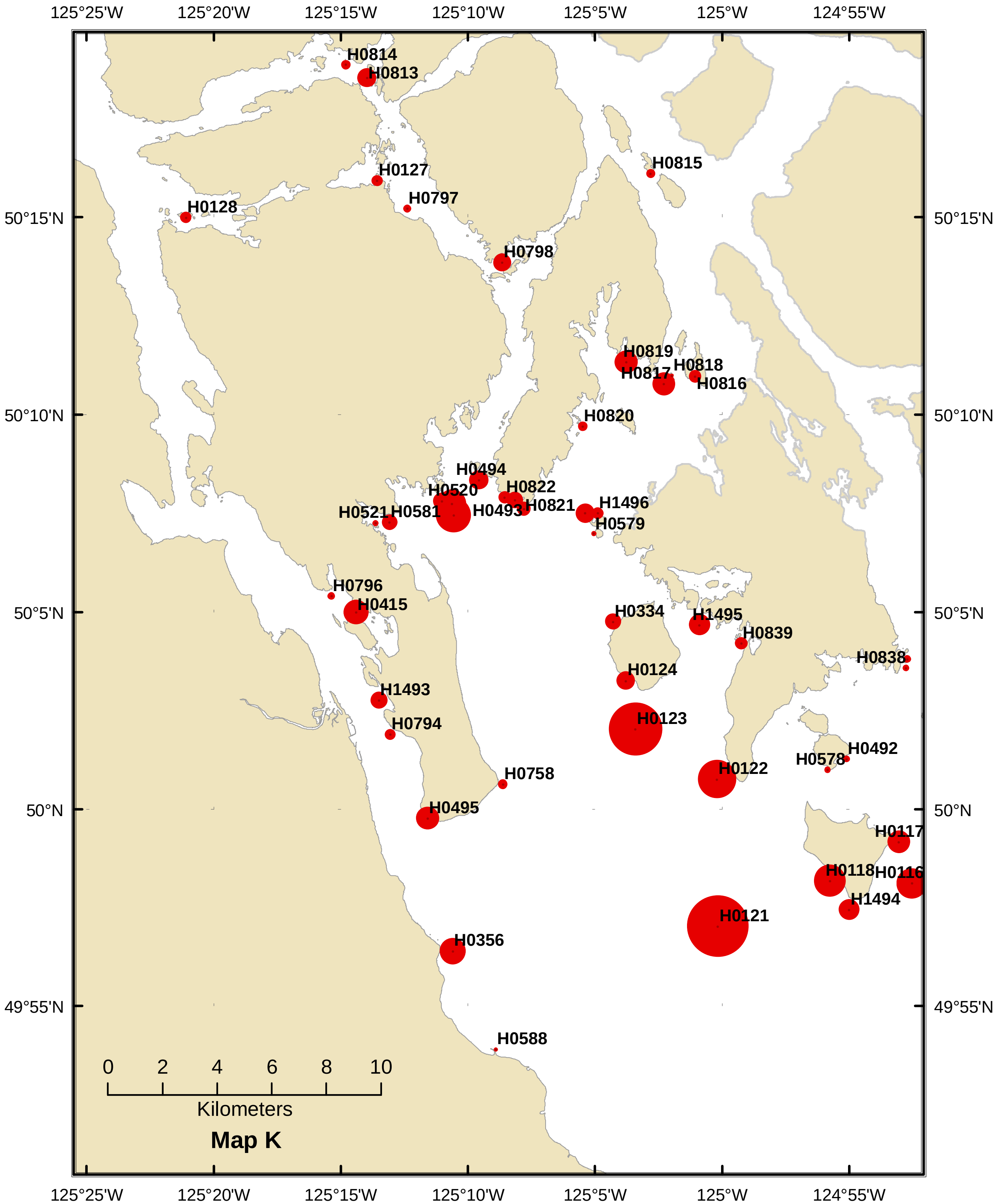
2
4
6
8
10
Kilometers
Map J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125°15'W
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125°5'W
125°W
124°55'W
50°15'N
50°10'N
50°5'N
50°N
49°55'N
H0814
H0813
H0127
H0797
H0128
H0815
H0798
H0819
H0818
H0817
H0816
H0820
H0494
H0822
H0520
H0821
H1496
H0521
H0581
H0493
H0579
H0796
H0415
H0334
H1495
H0839
H0838
H0124
H1493
H0123
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H0492
H0578
H0122
H0758
H0495
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H1494
H0121
H0356
H0588
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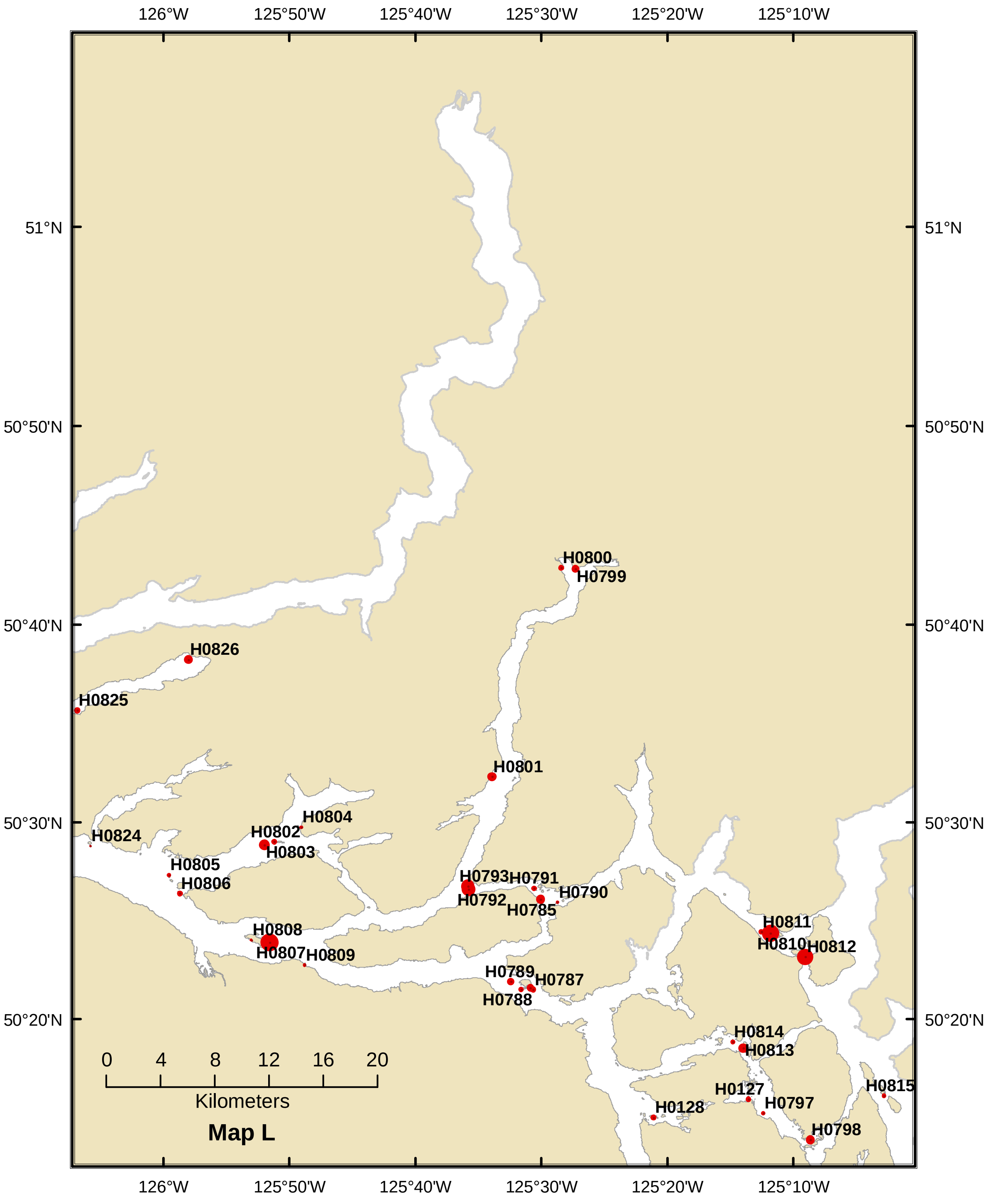
2
4
6
8
10
Kilometers

Map K


126°W
125°50'W
125°40'W
125°30'W
125°20'W
125°10'W
51°N
50°50'N
50°40'N
50°30'N
50°20'N
H0800
H0799
H0826
H0825
H0801
H0804
H0824
H0802
H0803
H0805
H0806
H0793
H0791
H0790
H0792
H0785
H0808
H0807
H0809
H0811
H0810
H0812
H0789
H0787
H0788
H0814
H0813
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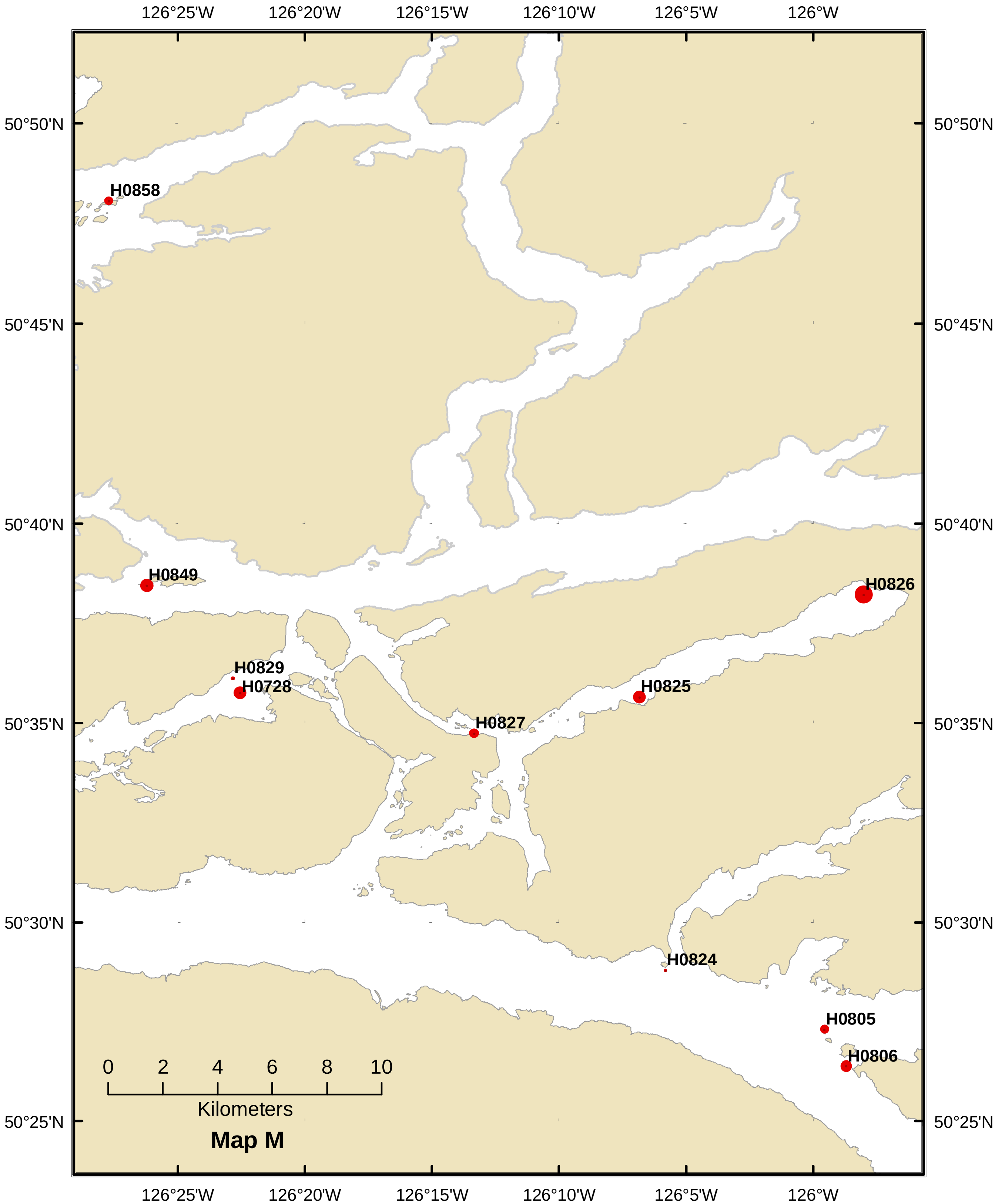
H0797
H0815
H0128
H0798
0
4
8
12
16
20
Kilometers
Map L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126°10'W
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126°W
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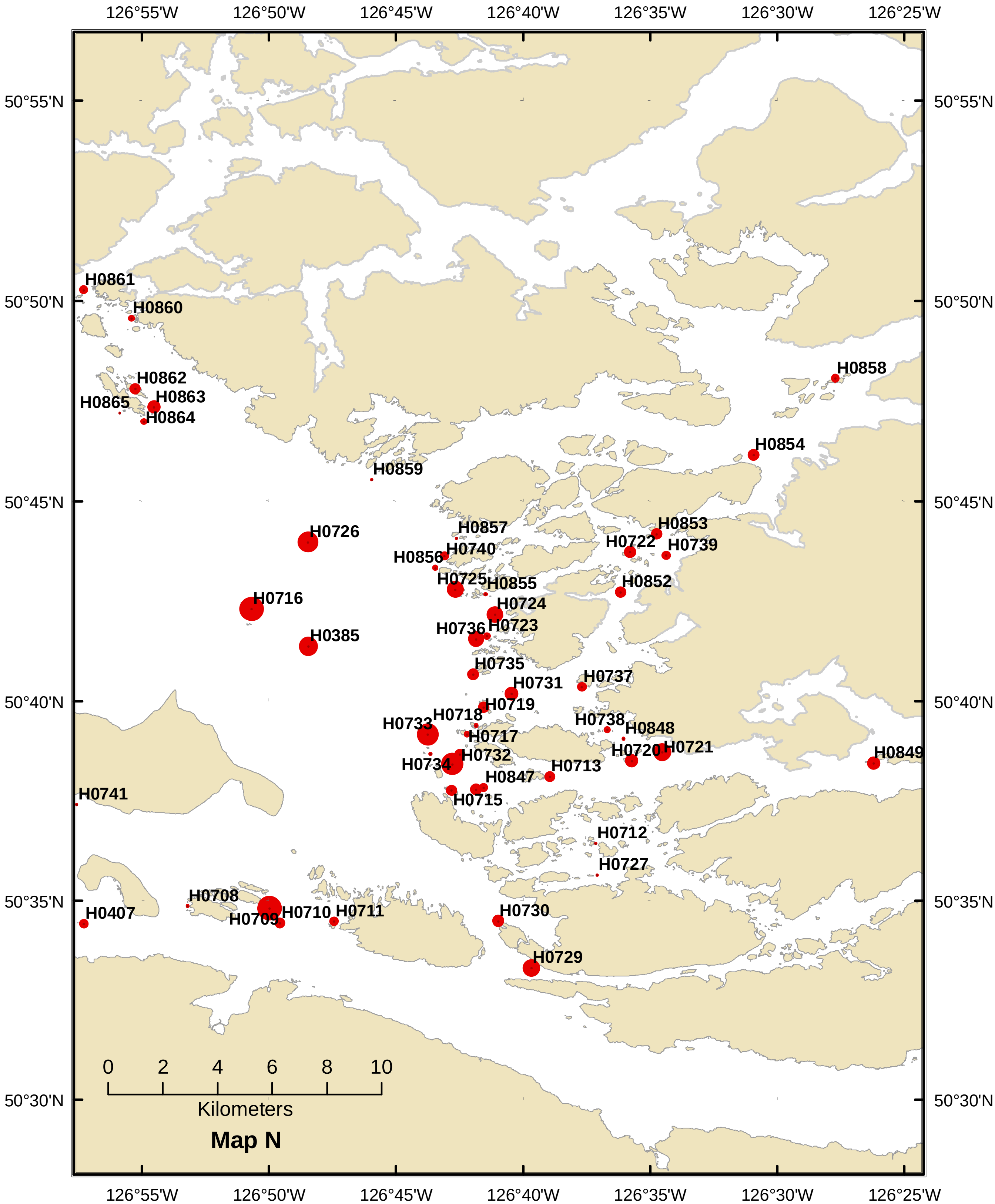
50°45'N
50°40'N
50°35'N
50°30'N
50°25'N
H0858
H0849
H0826
H0829
H0728
H0825
H0827
H0824
H0805
H0806
0
2
4
6
8
10
Kilometers
Map M


