

Biomass Estimates for Yáanuu · Giinuu Giant Red Sea Cucumber (*Apostichopus californicus*, Stimpson, 1857) as Determined Through Surveys Conducted in Haida Gwaii from 2023 to 2024

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Conducted in Haida Gwaii from 2023 to 2024

by

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ABSTRACT

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Stock assessment surveys of the yáanu · giinu Giant Red Sea Cucumber (*Apostichopus californicus*, Stimpson, 1857) (hereafter Sea Cucumber), population in British Columbia have been ongoing since 1998. These surveys are conducted to estimate Sea Cucumber density, weight, and biomass, which are provided to Fisheries and Oceans Canada (DFO) Fisheries Management. From 2023 through 2024, four surveys were conducted in 32 Pacific Fisheries Management (PFM) subareas in collaboration with Xaadée 'Wáadluwaan Née · XaaydaGa 'Waadluxan Naay, the Council of the Haida Nation, following the Open Survey design.

Results are reported for each PFM subarea and/or Analysis Area. For PFM subareas within the Gwaii Haanas National Marine Conservation Area and Haida Heritage Site, data were grouped into either the Multiple Use or the Strict Protection Zones, and are also reported by zone.

Across these four density surveys, PFM subarea adult Sea Cucumber lower 90% confidence bound density estimates ranged from 0.00 to 43.50 Sea Cucumbers per metre of shoreline (c/m-sh), mean transect adult split weight ranged from 39.8 g to 411.7 g, and juvenile lower 95% confidence bound density estimates ranged from 0.00 to 0.02 c/m-sh. Of the 32 surveyed PFM subareas presented herein, 11 had adult Sea Cucumber lower 90% confidence bound density estimates below the DFO Fisheries Management commercial fishery opening threshold (2.50 c/m-sh). The relative abundances of ad hoc observations of stan · st'an Pacific Geoduck (*Panopea generosa*), gudangee · guuding.ngaay Red Sea Urchins (*Mesocentrotus franciscanus*), stuu · daws styuu Green Sea Urchins (*Strongylocentrotus droebachiensis*), and beginning in 2024, sk'áam i hlt'ahldaláa · naaw k'aanaasGa Sunflower Sea Stars (*Pycnopodia helianthoides*) were also estimated and the results are presented here.

RÉSUMÉ

Lothead, J., St. Germain, C., Campbell, J.A., and Hansen, S.C. 2026. Biomass Estimates for Yáanu · Giinu Giant Red Sea Cucumber (*Apostichopus californicus*, Stimpson, 1857) as Determined Through Surveys Conducted in Haida Gwaii from 2023 to 2024. Can. Tech. Rep. Fish. Aquat. Sci. 3761: ix + 95 p. <https://doi.org/10.60825/w23r-5583>

Les relevés d'évaluation du stock yáanu · giinu d'holothuries de Californie (*Apostichopus californicus*, Stimpson, 1857) (ci-après le concombre de mer), en Colombie-Britannique sont menés depuis 1998. Ces relevés sont menés pour estimer la densité, le poids et la biomasse du concombre de mer, informations fournies à Pêches et Océans Canada (MPO) – Gestion des pêches. De 2023 à 2024, quatre enquêtes ont été réalisées dans 32 sous-zones de Secteur de gestion des pêches du Pacifique (SGPP) en collaboration avec Xaadée 'Wáadluwaan Née · XaaydaGa 'Waadluxan Naay, le Conseil de la Nation Haida, suivant le modèle d'Enquête Ouverte.

Les résultats sont rapportés pour chaque sous-zone SGPP et/ou zone d'analyse. Pour les sous-zones SGPP situées dans la Réserve Nationale de Conservation Marine et le Site du Patrimoine Haida de Gwaii Haanas, les données ont été regroupées soit dans les zones à usage multiple, soit dans les zones de protection stricte, et sont également présentées par zone.

Dans le cadre de ces quatre relevés de densité, les estimations de densité à la limite inférieure de confiance à 90 % des concombres de mer adultes dans les sous-zones SGPP variaient de 0,00 à 43,50 concombres de mer par mètre de ligne de côte (c/m-co), le poids moyen des adultes par transect se situait entre 39,8 g et 411,7 g, et les estimations de densité à la limite inférieure de confiance à 95 % pour les juvéniles allaient de 0,00 à 0,02 c/m-co. Sur les 32 sous-zones SGPP étudiées présentées ici, 11 avaient des estimations de densité à la limite inférieure de confiance à 90 % des concombres de mer adultes inférieures au seuil d'ouverture de la pêche commerciale de Pêches et Océans Canada (2,50 c/m-co). L'abondance relative des observations ponctuelles de stan · st'an palourdes géantes (*Panopea generosa*), gudangee · guuding.ngaay d'oursins rouges (*Mesocentrotus franciscanus*), stuu · daws styuu d'oursins verts (*Strongylocentrotus droebachiensis*) et, à partir de 2024, sk'áam i hlt'ahldaláa · naaw k'aanaasGa d'étoiles de mer tournesol (*Pycnopodia helianthoides*) ont également été estimées et les résultats sont présentés ici.

PREFACE

Xaaydas Gan Unsid *Haida Knowledge Systems*

Throughout this report, some words are provided in one or both of the two Haida dialects **Gaw Tlagée** **Xaad kíl** and **Hlgaagilda Xaayda kil**, which are identified in blue and green, respectively. The lack of a **Xaad kíl** or **Xaayda kil** equivalent should not be interpreted to mean that the word does not exist. This document should not be used as a language reference. All inquiries should be directed to the respective language authorities **Xaad Kíl Nee** for **Xaad kíl** (<https://www.haidanation.ca/xaad-kil>) or **Hlgaagilda Xaayda kil Naay** for **Xaayda kil** (<https://www.haidanation.ca/xaayda-kil>).

Xaadáa Gwáay · **Xaayda Gwaay.yaay** *Haida Gwaii* is the homeland of the Haida Nation.

Haida ethics and values (CHN 2007), based on Haida laws, guide marine planning initiatives and support decision-making processes for Haida Gwaii:

Yahgudáng · **Yahguudang** *Respect*. Respect for each other and all living things is rooted in our culture. We take only what we need, we give thanks, and we acknowledge those who behave accordingly.

K'uláagée · **'Laa guu ga kanhlins** *Responsibility*. We accept the responsibility passed on by our ancestors to manage and care for our sea and land. We will ensure that our heritage is passed onto future generations.

Gin 'wáadluwan gud .ahl kwáagiidang · **Gina 'waadluxan gud ad kwaagid** *Interconnectedness* – Everything depends on everything else. The principle of interconnectedness is fundamental to integrated planning and management. This comprehensive approach considers the relationships between species and habitats, and accounts for short-term, long-term, and cumulative effects of human activities on the environment. Interrelationships are accounted for across spatial and temporal scales and across agencies and jurisdictions.

Agan t'ats'gang · **Giid tlljuus** *Balance*. Balance is needed in our interactions with the natural world. If we aren't careful in everything we do, we can easily reach a point of no return. Our practices and those of others must be sustainable.

Ginn gán ga únsids kíl tla gudáng'wa · **Gina k'aadang.nga gii uu tll k'anguudang** *Seeking Wise Counsel*. Our elders teach us about traditional ways and how to work in harmony. Like the forests, the roots of our people are intertwined. Together we consider new ideas and information in keeping with our culture, values, and laws.

'Isda isgyaan diigaa isdii · **Isda ad dii gii isda** *Giving and Receiving*. Reciprocity is a respected practice in our culture, essential in our interactions with each other and the natural world. We continually give thanks to the natural world for the gifts that we receive.

Haida oral histories tell that In the Beginning, the Haida people came from supernatural beings that came out of the ocean.

"This island was nothing but saltwater, they say. Raven flew around. He looked for a place to land in the water. By and by, he flew to a reef lying at the south end of the island, to sit on it. But the great mass of supernatural beings had their necks resting on one another on it, like Sea Cucumbers...It was both light and dark, they say." - John Sky of the K'uuna Kiigawaay, Haida Texts and Myths: Hlgaagilda Xaayda kil Skidegate Dialect (1905).

For this reason Haida consider themselves to be from the sea, and traditionally hold all their marine relatives in high regard. It was taboo to speak ill of any living thing in the sea. There are many stories of tsunamis, floods, and drownings after people disrespected a descendant of the ocean. Many Haida families still maintain this tradition.

INTRODUCTION

Kwah.hlahl.dáyaa · Gaycahlida “Changing Tide” Framework for Reconciliation

On August 13, 2021, the [Xaadée ‘Wáadluwaan Née · XaaydaGa ‘Waadluxan Naay](#) the Council of the Haida Nation (CHN), Canada, and British Columbia signed the [Kwah.hlahl.dáyaa · Gaycahlida *Changing Tide Framework for Reconciliation* \(FR\)](#). Through this agreement and beyond, the Parties intend to foster a new Nation-to-Nation relationship through cooperation, partnership, and reconciliation, based on the recognition of Haida Rights and Title. As a first step of the [Kwah.hlahl.dáyaa · Gaycahlida FR](#), Fisheries and Oceans Canada (DFO) sought and received authority and resources to support the fisheries and marine matters good faith measures identified in the [Kwah.hlahl.dáyaa · Gaycahlida FR](#). One of these measures was:

“initiating work to cooperatively develop a Sea Cucumber management plan, including stock assessment for Haida Gwaii, making best efforts to complete the plan within three years”.

The surveys described in this report were developed and conducted collaboratively by [Xaadée ‘Wáadluwaan Née · XaaydaGa ‘Waadluxan Naay](#) the Council of the Haida Nation’s Haida Fisheries Program and DFO to achieve the stock assessment component of this good faith measure. [Xaadée ‘Wáadluwaan Née · XaaydaGa ‘Waadluxan Naay](#) and the DFO Shellfish Data Unit hold custody of all project data.

Biology

This temperate species [yáanuu · Giinuu](#) Sea Cucumber (*Apostichopus californicus*, formerly *Parastichopus californicus*) (Stimpson, 1857; Phylum Echinodermata: Class Holothuroidea) ranges from the Gulf of Alaska to Baja California, from the intertidal zone to depths of 250 m (Lambert, 1997), within oxygen stable waters (Weinrauch & Blewett, 2019). This species is commonly referred to as the Giant Red or California Sea Cucumber, but will hereafter simply be referred to as “Sea Cucumber”. Though Sea Cucumbers can be found in various substrates and current regimes, the highest densities are observed in moderate currents with a preference for harder, more complex substrates (i.e., bedrock, boulder, cobble, shell debris, gravel) rather than soft ones (i.e., mud, silt) (Zhou & Shirley, 1996; Cripps & Campbell, 2000; Woodby et al., 2000). The basic external anatomy is comprised of a mouth crowned with 20 tentacles, a body surface adorned with conical papillae, tube feet arranged in 5 bands for locomotion on the underside, and a terminal anus (Lambert, 1986; 1997). Body shape is plastic, since the internal cavity has a high proportion of water content and contraction or relaxation of the body wall muscles can shorten or lengthen the animal (Immura & Kruse, 1990; Hannah et al., 2012). Sea Cucumbers undergo an annual cycle of visceral atrophy; their internal organs start to be reabsorbed in the fall before the individual enters winter dormancy and regenerate over a few weeks in the spring (Swan, 1961; Fankboner & Cameron, 1985; Lambert, 1997). The reasons for this reabsorption remain largely unknown, but several hypotheses have been proposed (Swan, 1961; Ebert, 1996; Fankboner, 2002; Brothers et al., 2015). The

body wall also undergo seasonal changes. The nutrients gathered throughout the spring and summer, coupled with the nutrients absorbed through the visceral atrophy, result in thicker muscles bands in the fall. These energy stores sustain their basal metabolic functions throughout winter dormancy and spring internal organ regeneration. The resultant seasonal fluctuations in body mass, skin thickness, and muscle weight have important implications for management.

Sea Cucumbers are primarily deposit-feeders that ingest organic detritus from nutrient-rich marine sediments; food particles are transferred to the mouth using their adhesive tentacles (Cameron & Fankboner, 1984; Cameron, 1985). Sea Cucumbers have limited mobility, with their movement averaging approximately 4 metres per day along the seafloor (da Silva & Fankboner, 1986), yet they are reported to migrate to different depths on a seasonal basis (DFO, 1999; 2002). Ecologically, Sea Cucumbers in general play an important role in bioturbation, sediment cleaning, nutrient recycling, and influencing local water chemistry (Purcell et al., 2016). Furthermore, Sea Cucumbers generally act as symbiotic hosts and support marine food webs (Purcell et al., 2016).

Sea Cucumbers have separate sexes without external evidence of sexual dimorphism, and an assumed 1:1 sex ratio (Cameron & Fankboner, 1989). During an annual reproductive cycle, spawning is partially synchronous and occurs from spring through summer (Cameron, 1985; Cameron & Fankboner, 1986). Gametes are broadcast into the open water where external fertilization takes place (Cameron & Fankboner, 1986). Developing pelagic larvae are planktotrophic (i.e. can feed) and may take up to 127 days to develop into their settlement stage (Cameron & Fankboner 1989). Post-settlement juveniles are vulnerable and often associated with red algae “nursery” habitats notably devoid of predatory *sk'áam sea stars*, which suggests that early life stages are cryptic (Cameron, 1985). In general, juveniles are not found in adult habitats, and at less than 1-year-old and/or 1 cm in length often go undetected by divers (Cameron & Fankboner, 1986). Growth is slow, with juveniles attaining 4 to 10 cm length after two years (Boutillier et al., 1998; DFO, 1999; 2002). Adult Sea Cucumbers have few known predators, except for *ku · kuu Sea Otters (Enhydra lutris)* (Larson et al., 2013) and *sk'áam i hlt'ahldaláa sunflower sea stars* (e.g. *Pycnopodia helianthoides*; Cameron & Fankboner, 1989). Adult Sea Cucumbers can exhibit a violent escape response, which involves undulating the body in the water column to “swim”. This reaction is often initiated by physical contact with the Sunflower Star (*Pycnopodia helianthoides*) or other species of sea stars (Margolin, 1976; Lambert, 1997). Adult populations are typically uniform in size with individuals seldom measuring less than 15 cm in length (Cameron and Fankboner, 1989; DFO, 1999; 2002). It is estimated that sexual maturity is reached between 4 and 8 years of age, with a maximum age estimated at 12 years in BC (Cameron & Fankboner, 1989). The age at recruitment to the fishery is thought to be at least 4 years based on length-frequency data for the first three years of growth (DFO, 1999; 2002).

Many life history characteristics of *yáanu · giinu Sea Cucumbers* are still unknown, which complicates the assessment and management of this species. Sea Cucumbers lack the hard structures necessary to be aged, and therefore speculations about natural mortality, growth rates, age at recruitment, and lifespan are unconfirmed, however there are anecdotal reports of Sea Cucumbers reaching 30 years of age in captivity and work is currently underway to investigate rDNA methylation as a tool for ageing Sea Cucumbers (Janet Lohead, DFO, 2026, unpublished data). Given the plastic body shape, seasonal visceral atrophy, and fluctuations in body mass, skin thickness, and muscle weight, measurements of body dimensions from live specimens are inconsistent (but see Hannah et al. 2012 and Mueller 2016). Sea Cucumber tagging studies are rarely effective in determining distribution and/or movement, given that external tags are repeatedly lost and internal tags can be shed through defensive mechanisms like evisceration. For

these reasons, management of this species currently relies largely upon densities and lethal split weights that are scaled up to estimate biomass by available habitat.

History of the Commercial Fishery

Yáanu · Giinu *Apostichopus californicus* is the largest and only commercially harvested species of Sea Cucumber in British Columbia (BC), Canada, and they are amongst BC's top seafood exports, with a value of \$15.6 million in 2024 (DFO, 2025).

The commercial dive fishery for this species began in BC in 1971, however it has been a food source for coastal Indigenous communities for countless generations. The commercial fishery underwent several management changes throughout the 1980s and 1990s (refer to the *2025/2026 Sea Cucumber by Dive Integrated Fishery Management Plan* (IFMP; DFO, 2025) or Lohead et al. (2023a) for a full historical record). The first Sea Cucumber stock assessment was published in the mid 1990s (Phillips and Boutillier, 1998). It made a series of recommendations to improve stock assessment concerns associated with a lack of fishery and biological data. An Adaptive Management Plan (AMP) was implemented for the Sea Cucumber fishery in 1997 to collect fishery and biological data, and to conduct research that would assess the impacts of the fishery on the Sea Cucumber stock. The AMP limited commercial fishing to approximately 25 percent of the BC coast and set aside 25 percent of the coast for research purposes, including four Experimental Fishing Areas (EFAs) (Hand et al., 2009; Hajas et al., 2023).

After a decade (1997 to 2007) of extensive research under the AMP (Phase 1 Fishery), Science recommendations were made to, and accepted by, the Pacific Invertebrate Subcommittee of the Canadian Science Advisory Secretariat (CSAS) in 2007 (Hand et al., 2009). The recommendations included: a) the potential re-opening of areas closed to commercial fishing during the AMP, when surveys determined that the minimum commercial fishery density threshold was met (2.50 Sea Cucumbers per metre of shoreline, c/m-sh), b) consideration of rotational harvest strategies, and c) the implementation of risk-averse sustainable exploitation rates (Hand et al., 2009).

The Sea Cucumber fishery then entered Phase 2 (fishing for commerce) in 2008 (Perry et al., 1999). A rotational style fishery was adopted in 2011, with the implementation of the Adaptive Rotational Fishery Strategy (ARFS), where each Sea Cucumber Quota Management Area (QMA) was harvested approximately once every three years (DFO, 2024). Some QMAs were returned to annual style fishery harvest in 2017 (DFO, 2024). The fifth round of the ARFS took place from 2023 to 2025 (DFO, 2024) and the sixth round is occurring from 2026 to 2029 (DFO, 2025).

Surveys are conducted to estimate the density and biomass of Sea Cucumbers within select Pacific Fishery Management (PFM) Subareas before these areas are considered for re-opening to commercial harvest (Hand et al., 2009; Duprey et al., 2011; Duprey, 2011; 2012; 2014; Duprey & Stanton, 2015; 2018). Surveys are generally conducted annually in the summer, following discussions regarding areas of interest between First Nations, DFO Fisheries Management, DFO Science, and the Pacific Sea Cucumber Harvesters Association (PSCHA). The commercial Sea Cucumber fishery has not operated in Haida Gwaii since 1995, with the exception of a small area (PFMA 2-6) that was briefly fished in 2012. The *2025/2026 Sea Cucumber by Dive IFMP* (DFO, 2025) lists all PFM Subareas currently open for commercial harvest of Sea Cucumber in BC.

This report presents the results of four surveys conducted in Haida Gwaii in 2023 and 2024 using the Open survey design (herein referred to as a biomass survey) (Duprey et al., 2011; Bazinet et al., 2025).

- Around K'uuna Gwaay.yaay *Louise Island*, PFM Subareas 2-3, 2-4, 2-5, and 2-6 in Hl'kinul Kaahl'ii Cumshewa Inlet and Tl'In Suu Selwyn Inlet were surveyed in March 2023. These areas had been previously surveyed in 2012.
- In Gwaii Haanas 'Laanaay 'waadluxan Tl'ga Kaaganda, Tang.gwan 'Laanaay 'waadluxan Kaaganda, and Xaaydas Giinaa.ah 'Laana Gwaii Haanas National Park Reserve, National Marine Conservation Area Reserve, and Haida Heritage Site (hereafter referred to collectively as Gwaii Haanas), PFM Subareas 2-11 in upper Gandaawuu.ngaay Xyangs Juan Perez Sound and 2-13 in GaysiiGas K'iidsii Burnaby Strait were surveyed in August 2023.
- In Gwaii Haanas, PFM Subareas 2-10 in K'ing.gii Kaahl'ii Darwin Sound and 2-15 in Sk'in Kaahl'ii Skincuttle Inlet were surveyed in March 2024. PFM Subarea 2-15 had been previously surveyed in 2012.
- On Duu Guusd West Coast Haida Gwaii, PFM Subareas 2-51 to 2-60 in Kaysuun Kaahl'ii Englefield Bay and PFM Subareas 2-65, 2-68, 2-70 to 2-77, and 2-80 to 2-84 in Chaahluu Kaahl'ii Rennell Sound were surveyed in August 2024.

This report summarizes the survey background, describes the survey methodology, and presents the results of data analyses for density, mean weight, and biomass of adult yáanu · giinu Sea Cucumber populations, density estimates for juvenile yáanu · giinu Sea Cucumber populations, and ad hoc relative abundance estimates of stan · st'an Pacific Geoduck (*Panopea generosa*), gudangee · guuding.ngaay Red Sea Urchins (*Mesocentrotus franciscanus*), stuu · daws styuu Green Sea Urchins (*Strongylocentrotus droebachiesnsis*), and for 2024 surveys sk'áam i hlt'ahldaláa · naaw k'aanaasGa Sunflower Sea Stars (*Pycnopodia helianthoides*). Relative abundance estimates of gálgahl'yaa · gaal gahlxyang Northern Abalone (*Haliotis kamtschatkana*) were also recorded but are not presented herein due to Species at Risk Act Section 124 and gálgahl'yaa · gaal gahlxyang Northern Abalone Action Plan restrictions.

METHODS

Biomass surveys, as described in Duprey et al. (2011) and updated in Bazinet et al. (2025), are used to estimate the densities, mean weights, and biomass of yáanu · giinu Sea Cucumbers. Priority PFM subareas to survey throughout BC are determined at annual research meetings through discussion between DFO Fisheries Management, DFO Science, multiple First Nations, and the Pacific Sea Cucumber Harvesters Association. Typically these PFM subareas are either being considered for re-opening to the commercial fishery, remained open during Phase 1 (1998-2007) and into Phase 2 (2008-present) but have not yet been surveyed, or are open and being re-surveyed.

The survey locations presented in this report were chosen collaboratively by the CHN and DFO by taking into consideration Haida interests, Gwaii Haanas zoning, past DFO Sea Cucumber and multispecies benthic invertebrate dive survey data (Lochead et al., 2023b), historical fishery landings, and expert opinion from the members of the Pacific Sea Cucumber Harvesters Association.

Additionally, PFMA's that were originally surveyed in Haida Gwaii in 2012 (PFMA 2-3, 2-4, 2-5, 2-6, and 2-15) were chosen to be re-surveyed to update the stock assessment information and determine whether statistically significant changes in density and mean split weight had occurred over time.

The Gwaii Haanas Gina 'Waadluxan KilGuhlGa Land-Sea-People Management Plan (CHN-PC, 2018), collaboratively developed by CHN and Parks Canada (PC), sets direction for the Archipelago

Management Board (AMB) to manage Gwaii Haanas from mountaintop to seafloor as a single, interconnected ecosystem. It outlines a shared vision for the future, includes guiding principles based on Haida cultural values, describes the AMB's goals and objectives, and provides zoning for the land and sea. The marine habitat within Gwaii Haanas is divided into Strict Protection Zones where recreational and commercial harvesting are prohibited, and Multiple Use Zones where recreational and commercial harvesting are permitted. Surveys of PFM Subareas within Gwaii Haanas (2-10, 2-11, 2-13, and 2-15) were conducted in both the Strict Protection Zones and Multiple Use Zones (Figure 1), to enable future comparison of trends in size and abundance between fished and unfished areas, to better understand impacts of the commercial fishery, and the effectiveness of the closures over time. The names of the Gwaii Haanas Strict Protection Zones and their geographical association with the surveyed PFMA Subareas are as follows:

- PFM Subarea 2-15 contains *Gawgajaang Louscoone Inlet Daanaay Kuuyada precious area 6b* or *Gwaii Haanas Strict Protection Zone 6b*, and is also largely covered by the *Tang.Gwan Giisda Kaadlljuu Coming Out of the Ocean First Daanaay Kuuyada precious area 7* or *Gwaii Haanas Strict Protection Zone 7*.
- PFM Subarea 2-13 includes a portion of the *Kuuniisii Xaw GawGa sda Gaaduu Gwaay Matheson Inlet to Huxley Island Daanaay Kuuyada precious area 8* or *Gwaii Haanas Strict Protection Zone 8*. This subarea also includes the northern portion of the *Tang.Gwan Giisda Kaadlljuu Coming Out of the Ocean First Daanaay Kuuyada precious area 7* or *Gwaii Haanas Strict Protection Zone 7*.
- PFM Subarea 2-11 is mostly covered by the *Gandaawuu.ngaay Xyangs sda Tllga Kun Gwaay.yaay Juan Perez Sound to Lyell Island Daanaay Kuuyada precious area 9* or *Gwaii Haanas Strict Protection Zone 9*.
- PFM Subarea 2-10 includes the *Didxwahxyangs Darwin Sound Daanaay Kuuyada precious area 10* or *Gwaii Haanas Strict Protection Zone 10*.

The marine waters located outside of Strict Protection Zones in Gwaii Haanas, are inside the Multiple Use Zones, which do not have individual names and are referred to collectively as the Multiple Use Zones (Figure 1).

Survey Methodology

Each biomass survey was planned and conducted using the same standardized methods to ensure comparability of results both within and across individual surveys. Transect locations are placed systematically at 2 km intervals along the shoreline within the selected PFM subareas for each survey (Duprey et. al., 2011). The shoreline of each PFM subarea was calculated in 1996 based on the zero chart datum bathymetry line and at a 20 m grid resolution, with zero chart datum being defined by Canadian Hydrographic Service as either Lower Low Water, Large Tide or Lowest Normal Tide as stated in the title of each chart. This deliberate underestimation of the shoreline allows for more precautionary calculations of *yáanu · giinu Sea Cucumber* biomass (see Biomass Estimate section for more information on the biomass calculation).

At the transect location, a transect leadline was placed perpendicular to the shore from zero to 15.2 m (50 feet) gauge depth, as close as possible to planned transect locations. Occasionally, environmental hazards required that transects be moved from their planned location. The deep end of the transect was clipped off to a weighted buoy. Transect leadlines were pre-marked at a 5 m interval using zap-straps and coloured electrical tape to delimit quadrats. For each transect, two SCUBA divers (designated left and right diver) descended the buoy line to the zap-strap nearest 15.2 m depth and began surveying along the leadline from this depth. Each diver had a 2 m pole held perpendicular to the leadline with an attached datasheet.

Divers swam along the leadline, counting and recording all Sea Cucumbers within each 5 x 4 m quadrat (corresponding to the area within 2 m of either side of the leadline from one zap-strap to the next). Sea Cucumbers straddling the transect line were counted by the left diver. Sea Cucumbers were considered to be inside the quadrat and were counted if more than half of the body was within the quadrat, or if the anterior end was exactly halfway in. The following information was recorded within each quadrat: the number of adult and juvenile [yáanu](#) · [giinu](#) Sea Cucumber (juveniles are arbitrarily defined as being smaller than 15 cm), up to three dominant substrate types and two dominant algae types, the percent coverage of algae, and the depth of each quadrat. Relative abundance estimates were also recorded on the dive for four species of interest: [stan](#) · [st'an](#) Pacific Geoduck (*Panopea generosa*), [gudangee](#) · [guuding.ngaay](#) Red Sea Urchins (*Mesocentrotus franciscanus*), [stuu](#) · [daws styuu](#) Green Sea Urchins (*Strongylocentrotus droebachiesnsis*), and beginning in 2024, [sk'áam i hlt'ahldaláa](#) · [naaw k'aanaasGa](#) Sunflower Sea Stars (*Pycnopodia helianthoides*). While the survey is not specifically designed with these species in mind, the habitats surveyed are sufficiently diverse to include preferred habitats of these four additional species. Such opportunistic ad hoc observations are sufficient to generate relative abundance and presence/absence data which are suitable for various analyses such as species distribution models (Nephin et al., 2020). Each site was designated as having either None (0), Few (1-10), Many (11-100) or Abundant (100+) animals, based on diver observations surrounding each transect, regardless of distance from the transect line. Relative abundance information for Pacific Geoduck, Green Sea Urchins, Red Sea Urchins, and Sunflower Sea Stars (when available) are presented,

Biological Sampling

A subsample of [yáanu](#) · [giinu](#) Sea Cucumbers were longitudinally split and individually weighed to determine the average weight and weight-frequency distribution of the population by PFM Subarea. At the time of survey planning, a subset of transects were randomly selected for biological sampling; one transect was randomly selected from every 10 transects in a subarea or for every 10 transects within a group of subareas being analyzed together. For example, if a subarea contained 40 transects, one sample transect was randomly allocated to transect numbers 1-10, one to 11-20, one to 21-30, and one to 31-40 (not 4 samples randomly assigned to transects 1-40); this prevents random clustering of biological sample transects and ensures split weights are representative of the entire subarea since transects are placed systematically along the shoreline. Divers surveyed the selected biological sample transects before handpicking the first 25 Sea Cucumbers (excluding juveniles, Duprey and Stanton, 2018) observed from the transect line and surrounding area up to a maximum depth of 15.2 m. When no Sea Cucumbers were present on a predetermined biological sample transect, divers selected a different transect within the subarea to collect the sample. Afterwards, the animals were brought on board the boat where they were longitudinally split, left to drain, and individually weighed to the nearest gram. Small pieces of skin tissue were removed with scissors and preserved in ethanol for future genetic analyses.

Data Analysis

The total biomass of [yáanu](#) · [giinu](#) Sea Cucumbers in a given area is calculated as the product of three estimated parameters: linear density (number of Sea Cucumbers per metre of shoreline, c/m-sh), mean animal weight in grams, and the estimated length of shoreline in metres. More details are provided on these four metrics below. Analyses were performed in R version 4.0.2 (R Core Team, 2021).

Linear Density

Linear estimates of density are considered appropriate for assessing Sea Cucumber populations because individuals are found dispersed over most of the shallow sea bed, rather than in well-defined aggregations (Duprey et al., 2011; Boutillier et al., 1998). In addition, no spatial estimates of their seafloor habitat are available due to a lack of accurate high resolution seafloor classification data. The linear density of

yáanu · ġiinu Sea Cucumbers was calculated for each transect by dividing the total number of Sea Cucumbers observed by the width of the transect (4 m, or 2 m in rare cases when only one diver completed a transect). The methods for accounting for absent, or NA, observations has recently been updated from previous reports (see Bazinet et al. 2025 for more details). In past reports, some transects may have underestimated Sea Cucumber density in the rare case when one diver was not able to survey their side of a quadrat or transect. In those previous calculations, the quadrat count from the diver who completed their side of the quadrat were not retained and the quadrat was assigned a total count of 0. In this and all future reports, this calculation has been updated to ignore the missing value and to instead assign the quadrat a total count equal to the count from the diver who did complete their side of the quadrat. In the rare case when one diver was unable to provide counts for their side of the entire transect (e.g. second diver was unable to complete the transect or a data sheet was lost), the total transect count from the diver who did complete the transect was divided by the surveyed transect width of 2 m to obtain the linear density for that transect.

The mean linear density (c/m-sh) and confidence bounds were calculated using a basic non-parametric bootstrapping technique. Transect data were re-sampled with 10,000 iterations using the `smean.cl.boot` function in the `Hmisc` package (Harrell, 2020), combined with a random seed of 756 for reproducibility.

Some PFM Subareas contain only a small length of shoreline and therefore can only accommodate a few transects, however to obtain defensible results from bootstrapping a sample size of at least 10 transects is required. “Analysis areas” were developed to avoid this complication, whereby PFM Subareas falling below the required sample size thresholds were pooled with other nearby PFM Subareas in the same survey that had similar bathymetry and exposure and were analyzed as one area (see Table 1 for a list of analysis areas). For PFM Subareas within the Gwaii Haanas (2-10, 2-11, 2-13 and 2-15) data were grouped into either the Multiple Use or the Strict Protection Zones and were analysed by Zone. The mean adult yáanu · ġiinu Sea Cucumber density and 75%, 90%, 95%, 99% confidence bounds were calculated for each subarea, analysis area, or Gwaii Haanas Zone. This range of confidence bounds is calculated and presented in the tables to provide Fishery Management with the necessary science advice to manage the fishery at a variety of risk tolerance levels. The lower 90% confidence bound of the adult density estimates are presented in text since those are currently used in the management of the fishery for quota setting purposes. The mean juvenile yáanu · ġiinu Sea Cucumber density 95% and 99% confidence bounds were also calculated for each subarea or analysis area. Juvenile densities are not currently used in the management of the fishery, so they are presented with only two conventional confidence bounds.

Mean Weight

Biological samples were used to estimate mean animal weight (split weight; see ‘Biological sampling’ Section, above) within each PFM Subarea. Each Sea Cucumber collected in a biological sample (25 Sea Cucumbers per transect) was weighed individually and averaged to produce a mean weight from the sampled transect. The PFM Subarea’s mean weight was the mean of all the biological sample transect averages collected within that subarea. If no biological samples were collected within a PFM Subarea, then the lowest mean weight estimate of all subareas in the same survey was used (Duprey et al., 2011).

Shoreline Length

The shoreline length used in biomass calculations was measured using the GIS software Compugrid and is currently housed in the DFO Fisheries Management database. In this report, the shoreline categorized as “exposed” (Shoreline_{Exposed}) is the cumulative shoreline in a subarea that has been designated “exposed” in the BC Shorezone Classification dataset (Hand et al., 2009; Duprey et al., 2011) and the shoreline categorized as “protected” (Shoreline_{Protected}) is the cumulative shoreline in a subarea that has

been designated “semi-exposed” to “very protected” (Duprey et al., 2011). The shoreline categorized as “very exposed” in the BC Shorezone Classification dataset is not included in this report, as “very exposed” shoreline is assigned a Sea Cucumber density of 0.00 c/m-sh (Hand et al., 2009; Duprey et al., 2011).

Biomass Estimates

The biomass of *yáanuu* · *giinuu* Sea Cucumbers in a PFM Subarea was estimated at various confidence bounds (CB) using the following formula:

$$^1\text{Biomass}_{\text{CB}} = [(\text{Shoreline}_{\text{Protected}} * \text{Density}_{\text{CB}}) * \text{Wt}_{\text{mean}}] + [(\text{Shoreline}_{\text{Exposed}} * 2.50) * \text{Wt}_{\text{mean}}] \quad [1]$$

where $\text{Shoreline}_{\text{Protected}}$ and $\text{Shoreline}_{\text{Exposed}}$ are the shoreline lengths (described above) in metres, $\text{Density}_{\text{CB}}$ is the confidence bound density estimate from the bootstrap output, Wt_{mean} is the mean Sea Cucumber weight (in grams) attributed to the subarea from biological sampling, and the constant of 2.50 c/m-sh represents the linear density used for exposed shoreline in BC (see Duprey et al., 2011 for further explanation). Biomass was then converted from grams to kilograms.

For equation 1, on all areas of the BC coast, the lowest and more precautionary density value is used in the $\text{Shoreline}_{\text{Exposed}}$ portion of the biomass estimate calculation, whether a regional baseline value (see below; there is no regional baseline value for Haida Gwaii) or the calculated LCB of the density estimate (Bazinet et al. 2025). For the West Coast Vancouver Island (WCVI) region, the regional baseline is 1.90 c/m-sh and therefore replaces the 2.50 constant. In the other regions, the regional baseline densities are higher than the 2.50 constant (North Coast = 6.00 c/m-sh; Central Coast = 6.00 c/m-sh; South Coast Inside Waters = 4.10 c/m-sh) and do not replace the constant. If the $\text{Density}_{\text{CB}}$ value or regional baseline density value (e.g. WCVI value of 1.90) is lower than 2.50 c/m-sh, then $(\text{Shoreline}_{\text{Exposed}} * 2.50)$ is replaced with $(\text{Shoreline}_{\text{Exposed}} * \text{Density}_{\text{CB}}$ or $\text{Shoreline}_{\text{Exposed}} * \text{Density}_{\text{regional}})$.

Regional baseline densities were originally developed for extrapolation and application to unsurveyed areas within each region based on the 90% LCB of the density estimate from previously conducted surveys in each region (North Coast, Central Coast, South Coast Inside Waters, or West Coast Vancouver Island,). Given the caveat that density is not well predicted based on geographical location, these regional baseline densities are intended to be used precautionarily in the absence of better, local survey data, for example in exposed parts of the coast that are difficult to survey (Duprey et al. 2011). Regional baseline densities have not been established for Haida Gwaii. It is expected that any area to be considered for opening will be surveyed first. See Duprey et al. (2011) for a detailed description of methods used to generate regional density constants for exposed shorelines as well as the biomass estimate calculations.

The surveys reported here presented a situation not before encountered on Sea Cucumber surveys. The shoreline of several PFM Subareas were either completely or mostly classified as exposed by the BC Shorezone classification system. Using equation 1, above, the 2.50 c/m-sh constant would be applied over all or most of the shoreline in those PFM Subareas, which may not be the best approach in all cases, particularly when large portions of exposed coast were successfully surveyed. Defaulting to the constant value rather than relying on the collected data seemed counterintuitive, therefore, in addition to using equation 1 to calculate $^1\text{Biomass}_{\text{CB}}$, a second equation, $^2\text{Biomass}_{\text{CB}}$, was developed that applied the $\text{Density}_{\text{CB}}$ calculated from the collected data to the entire shoreline ($\text{Shoreline}_{\text{Total}}$; i.e., both the exposed and protected shoreline).

$$^2\text{Biomass}_{\text{CB}} = [(\text{Shoreline}_{\text{Total}} * \text{Density}_{\text{CB}}) * \text{Wt}_{\text{mean}}] \quad [2]$$

The percent difference between ¹Biomass_{SCB} and ²Biomass_{SCB} was calculated for each surveyed PFM Subarea.