126°55'W
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126°45'W
126°40'W
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50°45'N
50°40'N
50°35'N
50°30'N
H0861
H0860
H0862
H0865
H0863
H0864
H0858
H0854
H0859
H0726
H0857
H0853
H0722
H0739
H0856
H0740
H0725
H0855
H0852
H0716
H0724
H0736
H0723
H0385
H0735
H0737
H0731
H0719
H0733
H0718
H0738
H0848
H0717
H0720
H0721
H0849
H0734
H0732
H0713
H0847
H0741
H0715
H0712
H0727
H0708
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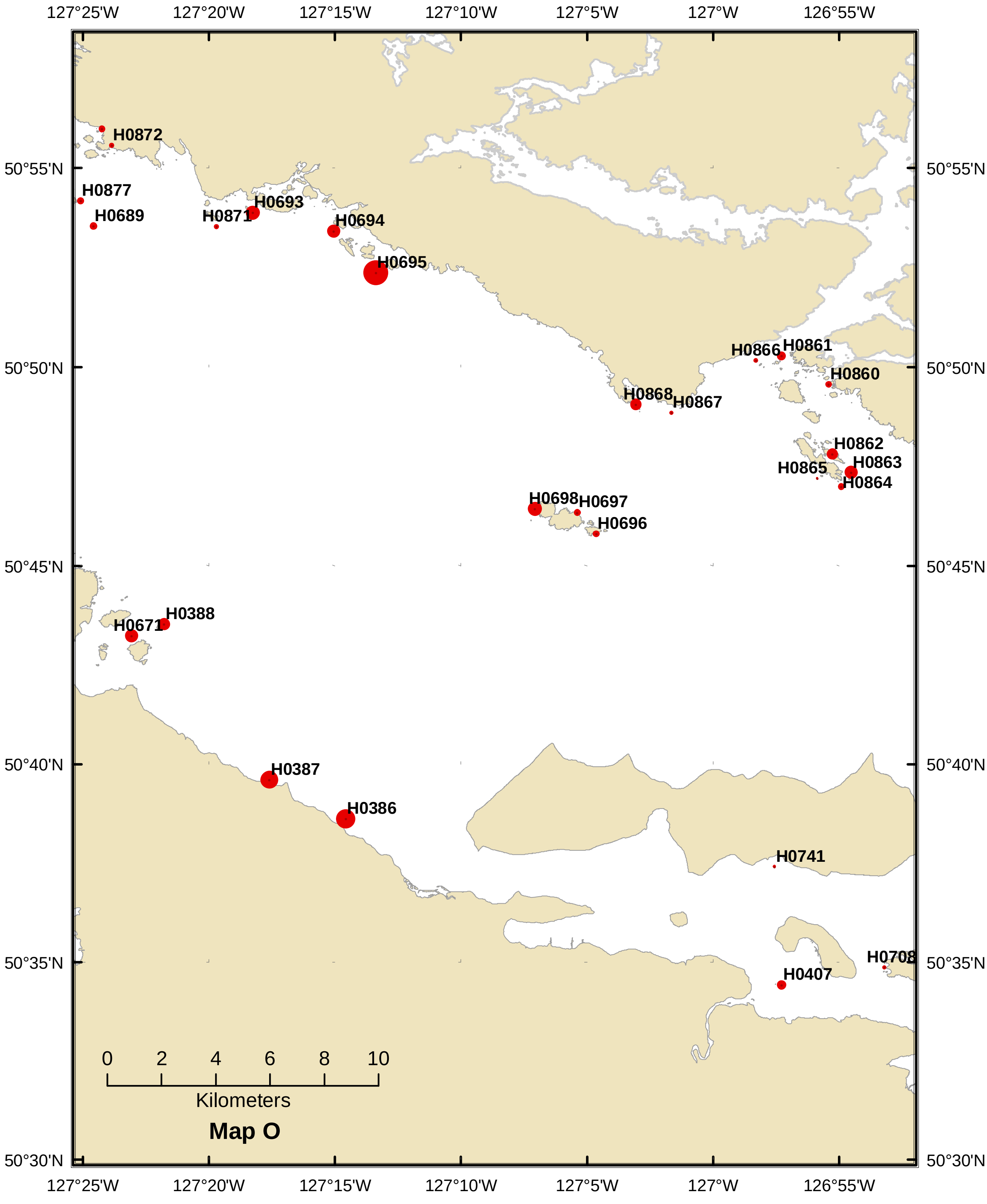
H0709
H0710
H0711
H0730
H0729
0
2
4
6
8
10
Kilometers
Map N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127°5'W
127°W
126°55'W
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50°45'N
50°40'N
50°35'N
50°30'N
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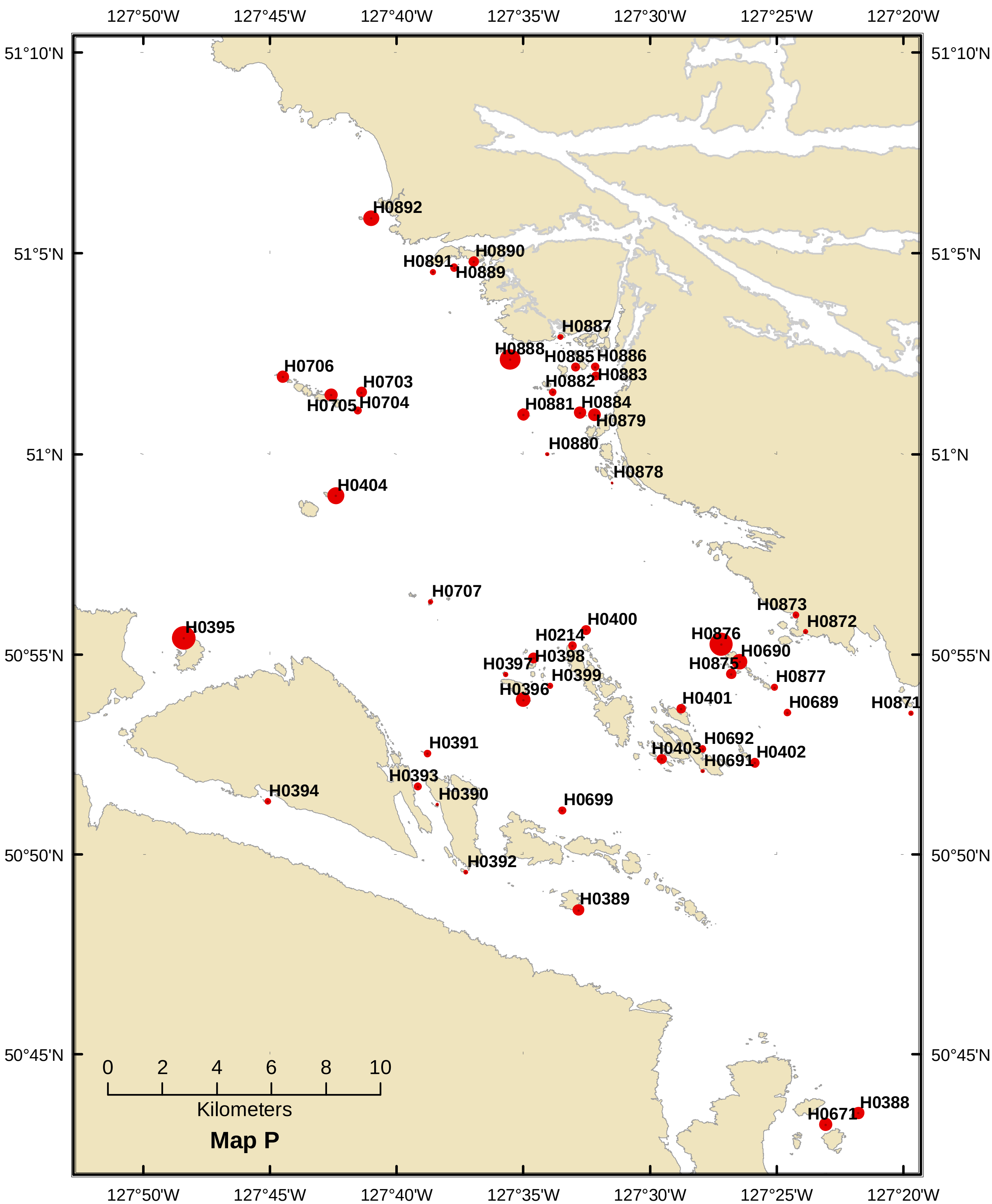
H0877
H0689
H0871
H0693
H0694
H0695
H0866
H0861
H0860
H0868
H0867
H0862
H0863
H0865
H0864
H0698
H0697
H0696
H0388
H0671
H0387
H0386
H0741
H0708
H0407
0
2
4
6
8
10
Kilometers
Map O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127°30'W
127°25'W
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51°10'N
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51°N
50°55'N
50°50'N
50°45'N
H0892
H0890
H0891
H0889
H0887
H0888
H0885
H0886
H0883
H0882
H0706
H0703
H0705
H0704
H0881
H0884
H0879
H0880
H0878
H0404
H0707
H0873
H0872
H0395
H0400
H0214
H0876
H0690
H0397
H0398
H0875
H0877
H0399
H0396
H0401
H0689
H0871
H0391
H0692
H0403
H0691
H0402
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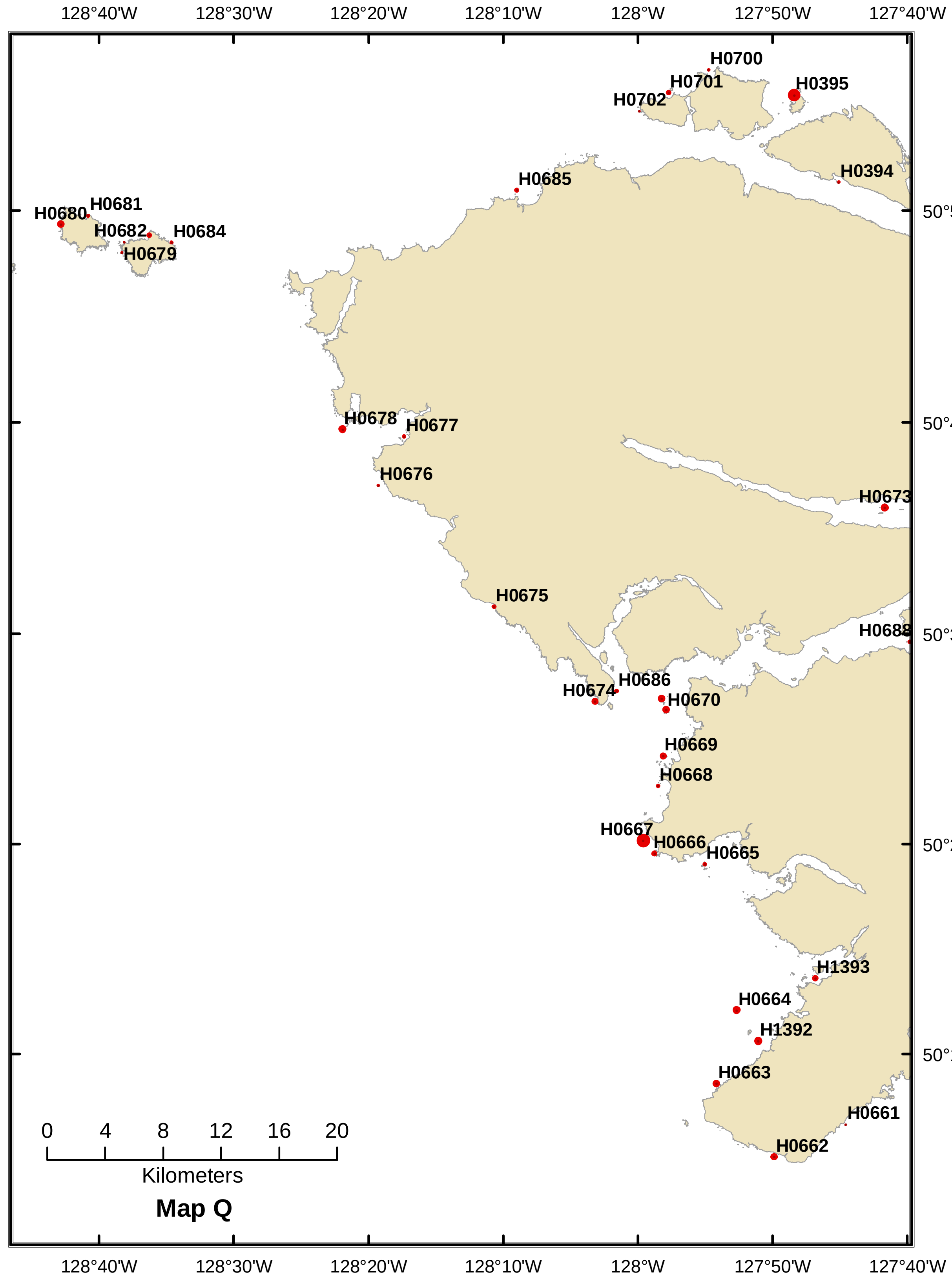
H0390
H0699
H0392
H0389
H0388
H0671
0 2 4 6 8 10
Kilometers
Map P