Interannual Comparisons

To determine whether densities or weights within subarea 2-3, 2-4, 2-5 and 2-6 have changed between 2012 and 2023, non-parametric Wilcoxon Tests were applied to the densities and parametric students t-tests were applied to the weights. Non-parametric methods were used for the comparison of densities as they did not meet assumptions of normality or homogeneity of variance.

RESULTS

The four biomass surveys described in this report were conducted in 2023 and 2024 and stretched from *Hlkinul Kaahlíi Cumshewa Inlet* to *Sk'in Kaahlíi Skincuttle Inlet* on the east coast of Haida Gwaii, and from *Chaahluu Kaahlíi Rennell Sound* to *Kaysuun Kaahlíi Englefield Bay* on the west coast (Figure 1). These surveys all represent previously unpublished data. The surveys were conducted in partnership with the Haida Fisheries Program (HFP), using the Canpac Valour as the liveaboard vessel. Four DFO biologists and four HFP biologists participated in each survey.

The following sections describe the survey areas, mean linear *yáanu · giinu Sea Cucumber* densities, estimated mean weight of biological samples, biomass estimates, juvenile mean linear densities, and relative abundance observations of the four additional species for each PFM Subarea (Tables 2-7). For a written description of the management area boundaries for each PFM Subarea please refer to the [Pacific Fishery Management Area Regulations 2007](https://www.pac.dfo-mpo.gc.ca/fm-gp/maps-cartes/areas-secteurs/index-eng.html) (<https://www.pac.dfo-mpo.gc.ca/fm-gp/maps-cartes/areas-secteurs/index-eng.html>).

Total shoreline lengths reported in each PFMA Subarea description were taken from the Shorezone shoreline lengths table in the Sea Cucumber Management Database (2008).

A set of figures was developed for each biomass survey, indicating the position of surveyed transects and providing scaled symbols for *yáanu · giinu Sea Cucumber* 90% LCB of the mean density (Figures 2 to 11). The density ranges represented by the bubble size and colour in the figures were chosen for their relevance to stock assessment benchmarks (Table 8). Split weight histograms were generated for all PFM Subareas where biosamples were collected (Figures 12 – 16)

Results of interannual comparisons of density and mean split weight are provided for PFMA that were surveyed in 2012 and again in 2023 (PFMA 2-3, 2-4, 2-5, 2-6) or 2024 (2-15).

K'uuna Gwaay.yaay Louise Island – Hlkinul Kaahlíi Cumshewa Inlet (PFMA 2-3, 2-4, and 2-5) and Tlln Suu Selwyn Inlet (PFMA 2-6), March 2023

The *Hlkinul Kaahlíi Cumshewa Inlet – Tlln Suu Selwyn Inlet* biomass survey was located within Pacific Fisheries Management Area (PFMA) 2 – *T'aaxwii XaaydaGa Gwaay.yaay linaGwaay Moresby Island* on Haida Gwaii in the Northern Coast Region (Figure 1). This area has been closed to Sea Cucumber harvesting since 1995 (with the exception of PFMA 2-6 that was harvested in 2012 but the harvest was not supported by *Xaayda GwaayGalang Ganga Kaaxaajuus the Council of the Haida Nation*), and was

surveyed for potential re-opening. The survey included four PFM Subareas, 2-3 to 2-6, and was conducted from March 9-16, 2023 onboard the multipurpose commercial vessel Canpac Valour.

PFMA 2-3 (K'uuna Gwaay.yaay Louise Island – Hlkinul Kaahlia Cumshewa Inlet)

Survey area description

PFM Subarea 2-3 includes the waters of Hlkinul Kaahlia Cumshewa Inlet east of a bounding line that runs from Conglomerate Point south to K'uuna Gwaay.yaay Louise Island and west of a bounding line that runs from Iitl'lgas Gray Point to just northeast of Gwaayts'ads Skedans Islands and then west to K'uuna Kun Skedans Point. This subarea includes Kunxalas Cumshewa Head, Kal Guuda Gwaay.yaay Cumshewa Island, and Kunxalas HlGaagaay Cumshewa Rocks, K'ing Gwaay Kingui Island, KuuGahl McCoy Cove, Hlkinul Gwaay.yaay Haans Islet, Gwaay Daa.uhl McLellan Island, Kun Jinda Kitson Point, Kun Jinda ChiiGas.sgii Davies Shoal, KuuGahl ChiiGas.sgii McLean Shoal, Hlkinul ChiiGas.sgii Fairbairn Shoals, Kid HlGaajiaaw Kun Girard Point, and K'uuna Kun Skedans Point, but not Gwaayts'ads Skedans Islands. The total shoreline length of PFM Subarea 2-3 is 62.00 km (Table 1).

Yáanu · Giinu Sea Cucumber

A total of 13 transects were completed and 17 transects were skipped within PFM Subarea 2-3. Transects 1-10 and 27-29 were on exposed shoreline that had too much swell and wave action to be completed safely, and transects 16-18 and 48 were not completed due to unfavourable weather conditions (data inquiries about individual transects presented in this report can be directed to Pacific.CatchStats@dfo-mpo.gc.ca). Seven transects along the southern shoreline of Hlkinul Kaahlia Cumshewa Inlet had densities of 0.00 c/m-sh and one transect had a density of 0.25 c/m-sh (Figure 2). The five transects along the northern shore had densities that ranged from 0.00 to 27.00 c/m-sh. A total of 4 of the 13 transects (31%) surveyed had a density greater than 2.50 c/m-sh (the commercial fishery threshold) (Figure 2).

The DFO Fisheries Management database has a total shoreline length for PFM Subarea 2-3 of 62,007 m, of which 26,700 m is classified as “exposed” and 35,308 m is classified as “protected” by the BC Shorezone classification system. Thirteen transects on exposed shoreline and 4 on protected shoreline were not completed; as a result, 26,000 m of exposed shoreline and 8,000 m of protected shoreline were removed for the biomass calculations (Tables 5 and 6). Therefore, the total shoreline length used for biomass calculations was 700 m exposed and 27,308 m protected (Tables 5 and 6).

The mean yáanu · giinu Sea Cucumber density for PFM Subarea 2-3 was estimated to be 3.40 c/m-sh with a 90% LCB of 0.67 c/m-sh (Tables 2, 5 and 6). The mean juvenile density was estimated to be 0.04 c/m-sh with a 95% LCB of 0.00 c/m-sh (Table 3). The average weight of the one biological sample (transect 15) was 231 g (Table 4).

The 90% LCB of the mean biomass estimate was 4,335 kg with both ¹Biomass_{CB} (equation 1) and ²Biomass_{CB} (equation 2). This is because the 90% LCB of the survey density estimate was less than the default value over exposed shoreline (2.50 c/m-sh) and therefore the default value was used in both cases (Duprey et al., 2011) (Table 5 and 6).

Stan · st'an Geoduck, gudangee · guuding.ngaay Red Sea Urchin, and stuu · daws styuu Green Sea Urchin abundance

Relative abundances were estimated for stan · st'an Pacific Geoduck, gudangee · guuding.ngaay Red Sea Urchins, and stuu · daws styuu Green Sea Urchins for all 13 transects surveyed in PFM Subarea 2-3 (Table 7). Totals may not add up to exactly 100% due to rounding. ‘Abundant’ Pacific Geoduck were observed at 0% of the transects, ‘Many’ Pacific Geoduck were observed at 8% of the transects, ‘Few’ were observed at 23% of the transects, and no Pacific Geoduck were observed at the remaining 69% of

the transects. ‘Abundant’ Red Sea Urchins were observed at 23% of the transects, ‘Many’ were observed at 8% of the transects, while no Red Sea Urchins were observed at 69% of the transects. Green Sea Urchins were absent from all transects.

PFMA 2-4 (*K’uuna Gwaay.yaay Louise Island – Hlkinul Kaahlii Cumshewa Inlet*)

Survey area description

PFM Subarea 2-4 includes the waters of *Hlkinul Kaahlii* west of a bounding line from Conglomerate Point south to *K’uuna Gwaay.yaay*, and north of a bounding line that runs from just south of *K’aayxada Kun Barge Point* to just south of *Tllga KidsGalaang.nga Beattie Anchorage*. This subarea includes ‘*LaaGanaa’us GawGa Dawson Cove, Gawu Kuns GawGa Gillatt Arm, Davey Islets, Sii.niihl Gwaay.yaay Gordon Cove, K’aayxada Kun Barge Point, Gwaay Xaajuus Oliver Islet, K’aayxada Gwaay.yaay Nedden Island, Tllga KidsGalaang.nga Beattie Anchorage, and Tllga KidsGalaang.nga Kun Renner Point*. The total shoreline length of PFM Subarea 2-4 is 48.85 km (Table 1).

Yáanu · Giinu Sea Cucumber

A total of 13 transects were completed and 6 transects were skipped within PFM Subarea 2-4. Transects 30, 41, 44, 45, 46 and 47 were not completed due to unfavourable weather conditions. Densities for 12 of the transects were low and ranged from 0.00 c/m-sh to 2.50 c/m-sh, and one transect had a density of 8.25 c/m-sh. One of the 13 transects (8%) transects surveyed had a density greater than 2.50 c/m-sh (the commercial fishery threshold) (Figure 2).

The DFO Fisheries Management database has a total shoreline length for PFM Subarea 2-4 of 48,846 m, of which 0 m is classified as “exposed” and 48,846 m is classified as “protected” by the BC Shorezone classification system. Six transects on protected shoreline were not completed; as a result, 12,000 m of protected shoreline was removed for the biomass calculations (Tables 5 and 6). Therefore, the total shoreline length used for biomass calculations was 0 m exposed and 36,846 m protected (Tables 5 and 6).

The mean *yáanu · giinu Sea Cucumber* density for PFM Subarea 2-4 was estimated to be 1.10 c/m-sh with a 90% LCB of 0.27 c/m-sh (Tables 2, 5 and 6). The mean juvenile density was estimated to be 0 c/m-sh (Table 3). No biological samples were collected in PFM Subarea 2-4 (Table 4) so the lowest PFMA Subarea mean weight from the *K’uuna Gwaay.yaay Louise Island* survey, 115 g from PFM Subarea 2-5, was used for biomass calculations (Tables 5 and 6).

The 90% LCB of the mean biomass estimate was 1,144 kg whether exposed shoreline was given the default value of 2.50 c/m-sh (Duprey et al., 2011) (Table 5) or the 90 % LCB of the survey density estimate, because none of the shoreline was classified as exposed (Table 6).

Stan · st’an Geoduck, gudangee · guuding.ngaay Red Sea Urchin, and stuu · daws styuu Green Sea Urchin abundance

Relative abundances were estimated for *stan · st’an Pacific Geoduck, gudangee · guuding.ngaay Red Sea Urchins, and stuu · daws styuu Green Sea Urchins* for all 13 transects surveyed in PFM Subarea 2-4 (Table 7). Totals may not add up to exactly 100% due to rounding. ‘Abundant’ Pacific Geoduck were observed at 0% of the transects, ‘Many’ Pacific Geoduck were observed at 8% of the transects, ‘Few’ were observed at 0% of the transects, and no Pacific Geoduck were observed at the remaining 92% of the transects. ‘Abundant’ Red Sea Urchins were observed at 0% of the transects, ‘Many’ were observed at 8% of the transects, ‘Few’ Red Sea Urchins were observed at 23% of the transects, while no Red Sea Urchins were observed at 69% of the transects. ‘Abundant’ Green Sea Urchins were observed at 0% of the transects, ‘Many’ at 0% of the transects, ‘Few’ at 23% of the transects, and no Green Sea Urchins were observed at 77% of the transects.

PFMA 2-5 (*K'uuna Gwaay.yaay Louise Island – Hlkinul Kaahlii Cumshewa Inlet*)

Survey area description

PFM Subarea 2-5 includes the waters of *Kaana Charmichael Passage* south of a bounding line that runs from just south of *K'aayxada Kun Barge Point* to just south of *Tilga KidsGalaang.nga Beattie Anchorage* down to the south end of *K'uuna K'iidaay Louise Narrows*. This subarea includes *Gwaay King Mabbs Islet* and *K'uuna K'iidaay Louise Narrows*. The total shoreline length of PFM Subarea 2-5 is 24.99 km (Table 1).

Yáanu · Giinuu Sea Cucumber

A total of 10 transects were completed and 0 transects were skipped within PFM Subarea 2-5. Three transects had densities equal to 0 c/m-sh and densities for 7 remaining transects ranged from 0.75 c/m-sh to 16.75 c/m-sh. A total of 6 of the 10 transects (60%) transects surveyed had a density greater than 2.50 c/m-sh (the commercial fishery threshold) (Figure 2).

The DFO Fisheries Management database has a total shoreline length for PFM Subarea 2-5 of 48,846 m, of which 0 m is classified as “exposed” and 24,993 m is classified as “protected” by the BC Shorezone classification system. No transects were skipped so the total shoreline length used for biomass calculations was 0 m exposed and 24,993 m protected (Tables 5 and 6).

The mean *yáanu · giinuu Sea Cucumber* density for PFM Subarea 2-5 was estimated to be 6.85 c/m-sh with a 90% LCB of 3.67 c/m-sh (Tables 2, 5 and 6). The mean juvenile density was estimated to be 0.10 c/m-sh with a 95% LCB of 0.00 c/m-sh (Table 3). Biological samples were collected from one transect (transect 58) in PFM Subarea 2-5 (Table 4) and the average weight was 115 g (Table 4).

The 90% LCB of the mean biomass estimate was 10,548 kg whether exposed shoreline was given the default value of 2.50 c/m-sh (Duprey et al., 2011) (Table 5) or the 90 % LCB of the survey density estimate, because none of the shoreline was classified as exposed (Table 6).

Stan · st'an Geoduck, gudangee · guuding.ngaay Red Sea Urchin, and stuu · daws styuu Green Sea Urchin abundance

Relative abundances were estimated for *stan · st'an Pacific Geoduck*, *gudangee · guuding.ngaay Red Sea Urchins*, and *stuu · daws styuu Green Sea Urchins* for all 10 transects surveyed in PFM Subarea 2-5 (Table 7). Totals may not add up to exactly 100% due to rounding. ‘Abundant’ Pacific Geoduck were observed at 0% of the transects, ‘Many’ Pacific Geoduck were observed at 0% of the transects, ‘Few’ were observed at 10% of the transects, and no Pacific Geoduck were observed at 90% of the transects. ‘Abundant’ Red Sea Urchins were observed at 20% of the transects, ‘Many’ were observed at 0% of the transects, ‘Few’ Red Sea Urchins were observed at 40% of the transects, while no Red Sea Urchins were observed at 40% of the transects. ‘Abundant’ Green Sea Urchins were observed at 0% of the transects, ‘Many’ at 0% of the transects, ‘Few’ at 20% of the transects, and no Green Sea Urchins were observed at 80% of the transects.

PFMA 2-6 (*K'uuna Gwaay.yaay Louise Island – Tlin Suu Selwyn Inlet*)

Survey area description

PFM Subarea 2-6 includes the waters of *Tlin Suu Selwyn Inlet* and *Ts'uu.iid GawGa Dana Inlet* west of bounding lines between *XwulGaws Kun Nelson Point* and *Hltaalang Kun Heming Head*, and between *Hltaalang Kun Heming Head* and *Ts'uu.iid Kun Porter Head*. This subarea includes *Gaahlins Lagoon Inlet*, *XwulGaws HlGaa Sewel Inlet*, *XulGas GawGa Cecil Cove*, *K'yal GawGa Pacofi Bay*, *Xil Ts'ii*

Rockfish Harbour, *Gaaw Giids* Thurston Harbour, *Hltaalang Xyang* Dana Passage, Dwight Rock, and *Xang Gwaay* Helmet Island. The total shoreline length of PFM Subarea 2-6 is 158.70 km (Table 1).

Yáanu · Giinu Sea Cucumber

A total of 61 transects were completed and 11 transects were skipped within PFM Subarea 2-6. Transects 91-94, 96-98 were on exposed shoreline that had too much swell and wave action to be completed safely, and transects 73 and 103-105 were not completed due to survey time constraints. Densities ranged from 0.00 to 34.25 c/m-sh. A total of 32 of the 61 (52%) transects surveyed had a density greater than 2.50 c/m-sh (the commercial fishery threshold) (Figure 2).

The DFO Fisheries Management database has a total shoreline length for PFM Subarea 2-6 of 158,704 m, of which 10,405 m is classified as “exposed” and 148,299 m is classified as “protected” by the BC Shorezone classification system. Five transects on exposed shoreline and 6 on protected shoreline were not completed; as a result, 10,000 m of exposed shoreline and 12,000 m of protected shoreline were removed for the biomass calculations (Tables 5 and 6). Therefore, the total shoreline length used for biomass calculations was 405 m exposed and 136,299 m protected (Tables 5 and 6).

The mean *yáanu · giinu Sea Cucumber* density for PFM Subarea 2-6 was estimated to be 4.98 c/m-sh with a 90% LCB of 3.67 c/m-sh (Tables 2, 5 and 6). The mean juvenile density was estimated to be 0.04 c/m-sh with a 95% LCB of 0.01 c/m-sh (Table 3). The average weight of the 7 biological samples (transects 66, 80, 86, 99, 107, 117, 131) was 315 g (Table 4).

The 90% LCB of the mean biomass estimate was 157,887 kg when exposed shoreline was given the default value of 2.50 c/m-sh (Duprey et al., 2011) (Table 5) and was 158,037 kg when exposed shoreline was given the 90 % LCB of the survey density estimate (Table 6).

Stan · st'an Geoduck, gudangee · guuding.ngaay Red Sea Urchin, and stuu · daws styuu Green Sea Urchin abundance

Relative abundances were estimated for *stan · st'an Pacific Geoduck*, *gudangee · guuding.ngaay Red Sea Urchins*, and *stuu · daws styuu Green Sea Urchins* for all 61 transects surveyed in PFM Subarea 2-6 (Table 7). Totals may not add up to exactly 100% due to rounding. ‘Abundant’ Pacific Geoduck were observed at 0% of the transects, ‘Many’ Pacific Geoduck were observed at 5% of the transects, ‘Few’ were observed at 13% of the transects, and no Pacific Geoduck were observed at 82% of the transects. ‘Abundant’ Red Sea Urchins were observed at 20% of the transects, ‘Many’ were observed at 16% of the transects, ‘Few’ Red Sea Urchins were observed at 20% of the transects, while no Red Sea Urchins were observed at 44% of the transects. ‘Abundant’ Green Sea Urchins were observed at 0% of the transects, ‘Many’ at 10% of the transects, ‘Few’ at 23% of the transects, and no Green Sea Urchins were observed at 67% of the transects.

Interannual comparison

PFM Subareas 2-3, 2-4, and 2-5 did not have statistically significant differences in densities between 2012 and 2023, whereas PFM Subarea 2-6 had statistically significant lower densities in 2023 than in 2012. For PFMA 2-3, the mean density ($\pm$ standard deviation, sd) in 2023 (3.40 ± 7.56 c/m-sh, $n = 13$ transects) was not significantly different than in 2012 (3.94 ± 11.79 c/m-sh, $n = 12$; Wilcoxon Non-Parametric Test: $W = 80.5$, $p = 0.90$). For PFMA 2-4, the mean density ($\pm$ sd) in 2023 (1.10 ± 2.28 c/m-sh, $n = 13$ transects) was not significantly different than in 2012 (2.00 ± 5.96 c/m-sh, $n = 19$; Wilcoxon Non-Parametric Test: $W = 109.5$, $p = 0.57$). For PFMA 2-5, the mean density ($\pm$ sd) in 2023 (6.85 ± 6.70 c/m-sh, $n = 10$ transects) was not significantly different than in 2012 (2.03 ± 3.21 c/m-sh, $n = 10$; Wilcoxon Non-Parametric Test: $W = 34.5$, $p = 0.25$). For PFMA 2-6, the mean density ($\pm$ sd) in 2023

(4.98 ± 6.55 c/m-sh, $n = 61$ transects) was significantly lower than in 2012 (6.68 ± 6.57 c/m-sh, $n = 72$; Wilcoxon Non-Parametric Test: $W = 2679.0$, $p = 0.03$).

Enough data were only available for a comparison of mean weights for PFMA 2-6 (2012 biological samples: 2-3 = 1, 2-4 = 1, 2-5 = 0, 2-6 = 7; 2023 biological samples: 2-3 = 1, 2-4 = 0, 2-5 = 1, 2-6 = 7). The mean weight ($\pm$ sd) in 2023 (314.8 ± 56.4 g, $n = 7$) was not significantly different than in 2012 (319.2 ± 65.0 g, $n = 7$; students t-test: $t = 0.14$, $p = 0.89$).

Gwaii Haanas - Gandaawuu.ngaay Xyangs Juan Perez Sound (PFMA 2-11) and GaysiiGas K'iidsii Burnaby Strait (PFMA 2-13), August 2023

The upper Gandaawuu.ngaay Xyangs Juan Perez Sound and GaysiiGas K'iidsii Burnaby Strait biomass survey was located within Pacific Fisheries Management Area (PFMA) 2 – T'aaxwii XaaydaGa Gwaay.yaay IinaGwaay Moresby Island on Haida Gwaii in the Norther Coast Region (Figure 1). This area has been closed to Sea Cucumber harvesting since 1995 and was surveyed for potential re-opening. The survey included two PFM Subareas, 2-11 and 2-13, and was conducted from August 20-27, 2023, onboard the multipurpose commercial vessel Canpac Valour.

PFMA 2-11 (Gwaii Haanas - Gandaawuu.ngaay Xyangs Juan Perez Sound)

Survey area description

PFM Subarea 2-11 includes the waters of Upper Gandaawuu.ngaay Xyangs Juan Perez Sound inside bounding lines that run from Fuller Point to a point northeast of Tuft Islets, then south to a point east of Andrew Point (on Ramsay Island), then west to Andrew Point, a bounding line that runs between Ramsay Point and Werner Point, and a bounding line that runs between Darwin Point and Richardson Point. This Subarea includes Windy Bay, Gogit Passage, Tufts Islets, Skaga Island, Tar Islands, Agglomerate Island, Farraday Passage, Farraday Island, Murchison Island, Hotspring Island, House Island, Ramsay Passage, the north shore of Ramsay Island, Sedgwick Bay, Beresford Inlet, Bischof Islands, Skittagetan Lagoon, De la Beche Inlet, De la Beche Island, Sac Bay, Haswell Bay, Sivart Island, Hoskins Islets, Hutton Inlet, and Marco Island. This Subarea is mostly covered by the Gandaawuu.ngaay Xyangs sda Tllga Kun Gwaay.yaay Juan Perez Sound to Lyell Island Daanaay Kuuyada precious area 9 or Gwaii Haanas Strict Protection Zone 9, which is an area of very high cultural value that includes two Gina Ga Kyahs'tas Haida Gwaii Watchmen sites (CHN-PC, 2018). Several marine and terrestrial ecological restoration projects have been located in this highly productive area (CHN-PC, 2018). The total shoreline length of PFM Subarea 2-11 is 231.36 km (Table 1).

Yáanu · Giinuu Sea Cucumber

A total of 90 transects were completed and 22 transects were skipped within PFM Subarea 2-11. Transects 267, 271, 272, 273, 283, 298, 308, 309, 311, 317, 318, 320, 355, 356, 357, 364, 366, 372, 373, 374, 375 and 376 were not completed due to survey time constraints. Densities ranged from 0.00 to 43.50 c/m-sh. A total of 52 of the 90 (58%) transects surveyed had a density greater than 2.50 c/m-sh (the commercial fishery threshold) (Figure 3).

The DFO Fisheries Management database has a total shoreline length for PFM Subarea 2-11 of 231,363 m, of which 72,460 m is classified as “exposed” and 158,903 m is classified as “protected” by the BC Shorezone classification system. Six transects on exposed shoreline and 16 on protected shoreline were not completed; as a result, 12,000 m of exposed shoreline and 32,000 m of protected shoreline were removed for the biomass calculations (Tables 5 and 6). Therefore, the total shoreline length used for

PFMA Subarea 2-11 biomass calculations was 60,460 m exposed and 126,903 m protected (Tables 5 and 6). Fourteen skipped transects were in the *Daanaay Kuuyada 9* or *Gwaii Haanas Strict Protection Zone 9* and 8 skipped transects were in the *Gwaii Haanas Multiple Use Zone*. After removal of shoreline for skipped transects, total shoreline for biomass calculations was 60,460 m exposed and 65,316 m protected shoreline for PFMA Subarea 2-11 *Daanaay Kuuyada 9* or *Gwaii Haanas Strict Protection Zone 9*, and 0 m exposed and 61,587 m protected shoreline for PFMA Subarea 2-11 *Gwaii Haanas Multiple Use Zone*.

The mean *yáanu · giinu Sea Cucumber* density was estimated to be 7.28 c/m-sh with a 90% LCB of 5.74 c/m-sh for PFMA Subarea 2-11 as a whole, 6.80 c/m-sh with a 90% LCB of 4.35 c/m-sh for 2-11 *Daanaay Kuuyada 9* or *Gwaii Haanas Strict Protection Zone 9*, and 7.47 c/m-sh with a 90% LCB of 5.59 c/m-sh for 2-11 *Gwaii Haanas Multiple Use Zone* (Tables 2, 5 and 6). The mean juvenile density was estimated to be 0.03 c/m-sh with a 95% LCB of 0.01 c/m-sh for PFMA Subarea 2-11, 0.04 c/m-sh with a 90% LCB of 0.00 c/m-sh for 2-11 *Daanaay Kuuyada 9* or *Gwaii Haanas Strict Protection Zone 9*, and 0.02 c/m-sh with a 90% LCB of 0.00 c/m-sh for 2-11 *Gwaii Haanas Multiple Use Zone* (Table 3).

The average weight of the 7 biological samples in PFMA Subarea 2-11 (transects 265, 301, 310, 321, 345, 361, 362) was 227 g. The average weight of the 1 biological sample in PFMA Subarea 2-11 Strict Protection Zone 9 (transect 345) was 364 g. The average weight of the 6 biological samples in PFMA Subarea 2-11 Multiple Use Zone (transects 265, 301, 310, 321, 361, 362) was 216 g (Table 4).

When exposed shoreline was given the default value of 2.50 c/m-sh, the 90% LCB of the mean biomass estimate was 199,663 kg for PFMA Subarea 2-11, 158,440 kg for 2-11 *Daanaay Kuuyada 9* or *Gwaii Haanas Strict Protection Zone 9*, and 74,363 kg for 2-11 *Gwaii Haanas Multiple Use Zone* (Table 5). When exposed shoreline was given the 90 % LCB of the survey density estimate, the 90% LCB of the mean biomass estimate was 244,130 kg for PFMA Subarea 2-11, 199,154 kg for 2-11 *Daanaay Kuuyada 9* or *Gwaii Haanas Strict Protection Zone 9*, and 74,363 kg for 2-11 *Gwaii Haanas Multiple Use Zone* (Table 6).

Stan · st'an Geoduck, gudangee · guuding.ngaay Red Sea Urchin, and stuu · daws styuu Green Sea Urchin abundance

Relative abundances were estimated for *stan · st'an Pacific Geoduck*, *gudangee · guuding.ngaay Red Sea Urchins*, and *stuu · daws styuu Green Sea Urchins* for all 90 transects surveyed in PFMA Subarea 2-6 (Table 7). Totals may not add up to exactly 100% due to rounding. 'Abundant' Pacific Geoduck were observed at 3% of the transects, 'Many' Pacific Geoduck were observed at 2% of the transects, 'Few' were observed at 16% of the transects, and no Pacific Geoduck were observed at 78% of the transects. 'Abundant' Red Sea Urchins were observed at 74% of the transects, 'Many' were observed at 7% of the transects, 'Few' Red Sea Urchins were observed at 4% of the transects, while no Red Sea Urchins were observed at 13% of the transects. 'Abundant' Green Sea Urchins were observed at 12% of the transects, 'Many' at 23% of the transects, 'Few' at 18% of the transects, and no Green Sea Urchins were observed at 46% of the transects.

PFMA 2-13 (Gwaii Haanas – *GaysiiGas K'iidsii Burnaby Strait*)

Survey area description

PFMA Subarea 2-13 includes the waters of *GaysiiGas K'iidsii Burnaby Strait* south of a line beginning at *T'aaxwii XaaydaGa Gwaay.yaay IinaGwaay Moresby Island* and running through the south ends of *Gwaay Ts'iisii Park Island*, *Gaadu Gwaay Huxley Island*, and *K'uuna Gwaay.yaay Alder Island*, and then to the north Shore of Burnaby Island just east of *K'uuna Gwaay.yaay Alder Island*. This Subarea includes *Xuu.ajii Gwaay Nakons Islets*, *GaysiiGas K'iidsii GawGa Section Cove*, *GaysiiGas K'iidsii Gwaay Section Island*, *Kuu Gwaay Koga Islet*, *K'aad K'adjuu Gwaay Center Islet*, *K'aad Gwaay*

Wanderer Island, Diidxwah K'aad Gwaay Sels Islet, Sgaada Gwaay Nomad Islet, TildaGaaw Ga Kuuna Skaat Harbour, Gwaay GudgiiGaagid Kat Island, K'yu K'amal GawGa Island Bay, and GaysiiGas K'iidsii Burnaby Strait down to the south end of *K'iid Xyangs K'iidaay Dolomite Narrows*. This subarea includes a portion of the *Kuuniisii Xaw GawGa sda Gaaduu Gwaay Matheson Inlet to Huxley Island Daanaay Kuuyada precious area 8* or *Gwaii Haanas Strict Protection Zone 8*. This is an area of archaeological significance, both on the land and under the sea, where underwater exploratory research has identified a potential human habitation site from when sea levels were lower (CHN-PC, 2018). This subarea also includes the northern portion of the *Tang.Gwan Giisda Kaadlljuu Coming Out of the Ocean First Daanaay Kuuyada precious area 7* or *Gwaii Haanas Strict Protection Zone 7*, which extends into *K'iid Xyangs K'iidaay Burnaby Narrows*. This is the site of one of the most abundant and diverse temperate intertidal communities in the world (CHN-PC, 2018). The total shoreline length of PFM Subarea 2-13 is 78.36 km (Table 1).

Yáanu · Giinu Sea Cucumber

A total of 23 transects were completed and 11 transects were skipped within PFM Subarea 2-13. Transects 421, 422, 428, 430, 431, 433, 435, 436, 437, 438, and 441 were not completed due to survey time constraints. Densities ranged from 0.00 to 88.75 c/m-sh. A total of 13 of the 23 (57%) transects surveyed had a density greater than 2.50 c/m-sh (the commercial fishery threshold) (Figure 3).

The DFO Fisheries Management database has a total shoreline length for PFM Subarea 2-13 of 78,363 m, of which 1,205 m is classified as “exposed” and 77,158 m is classified as “protected” by the BC Shorezone classification system. The 11 skipped transects were on protected shoreline, and as a result, 22,000 m of protected shoreline was removed for the PFMA Subarea 2-13 biomass calculations (Tables 5 and 6). Therefore, the total shoreline length used for PFMA Subarea 2-13 biomass calculations was 1,205 m exposed and 55,158 m protected (Tables 5 and 6). Seven skipped transects were in Strict Protection Zone 7, 0 skipped transects were in Strict Protection Zone 8, and 4 skipped transects were in the Multiple Use Zone. After removal of shoreline for skipped transects, total shoreline for biomass calculations was 0 m exposed and 10,831 m protected shoreline for PFM Subarea 2-13 *Daanaay Kuuyada 7* or *Gwaii Haanas Strict Protection Zone 7*, and 0 m exposed and 3,202 m protected shoreline for PFM Subarea 2-13 *Daanaay Kuuyada 8* or *Gwaii Haanas Strict Protection Zone 8*, and 1,205 m exposed and 41,125 m protected shoreline for PFM Subarea 2-13 *Gwaii Haanas Multiple Use Zone*.

The mean *yáanu · giinu Sea Cucumber* density was estimated to be 17.37 c/m-sh with a 90% LCB of 9.25 c/m-sh for PFM Subarea 2-13, 3.25 c/m-sh (not able to generate bootstrapped confidence bounds due to transect sample size equal to one) for 2-13 *Daanaay Kuuyada 7* or *Gwaii Haanas Strict Protection Zone 7*, 57.88 c/m-sh with a 90% LCB of 43.50 c/m-sh for 2-13 *Daanaay Kuuyada 8* or *Gwaii Haanas Strict Protection Zone 8*, and 14.03 c/m-sh with a 90% LCB of 6.35 c/m-sh for 2-13 *Gwaii Haanas Multiple Use Zone* (Tables 2, 5 and 6). The mean juvenile density was estimated to be 0.10 c/m-sh with a 95% LCB of 0.02 c/m-sh for PFM Subarea 2-13, 0 c/m-sh (not able to generate bootstrapped confidence bounds due to transect sample size equal to one) for 2-13 *Daanaay Kuuyada 7* or *Gwaii Haanas Strict Protection Zone 7*, 0.25 c/m-sh with a 90% LCB of 0.00 c/m-sh for 2-13 *Daanaay Kuuyada 8* or *Gwaii Haanas Strict Protection Zone 8*, and 0.09 c/m-sh with a 90% LCB of 0.01 c/m-sh for 2-13 *Gwaii Haanas Multiple Use Zone* (Table 3).

There was only 1 biological sample in PFM Subarea 2-13 (transect 448 – in the *Gwaii Haanas Multiple Use Zone*) and the mean weight was 191 g. This PFM Subarea average weight was also used in the biomass calculations for Strict Protection Zones 7 and 8 (Table 4).

When exposed shoreline was given the default value of 2.50 c/m-sh, the 90% LCB of the mean biomass estimate was 98,026 kg for PFM Subarea 2-13, no estimate for 2-13 Strict Protection Zone 7 because only

one transect was surveyed, 26,604 kg for 2-13 Strict Protection Zone 8, and 50,454 kg for 2-13 Multiple Use Zone (Table 5). When exposed shoreline was given the 90% LCB of the survey density estimate, the 90% LCB of the mean biomass estimate was 99,579 kg for PFM Subarea 2-13, no estimate for 2-13 Strict Protection Zone 7 because only one transect was surveyed, 26,604 kg for 2-13 Strict Protection Zone 8, and 51,340 kg for 2-13 Multiple Use Zone (Table 6).

Stan · st'an Geoduck, gudangee · guuding.ngaay Red Sea Urchin, and stuu · daws styuu Green Sea Urchin abundance

Relative abundances were estimated for *stan · st'an Pacific Geoduck*, *gudangee · guuding.ngaay Red Sea Urchins*, and *stuu · daws styuu Green Sea Urchins* for all 23 transects surveyed in PFM Subarea 2-13 (Table 7). Totals may not add up to exactly 100% due to rounding. 'Abundant' Pacific Geoduck were observed at 4% of the transects, 'Many' Pacific Geoduck were observed at 0% of the transects, 'Few' were observed at 13% of the transects, and no Pacific Geoduck were observed at 74% of the transects. 'Abundant' Red Sea Urchins were observed at 26% of the transects, 'Many' were observed at 9% of the transects, 'Few' Red Sea Urchins were observed at 13% of the transects, while no Red Sea Urchins were observed at 43% of the transects. 'Abundant' Green Sea Urchins were observed at 0% of the transects, 'Many' at 9% of the transects, 'Few' at 0% of the transects, and no Green Sea Urchins were observed at 83% of the transects.

Gwaii Haanas - K'ing.gii Kaahlíi Darwin Sound (PFMA 2-10) and Sk'in Kaahlíi Skincuttle Inlet (PFMA 2-15), March 2024

The *K'ing.gii Kaahlíi Darwin Sound* and *Sk'in Kaahlíi Skincuttle Inlet* biomass survey was located within Pacific Fisheries Management Area (PFMA) 2 – T'aaxwii XaaydaGa Gwaay.yaay IinaGwaay Moresby Island on Haida Gwaii in the Northern Coast Region (Figure 1). This area has been closed to Sea Cucumber harvesting since 1995 and was surveyed for potential re-opening. The survey included two PFM Subareas, 2-10 and 2-15, and was conducted from March 13-19, 2024 onboard the multipurpose commercial vessel Canpac Valour.

PFMA 2-10 (Gwaii Haanas – K'ing.gii Kaahlíi Darwin Sound)

Survey area description

PFM Subarea 2-10 includes the waters of *K'ing.gii Kaahlíi Darwin Sound* and adjacent inlets bounded on the north end by a line that runs from *GawGa IinaGwaay Kun Crescent Point* due east to *SGaanaGwaay Gwaay.yaay Richardson Island*, and on the south end by a line that runs from *King.gii Kaahlíi Kun Darwin Point* northeast to *Kingts'ii GawGa Kun Richardson Point*. This subarea includes the *Didxwahxyangs Darwin Sound Daanaay Kuuyada precious area 10* or *Gwaii Haanas Strict Protection Zone 10*, which is a unique, sheltered area of high productivity in *DaaGaaw Xyang Shuttle Passage* between *Gwaay DaaGaaw Shuttle Island* and *Tllga Kun Gwaay.yaay Lyell Island* (CHN-PC, 2018). The total shoreline length of PFM Subarea 2-10 is 117.72 km (Table 1).