128°40'W
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128°20'W
128°10'W
128°W
127°50'W
127°40'W
50°50'N
50°40'N
50°30'N
50°20'N
50°10'N
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H0701
H0702
H0395
H0394
H0685
H0680
H0681
H0682
H0684
H0679
H0678
H0677
H0676
H0673
H0675
H0688
H0686
H0674
H0670
H0669
H0668
H0667
H0666
H0665
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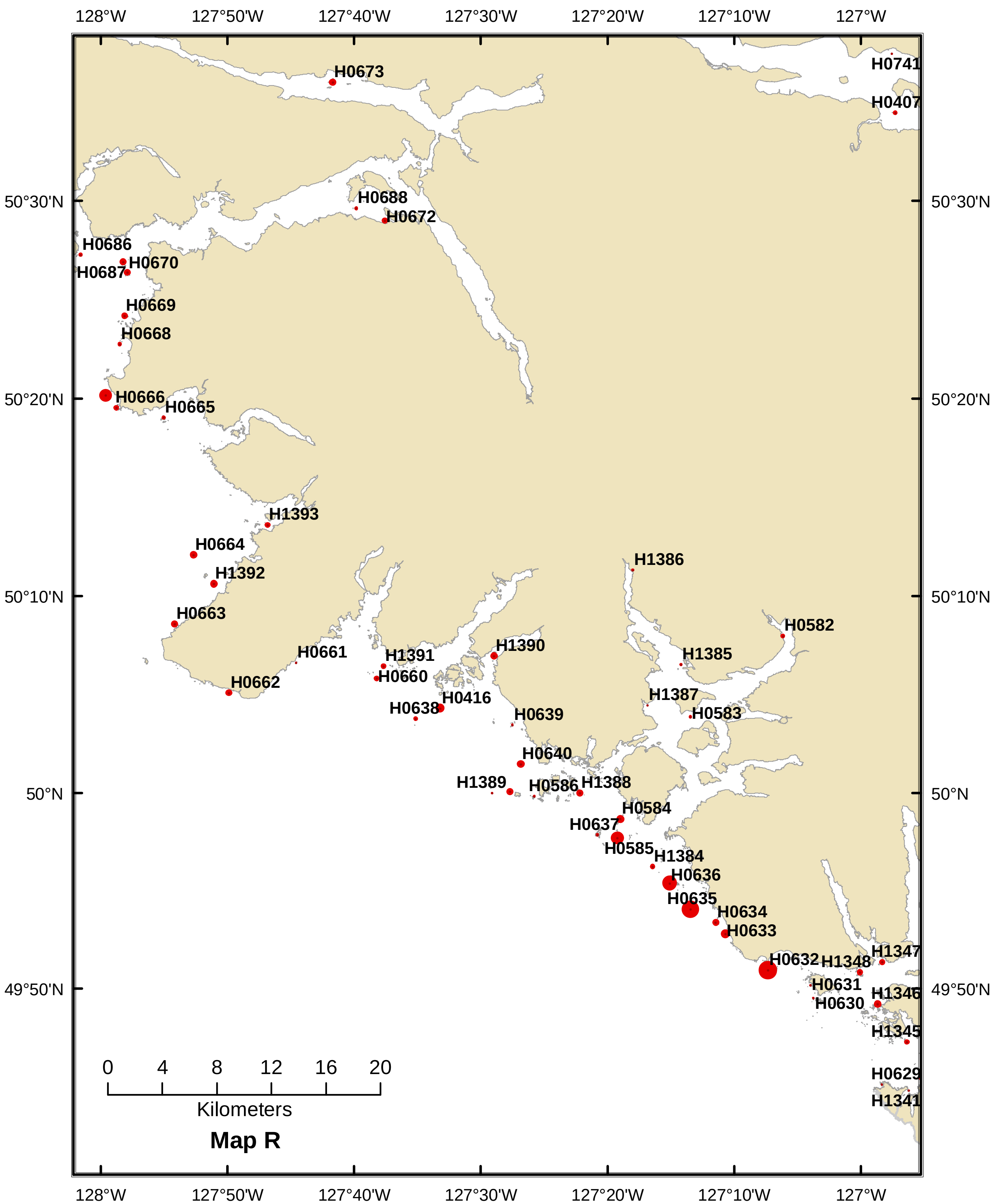
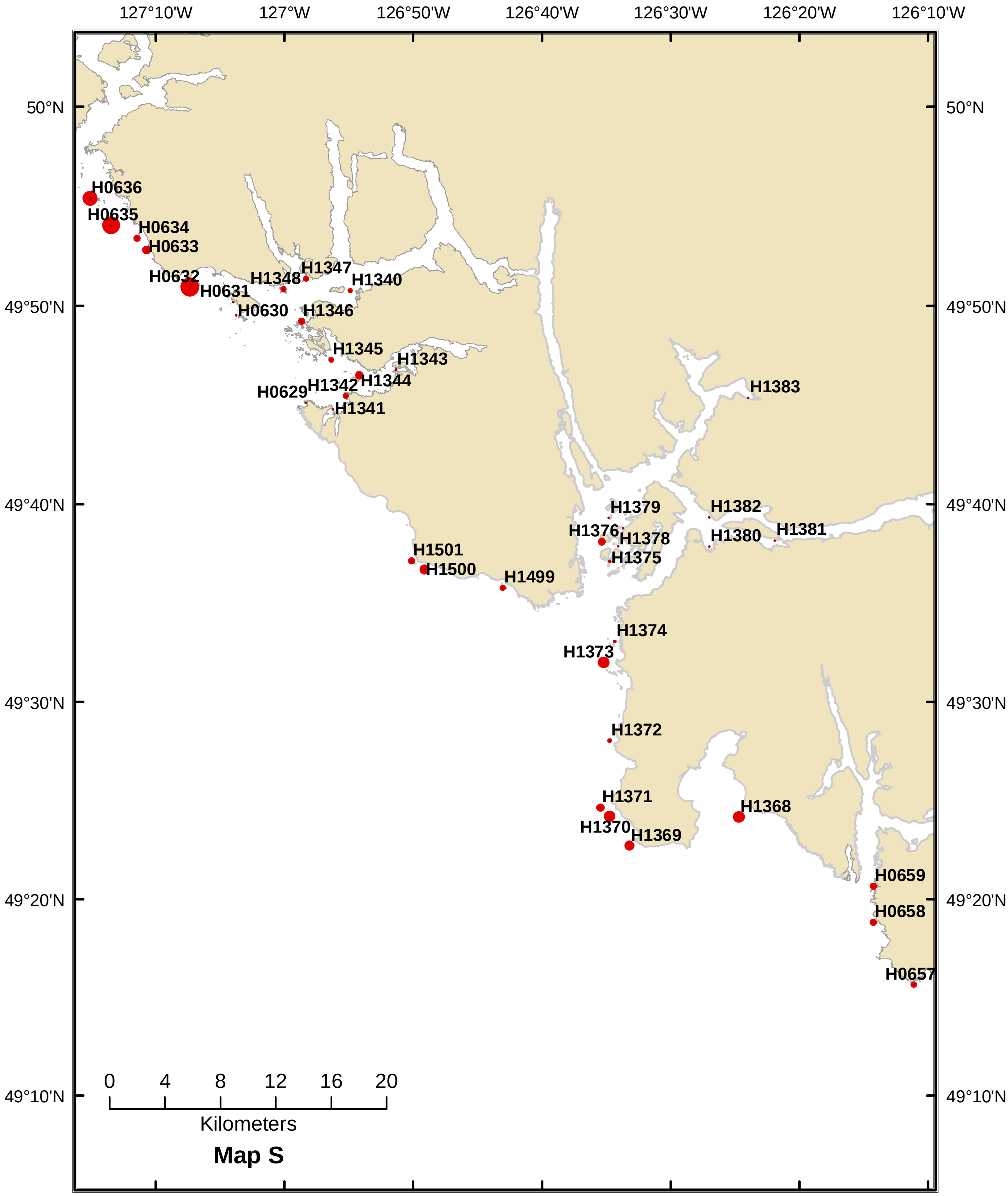
H0664
H1392
H0663
H0661
H0662
0
4
8
12
16
20
Kilometers
Map Q


128°W
127°50'W
127°40'W
127°30'W
127°20'W
127°10'W
127°W
50°30'N
50°20'N
50°10'N
50°N
49°50'N
H0673
H0741
H0407
H0688
H0672
H0686
H0670
H0687
H0669
H0668
H0666
H0665
H1393
H0664
H1392
H0663
H0661
H0662
H1391
H0660
H0416
H0638
H1390
H0639
H1386
H0582
H1385
H1387
H0583
H0640
H1389
H0586
H1388
H0584
H0637
H0585
H1384
H0636
H0635
H0634
H0633
H0632
H1348
H1347
H0631
H0630
H1346
H1345
H0629
H1341
0
4
8
12
16
20
Kilometers
Map R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126°50'W
126°40'W
126°30'W
126°20'W
126°10'W
50°N
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49°30'N
49°20'N
49°10'N
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H0635
H0634
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H0631
H0630
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H1345
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H1378
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H1500
H1499
H1374
H1373
H1372
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H1368
H0659
H0658
H0657
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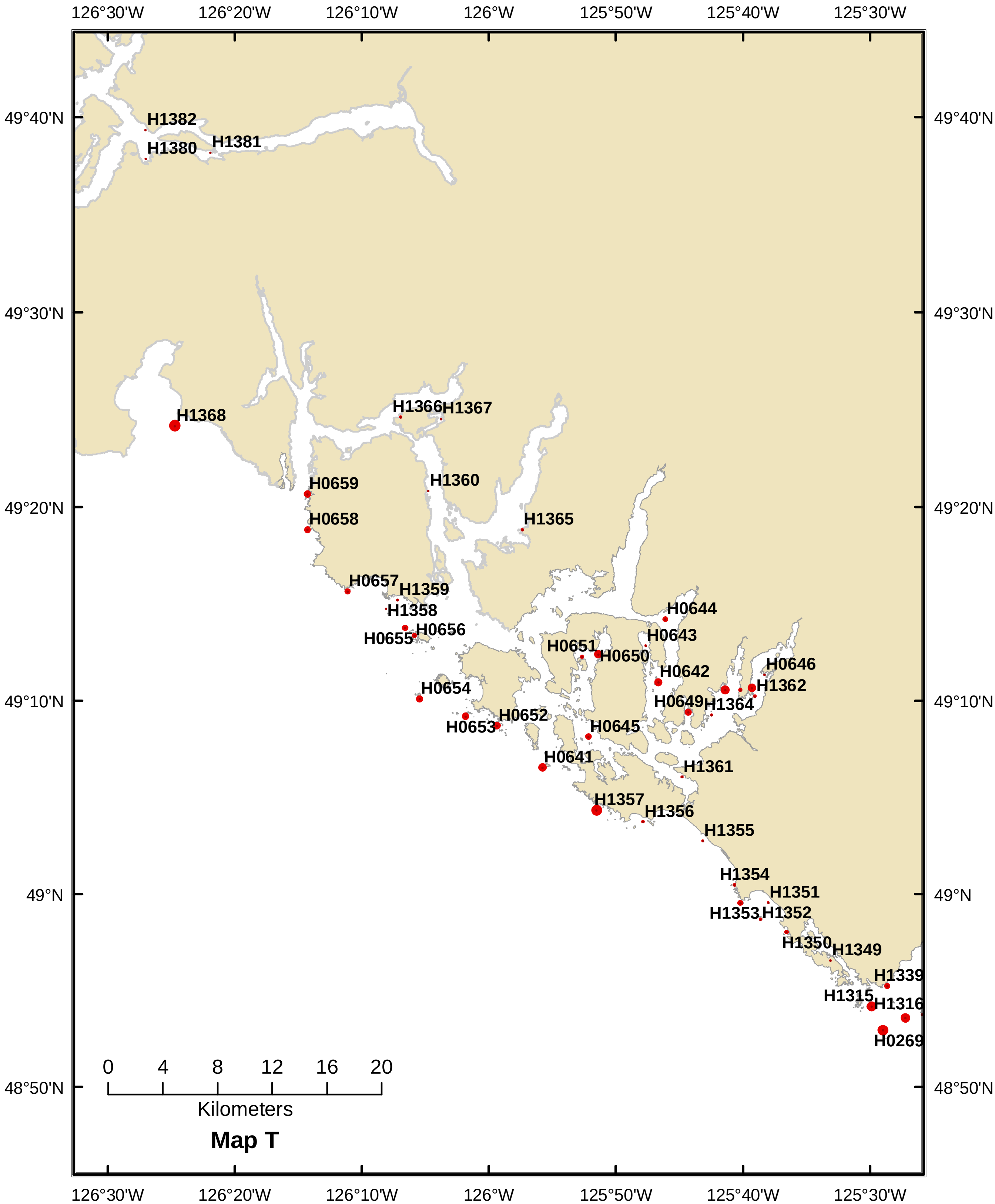
4
8
12
16
20
Kilometers
Map S


126°30'W
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126°10'W
126°W
125°50'W
125°40'W
125°30'W
49°40'N
49°30'N
49°20'N
49°10'N
49°N
48°50'N
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H1367
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H0643
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H0650
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H0646
H1362
H0654
H0649
H1364
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H0653
H0645
H0641
H1361
H1357
H1356
H1355
H1354
H1351
H1353
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4
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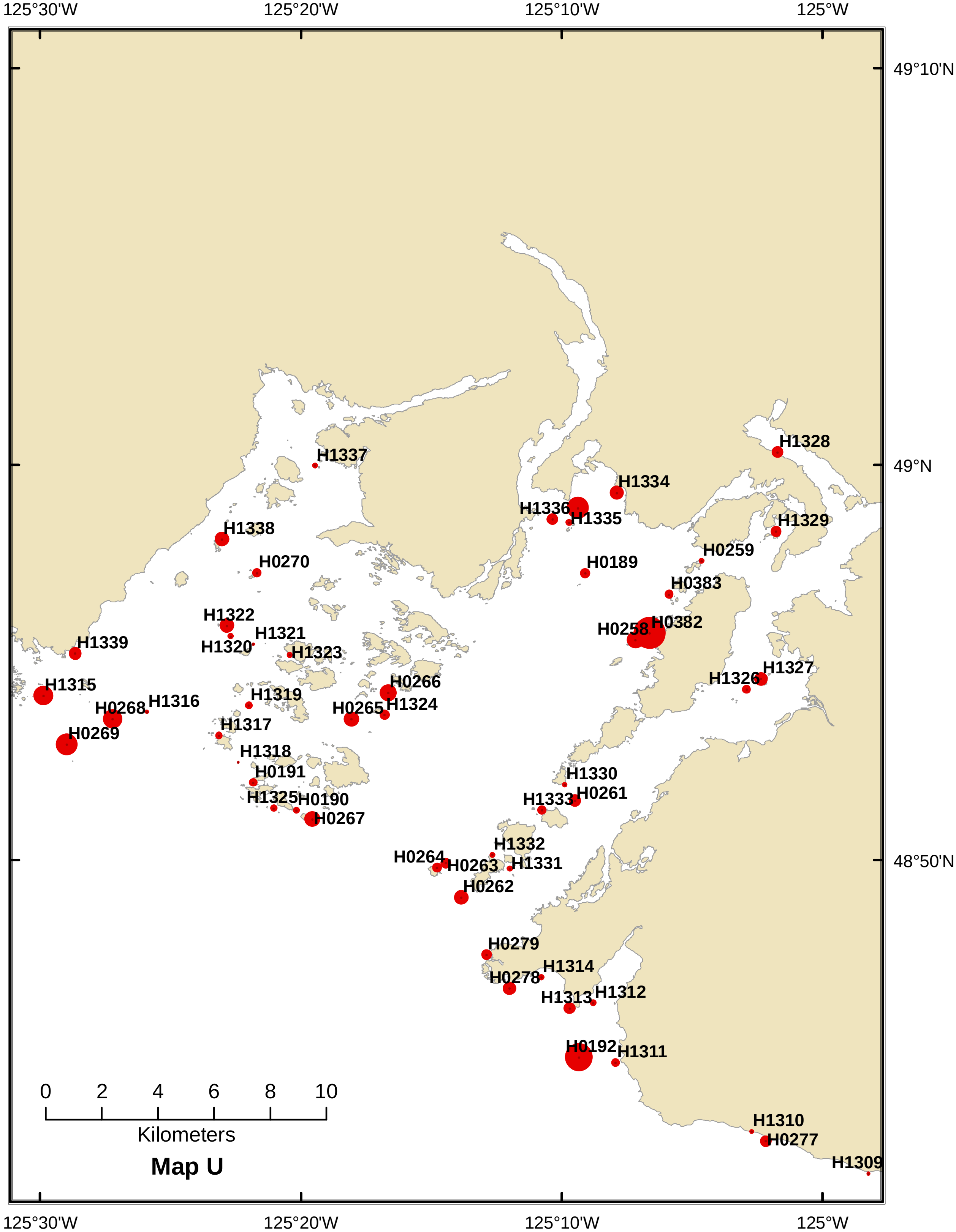
12
16
20
Kilometers