Yáanu · Giinu Sea Cucumber

A total of 51 transects were completed and 6 transects were skipped within PFM Subarea 2-10. Transects 210, 211, 242, 243 were inaccessible in shallow bays, and 222 and 261 were not completed due to strong currents. Densities ranged from 0.00 to 48.25 c/m-sh. A total of 41 of the 51 (80%) transects surveyed had a density greater than 2.50 c/m-sh (the commercial fishery threshold) (Figure 4).

The DFO Fisheries Management database has a total shoreline length for PFM Subarea 2-10 of 117,716 m, of which 11,299 m is classified as “exposed” and 106,417 m is classified as “protected” by the BC

Shorezone classification system. Six transects on protected shoreline were not completed; as a result, 12,000 m of protected shoreline was removed for the biomass calculations (Tables 5 and 6). Therefore, the total shoreline length used for PFMA Subarea 2-10 biomass calculations was 11,299 m exposed and 94,417 m protected (Tables 5 and 6). No transects were skipped in the Strict Protection Zone 10 and 6 transects were skipped in the Multiple Use Zone. After removal of shoreline for skipped transects, total shoreline for biomass calculations was 0 m exposed and 29,739 m protected shoreline for PFM Subarea 2-10 *Daanaay Kuuyada* 10 or *Gwaii Haanas Strict Protection Zone 10*, and 11,299 m exposed and 75,478 m protected shoreline for PFM Subarea 2-10 Multiple Use Zone.

The mean *yáanuu · ġinuu Sea Cucumber* density was estimated to be 10.51 c/m-sh with a 90% LCB of 8.38 c/m-sh for PFM Subarea 2-10, 12.19 c/m-sh with a 90% LCB of 7.16 c/m-sh for 2-10 *Daanaay Kuuyada* 10 or *Gwaii Haanas Strict Protection Zone 10*, and 10.20 c/m-sh with a 90% LCB of 7.88 c/m-sh for 2-10 *Gwaii Haanas Multiple Use Zone* (Tables 2, 5 and 6). The mean juvenile density was estimated to be 0.19 c/m-sh with a 95% LCB of 0.00 c/m-sh for PFM Subarea 2-10, 0.03 c/m-sh with a 90% LCB of 0.00 c/m-sh for 2-10 *Daanaay Kuuyada* 10 or *Gwaii Haanas Strict Protection Zone 10*, and 0.22 c/m-sh with a 90% LCB of 0.00 c/m-sh for 2-10 *Gwaii Haanas Multiple Use Zone* (Table 3).

The average weight of the 6 biological samples in PFMA Subarea 2-10 (transects 208, 227, 236, 245, 258, 260) was 248 g. The average weight of the 1 biological sample in PFMA Subarea 2-10 *Daanaay Kuuyada* 10 or *Gwaii Haanas Strict Protection Zone 10* (transect 258) was 412 g. The average weight of the 5 biological samples in PFMA Subarea 2-10 *Gwaii Haanas Multiple Use Zone* (transects 208, 227, 236, 245, 260) was 215 g (Table 4).

When exposed shoreline was given the default value of 2.50 c/m-sh, the 90% LCB of the mean biomass estimate was 203,167 kg for PFM Subarea 2-10, 87,728 kg for 2-10 *Daanaay Kuuyada* 10 or *Gwaii Haanas Strict Protection Zone 10*, and 133,948 kg for 2-10 *Gwaii Haanas Multiple Use Zone* (Table 5). When exposed shoreline was given the 90% LCB of the survey density estimate, the 90% LCB of the mean biomass estimate was 219,636 kg for PFM Subarea 2-10, 87,728 kg for 2-10 *Daanaay Kuuyada* 10 or *Gwaii Haanas Strict Protection Zone 10*, and 147,018 kg for 2-10 *Gwaii Haanas Multiple Use Zone* (Table 6).

Stan · st'an Geoduck, gudangee · guuding.ngaay Red Sea Urchin, stuu · daws styuu Green Sea Urchin, and sk'ám i hlt'ahldaláa · naaw k'aanaasga Sunflower Sea Star abundance

Relative abundances were estimated for *stan · st'an Pacific Geoduck, gudangee · guuding.ngaay Red Sea Urchins, stuu · daws styuu Green Sea Urchins, and sk'ám i hlt'ahldaláa · naaw k'aanaasga Sunflower Sea Stars* for all 51 transects surveyed in PFM Subarea 2-10 (Table 7). Totals may not add up to exactly 100% due to rounding. 'Abundant' Pacific Geoduck were observed at 0% of the transects, 'Many' Pacific Geoduck were observed at 8% of the transects, 'Few' were observed at 8% of the transects, and no Pacific Geoduck were observed at 84% of the transects. 'Abundant' Red Sea Urchins were observed at 51% of the transects, 'Many' were observed at 18% of the transects, 'Few' Red Sea Urchins were observed at 8% of the transects, while no Red Sea Urchins were observed at 24% of the transects. 'Abundant' Green Sea Urchins were observed at 10% of the transects, 'Many' at 8% of the transects, 'Few' at 18% of the transects, and no Green Sea Urchins were observed at 65% of the transects. 'Abundant' Sunflower Sea Stars were observed at 2% of the transects (tiny juveniles), 'Many' at 0% of the transects, 'Few' at 4% of the transects, and no Sunflower Sea Stars were observed at 67% of the transects.

PFMA 2-15 (*Gwaii Haanas – Sk'in Kaahlii Skincuttle Inlet*)

Survey area description

PFM Subarea 2-15 includes the waters of *Sk'in Kaahlíi Skincuttle Inlet* east of a line between 'Laana DaaGang.nga Kun Smithe Point and *GawGan Kun Huston Point* and west of a line between *Sk'yaaw Kun* and *Kan Kiidas Kun Deluge Point*. This subarea includes 'Laana DaaGang.nga Swan Bay, 'Laana DaaGang.nga Gwaayts'idaay Swan Islands, Xaagyah Gwaay.yaay Bolkus Islands, 'Laana DaaGang.nga K'aada Gapdal Kingfisher Cove, Chiiyah *GawGa Gapdal Pelican Point*, Chiiyah Daanaay Bluejay Cove, half of the Copper Islands (*Kun Gwaay George Island*, *Sk'in Gaatl'l Skincuttle Island*, *Gwaay Giid Rock Islet*, *Xil Haanas Gwaay Slug Islet*), Jiidawaay *GawGa Harriet Harbour*, Jiidawaay *Gwaay Harriet Island*, *HiGaa Ungud Guuxyangs Elswa Rock*, *Xuuya GawGa Jedway Bay*, Bush Rock, *GawGan HiGaa Low Black Rock*, *Kal K'uhlging HiGaa Green Rock*, *Kal K'uhlging Gwaay Boulder Island*, *GawGan Gwaay.yaay Sea Pigeon Island*, and all of *GawGan Daanaay Huston Inlet*. A large portion of this subarea is covered by the *Tang.Gwan Giisda Kaadlljuu Coming Out of the Ocean First Daanaay Kuuyada precious area 7* or *Gwaii Haanas Strict Protection Zone 7*, which includes *Xaagyah Gwaay.yaay Bolkus Island*, a Haida origin site where *SGuuluu Jaad Foam Woman* first came out of the water (CHN-PC, 2018). *Suu Kaahlíi Skincuttle Inlet* is also an ecological hotspot, home to thousands of nesting seabirds (CHN-PC, 2018). *GawGajaang Louscoone Inlet Daanaay Kuuyada precious area 6b* or *Gwaii Haanas Strict Protection Zone 6b* is also located within subarea 2-15. The total shoreline length of PFM Subarea 2-15 is 80.76 km (Table 1).

Yáanu · Giinuu Sea Cucumber

A total of 39 transects were completed and zero transects were skipped within PFM Subarea 2-15. Densities ranged from 0.00 to 48.00 c/m-sh. A total of 30 of the 39 (77%) transects surveyed had a density greater than 2.50 c/m-sh (the commercial fishery threshold) (Figure 4).

The DFO Fisheries Management database has a total shoreline length for PFM Subarea 2-15 of 80,756 m, of which 11,720 m is classified as “exposed” and 69,036 m is classified as “protected” by the BC Shorezone classification system. No transects were skipped so those shoreline lengths were used for biomass calculations (Tables 5 and 6). Total shoreline for biomass calculations was 0 m exposed and 7,046 m protected shoreline for 2-15 *Daanaay Kuuyada 6b* or *Gwaii Haanas Strict Protection Zone 6d*, and 3,907 m exposed and 30,924 m protected shoreline for 2-15 *Daanaay Kuuyada 7* or *Gwaii Haanas Strict Protection Zone 7*, and 7,813 m exposed and 31,066 m protected shoreline for 2-15 *Gwaii Haanas Multiple Use Zone* (Tables 5 and 6).

The mean *yáanu · giinuu Sea Cucumber* density was estimated to be 14.12 c/m-sh with a 90% LCB of 10.97 c/m-sh for PFM Subarea 2-15, 12.25 c/m-sh with a 90% LCB of 2.08 c/m-sh for 2-15 *Daanaay Kuuyada 6b* or *Gwaii Haanas Strict Protection Zone 6d*, 15.57 c/m-sh with a 90% LCB of 10.82 c/m-sh for 2-15 *Daanaay Kuuyada 7* or *Gwaii Haanas Strict Protection Zone 7*, 13.36 c/m-sh with a 90% LCB of 9.05 c/m-sh for 2-15 *Gwaii Haanas Multiple Use Zone* (Tables 2, 5 and 6). The mean juvenile density was estimated to be 0.02 c/m-sh with a 95% LCB of 0.00 c/m-sh for PFM Subarea 2-15, 0.00 c/m-sh for 2-15 *Daanaay Kuuyada 6b* or *Gwaii Haanas Strict Protection Zone 6d*, 0.02 c/m-sh with a 95% LCB of 0.00 c/m-sh for 2-15 *Daanaay Kuuyada 7* or *Gwaii Haanas Strict Protection Zone 7*, 0.22 c/m-sh with a 95% LCB of 0.00 c/m-sh for 2-15 *Multiple Use Zone* (Table 3).

The average weight of the 4 biological samples in PFMA Subarea 2-15 (transects 489, 503, 508, 525) was 221 g. The average weight of the 1 biological sample in PFMA Subarea 2-15 *Daanaay Kuuyada 6b* or *Gwaii Haanas Strict Protection Zone 6d* (transect 503) was 316 g. The average weight of the 1 biological sample in PFMA Subarea 2-15 *Daanaay Kuuyada 7* or *Gwaii Haanas Strict Protection Zone 7* (transect 525) was 166 g. The average weight of the 2 biological samples in PFMA Subarea 2-15 *Gwaii Haanas Multiple Use Zone* (transects 489, 508) was 202 g (Table 4).

When exposed shoreline was given the default value of 2.50 c/m-sh, the 90% LCB of the mean biomass estimate was 173,813 kg for PFM Subarea 2-15, 4,631 kg for 2-15 *Daanaay Kuuyada 6b* or *Gwaii Haanas Strict Protection Zone 6d*, 57,165 kg for 2-15 *Daanaay Kuuyada 7* or *Gwaii Haanas Strict Protection Zone 7*, and 60,737 kg for 2-15 *Gwaii Haanas Multiple Use Zone* (Table 5). When exposed shoreline was given the 90 % LCB of the survey density estimate, the 90% LCB of the mean biomass estimate was 195,746 kg for PFM Subarea 2-15, 4,631 kg for 2-15 *Daanaay Kuuyada 6b* or *Gwaii Haanas Strict Protection Zone 6d*, 62,561 kg for 2-15 *Daanaay Kuuyada 7* or *Gwaii Haanas Strict Protection Zone 7*, and 71,075 kg for 2-15 *Gwaii Haanas Multiple Use Zone* (Table 6).

Stan · st'an Geoduck, gudangee · guuding.ngaay Red Sea Urchin, stuu · daws styuu Green Sea Urchin, and sk'áam i hlt'ahldaláa · naaw k'aanaasga Sunflower Sea Star abundance

Relative abundances were estimated for *stan · st'an Pacific Geoduck, gudangee · guuding.ngaay Red Sea Urchins, stuu · daws styuu Green Sea Urchins, and sk'áam i hlt'ahldaláa · naaw k'aanaasga Sunflower Sea Stars* for all 39 transects surveyed in PFM Subarea 2-15 (Table 7). Totals may not add up to exactly 100% due to rounding. 'Abundant' Pacific Geoduck were observed at 5% of the transects, 'Many' Pacific Geoduck were observed at 5% of the transects, 'Few' were observed at 21% of the transects, and no Pacific Geoduck were observed at 69% of the transects. 'Abundant' Red Sea Urchins were observed at 44% of the transects, 'Many' were observed at 13% of the transects, 'Few' Red Sea Urchins were observed at 5% of the transects, while no Red Sea Urchins were observed at 38% of the transects. 'Abundant' Green Sea Urchins were observed at 8% of the transects, 'Many' at 26% of the transects, 'Few' at 18% of the transects, and no Green Sea Urchins were observed at 49% of the transects. 'Abundant' Sunflower Sea Stars were observed at 0% of the transects, 'Many' at 0% of the transects, 'Few' at 3% of the transects, and no Sunflower Sea Stars were observed at 97% of the transects.

Interannual comparison

For PFMA 2-15, the mean density ($\pm$ sd) in 2024 (14.12 ± 12.41 c/m-sh, $n = 39$ transects) was significantly higher than in 2012 (6.46 ± 5.00 c/m-sh, $n = 39$; Wilcoxon Non-Parametric Test: $W = 508.5$, $p = 0.01$).

No biological samples were collected in PFMA 2-15 in 2012 therefore a comparison of mean weight was not possible.

Duu Guusd West Coast Haida Gwaii – Kaysuun Kaahlíi Englefield Bay (PFMAs 2-51, 2-52, 2-53, 2-54, 2-55, 2-56, 2-57, 2-58, 2-59 and 2-60), August 2024

The Englefield Bay biomass survey was located within Pacific Fisheries Management Area (PFMA) 2 – *T'aaxwii XaaydaGa Gwaay.yaay IinaGwaay Moresby Island* on Haida Gwaii in the Northern Coast Region (Figure 1). This area has been closed to Sea Cucumber harvesting since 1995 and was surveyed for potential re-opening. The survey included ten PFM Subareas, 2-51 to 2-60, and was conducted from August 16-21, 2024 onboard the multipurpose commercial vessel Canpac Valour.

PFMA 2-51 and 2-53 (*Kaysuun Kaahlíi Englefield Bay North and Kaysuun Xyangs Inskip Channel West*)

Survey area description

PFM Subarea 2-51 includes waters on the north coast of *Kaysuun Kaahlíi Englefield Bay* bounded by a line that runs from *T'aaxwii XaaydaGa Gwaay.yaay IinaGwaay Moresby Island* south to Percy Point, and

a line that runs between Fairlie Point and the eastern point of Lihou Island, then up to the eastern point of Carswell Island, then north to *T'aaxwii XaaydaGa Gwaay.yaay IinaGwaay Moresby Island*. The total shoreline length of PFM Subarea 2-51 is 6.82 km (Table 1).

PFM Subarea 2-53 includes the waters on the west side of *Kaysuun Xyangs Inskip Channel*, inside of a line that runs between *Ts'uu Guus Kun Fairlie Point* and *Gandll KwaasGaagidaawa Kun Susan Sturgis Point* on the west side and from *Gaayuu Kyangs Kun Hastings Point* south to *Gwaay Daan Hibben Island* on the east side. This subarea includes *Kaysuun Xyangs GawGa Baylee Bay* and *Kaysuun Xyangs Gwaay Instructor Island*. The total shoreline length of PFM Subarea 2-53 is 20.05 km (Table 1).

Yáanu · Giinu Sea Cucumber

The transects within PFM Subareas 2-51 and 2-53 were combined into one analysis area, as 4 transects were surveyed in PFM Subarea 2-51 and 10 transects were surveyed in PFM Subarea 2-53. Given the low number of transects completed in PFM Subarea 2-51, caution is required when interpreting results extrapolated to this subarea. No transects were skipped in PFM Subareas 2-51 or 2-53. Densities ranged from 0.00 to 19.00 c/m-sh. A total of 11 of the 14 (79%) transects surveyed had a density of greater than 2.50 c/m-sh (the commercial fishery threshold) (Figure 5).

The DFO Fisheries Management database has a total shoreline length for PFM Subarea 2-51 of 5,460 m, of which 5,023 m is classified as “exposed” and 437 m is classified as “protected” by the BC Shorezone classification system. For PFM Subarea 2-53 the DFO Fisheries Management database has a total shoreline length of 18,497 m, of which 2,278 m is classified as “exposed” and 16,218 m is classified as “protected” by the BC Shorezone classification system. No transects were skipped so these shoreline lengths were used for biomass calculations (Tables 5 and 6).

The mean *yáanu · giinu Sea Cucumber* density for the analysis area was estimated to be 7.34 c/m-sh with a 90% LCB of 5.02 c/m-sh (Tables 2, 5 and 6). The mean juvenile density for the analysis area was estimated to be 0.04 c/m-sh with a 95% LCB of 0.00 c/m-sh (Table 3). An average weight was calculated for the one biological sample transect in PFM Subarea 2-51 (transect 810) and the overall average weight for this subarea was 181 g (Table 4). An average weight was calculated for the two biological sample transects in PFM Subarea 2-53 (transects 824 and 883) and the overall average weight for this subarea was 131 g (Table 4).

For PFM Subarea 2-51, the 90% LCB of the mean biomass estimate was 2,670 kg when exposed shoreline was given the default value of 2.50 c/m-sh (Duprey et al., 2011) (Table 5) and was 4,961 kg when exposed shoreline was given the 90% LCB of the survey density estimate (Table 6).

For PFM Subarea 2-53, the 90% LCB of the mean biomass estimate was 11,411 kg when exposed shoreline was given the default value of 2.50 c/m-sh (Duprey et al., 2011) (Table 5) and was 12,163 kg when exposed shoreline was given the 90% LCB of the survey density estimate (Table 6).