Map T


125°30'W
125°20'W
125°10'W
125°W
49°10'N
49°N
48°50'N
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H1337
H1334
H1336
H1335
H1329
H1338
H0270
H0189
H0259
H0383
H1322
H1321
H1320
H1323
H1339
H0258
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H1319
H0266
H0265
H1324
H1326
H1327
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H1318
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H0190
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H1333
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H0263
H1331
H0262
H0279
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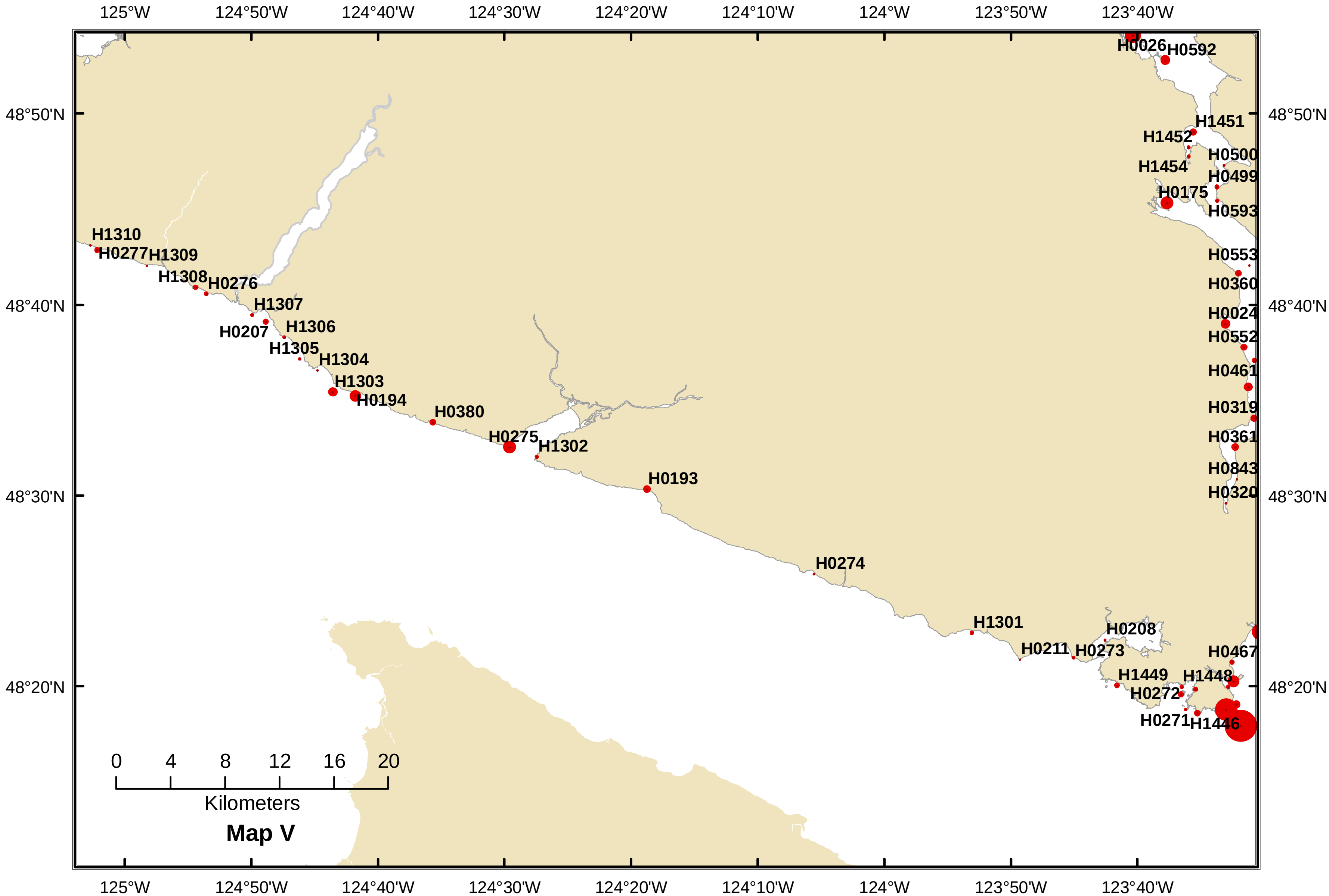
H1312
H0192
H1311
H1310
H0277
H1309
0 2 4 6 8 10
Kilometers
Map U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124°50'W
124°40'W
124°30'W
124°20'W
124°10'W
124°W
123°50'W
123°40'W
48°50'N
48°40'N
48°30'N
48°20'N
H0026
H0592
H1451
H1452
H0500
H1454
H0499
H0175
H0593
H1310
H0277
H1309
H1308
H0276
H0553
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H1307
H0207
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H0361
H0193
H0843
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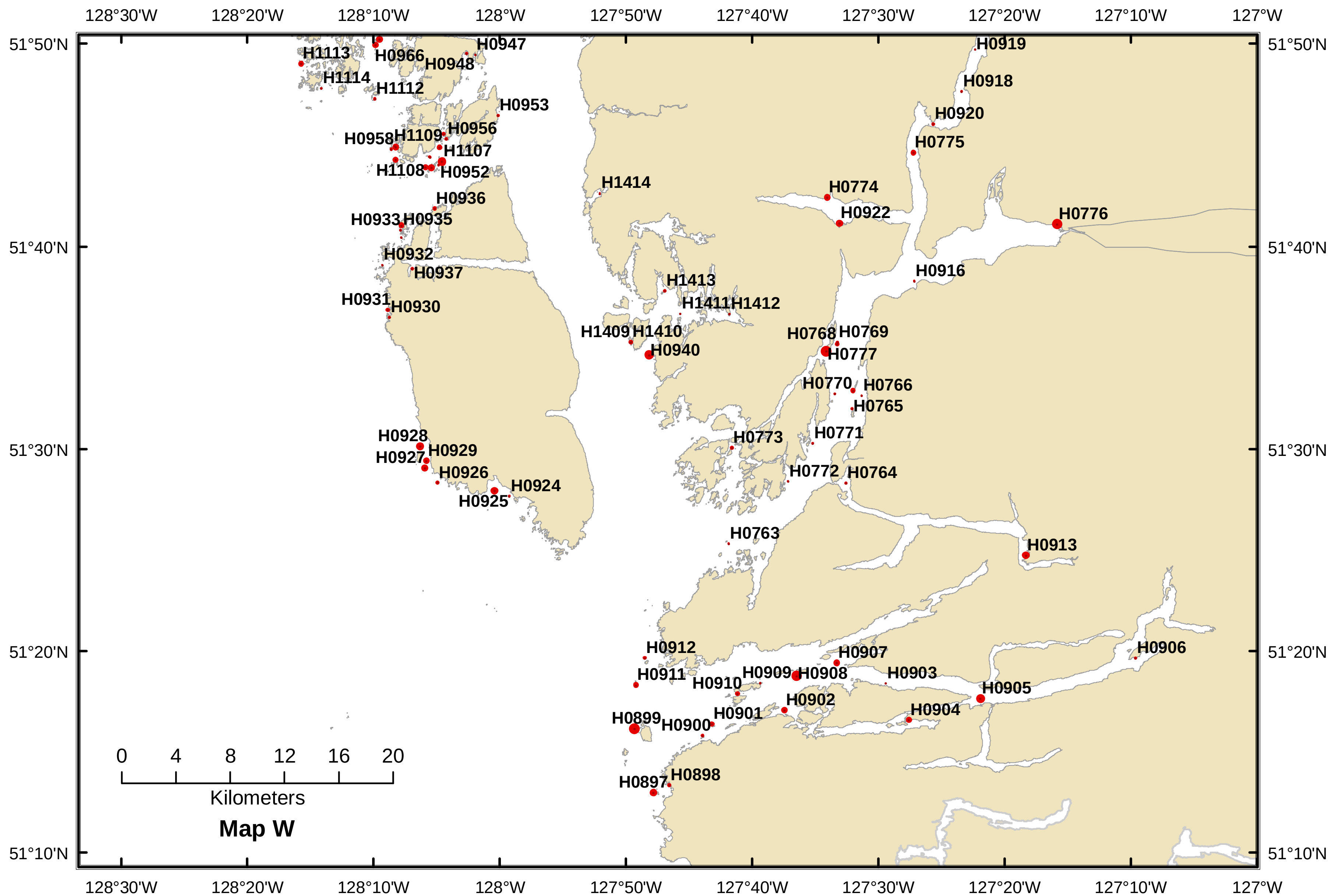
16
20
Kilometers
Map V


128°30'W
128°20'W
128°10'W
128°W
127°50'W
127°40'W
127°30'W
127°20'W
127°10'W
127°W
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51°30'N
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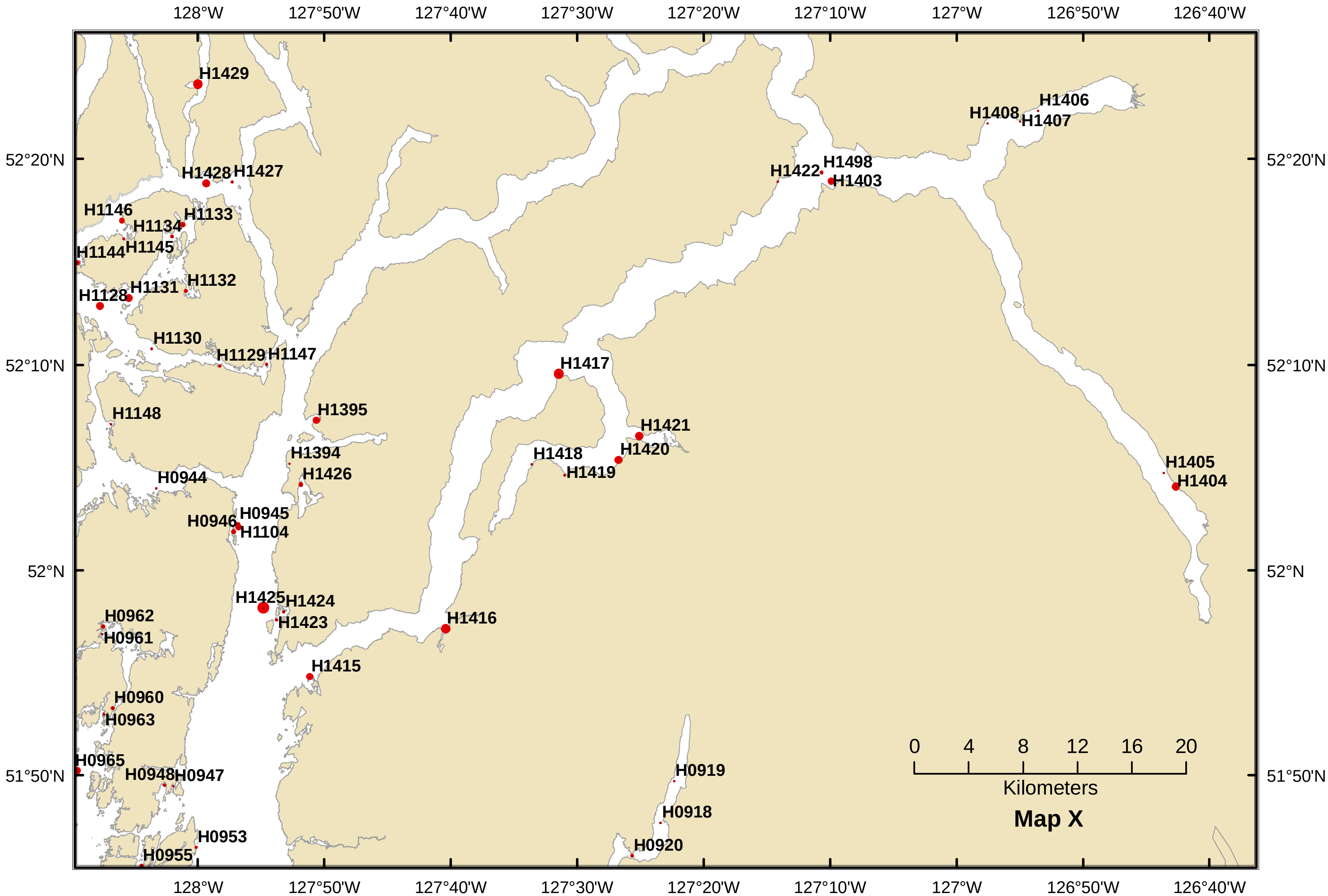
4
8
12
16
20
Kilometers
Map W


128°W
127°50'W
127°40'W
127°30'W
127°20'W
127°10'W
127°W
126°50'W
126°40'W
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52°10'N
52°N
51°50'N
H1429
H1428
H1427
H1146
H1133
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H1145
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H1132
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H1129
H1147
H1148
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H0945
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H0955
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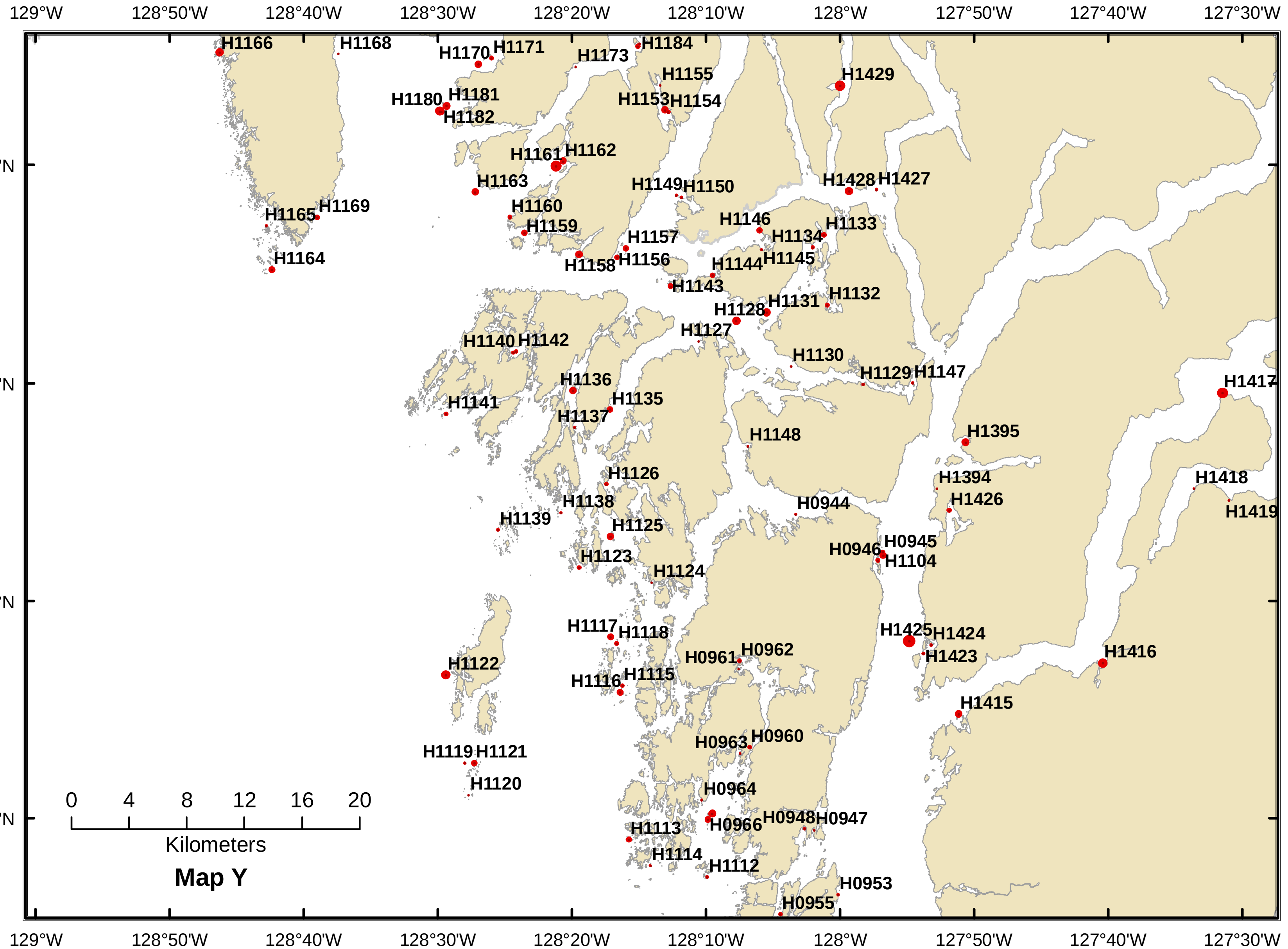
20
Kilometers
Map X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128°20'W
128°10'W
128°W
127°50'W
127°40'W
127°30'W
52°20'N
52°10'N
52°N
51°50'N
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H0960
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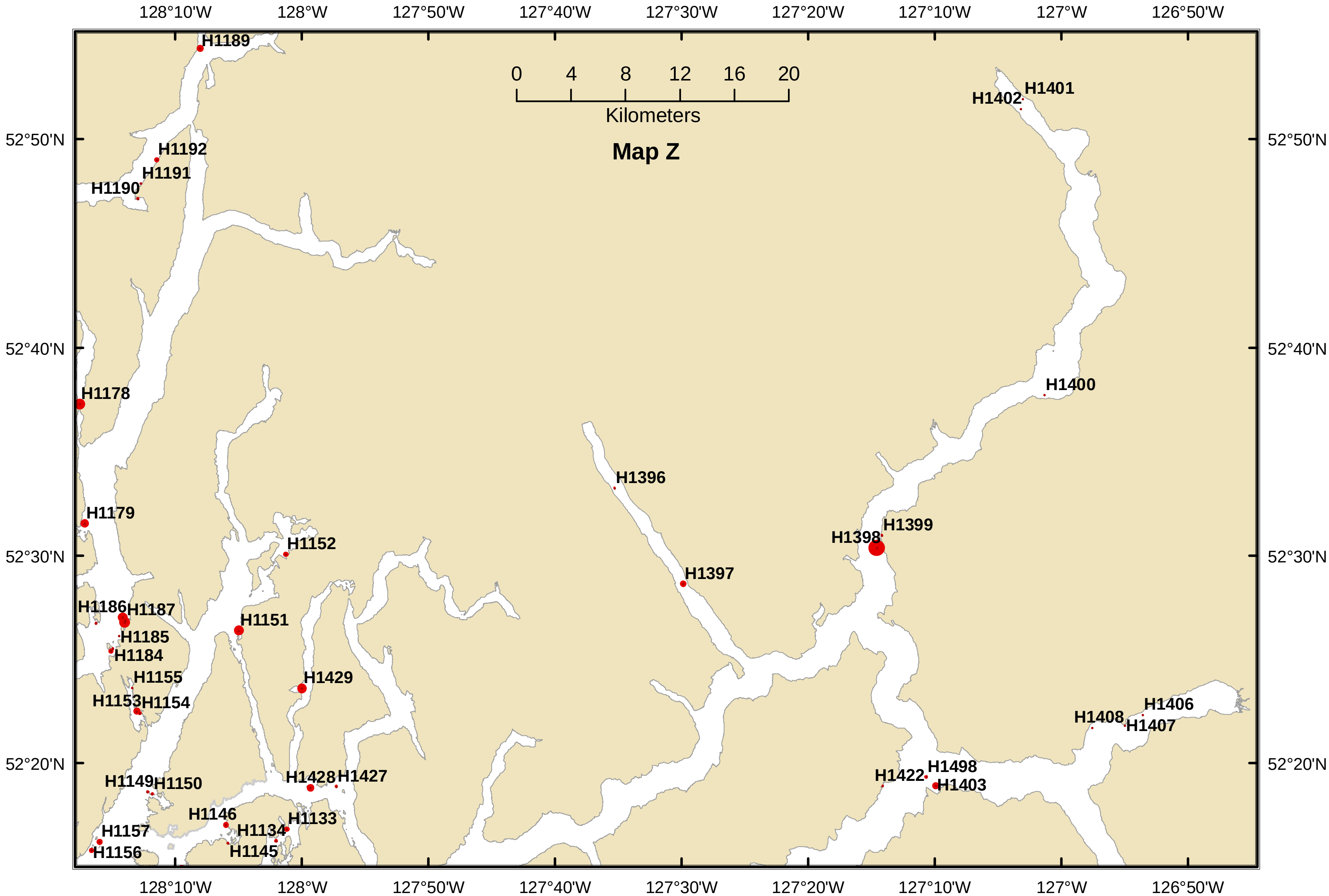
16
20
Kilometers
Map Y



128°10'W
128°W
127°50'W
127°40'W
127°30'W
127°20'W
127°10'W
127°W
126°50'W
52°50'N
52°40'N
52°30'N
52°20'N
0
4
8
12
16
20
Kilometers
Map Z
H1189
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H1191
H1190
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H1187
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H1185
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H1145
H1401
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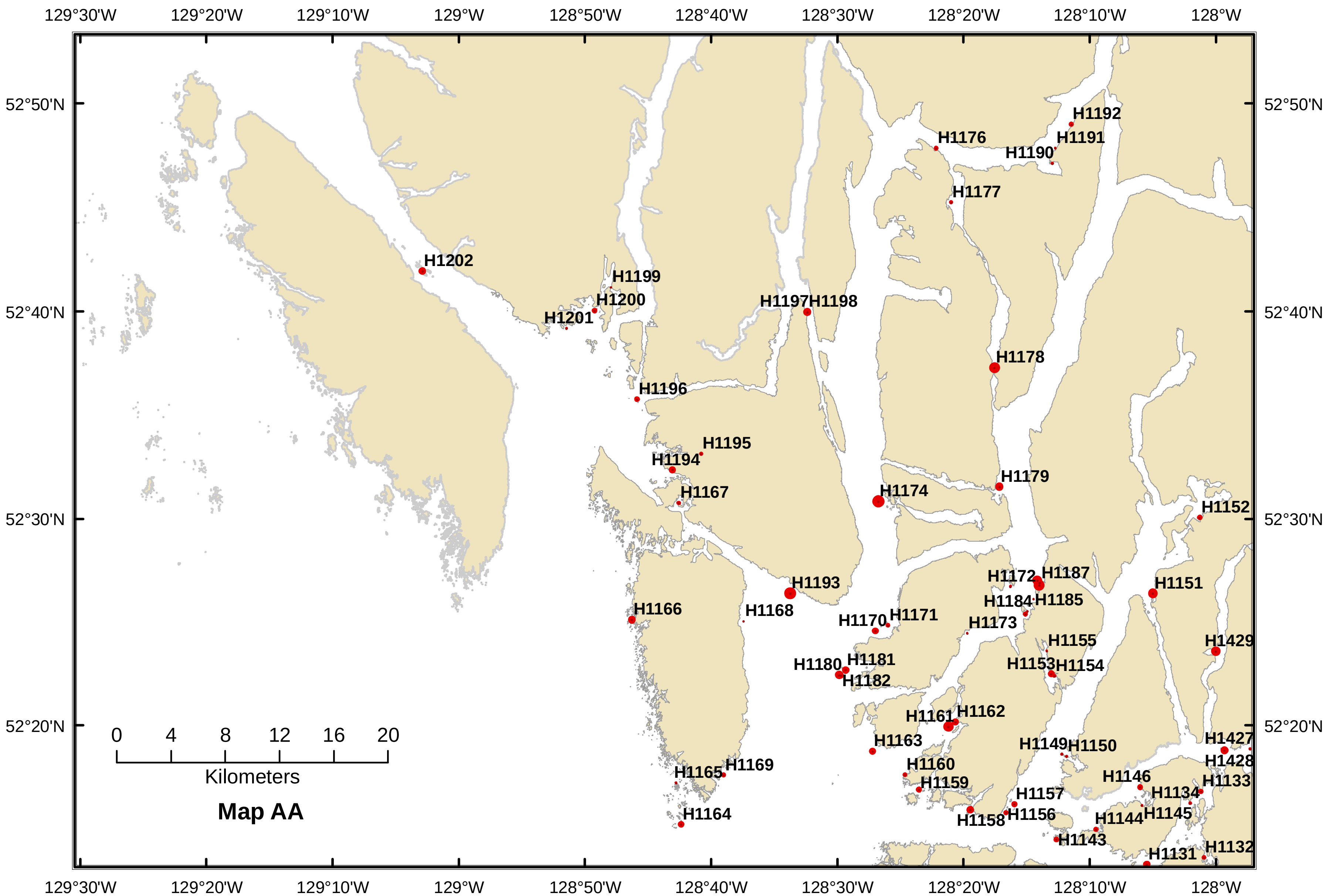
H1403


129°30'W
129°20'W
129°10'W
129°W
128°50'W
128°40'W
128°30'W
128°20'W
128°10'W
128°W
52°50'N
52°40'N
52°30'N
52°20'N
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H1191
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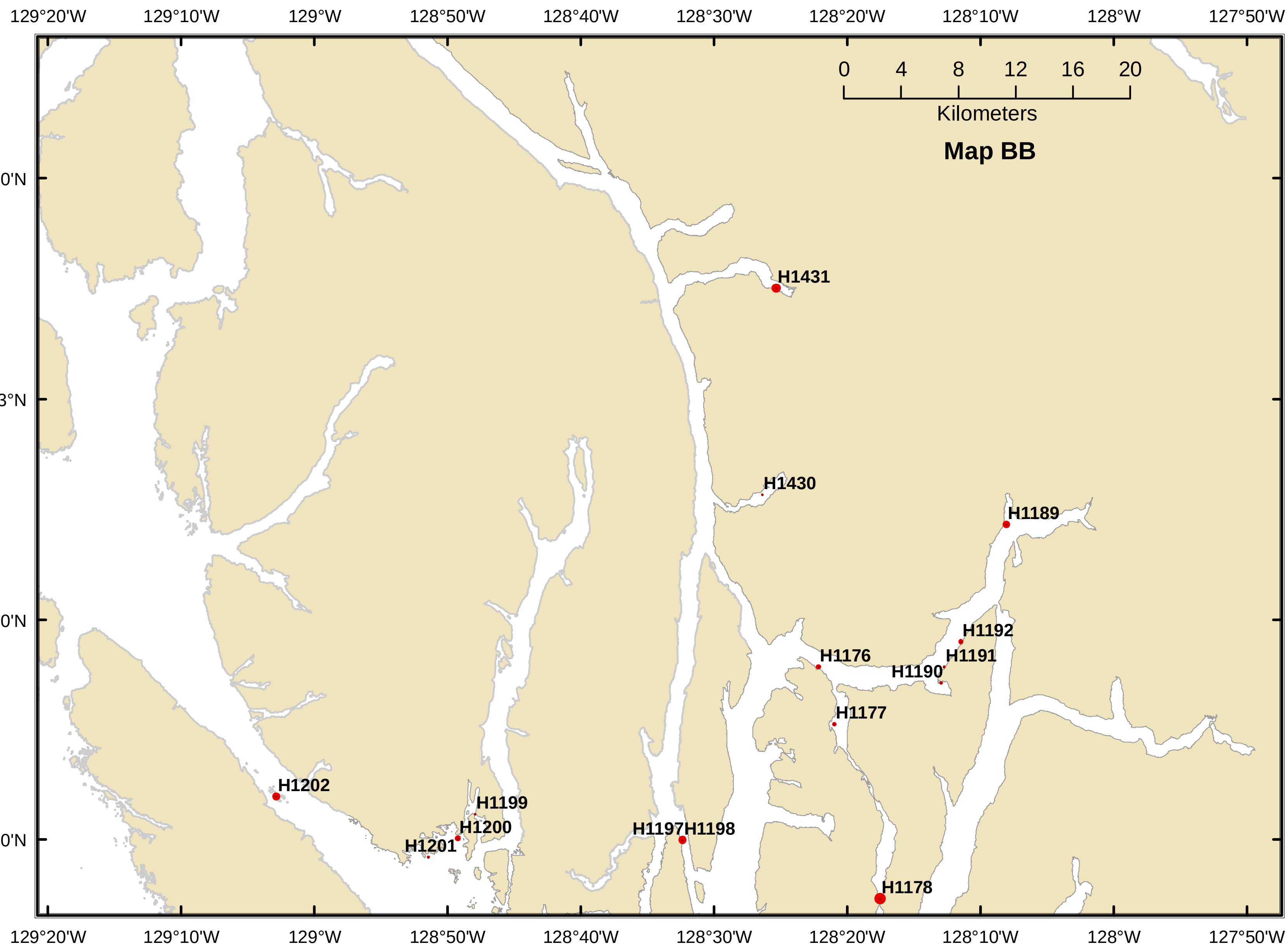
16
20
Kilometers
Map AA