Stan · st'an Geoduck, gudangee · guuding.ngaay Red Sea Urchin, stuu · daws styuu Green Sea Urchin, and sk'áam i hlt'ahldaláa · naaw k'aanaasGa Sunflower Sea Star abundance

Relative abundances were estimated for *stan · st'an Pacific Geoduck*, *gudangee · guuding.ngaay Red Sea Urchins*, *stuu · daws styuu Green Sea Urchins*, and *sk'áam i hlt'ahldaláa · naaw k'aanaasGa Sunflower Sea Stars* for all 4 transects surveyed in PFM Subarea 2-51 (Table 7). Totals may not add up to exactly 100% due to rounding. ‘Abundant’ Pacific Geoduck were observed at 0% of the transects, ‘Many’ Pacific Geoduck were observed at 25% of the transects, ‘Few’ were observed at 0% of the transects, and no Pacific Geoduck were observed at 75% of the transects. ‘Abundant’ Red Sea Urchins were observed at 100% of the transects, ‘Many’ were observed at 0% of the transects, ‘Few’ Red Sea Urchins were

observed at 0% of the transects, while no Red Sea Urchins were observed at 0% of the transects. 'Abundant' Green Sea Urchins were observed at 0% of the transects, 'Many' at 25% of the transects, 'Few' at 75% of the transects, and no Green Sea Urchins were observed at 0% of the transects. 'Abundant' Sunflower Sea Stars were observed at 0% of the transects, 'Many' at 0% of the transects, 'Few' at 0% of the transects, and no Sunflower Sea Stars were observed at 100% of the transects.

Relative abundances were estimated for *stan · st'an Pacific Geoduck*, *gudangee · guuding.ngaay Red Sea Urchins*, *stuu · daws styuu Green Sea Urchins*, and *sk'aam i hlt'ahldalaa · naaw k'aanaasga Sunflower Sea Stars* for all 10 transects surveyed in PFM Subarea 2-53 (Table 7). Totals may not add up to exactly 100% due to rounding. 'Abundant' Pacific Geoduck were observed at 30% of the transects, 'Many' Pacific Geoduck were observed at 0% of the transects, 'Few' were observed at 20% of the transects, and no Pacific Geoduck were observed at 50% of the transects. 'Abundant' Red Sea Urchins were observed at 100% of the transects, 'Many' were observed at 0% of the transects, 'Few' Red Sea Urchins were observed at 0% of the transects, while no Red Sea Urchins were observed at 0% of the transects. 'Abundant' Green Sea Urchins were observed at 0% of the transects, 'Many' at 0% of the transects, 'Few' at 60% of the transects, and no Green Sea Urchins were observed at 40% of the transects. 'Abundant' Sunflower Sea Stars were observed at 0% of the transects, 'Many' at 0% of the transects, 'Few' at 0% of the transects, and no Sunflower Sea Stars were observed at 100% of the transects.

PFMA 2-52 (*Kaysuun Kaahlii Englefield Bay - Ts'uu Guus GawGa Security Inlet*)

Survey area description

PFM Subarea 2-52 includes the waters of *Ts'uu Guus GawGa Security Inlet* east of a line that runs from *T'aaxwii XaaydaGa Gwaay.yaay IinaGwaay Moresby Island* south to *Kalga Kun Percy Point*. This subarea includes *Xandiis GawGa MacKenzie Cove*, *Xandiis Kun Bland Point*, *Ts'uu Xyangs Kun Kennedy Point*, *Ts'uu Kun Security Point*, and Security Cove, with an estuary at the head of the inlet. The total shoreline length of PFM Subarea 2-52 is 22.96 km (Table 1).

Yáanu · Giinu Sea Cucumber

A total of 10 transects were completed and 1 transect was skipped within PFM Subarea 2-52. Transect 817 on protected shoreline was skipped because it was inaccessible. Densities ranged from 0.00 c/m-sh to 7.25 c/m-sh. A total of 3 of the 10 (30%) transects surveyed had a density greater than 2.50 c/m-sh (the commercial fishery threshold) (Figure 5).

The DFO Fisheries Management database has a total shoreline length for PFM Subarea 2-52 of 14,482 m, of which 1,087 m is classified as "exposed" and 13,395 m is classified as "protected" by the BC Shorezone classification system. One transect on protected shoreline was not completed; as a result, 2,000 m of protected shoreline were removed for the biomass calculations (Tables 5 and 6). Therefore, the total shoreline length used for biomass calculations was 1,087m exposed and 11,395 m protected (Tables 5 and 6).

The mean *yáanu · giinu Sea Cucumber* density for PFM Subarea 2-52 was estimated to be 2.28 c/m-sh with a 90% LCB of 0.85 c/m-sh (Tables 2, 5 and 6). The mean juvenile density was estimated to be 0.08 c/m-sh with a 95% LCB of 0.00 c/m-sh (Table 3). No biological samples were collected from PFM Subarea 2-52, and therefore the lowest PFM Subarea mean weight for the *Kaysuun Kaahlii Englefield Bay* survey, 40 g from 2-56, was used for biomass calculations (Table 4).

The 90% LCB of the mean biomass estimate was 424 kg with both ¹Biomass_{CB} (equation 1) and ²Biomass_{CB} (equation 2). This is because the 90% LCB of the survey density estimate (0.85 c/m-sh) was

less than the default value (2.50 c/m-sh) and therefore the default value was used in both cases (Duprey et al., 2011) (Table 5 and 6).

Stan · st'an Geoduck, gudangee · guuding.ngaay Red Sea Urchin, stuu · daws styuu Green Sea Urchin, and sk'áam i hlt'ahldaláa · naaw k'aanaasga Sunflower Sea Star abundance

Relative abundances were estimated for stan · st'an Pacific Geoduck, gudangee · guuding.ngaay Red Sea Urchins, stuu · daws styuu Green Sea Urchins, and sk'áam i hlt'ahldaláa · naaw k'aanaasga Sunflower Sea Stars for all 10 transects surveyed in PFM Subarea 2-52 (Table 7). Totals may not add up to exactly 100% due to rounding. 'Abundant' Pacific Geoduck were observed at 0% of the transects, 'Many' Pacific Geoduck were observed at 10% of the transects, 'Few' were observed at 10% of the transects, and no Pacific Geoduck were observed at 80% of the transects. 'Abundant' Red Sea Urchins were observed at 30% of the transects, 'Many' were observed at 20% of the transects, 'Few' Red Sea Urchins were observed at 0% of the transects, while no Red Sea Urchins were observed at 50% of the transects. 'Abundant' Green Sea Urchins were observed at 0% of the transects, 'Many' at 10% of the transects, 'Few' at 10% of the transects, and no Green Sea Urchins were observed at 80% of the transects. 'Abundant' Sunflower Sea Stars were observed at 0% of the transects, 'Many' at 0% of the transects, 'Few' at 0% of the transects, and no Sunflower Sea Stars were observed at 100% of the transects.

PFMA 2-54 and 2-55 (Kaysuun Kaahlii Englefield Bay - Kaysuun Xyangs Inskip Channel East and Kuper Inlet North)

Survey area description

PFM Subarea 2-54 includes the waters on the east side of Kaysuun Xyangs Inskip Channel, inside of a line that runs from Gaayuu Xyangs Kun Hastings Point south to Gwaay Daan Hibben Island on the west side, and from Gwaay Daan Kun Sangster Point north to T'aaxwii XaaydaGa Gwaay.yaay IinaGwaay Moresby Island on the east side. The total shoreline length of PFM Subarea 2-54 is 10.87 km (Table 1).

PFM Subarea 2-55 includes the waters of Kuper Inlet east of Gwaay Daan Hibben Island and inside of bounding lines running from Gwaay Daan Kun Sangster Point north to T'aaxwii XaaydaGa Gwaay.yaay IinaGwaay Moresby Island, Gwaay Daan Kun Sangster Point south MacNeill Point, Huu Tlaan Kun Recovery Point to Huu Tlaan Siiwaay Kun Colton Point, and Stads K'uns Kun Peel Point north to T'aaxwii XaaydaGa Gwaay.yaay IinaGwaay Moresby Island. This subarea includes Xaaguu HIGaa Leopold Island and several other small islands. The total shoreline length of PFM Subarea 2-55 is 10.13 km (Table 1).

Yáanu · Giinuu Sea Cucumber

The transects within PFM Subareas 2-54 and 2-55 were combined into one analysis area because only five transects were completed in each area. Given the low number of transects completed, caution is required when interpreting results. No transects were skipped in PFM Subareas 2-54 or 2-55. Densities ranged from 0.00 to 21.75 c/m-sh. A total of 6 of the 10 (60%) transects surveyed had a density of greater than 2.50 c/m-sh (the commercial fishery threshold) (Figure 6).

The DFO Fisheries Management database has a total shoreline length for PFM Subarea 2-54 of 10,466 m, all of which is classified as "protected" by the BC Shorezone classification system. For PFM Subarea 2-55 the DFO Fisheries Management database has a total shoreline length of 8,131 m, all of which is classified as "protected" by the BC Shorezone classification system. No transects were skipped so these shoreline lengths were used for biomass calculations (Tables 5 and 6).

The mean yáanu · giinuu Sea Cucumber density for the analysis area was estimated to be 6.55 c/m-sh with a 90% LCB of 3.30 c/m-sh (Tables 2, 5 and 6). The mean juvenile density for the analysis area was

estimated to be 0.00 c/m-sh (Table 3). No biological samples were collected from PFM Subarea 2-54, and therefore the lowest PFM Subarea mean weight for the Kaysuun Kaahlíi Englefield Bay survey, 40 g from 2-56, was used for biomass calculations (Table 4). An average weight was calculated for the one biological sample transect in PFM Subarea 2-55 (transect 851) and the overall average weight for this subarea was 170 g (Table 4).

For PFM Subarea 2-54, the 90% LCB of the mean biomass estimate was 1,382 kg whether exposed shoreline was given the default value of 2.50 c/m-sh (Duprey et al., 2011) (Table 5) or the 90 % LCB of the survey density estimate, because none of the shoreline was classified as exposed (Table 6).

For PFM Subarea 2-55, the 90% LCB of the mean biomass estimate was 4,561 kg whether exposed shoreline was given the default value of 2.50 c/m-sh (Duprey et al., 2011) (Table 5) or the 90 % LCB of the survey density estimate, also because none of the shoreline was classified as exposed (Table 6).

Stan · st'an Geoduck, gudangee · guuding.ngaay Red Sea Urchin, stuu · daws styuu Green Sea Urchin, and sk'áam i hlt'ahldaláa · naaw k'aanaasga Sunflower Sea Star abundance

Relative abundances were estimated for stan · st'an Pacific Geoduck, gudangee · guuding.ngaay Red Sea Urchins, stuu · daws styuu Green Sea Urchins, and sk'áam i hlt'ahldaláa · naaw k'aanaasga Sunflower Sea Stars for all 5 transects surveyed in PFM Subarea 2-54 (Table 7). Totals may not add up to exactly 100% due to rounding. 'Abundant' Pacific Geoduck were observed at 0% of the transects, 'Many' Pacific Geoduck were observed at 20% of the transects, 'Few' were observed at 40% of the transects, and no Pacific Geoduck were observed at 40% of the transects. 'Abundant' Red Sea Urchins were observed at 60% of the transects, 'Many' were observed at 20% of the transects, 'Few' Red Sea Urchins were observed at 0% of the transects, while no Red Sea Urchins were observed at 20% of the transects. 'Abundant' Green Sea Urchins were observed at 0% of the transects, 'Many' at 0% of the transects, 'Few' at 20% of the transects, and no Green Sea Urchins were observed at 80% of the transects. 'Abundant' Sunflower Sea Stars were observed at 0% of the transects, 'Many' at 0% of the transects, 'Few' at 0% of the transects, and no Sunflower Sea Stars were observed at 100% of the transects.

Relative abundances were estimated for stan · st'an Pacific Geoduck, gudangee · guuding.ngaay Red Sea Urchins, stuu · daws styuu Green Sea Urchins, and sk'áam i hlt'ahldaláa · naaw k'aanaasga Sunflower Sea Stars for all 5 transects surveyed in PFM Subarea 2-55 (Table 7). Totals may not add up to exactly 100% due to rounding. 'Abundant' Pacific Geoduck were observed at 0% of the transects, 'Many' Pacific Geoduck were observed at 20% of the transects, 'Few' were observed at 0% of the transects, and no Pacific Geoduck were observed at 80% of the transects. 'Abundant' Red Sea Urchins were observed at 60% of the transects, 'Many' were observed at 20% of the transects, 'Few' Red Sea Urchins were observed at 0% of the transects, while no Red Sea Urchins were observed at 20% of the transects. 'Abundant' Green Sea Urchins were observed at 0% of the transects, 'Many' at 0% of the transects, 'Few' at 20% of the transects, and no Green Sea Urchins were observed at 80% of the transects. 'Abundant' Sunflower Sea Stars were observed at 0% of the transects, 'Many' at 0% of the transects, 'Few' at 0% of the transects, and no Sunflower Sea Stars were observed at 100% of the transects.

PFMA 2-56 and 2-57 (Kaysuun Kaahlíi Englefield Bay - Stads K'uns GawGa Peel Inlet and Huu Tlaan GawGa Mudge Inlet)

Survey area description

PFM Subarea 2-56 includes the waters of Stads K'uns GawGa Peel Inlet southeast of a line that runs from Stads K'uns Kun Peel Point north to T'aaxwii XaaydaGa Gwaay.yaay IinaGwaay Moresby Island. This

subarea includes [GawGa Kun](#) *Laing Point*, several islands, and an estuary at the head of the inlet. The total shoreline length of PFM Subarea 2-56 is 19.38 km (Table 1).

PFM Subarea 2-57 includes the waters of [Huu Tlaan GawGa](#) *Mudge Inlet* southeast of a line that runs between [Huu Tlaan Siiwaay Kun](#) *Colton Point* and [Huu Tlaan Kun](#) *Recovery Point*. This subarea includes [Huu Tlaan Gwaay](#) *Colton Islet* and an estuary at the head of the inlet. The total shoreline length of PFM Subarea 2-57 is 10.10 km (Table 1).

[Yáanu](#) · [Giinu](#) *Sea Cucumber*

The transects within PFM Subareas 2-56 and 2-57 were combined into one analysis area because only five transects were completed in PFM Subarea 2-57. Given the low number of transects completed, caution is required when interpreting results from PFM Subarea 2-57. No transects were skipped in PFM Subareas 2-56 or 2-57. Densities ranged from 0.00 to 4.00 c/m-sh. A total of 2 of the 15 (13%) transects surveyed had a density of greater than 2.50 c/m-sh (the commercial fishery threshold).

The DFO Fisheries Management database has a total shoreline length for PFM Subarea 2-56 of 17,942 m, all of which is classified as “protected” by the BC Shorezone classification system. For PFM Subarea 2-57 the DFO Fisheries Management database has a total shoreline length of 9,996 m, all of which is classified as “protected” by the BC Shorezone classification system. No transects were skipped so these shoreline lengths were used for biomass calculations (Tables 5 and 6).

The mean [yáanu](#) · [giinu](#) *Sea Cucumber* density for the analysis area was estimated to be 0.72 c/m-sh with a 90% LCB of 0.22 c/m-sh (Tables 2, 5 and 6). The mean juvenile density for the analysis area was estimated to be 0.05 c/m-sh with a 95% LCB of 0.00 c/m-sh (Table 3). An average weight was calculated for the one biological sample transect in PFM Subarea 2-56 (transect 841) and the overall average weight for this subarea was the lowest in the [Kaysuun Kaahlii](#) *Englefield Bay* survey, at 40 g (Table 4). No biological samples were collected from PFM Subarea 2-57, and therefore the lowest PFM Subarea mean weight for the [Kaysuun Kaahlii](#) *Englefield Bay* survey, 40 g from 2-56, was used for biomass calculations (Table 4).

For PFM Subarea 2-56, the 90% LCB of the mean biomass estimate was 158 kg whether exposed shoreline was given the default value of 2.50 c/m-sh (Duprey et al., 2011) (Table 5) or the 90 % LCB of the survey density estimate, because none of the shoreline was classified as exposed (Table 6).

For PFM Subarea 2-57, the 90% LCB of the mean biomass estimate was 88 kg whether exposed shoreline was given the default value of 2.50 c/m-sh (Duprey et al., 2011) (Table 5) or the 90 % LCB of the survey density estimate, because none of the shoreline was classified as exposed (Table 6).

[Stan](#) · [st'an](#) *Geoduck*, [gudangee](#) · [guuding.ngaay](#) *Red Sea Urchin*, [stuu](#) · [daws styuu](#) *Green Sea Urchin*, and [sk'áam i hlt'ahldaláa](#) · [naaw k'aanaasga](#) *Sunflower Sea Star* abundance

Relative abundances were estimated for [stan](#) · [st'an](#) *Pacific Geoduck*, [gudangee](#) · [guuding.ngaay](#) *Red Sea Urchins*, [stuu](#) · [daws styuu](#) *Green Sea Urchins*, and [sk'áam i hlt'ahldaláa](#) · [naaw k'aanaasga](#) *Sunflower Sea Stars* for all 10 transects surveyed in PFM Subarea 2-56 (Table 7). Totals may not add up to exactly 100% due to rounding. ‘Abundant’ Pacific Geoduck were observed at 10% of the transects, ‘Many’ Pacific Geoduck were observed at 0% of the transects, ‘Few’ were observed at 0% of the transects, and no Pacific Geoduck were observed at 90% of the transects. ‘Abundant’ Red Sea Urchins were observed at 10% of the transects, ‘Many’ were observed at 20% of the transects, ‘Few’ Red Sea Urchins were observed at 0% of the transects, while no Red Sea Urchins were observed at 70% of the transects. ‘Abundant’ Green Sea Urchins were observed at 10% of the transects, ‘Many’ at 0% of the transects, ‘Few’ at 0% of the transects, and no Green Sea Urchins were observed at 90% of the transects.

‘Abundant’ Sunflower Sea Stars were observed at 0% of the transects, ‘Many’ at 0% of the transects, ‘Few’ at 0% of the transects, and no Sunflower Sea Stars were observed at 100% of the transects.

Relative abundances were estimated for *stan · st’an Pacific Geoduck*, *gudangee · guuding.ngaay Red Sea Urchins*, *stuu · daws styuu Green Sea Urchins*, and *sk’áam i hlt’ahldaláa · naaw k’aanaasGa Sunflower Sea Stars* for all 5 transects surveyed in PFM Subarea 2-57 (Table 7). Totals may not add up to exactly 100% due to rounding. ‘Abundant’ Pacific Geoduck were observed at 0% of the transects, ‘Many’ Pacific Geoduck were observed at 20% of the transects, ‘Few’ were observed at 0% of the transects, and no Pacific Geoduck were observed at 80% of the transects. ‘Abundant’ Red Sea Urchins were observed at 20% of the transects, ‘Many’ were observed at 0% of the transects, ‘Few’ Red Sea Urchins were observed at 0% of the transects, while no Red Sea Urchins were observed at 80% of the transects. ‘Abundant’ Green Sea Urchins were observed at 0% of the transects, ‘Many’ at 0% of the transects, ‘Few’ at 0% of the transects, and no Green Sea Urchins were observed at 100% of the transects. ‘Abundant’ Sunflower Sea Stars were observed at 0% of the transects, ‘Many’ at 0% of the transects, ‘Few’ at 0% of the transects, and no Sunflower Sea Stars were observed at 100% of the transects.