129°20'W
129°10'W
129°W
128°50'W
128°40'W
128°30'W
128°20'W
128°10'W
128°W
127°50'W
53°10'N
53°N
52°50'N
52°40'N
0
4
8
12
16
20
Kilometers
Map BB
H1431
H1430
H1189
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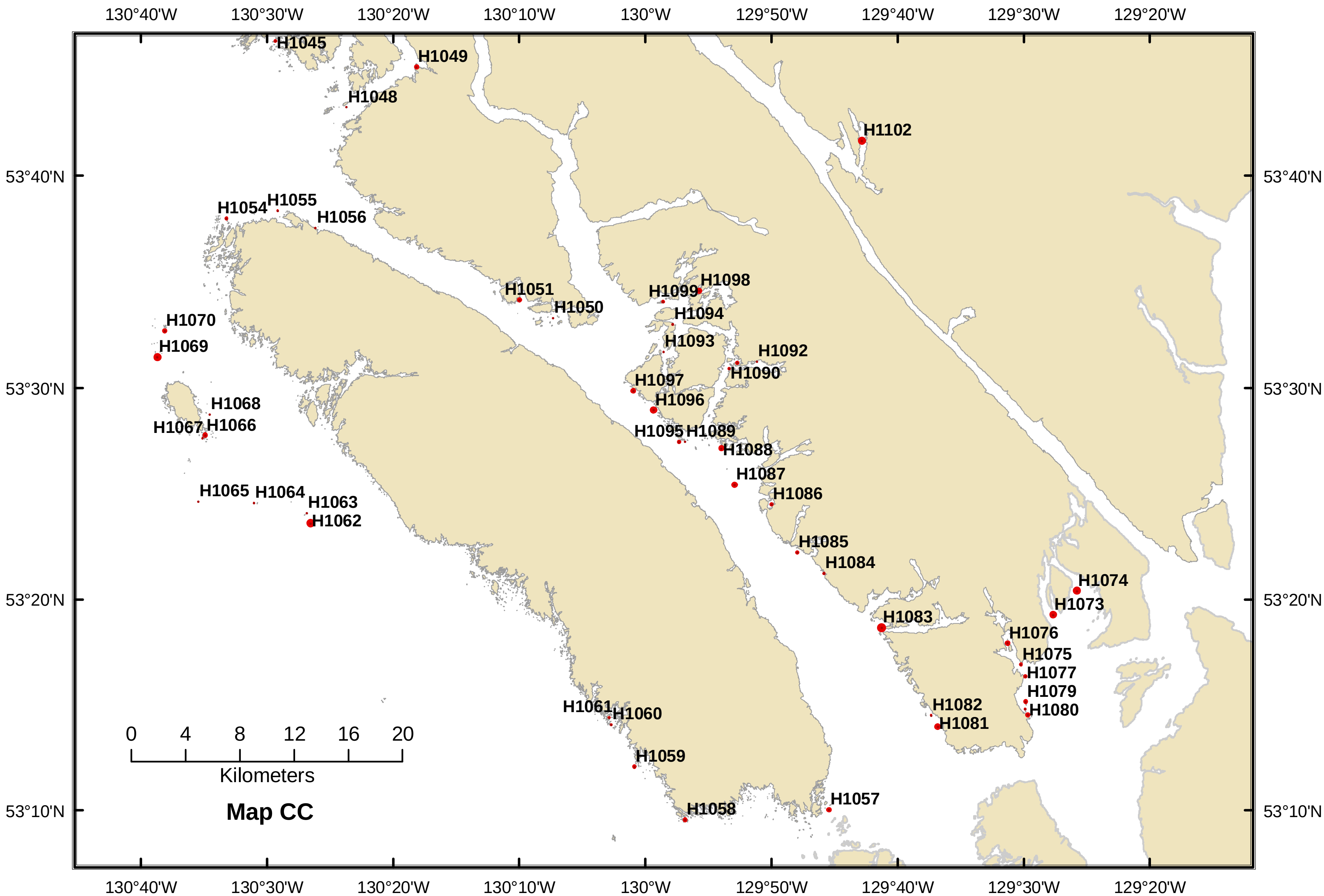
H1191
H1190
H1177
H1202
H1199
H1200
H1201
H1197
H1198
H1178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130°W
129°50'W
129°40'W
129°30'W
129°20'W
53°40'N
53°30'N
53°20'N
53°10'N
H1045
H1049
H1048
H1102
H1054
H1055
H1056
H1051
H1050
H1099
H1098
H1094
H1070
H1069
H1093
H1092
H1090
H1097
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H1095
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H1088
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H1064
H1063
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H1074
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H1075
H1077
H1079
H1080
H1082
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H1058
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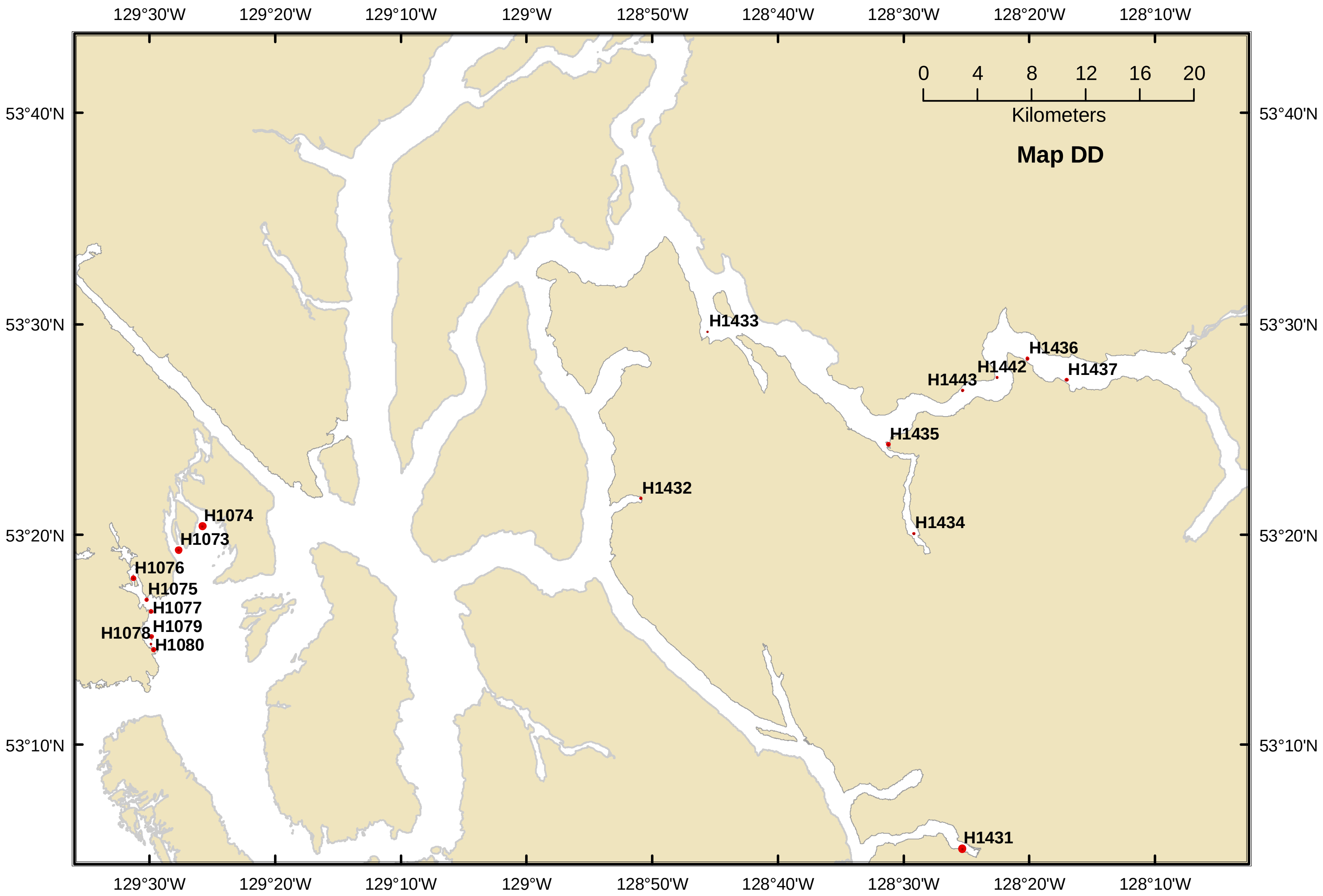
4
8
12
16
20
Kilometers
Map CC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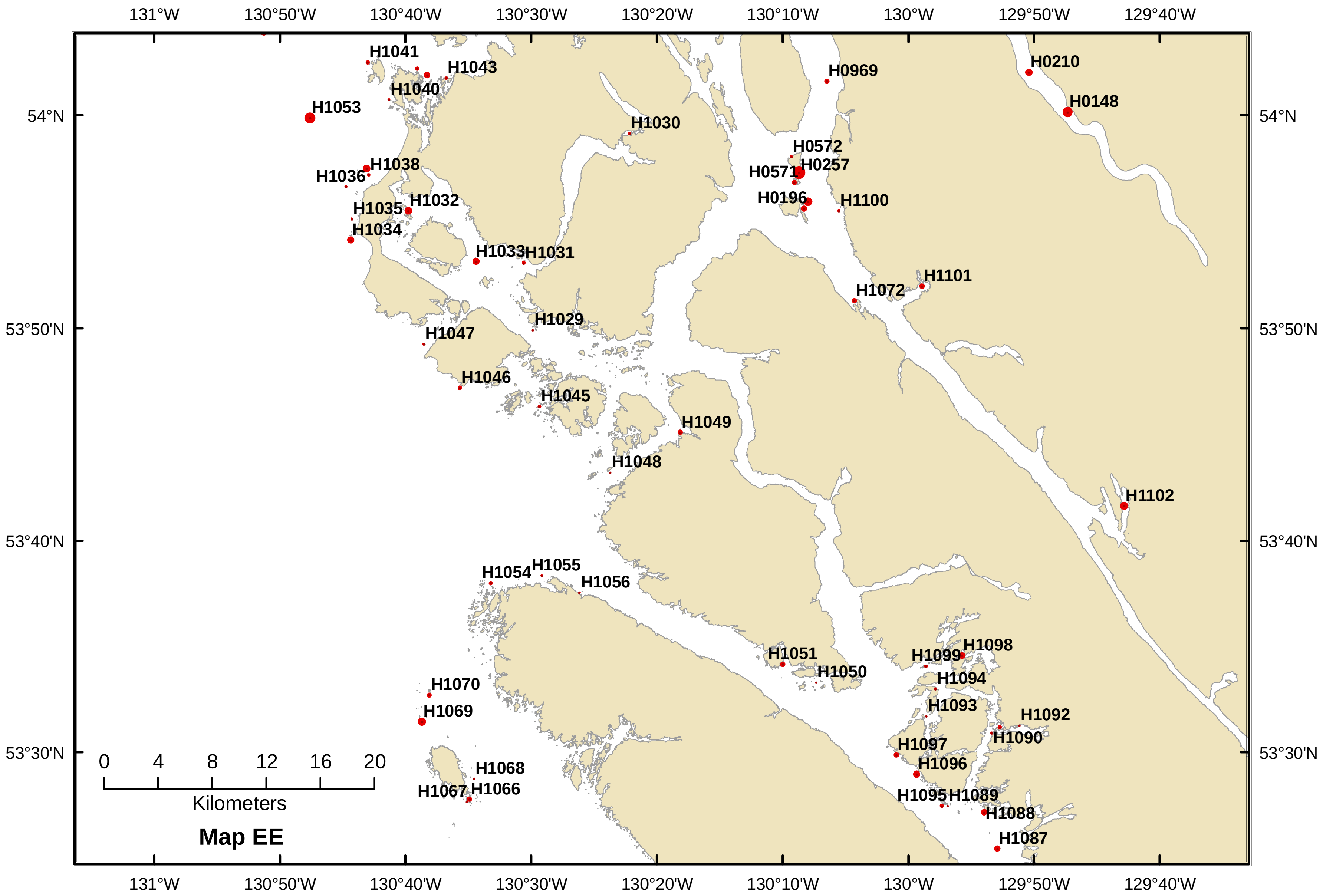
128°20'W
128°10'W
53°40'N
53°30'N
53°20'N
53°10'N
0
4
8
12
16
20
Kilometers
Map DD
H1433
H1436
H1442
H1437
H1443
H1435
H1432
H1434
H1074
H1073
H1076
H1075
H1077
H1079
H1078
H1080
H1431



131°W
130°50'W
130°40'W
130°30'W
130°20'W
130°10'W
130°W
129°50'W
129°40'W
54°N
53°50'N
53°40'N
53°30'N
H1041
H1043
H1040
H1053
H1030
H0969
H0210
H0148
H0572
H0571
H0257
H0196
H1100
H1038
H1036
H1032
H1035
H1034
H1033
H1031
H1101
H1072
H1029
H1047
H1046
H1045
H1049
H1048
H1102
H1054
H1055
H1056
H1051
H1050
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H1090
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H1096
H1095
H1089
H1088
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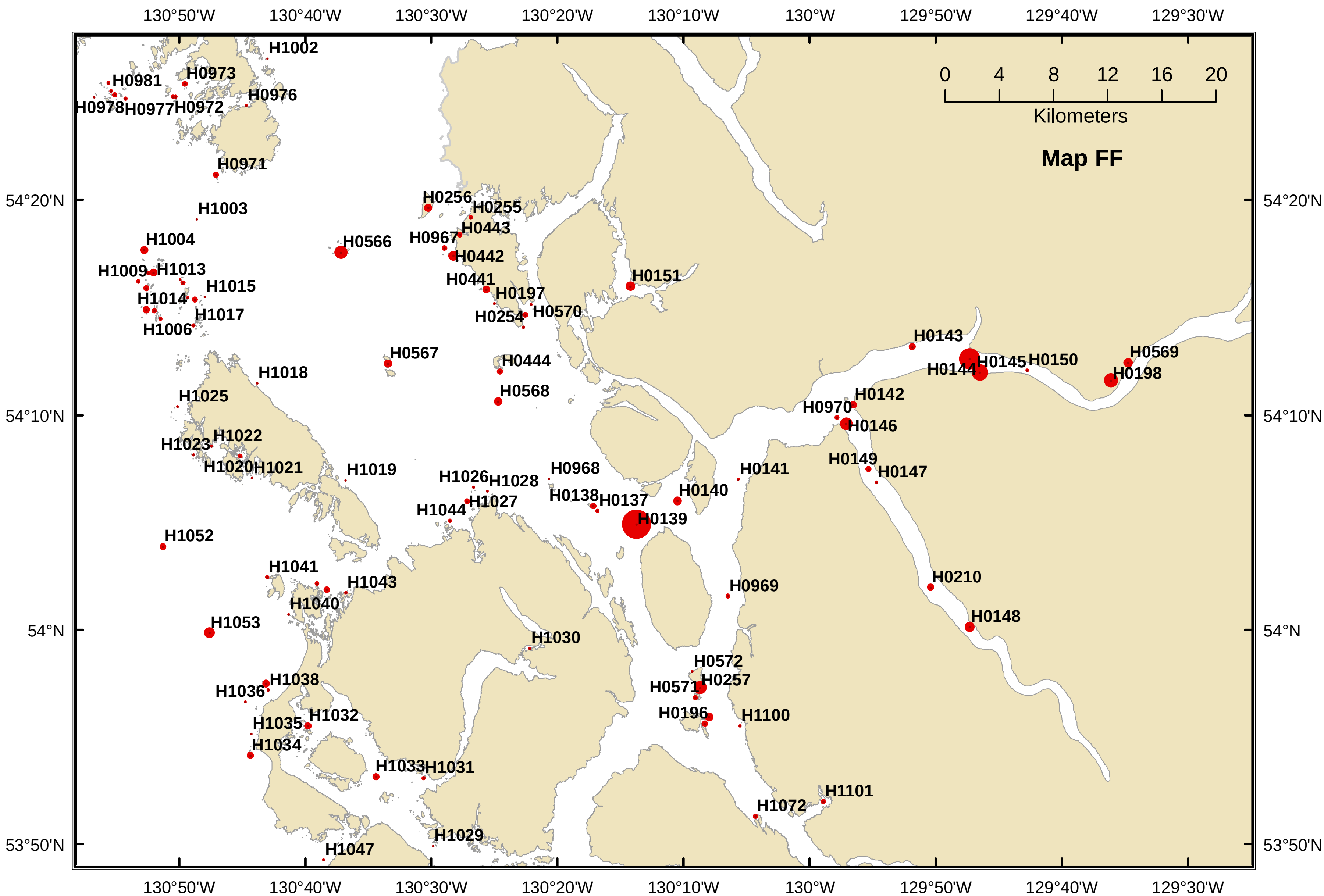
H1069
H1068
H1067
H1066
0
4
8
12
16
20
Kilometers
Map EE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130°20'W
130°10'W
130°W
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129°40'W
129°30'W
54°20'N
54°10'N
54°N
53°50'N
H1002
H0973
H0981
H0976
H0978
H0977
H0972
H0971
H1003
H0256
H0255
H0443
H0967
H0566
H1004
H0442
H1009
H1013
H1015
H0441
H0151
H0197
H1014
H1017
H0254
H0570
H1006
H0143
H0567
H0444
H0145
H0150
H0569
H1018
H0144
H0198
H0568
H1025
H0142
H0970
H0146
H1022
H1023
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H0147
H1020
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H1019
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H1028
H0968
H0141
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H0137
H0140
H1044
H1027
H0139
H1052
H1041
H0210
H1043
H0969
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H0148
H1053
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H0571
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H1031
H1101
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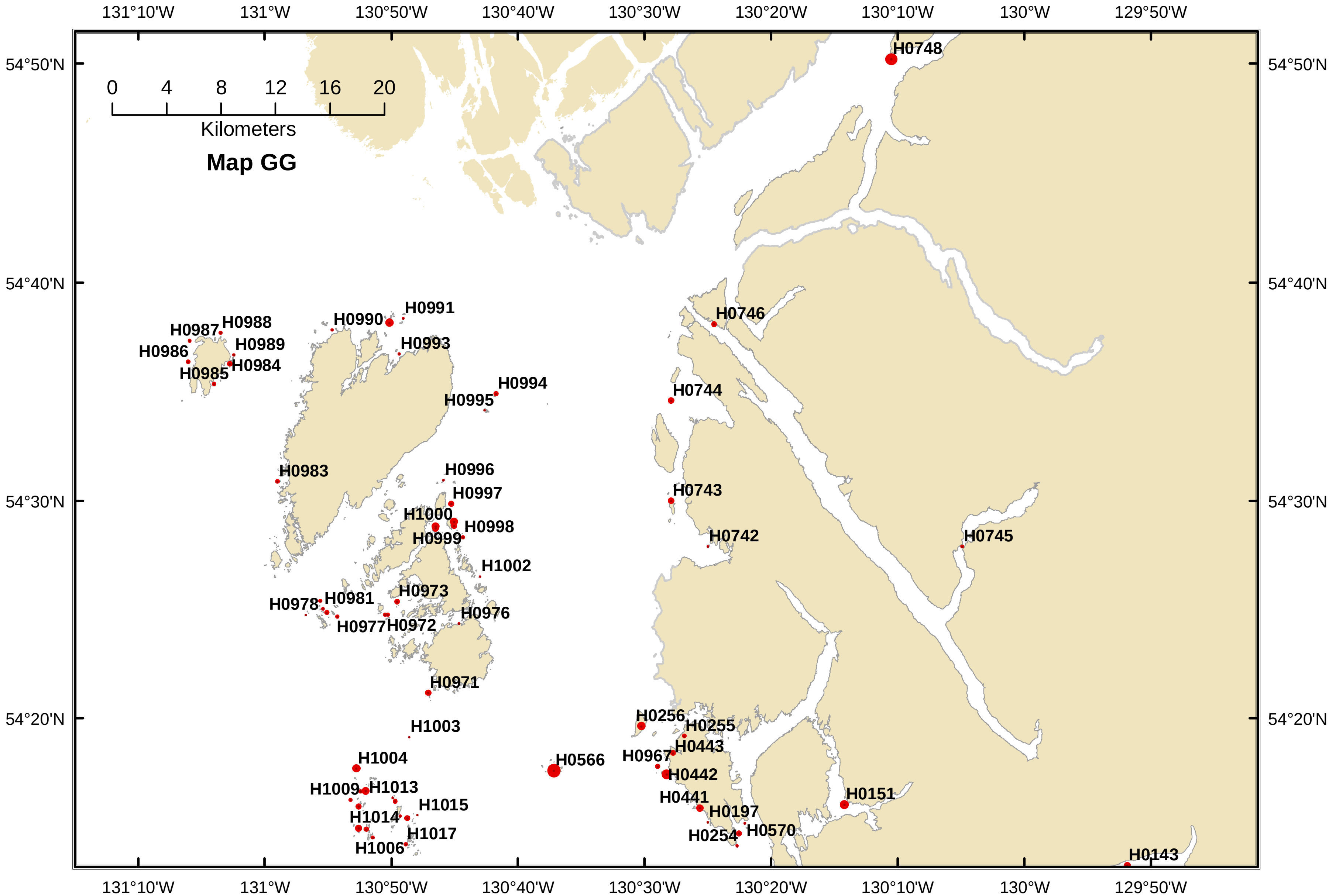
H1029
H1047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130°20'W
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130°W
129°50'W
54°50'N
54°40'N
54°30'N
54°20'N
0 4 8 12 16 20
Kilometers
Map GG
H0748
H0987
H0988
H0986
H0989
H0984
H0985
H0990
H0991
H0993
H0994
H0995
H0746
H0744
H0983
H0996
H0997
H1000
H0998
H0999
H0743
H0742
H0745
H1002
H0973
H0978
H0981
H0976
H0977
H0972
H0971
H1003
H0256
H0255
H0443
H0967
H0442
H0566
H1004
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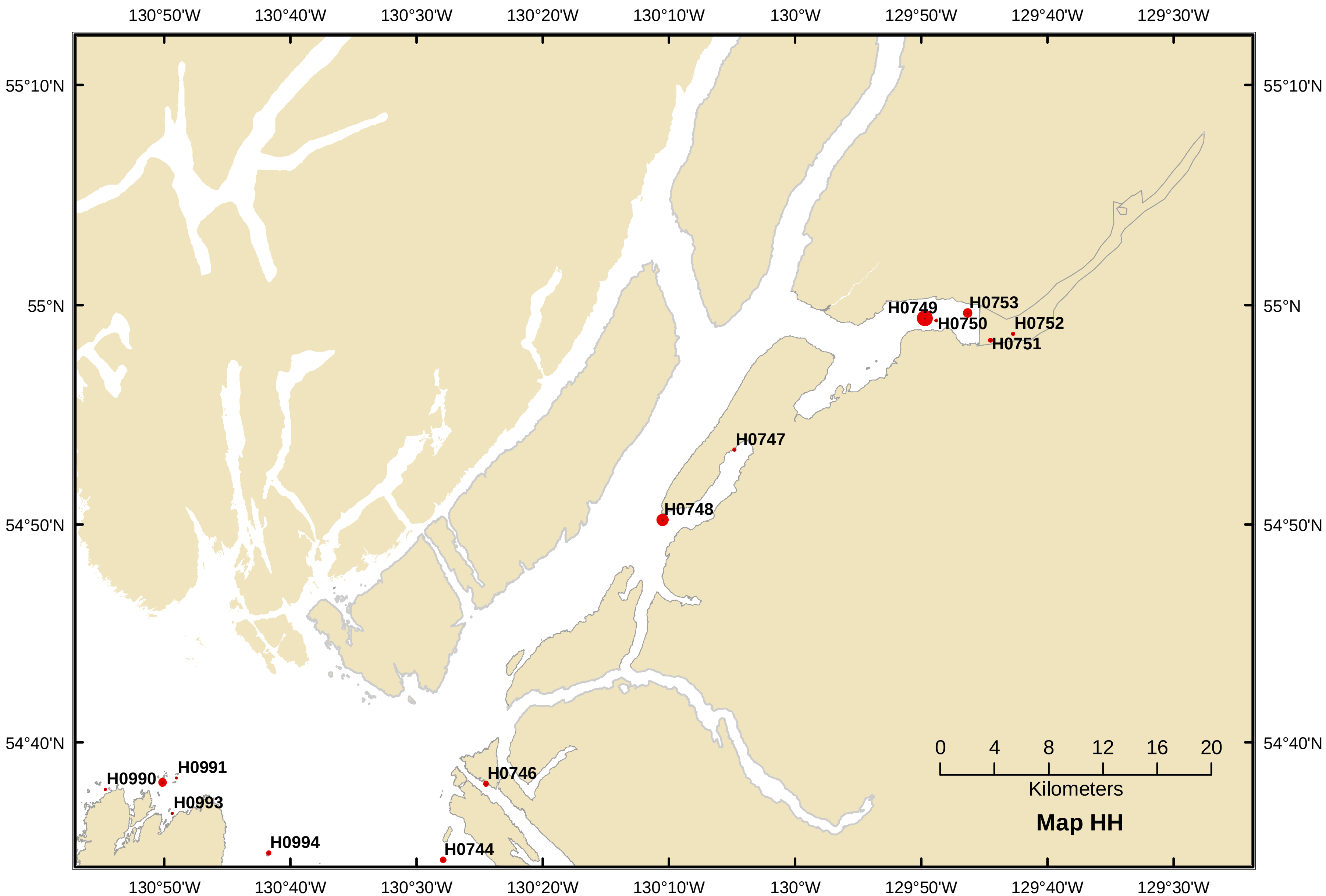
H1015
H1014
H1017
H1006
H0441
H0197
H0151
H0254
H0570
H0143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129°40'W
129°30'W
55°10'N
55°N
54°50'N
54°40'N
H0749
H0750
H0753
H0752
H0751
H0747
H0748
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H0990
H0993
H0994
H0744
H0746
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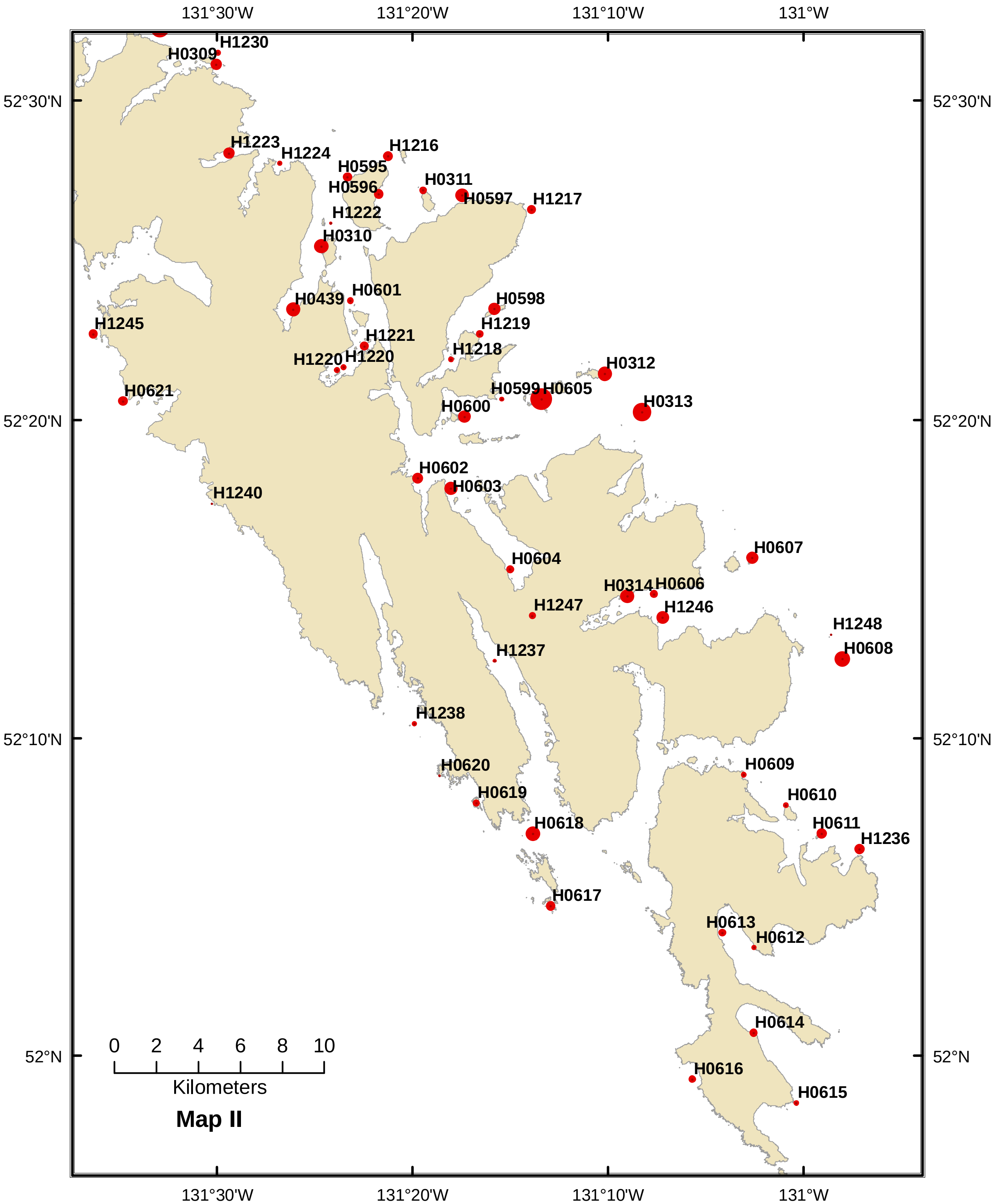
4
8
12
16
20
Kilometers
Map HH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52°N
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H1223
H1224
H1216
H0595
H0596
H0311
H0597
H1217
H1222
H0310
H0439
H0601
H0598
H1245
H1221
H1219
H1220
H1220
H1218
H0312
H0621
H0599
H0605
H0600
H0313
H0602
H0603
H1240
H0604
H0607
H0314
H0606
H1247
H1246
H1248
H1237
H0608
H1238
H0620
H0609
H0619
H0610
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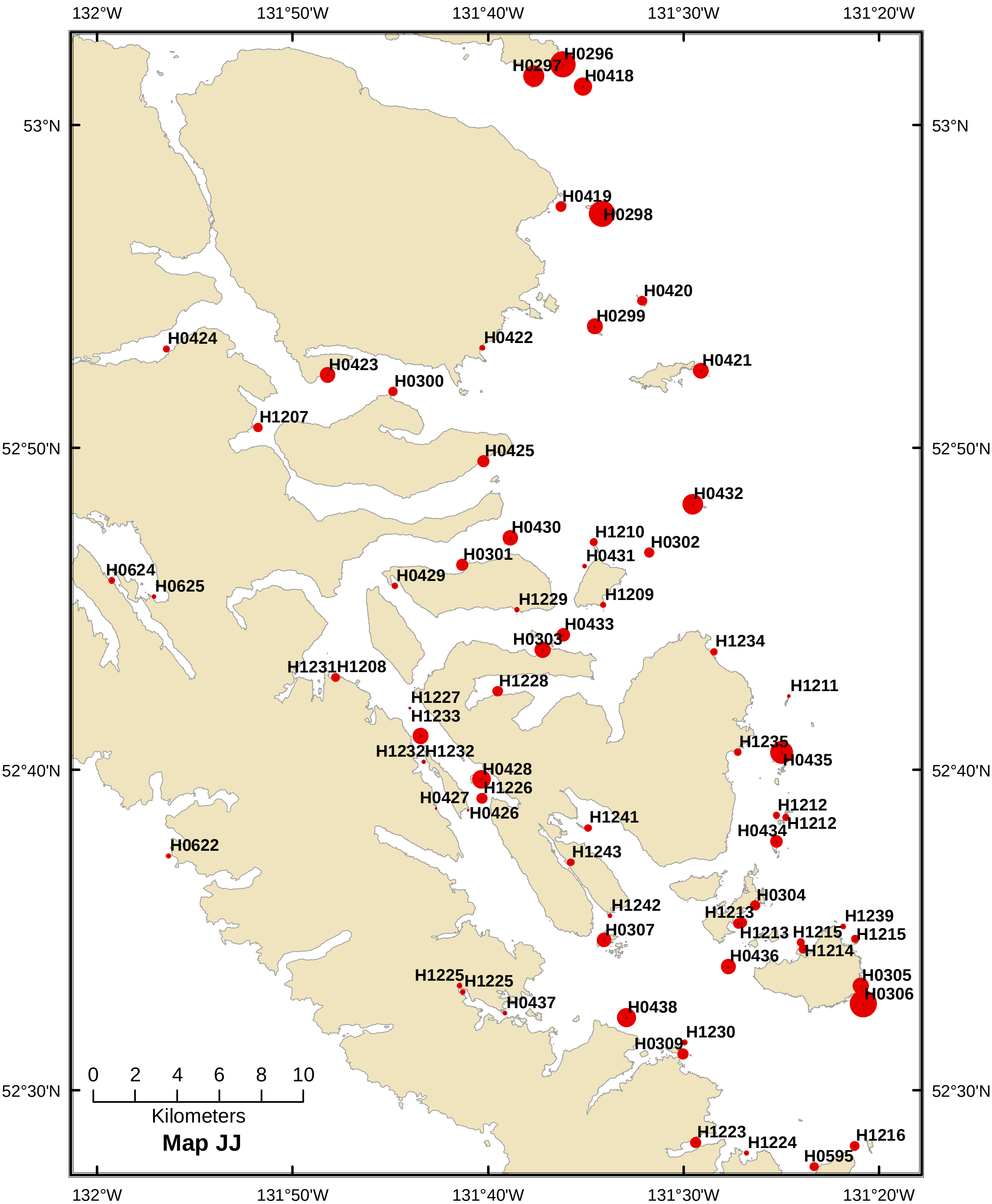
H0613
H0612
H0614
H0616
H0615
0 2 4 6 8 10
Kilometers