PFMA 2-58 and 2-59 (*Kaysuun Kaahlíi Englefield Bay - SGaay Taw GawGa Mitchell Inlet and Sint’a GawGa Douglas Inlet*)

Survey area description

PFM Subarea 2-58 includes the waters of *SGaay Taw GawGa Mitchell Inlet* southeast of a line that runs between *SGaay Taw Kun MacNeill Point* and the northeastern point of *Kun HlGunuhi Kun Josling Peninsula*. This subarea includes Thorn Rock, Una Point, Niven Point, Sansum Island, Thetis Anchorage, and an estuary at the head of the inlet. The total shoreline length of PFM Subarea 2-58 is 15.53 km (Table 1).

PFM Subarea 2-59 includes the waters of *Sint’a GawGa Douglas Inlet* southeast of a line that runs between *Sint’a Kun Bell Point* and *Kun Hamjuu Herbert Head*. This subarea includes *Stljuu Kun Leslie Point*, a couple of small islands, and a small estuary at the head of the inlet. The total shoreline length of PFM Subarea 2-59 is 16.51 km (Table 1).

Yáanu · Giinu Sea Cucumber

The transects within PFM Subareas 2-58 and 2-59 were combined into one analysis area because only 8 transects were completed PFM Subarea 2-58 and only 9 transects were completed in 2-59. Given the low number of transects completed, caution is required when interpreting results from these areas. No transects were skipped in PFM Subareas 2-58 or 2-59. Densities ranged from 0.00 to 31.25 c/m-sh. A total of 8 of the 17 (47%) transects surveyed had a density of greater than 2.50 c/m-sh (the commercial fishery threshold) (Figure 7).

The DFO Fisheries Management database has a total shoreline length for PFM Subarea 2-58 of 14,968 m, of which 100 m is classified as “exposed” and 14,868 m is classified as “protected” by the BC Shorezone classification system. For PFM Subarea 2-59 the DFO Fisheries Management database has a total shoreline length of 15,926 m, of which 175 m is classified as “exposed” and 15,751 m is classified as “protected” by the BC Shorezone classification system. No transects were skipped so these shoreline lengths were used for biomass calculations (Tables 5 and 6).

The mean *yáanu · giinu Sea Cucumber* density for the analysis area was estimated to be 5.81 c/m-sh with a 90% LCB of 3.04 c/m-sh (Tables 2, 5 and 6). The mean juvenile density for the analysis area was

estimated to be 0.01 c/m-sh with a 95% LCB of 0.00 c/m-sh (Table 3). The average weight for the one biological sample transect in PFM Subarea 2-58 (transect 859) was 79 g (Table 4). The average weight for the one biological sample transect in PFM Subarea 2-59 (transect 864) was 120 g (Table 4).

For PFM Subarea 2-58, the 90% LCB of the mean biomass estimate was 3,590 kg when the exposed shoreline was given the default value of 2.50 c/m-sh (Duprey et al., 2011) (Table 5) and was 3,595 kg when the exposed shoreline was given the 90 % LCB of the survey density estimate (Table 6).

For PFM Subarea 2-59, the 90% LCB of the mean biomass estimate was 5,798 kg when the exposed shoreline was given the default value of 2.50 c/m-sh (Duprey et al., 2011) (Table 5) and was 5,810 kg when the exposed shoreline was given the 90 % LCB of the survey density estimate (Table 6).

Stan · st'an Geoduck, gudangee · guuding.ngaay Red Sea Urchin, stuu · daws styuu Green Sea Urchin, and sk'áam i hlt'ahldaláa · naaw k'aanaasga Sunflower Sea Star abundance

Relative abundances were estimated for stan · st'an Pacific Geoduck, gudangee · guuding.ngaay Red Sea Urchins, stuu · daws styuu Green Sea Urchins, and sk'áam i hlt'ahldaláa · naaw k'aanaasga Sunflower Sea Stars for all 8 transects surveyed in PFM Subarea 2-58 (Table 7). Totals may not add up to exactly 100% due to rounding. 'Abundant' Pacific Geoduck were observed at 0% of the transects, 'Many' Pacific Geoduck were observed at 0% of the transects, 'Few' were observed at 12% of the transects, and no Pacific Geoduck were observed at 88% of the transects. 'Abundant' Red Sea Urchins were observed at 38% of the transects, 'Many' were observed at 0% of the transects, 'Few' Red Sea Urchins were observed at 38% of the transects, while no Red Sea Urchins were observed at 25% of the transects. 'Abundant' Green Sea Urchins were observed at 0% of the transects, 'Many' at 0% of the transects, 'Few' at 0% of the transects, and no Green Sea Urchins were observed at 100% of the transects. 'Abundant' Sunflower Sea Stars were observed at 0% of the transects, 'Many' at 0% of the transects, 'Few' at 12% of the transects, and no Sunflower Sea Stars were observed at 88% of the transects.

Relative abundances were estimated for stan · st'an Pacific Geoduck, gudangee · guuding.ngaay Red Sea Urchins, stuu · daws styuu Green Sea Urchins, and sk'áam i hlt'ahldaláa · naaw k'aanaasga Sunflower Sea Stars Pacific Geoduck for all 9 transects surveyed in PFM Subarea 2-59 (Table 7). Totals may not add up to exactly 100% due to rounding. 'Abundant' Pacific Geoduck were observed at 11% of the transects, 'Many' Pacific Geoduck were observed at 0% of the transects, 'Few' were observed at 0% of the transects, and no Pacific Geoduck were observed at 89% of the transects. 'Abundant' Red Sea Urchins were observed at 78% of the transects, 'Many' were observed at 11% of the transects, 'Few' Red Sea Urchins were observed at 11% of the transects, while no Red Sea Urchins were observed at 0% of the transects. 'Abundant' Green Sea Urchins were observed at 11% of the transects, 'Many' at 0% of the transects, 'Few' at 11% of the transects, and no Green Sea Urchins were observed at 78% of the transects. 'Abundant' Sunflower Sea Stars were observed at 0% of the transects, 'Many' at 0% of the transects, 'Few' at 0% of the transects, and no Sunflower Sea Stars were observed at 100% of the transects.

PFMA 2-60 (Kaysuun Kaahlii Englefield Bay – Moore Channel)

Survey area description

PFM Subarea 2-60 includes the waters of Kaysuun Kaahlii Moore Channel east of a line running from Kaasing Gwaay Kun Freshfield Point south to T'aaxwii XaaydaGa Gwaay.yaay IinaGwaay Moresby Island, west of a line between MacNeill Point and Gwaay Daan Kun Sangster Point, and north of the bounding lines for SGaay Taw GawGa Mitchell Inlet (PFM Subarea 2-58) and Sint'a GawGa Douglas Inlet (PFM Subarea 2-59). This subarea includes KunjuusGa Kun Roe Point, Archer Point, Hebert Head,

Kun HlGunuhl Kun *Josling Point*, K'iijuusGa Kun *Work Point*, and Sdal.la SGaagiidaay *Baylee Bluff*. The total shoreline length of PFM Subarea 2-60 is 19.95 km (Table 1).

Yáanu · Giinu Sea Cucumber

A total of 10 transects were completed and none were skipped within PFM Subarea 2-60. Densities ranged from 0.50 c/m-sh to 11.50 c/m-sh. A total of 3 of the 10 (30%) transects surveyed had a density greater than 2.50 c/m-sh (the commercial fishery threshold) (Figure 7).

The DFO Fisheries Management database has a total shoreline length for PFM Subarea 2-60 of 17,976 m, of which 10,333 m is classified as “exposed” and 7,643 m is classified as “protected” by the BC Shorezone classification system. No transects were skipped so these shoreline lengths were used for biomass calculations (Tables 5 and 6).

The mean yáanu · giinu Sea Cucumber density for PFM Subarea 2-60 was estimated to be 3.20 c/m-sh with a 90% LCB of 1.50 c/m-sh (Tables 2, 5 and 6). The mean juvenile density was estimated to be 0.00 c/m-sh (Table 3). An average weight was calculated for the one biological sample transect in PFM Subarea 2-60 (transect 880) and the overall average weight for this subarea was 96 g (Table 4).

The 90% LCB of the mean biomass estimate was 2,589 kg with both ¹Biomass_{CB} (equation 1) and ²Biomass_{CB} (equation 2). This is because the 90% LCB of the survey density estimate (1.50 c/m-sh) was less than the default value (2.50 c/m-sh) and therefore the default value was used in both cases (Duprey et al., 2011) (Table 5 and 6).

Stan · st'an Geoduck, gudangee · guuding.ngaay Red Sea Urchin, stuu · daws styuu Green Sea Urchin, and sk'áam i hlt'ahldaláa · naaw k'aanaasGa Sunflower Sea Star abundance

Relative abundances were estimated for stan · st'an Pacific Geoduck, gudangee · guuding.ngaay Red Sea Urchins, stuu · daws styuu Green Sea Urchins, and sk'áam i hlt'ahldaláa · naaw k'aanaasGa Sunflower Sea Stars for all 10 transects surveyed in PFM Subarea 2-60 (Table 7). Totals may not add up to exactly 100% due to rounding. ‘Abundant’ Pacific Geoduck were observed at 0% of the transects, ‘Many’ Pacific Geoduck were observed at 0% of the transects, ‘Few’ were observed at 0% of the transects, and no Pacific Geoduck were observed at 100% of the transects. ‘Abundant’ Red Sea Urchins were observed at 100% of the transects, ‘Many’ were observed at 0% of the transects, ‘Few’ Red Sea Urchins were observed at 0% of the transects, while no Red Sea Urchins were observed at 0% of the transects. ‘Abundant’ Green Sea Urchins were observed at 0% of the transects, ‘Many’ at 0% of the transects, ‘Few’ at 20% of the transects, and no Green Sea Urchins were observed at 80% of the transects. ‘Abundant’ Sunflower Sea Stars were observed at 0% of the transects, ‘Many’ at 0% of the transects, ‘Few’ at 0% of the transects, and no Sunflower Sea Stars were observed at 100% of the transects.

Duu Guusd West Coast Haida Gwaii – Chaahluu Kaahlíi Rennell Sound (PFMAs 2-65, 2-68, 2-70, 2-71, 2-73, 2-74, 2-75, 2-76, 2-77, 2-80, 2-81, 2-82, 2-83, and 2-84), August 2024

The Chaahluu Kaahlíi Rennell Sound biomass survey was located within Pacific Fisheries Management Area (PFMA) 2 – T'aaxwii XaaydaGa Gwaay.yaay linaGwaay Moresby Island on Haida Gwaii in the Northern Coast Region (Figure 1). This area has been closed to Sea Cucumber harvesting since 1995 and was surveyed for potential re-opening. The survey included fourteen PFM Subareas, 2-65, 2-68, 2-70, 2-71, 2-73 to 2-77, and 2-80 to 2-84, and was conducted from August 6-14, 2024 onboard the multipurpose commercial vessel Canpac Valour.

PFMA 2-65 (Duu Guusd West Coast Haida Gwaii – Jii.ngasii GawGaay Dawson Inlet and Skaats'ints'ii Dawson Harbour)

Survey area description

PFM Subarea 2-65 includes the waters of Jii.ngasii GawGaay Dawson Inlet and Skaats'ints'ii Dawson Harbour northeast of a line between Sgansgwans Kun Mercer Point and Gaw Ts'is Suu Kun Newton Point. The total shoreline length of PFM Subarea 2-65 is 29.84 km (Table 1).

Yáanu · Giinu Sea Cucumber

A total of 15 transects were completed and none were skipped within PFM Subarea 2-65. Densities ranged from 0.00 to 28.25 c/m-sh. A total of 9 of the 15 transects (60%) transects surveyed had a density greater than 2.50 c/m-sh (the commercial fishery threshold) (Figure 8).

The DFO Fisheries Management database has a total shoreline length for PFM Subarea 2-65 of 24,461 m, of which 2,492 m is classified as “exposed” and 21,969 m is classified as “protected” by the BC Shorezone classification system. No transects were skipped so these shoreline lengths were used for the biomass calculations (Tables 5 and 6).

The mean yáanu · giinu Sea Cucumber density for PFM Subarea 2-65 was estimated to be 4.67 c/m-sh with a 90% LCB of 2.35 c/m-sh (Tables 2, 5 and 6). The mean juvenile density was estimated to be 0.02 c/m-sh with a 95% LCB of 0.00 c/m-sh (Table 3). An average weight was calculated for the two biological sample transects in PFM Subarea 2-65 (transects 776 and 784) and the overall average weight for this subarea was 114 g (Table 4).

The 90% LCB of the mean biomass estimate was 6,553 kg with both ¹Biomass_{CB} (equation 1) and ²Biomass_{CB} (equation 2). This is because the 90% LCB of the survey density estimate (2.35 c/m-sh) was less than the default value (2.50 c/m-sh) and therefore the default value was used in both cases (Duprey et al., 2011) (Table 5 and 6).

Stan · st'an Geoduck, gudangee · guuding.ngaay Red Sea Urchin, stuu · daws styuu Green Sea Urchin, and sk'áam i hlt'ahldaláa · naaw k'aanaasga Sunflower Sea Star abundance

Relative abundances were estimated for stan · st'an Pacific Geoduck, gudangee · guuding.ngaay Red Sea Urchins, stuu · daws styuu Green Sea Urchin,s and sk'áam i hlt'ahldaláa · naaw k'aanaasga Sunflower Sea Stars for all 15 transects surveyed in PFM Subarea 2-65 (Table 7). Totals may not add up to exactly 100% due to rounding. ‘Abundant’ Pacific Geoduck were observed at 0% of the transects, ‘Many’ Pacific Geoduck were observed at 0% of the transects, ‘Few’ were observed at 7% of the transects, and no Pacific Geoduck were observed at 93% of the transects. ‘Abundant’ Red Sea Urchins were observed at 53% of the transects, ‘Many’ were observed at 20% of the transects, ‘Few’ Red Sea Urchins were observed at 7% of the transects, while no Red Sea Urchins were observed at 20% of the transects. ‘Abundant’ Green Sea Urchins were observed at 0% of the transects, ‘Many’ at 7% of the transects, ‘Few’ at 7% of the transects, and no Green Sea Urchins were observed at 87% of the transects. ‘Abundant’ Sunflower Sea Stars were observed at 0% of the transects, ‘Many’ at 0% of the transects, ‘Few’ at 0% of the transects, and no Sunflower Sea Stars were observed at 100% of the transects.

PFMA 2-68 (Duu Guusd West Coast Haida Gwaii – Gwaaygiids Kaahlíi Cartwright Sound and Kya.aaw Van Inlet)

Survey area description

PFM Subarea 2-68 includes the waters of Gwaaygiids Kaahlíi Cartwright Sound and Kya.aaw Van Inlet bounded by a line that begins at Jiuhlú Kun Hunter Point and moves west to the surfline, then southeast

to the surf line west of **K'ay K'iidaads Kun Tcenakun Point**, then east to **K'ay K'iidaads Kun Tcenakun Point**, then northeast to Ells Point. This subarea includes **Gwaay Giids Marble Island** and Marble Rock, Gagi Rock, **GaaGun Stiu Rock**, **T'aana GawGa Tana Bay**, **TI'ljuuwas Kun Tana Point**, **Gudal GawGa Gudal Bay**, Van Point, and **GaaGun Kun Stiu Point**. The total shoreline length of PFM Subarea 2-68 is 69.17 km (Table 1).

Yáanu · Giinu Sea Cucumber

A total of 11 transects were completed and 23 transects were skipped within PFM Subarea 2-68. Transects 740-745 and 757-774 were intentionally omitted because they were on very exposed shoreline or islands that typically have a lot of swell and wave action, and were deemed unsuitable habitat that was unlikely to be harvested. Densities ranged from 0.00 to 11.75 c/m-sh. A total of 6 of the 11 transects (55%) surveyed had a density greater than 2.50 c/m-sh (the commercial fishery threshold) (Figure 8).

The DFO Fisheries Management database has a total shoreline length for PFM Subarea 2-68 of 49,711 m, of which 35,876 m is classified as “exposed” and 13,835 m is classified as “protected” by the BC Shorezone classification system. Twenty-three transects were not completed, and as a result, all the exposed shoreline and 10,124 m of protected shoreline were removed for the biomass calculations (Tables 5 and 6). Therefore, the total shoreline length used for PFMA Subarea 2-68 biomass calculations was 0 m exposed and 3,711 m protected (Tables 5 and 6).

The mean **yáanu · Giinu Sea Cucumber** density for PFM Subarea 2-68 was estimated to be 4.93 c/m-sh with a 90% LCB of 2.66 c/m-sh (Tables 2, 5 and 6). The mean juvenile density was estimated to be 0.00 c/m-sh (Table 3). An average weight was calculated for the one biological sample transect in PFM Subarea 2-68 (transect 754) and the overall average weight for this subarea was 73 g (Table 4).

The 90% LCB of the mean biomass estimate was 721 kg whether exposed shoreline was given the default value of 2.50 c/m-sh (Duprey et al., 2011) (Table 5) or the 90 % LCB of the survey density estimate, because none of the shoreline was classified as exposed (Table 6).

Stan · st'an Geoduck, gudangee · guuding.ngaay Red Sea Urchin, stuu · daws styuu Green Sea Urchin, and sk'áam i hlt'ahldaláa · naaw k'aanaasga Sunflower Sea Star abundance

Relative abundances were estimated for **stan · st'an Pacific Geoduck**, **gudangee · guuding.ngaay Red Sea Urchins**, **stuu · daws styuu Green Sea Urchins**, and **sk'áam i hlt'ahldaláa · naaw k'aanaasga Sunflower Sea Stars** for all 15 transects surveyed in PFM Subarea 2-68 (Table 7). Totals may not add up to exactly 100% due to rounding. ‘Abundant’ Pacific Geoduck were observed at 0% of the transects, ‘Many’ Pacific Geoduck were observed at 0% of the transects, ‘Few’ were observed at 9% of the transects, and no Pacific Geoduck were observed at 91% of the transects. ‘Abundant’ Red Sea Urchins were observed at 73% of the transects, ‘Many’ were observed at 18% of the transects, ‘Few’ Red Sea Urchins were observed at 0% of the transects, while no Red Sea Urchins were observed at 9% of the transects. ‘Abundant’ Green Sea Urchins were observed at 0% of the transects, ‘Many’ at 27% of the transects, ‘Few’ at 36% of the transects, and no Green Sea Urchins were observed at 36% of the transects. ‘Abundant’ Sunflower Sea Stars were observed at 0% of the transects, ‘Many’ at 0% of the transects, ‘Few’ at 0% of the transects, and no Sunflower Sea Stars were observed at 100% of the transects.