Map II


132°W
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131°30'W
131°20'W
53°N
52°50'N
52°40'N
52°30'N
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H0297
H0418
H0419
H0298
H0420
H0299
H0422
H0424
H0423
H0421
H0300
H1207
H0425
H0432
H0430
H1210
H0302
H0431
H0301
H0624
H0429
H0625
H1209
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H0433
H0303
H1234
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H1211
H1227
H1233
H1235
H0435
H1232H1232
H0428
H1226
H0427
H0426
H1212
H1212
H0434
H1241
H0622
H1243
H0304
H1242
H1239
H1213
H1213 H1215
H1215
H0307
H1214
H0436
H0305
H1225H1225
H0306
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H1230
H0309
0 2 4 6 8 10
Kilometers
Map JJ
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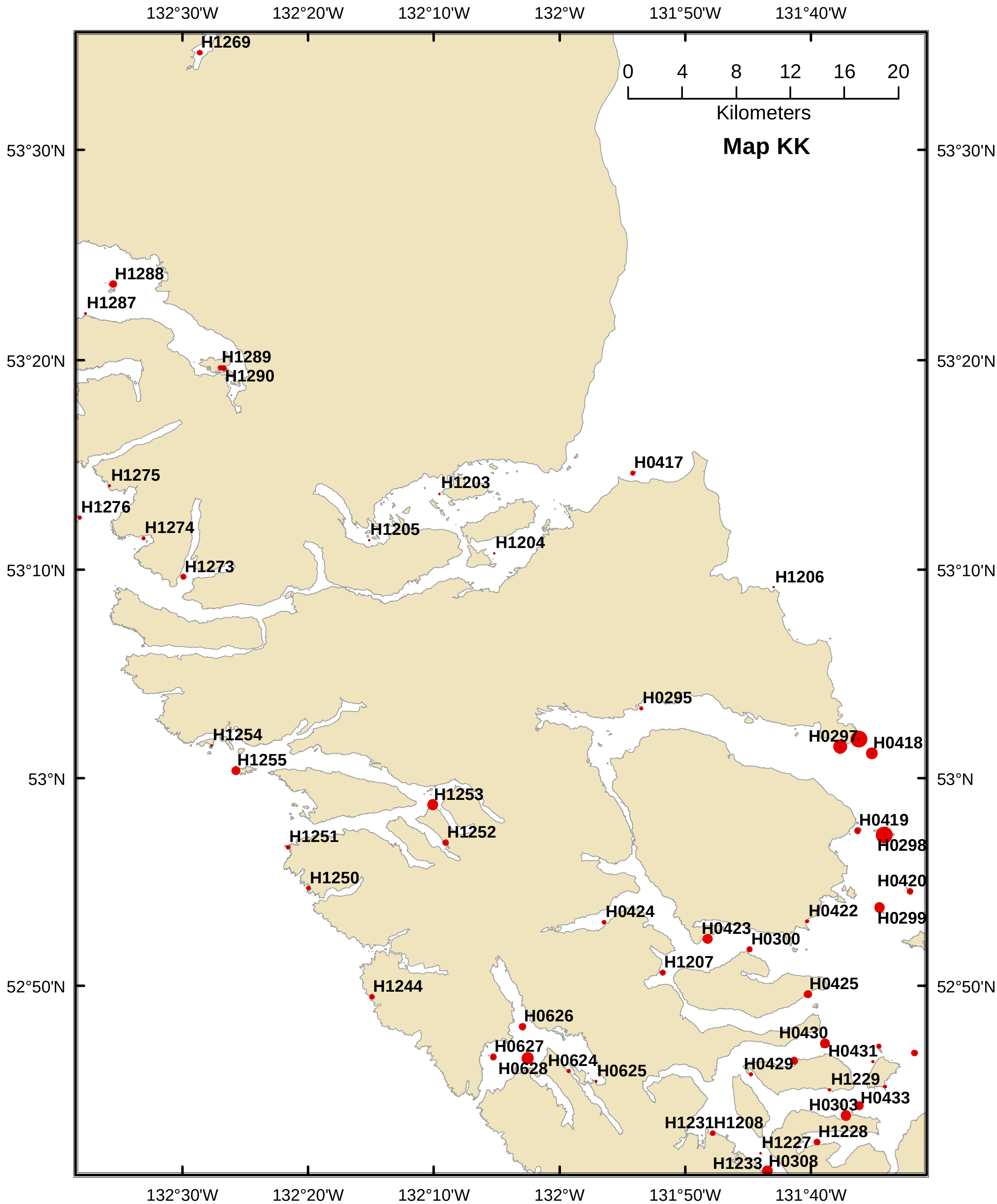
H1224
H1216
H0595



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132°10'W
132°W
131°50'W
131°40'W
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53°20'N
53°10'N
53°N
52°50'N
0
4
8
12
16
20
Kilometers
Map KK
H1269
H1288
H1287
H1289
H1290
H1275
H1276
H1274
H1273
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H1205
H1204
H0417
H1206
H0295
H1254
H1255
H0297
H0418
H1253
H1252
H1251
H0419
H0298
H1250
H0420
H0424
H0422
H0299
H0423
H0300
H1207
H1244
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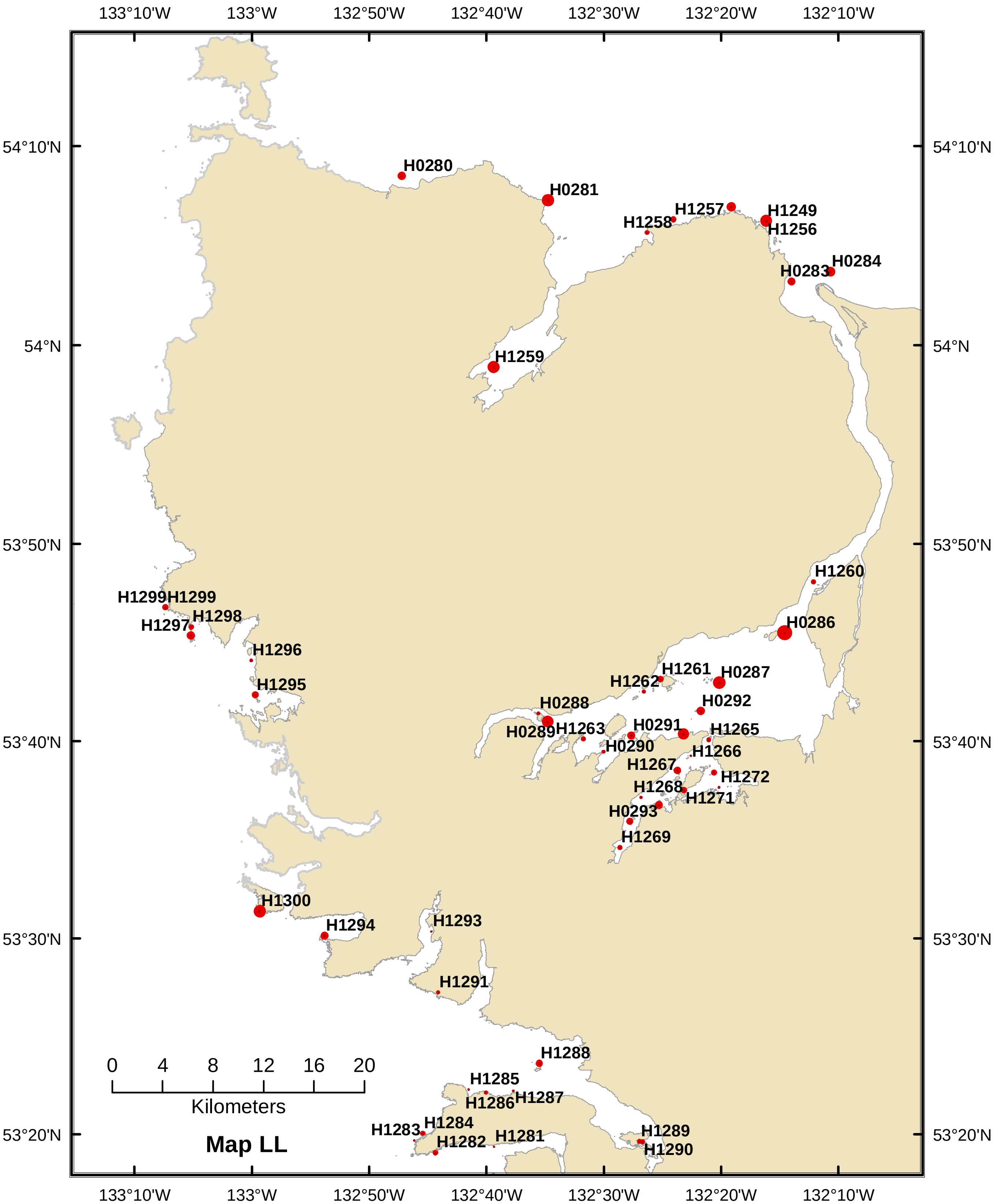
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53°50'N
53°40'N
53°30'N
53°20'N
H0280
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H0284
H1259
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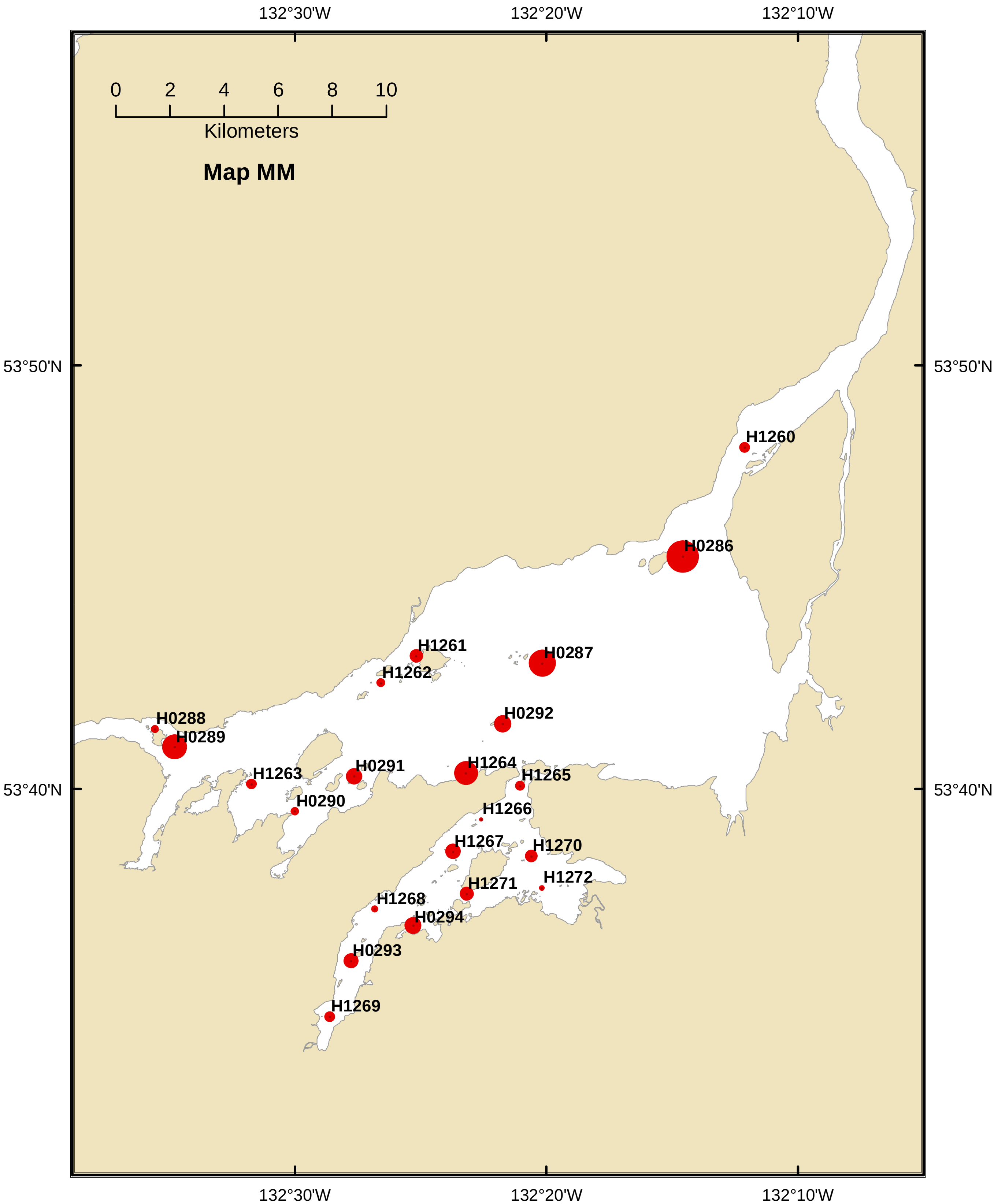
Kilometers
Map LL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2
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6
8
10
Kilometers
Map MM
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H0292
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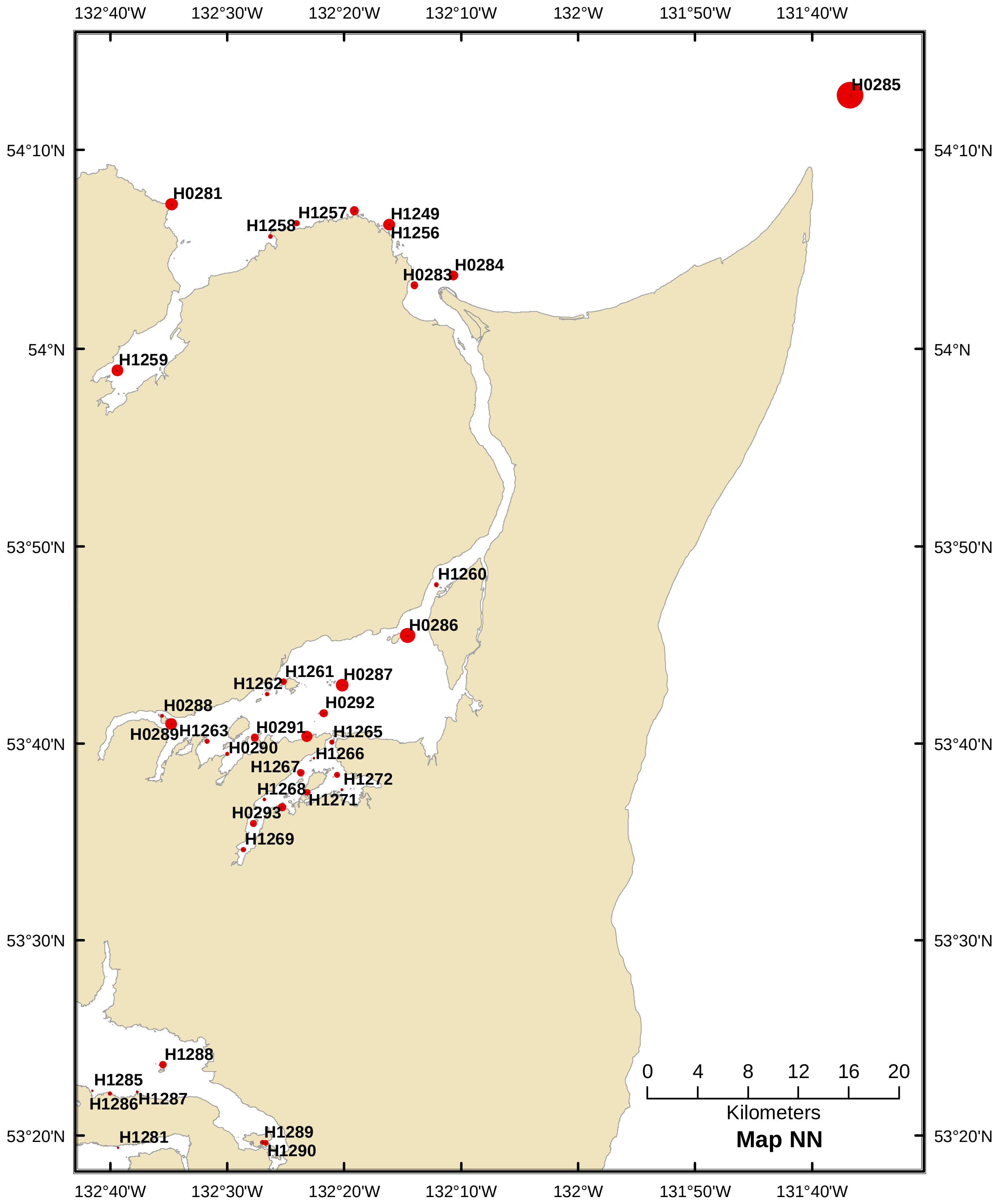
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Kilometers
Map NN