PFMA 2-70 and 2-71 (Duu Guusd West Coast Haida Gwaii – Kaa.nuu GawGaay Kano Inlet**)**

Survey area description

PFM Subarea 2-70 includes the waters of **Kaa.nuu GawGaay Kano Inlet** east of a line that runs from **Kaa.nuu Kun Kano Point** north to the north shore of **Kaa.nuu GawGaay Kano Inlet**. This subarea includes some small islands as well as two estuaries at the head of the inlet. The total shoreline length of PFM Subarea 2-70 is 22.81 km (Table 1).

PFM Subarea 2-71 includes the waters of Kaa.nuu GawGaay Kano Inlet southeast of a line that runs between Gyaaw Xidsii Kun Fame Point and Kaa.nuu Kun Kano Point. This subarea includes Stlaasiid Gwaay.yaay Cadman Island and Stlaasiid GawGa Carew Bay. The total shoreline length of PFM Subarea 2-71 is 15.40 km (Table 1).

Yáanu · Giinu Sea Cucumber

The transects within PFM Subareas 2-70 and 2-71 were combined into one analysis area because only 8 transects were completed in PFM Subarea 2-70 and only 7 transects were completed in 2-71. Given the low number of transects completed, caution is required when interpreting results from these areas. Three transects were skipped in PFM Subarea 2-70 (transects 718, 719 and 728) and one transect was skipped in PFM Subarea 2-71 (transect 729). All skipped transects were on shoreline that had too much swell and wave action to be completed safely. Densities ranged from 0.00 to 26.00 c/m-sh. A total of 9 of the 15 (60%) transects surveyed had a density of greater than 2.50 c/m-sh (the commercial fishery threshold) (Figure 9).

The DFO Fisheries Management database has a total shoreline length for PFM Subarea 2-70 of 18,077 m, of which 4,069 m is classified as “exposed” and 14,008 m is classified as “protected” by the BC Shorezone classification system. For PFM Subarea 2-71 the DFO Fisheries Management database has a total shoreline length of 12,835 m, of which 10,764 m is classified as “exposed” and 2,071 m is classified as “protected” by the BC Shorezone classification system. Three transects were not completed in 2-70, and as a result, all the exposed shoreline and 1,931 m of protected shoreline were removed for the biomass calculations (Tables 5 and 6). Therefore, the total shoreline length used for PFMA Subarea 2-70 biomass calculations was 0 m exposed and 12,077 m protected (Tables 5 and 6). One transect on exposed shoreline was not completed in 2-71, so 2,000 m exposed shoreline were removed, and the total shoreline lengths used for PFMA Subarea 2-71 biomass calculations was 8,764 m exposed and 2,071 m protected (Tables 5 and 6).

The mean yáanu · giinu Sea Cucumber density for the analysis area was estimated to be 7.47 c/m-sh with a 90% LCB of 4.42 c/m-sh (Table 2). The mean juvenile density for the analysis area was estimated to be 0.00 c/m-sh (Table 3). The average weight for the one biological sample transect in PFM Subarea 2-70 (transect 727) was 108 g (Table 4). The average weight for the one biological sample transect in PFM Subarea 2-71 (transect 732) was 199 g (Table 4).

For PFM Subarea 2-70, the 90% LCB of the mean biomass estimate was 5,765 kg whether the exposed shoreline was given the default value of 2.50 c/m-sh (Duprey et al., 2011) (Table 5) or the 90% LCB of the survey density estimate (Table 6), because none of the shoreline was classified as exposed.

For PFM Subarea 2-71, the 90% LCB of the mean biomass estimate was 6,182 kg when the exposed shoreline was given the default value of 2.50 c/m-sh (Duprey et al., 2011) (Table 5) and was 9,530 kg when the exposed shoreline was given the 90 % LCB of the survey density estimate (Table 6).

Stan · st'an Geoduck, gudangee · guuding.ngaay Red Sea Urchin, stuu · daws styuu Green Sea Urchin, and sk'áam i hlt'ahldaláa · naaw k'aanaasga Sunflower Sea Star abundance

Relative abundances were estimated for stan · st'an Pacific Geoduck, gudangee · guuding.ngaay Red Sea Urchins, stuu · daws styuu Green Sea Urchins, and sk'áam i hlt'ahldaláa · naaw k'aanaasga Sunflower Sea Stars for all 8 transects surveyed in PFM Subarea 2-70 (Table 7). Totals may not add up to exactly 100% due to rounding. ‘Abundant’ Pacific Geoduck were observed at 38% of the transects, ‘Many’ Pacific Geoduck were observed at 0% of the transects, ‘Few’ were observed at 12% of the transects, and no Pacific Geoduck were observed at 50% of the transects. ‘Abundant’ Red Sea Urchins were observed at 50% of the transects, ‘Many’ were observed at 12% of the transects, ‘Few’ Red Sea Urchins were

observed at 12% of the transects, while no Red Sea Urchins were observed at 25% of the transects. ‘Abundant’ Green Sea Urchins were observed at 0% of the transects, ‘Many’ at 0% of the transects, ‘Few’ at 12% of the transects, and no Green Sea Urchins were observed at 88% of the transects. ‘Abundant’ Sunflower Sea Stars were observed at 0% of the transects, ‘Many’ at 0% of the transects, ‘Few’ at 0% of the transects, and no Sunflower Sea Stars were observed at 100% of the transects.

Relative abundances were estimated for *stan · st'an Pacific Geoduck*, *gudangee · guuding.ngaay Red Sea Urchins*, *stuu · daws styuu Green Sea Urchins*, and *sk'áam i hlt'ahldaláa · naaw k'aanaasga Sunflower Sea Stars* Pacific Geoduck for all 7 transects surveyed in PFM Subarea 2-71 (Table 7). Totals may not add up to exactly 100% due to rounding. ‘Abundant’ Pacific Geoduck were observed at 29% of the transects, ‘Many’ Pacific Geoduck were observed at 14% of the transects, ‘Few’ were observed at 0% of the transects, and no Pacific Geoduck were observed at 57% of the transects. ‘Abundant’ Red Sea Urchins were observed at 86% of the transects, ‘Many’ were observed at 0% of the transects, ‘Few’ Red Sea Urchins were observed at 0% of the transects, while no Red Sea Urchins were observed at 14% of the transects. ‘Abundant’ Green Sea Urchins were observed at 0% of the transects, ‘Many’ at 0% of the transects, ‘Few’ at 0% of the transects, and no Green Sea Urchins were observed at 100% of the transects. ‘Abundant’ Sunflower Sea Stars were observed at 0% of the transects, ‘Many’ at 0% of the transects, ‘Few’ at 0% of the transects, and no Sunflower Sea Stars were observed at 100% of the transects.

PFMA 2-73, 2-74, and 2-75 (*Chaahluu Kaahlíi Rennell Sound - Central*)

Survey area description

PFM Subarea 2-73 includes the waters of *Chaahluu Kaahlíi Rennell Sound* inside bounding lines that run from *Kunjuu Gwa Kun Clonard Point* to *Gaysin.na Gandlaay Cone Head* and from *Kunjuu Gwa Kun Clonard Point* south to the southern shoreline of *Chaahluu Kaahlíi Rennell Sound*, excluding the waters of PFM Subarea 2-74. The total shoreline length of PFM Subarea 2-73 is 4.25 km (Table 1).

PFM Subarea 2-74 includes the waters inside of a small rectangle extending from the shoreline on the northeast side of *Gaysin.na Gandlaay Cone Head* on the south shore of *Chaahluu Kaahlíi Rennell Sound*. This subarea is fully surrounded by PFM Subarea 2-73. The total shoreline length of PFM Subarea 2-74 is 1.03 km (Table 1).

PFM Subarea 2-75 includes the waters of *Chaahluu Kaahlíi Rennell Sound* inside bounding lines that run from *Kunjuu Gwa Kun Clonard Point* south to the southern shore of *Chaahluu Kaahlíi Rennell Sound* and from *Chaahluu Kun Richardson Head* north to the northern shore of *Chaahluu Kaahlíi Rennell Sound*. This subarea includes *Chaahlung Gwaay Gospel Island* and several small islands, as well as several large bays. The total shoreline length of PFM Subarea 2-75 is 40.63 km (Table 1).

Yáanu · Giinu Sea Cucumber

The transects within PFM Subareas 2-73, 2-74 and 2-75 were combined into one analysis area because only 2 transects were completed in PFM Subarea 2-73, only one transect was completed in PFM Subarea 2-74, and 21 transects were completed in 2-75. Given the low number of transects completed, caution is required when interpreting results from 2-73 and 2-74. No transects were skipped in these areas. Densities ranged from 0.00 to 34.50 c/m-sh. A total of 11 of the 24 (46%) transects surveyed had a density of greater than 2.50 c/m-sh (the commercial fishery threshold) (Figure 9).

The DFO Fisheries Management database has a total shoreline length for PFM Subarea 2-73 of 2,705 m, all of which is classified as “exposed” by the BC Shorezone classification system. For PFM Subarea 2-74

the DFO Fisheries Management database has a total shoreline length of 1,865 m, all of which is classified as “exposed” by the BC Shorezone classification system. For PFM Subarea 2-75 the DFO Fisheries Management database has a total shoreline length of 32,693 m, of which 28,099 m is classified as “exposed” and 4,593 m is classified as “protected” by the BC Shorezone classification system. No transects were skipped in these areas, so these were the total shoreline lengths used for biomass calculations (Tables 5 and 6).

The mean [yáanu · giinu](#) *Sea Cucumber* density for the analysis area was estimated to be 4.58 c/m-sh with a 90% LCB of 2.44 c/m-sh (Tables 2, 5 and 6). The mean juvenile density for the analysis area was estimated to be 0.01 c/m-sh with a 95% LCB of 0.00 c/m-sh (Table 3). The average weight for the one biological sample transect in PFM Subarea 2-73 (transect 694) was 158 g (Table 4). No biological samples were collected from PFM Subarea 2-74, and therefore the lowest PFM Subarea mean weight for the [Chaahluu Kaahlii Rennell Sound](#) survey, 73 g from 2-68, was used for biomass calculations (Table 4). The average weight for the one biological sample transect in PFM Subarea 2-75 (transect 656) was 129 g (Table 4).

For PFM Subarea 2-73, the 90% LCB of the mean biomass estimate was 1,043 kg with both ¹Biomass_{CB} (equation 1) and ²Biomass_{CB} (equation 2). This is because the 90% LCB of the survey density estimate was less than the default value (2.50 c/m-sh) and therefore the default value was used in both cases (Duprey et al., 2011) (Table 5 and 6).

For PFM Subarea 2-74, the 90% LCB of the mean biomass estimate was 332 kg with both ¹Biomass_{CB} (equation 1) and ²Biomass_{CB} (equation 2). This is because the 90% LCB of the survey density estimate was less than the default value (2.50 c/m-sh) and therefore the default value was used in both cases (Duprey et al., 2011) (Table 5 and 6).

For PFM Subarea 2-75, the 90% LCB of the mean biomass estimate was 10,290 kg with both ¹Biomass_{CB} (equation 1) and ²Biomass_{CB} (equation 2). This is because the 90% LCB of the survey density estimate was less than the default value (2.50 c/m-sh) and therefore the default value was used in both cases (Duprey et al., 2011) (Table 5 and 6).

[Stan · st'an](#) *Geoduck*, [gudangee · guuding.ngaay](#) *Red Sea Urchin*, [stuu · daws styuu](#) *Green Sea Urchin*, and [sk'áam i hlt'ahldaláa · naaw k'aanaasga](#) *Sunflower Sea Star* abundance

Relative abundances were estimated for [stan · st'an](#) *Pacific Geoduck*, [gudangee · guuding.ngaay](#) *Red Sea Urchins*, [stuu · daws styuu](#) *Green Sea Urchins*, and [sk'áam i hlt'ahldaláa · naaw k'aanaasga](#) *Sunflower Sea Stars* for all 2 transects surveyed in PFM Subarea 2-73 (Table 7). Totals may not add up to exactly 100% due to rounding. ‘Abundant’ Pacific Geoduck were observed at 0% of the transects, ‘Many’ Pacific Geoduck were observed at 0% of the transects, ‘Few’ were observed at 0% of the transects, and no Pacific Geoduck were observed at 100% of the transects. ‘Abundant’ Red Sea Urchins were observed at 100% of the transects, ‘Many’ were observed at 0% of the transects, ‘Few’ Red Sea Urchins were observed at 0% of the transects, while no Red Sea Urchins were observed at 0% of the transects. ‘Abundant’ Green Sea Urchins were observed at 0% of the transects, ‘Many’ at 0% of the transects, ‘Few’ at 50% of the transects, and no Green Sea Urchins were observed at 50% of the transects. ‘Abundant’ Sunflower Sea Stars were observed at 0% of the transects, ‘Many’ at 0% of the transects, ‘Few’ at 0% of the transects, and no Sunflower Sea Stars were observed at 100% of the transects.

Relative abundances were estimated for [stan · st'an](#) *Pacific Geoduck*, [gudangee · guuding.ngaay](#) *Red Sea Urchins*, [stuu · daws styuu](#) *Green Sea Urchins*, and [sk'áam i hlt'ahldaláa · naaw k'aanaasga](#) *Sunflower Sea Stars* Pacific Geoduck for the one transect surveyed in PFM Subarea 2-74 (Table 7). Totals may not add

up to exactly 100% due to rounding. ‘Abundant’ Pacific Geoduck were observed at 0% of the transects, ‘Many’ Pacific Geoduck were observed at 0% of the transects, ‘Few’ were observed at 0% of the transects, and no Pacific Geoduck were observed at 100% of the transects. ‘Abundant’ Red Sea Urchins were observed at 100% of the transects, ‘Many’ were observed at 0% of the transects, ‘Few’ Red Sea Urchins were observed at 0% of the transects, while no Red Sea Urchins were observed at 0% of the transects. ‘Abundant’ Green Sea Urchins were observed at 0% of the transects, ‘Many’ at 0% of the transects, ‘Few’ at 0% of the transects, and no Green Sea Urchins were observed at 100% of the transects. ‘Abundant’ Sunflower Sea Stars were observed at 0% of the transects, ‘Many’ at 0% of the transects, ‘Few’ at 0% of the transects, and no Sunflower Sea Stars were observed at 100% of the transects.

Relative abundances were estimated for *stan · st'an* Pacific Geoduck, *gudangee · guuding.ngaay* Red Sea Urchins, *stuu · daws styuu* Green Sea Urchins, and *sk'áam i hlt'ahldaláa · naaw k'aanaasga* Sunflower Sea Stars Pacific Geoduck for all 21 transects surveyed in PFM Subarea 2-75 (Table 7). Totals may not add up to exactly 100% due to rounding. ‘Abundant’ Pacific Geoduck were observed at 10% of the transects, ‘Many’ Pacific Geoduck were observed at 10% of the transects, ‘Few’ were observed at 5% of the transects, and no Pacific Geoduck were observed at 76% of the transects. ‘Abundant’ Red Sea Urchins were observed at 90% of the transects, ‘Many’ were observed at 5% of the transects, ‘Few’ Red Sea Urchins were observed at 0% of the transects, while no Red Sea Urchins were observed at 5% of the transects. ‘Abundant’ Green Sea Urchins were observed at 0% of the transects, ‘Many’ at 0% of the transects, ‘Few’ at 19% of the transects, and no Green Sea Urchins were observed at 81% of the transects. ‘Abundant’ Sunflower Sea Stars were observed at 0% of the transects, ‘Many’ at 0% of the transects, ‘Few’ at 5% of the transects, and no Sunflower Sea Stars were observed at 95% of the transects.

PFMA 2-76 (*Chaahluu Kaahlíi Rennell Sound – Chaahluu GawGa Shields Bay*)

Survey area description

PFM Subarea 2-76 includes the waters of *Chaahluu Kaahlíi Rennell Sound* inside of bounding lines that run from Richardson Head north to the northern shoreline of *Chaahluu Kaahlíi Rennell Sound* and from north-central *Chaahluu Gwaay Shields Island* to *Chaahluu Gwaay Kun Dawson Head*, then north to the north shore of *Chaahluu Kaahlíi Rennell Sound*. This subarea includes *Chaahluu Gapdal Clonard Bay*, *Chaahluu Gwaay GawGa Ells Bay*, *Chaahluu Gwaay HIGaa Ells Rocks*, and *Chaahluu GawGa HIGaa Shields Rock*, and excludes the bay on the northeast side of *Chaahluu Gwaay Shields Island*. The total shoreline length of PFM Subarea 2-76 is 20.66 km (Table 1).

Yáanuu · Giinuu Sea Cucumber

A total of 10 transects were completed and none were skipped within PFM Subarea 2-76. Densities ranged from 0.00 to 14.50 c/m-sh. A total of 6 of the 10 (60%) transects surveyed had a density greater than 2.50 c/m-sh (the commercial fishery threshold) (Figure 10).

The DFO Fisheries Management database has a total shoreline length for PFM Subarea 2-76 of 19,505 m, of which 1,334 m is classified as “exposed” and 18,171 m is classified as “protected” by the BC Shorezone classification system. No transects were skipped so these are the total shoreline lengths used for PFMA Subarea 2-76 biomass calculations (Tables 5 and 6).

The mean *yáanuu · giinuu Sea Cucumber* density for PFM Subarea 2-76 was estimated to be 5.72 c/m-sh with a 90% LCB of 3.02 c/m-sh (Tables 2, 5 and 6). The mean juvenile density was estimated to be 0.00 c/m-sh (Table 3). An average weight was calculated for the one biological sample transect in PFM Subarea 2-76 (transect 685) and the overall average weight for this subarea was 147 g (Table 4).

The 90% LCB of the mean biomass estimate was 8,557 kg when exposed shoreline was given the default value of 2.50 c/m-sh (Duprey et al., 2011) (Table 5) and was 8,659 kg when the exposed shoreline was given the 90% LCB of the survey density estimate (Table 6).

Stan · st'an Geoduck, gudangee · guuding.ngaay Red Sea Urchin, stuu · daws styuu Green Sea Urchin, and sk'áam i hlt'ahldaláa · naaw k'aanaasga Sunflower Sea Star abundance

Relative abundances were estimated for stan · st'an Pacific Geoduck, gudangee · guuding.ngaay Red Sea Urchins, stuu · daws styuu Green Sea Urchins, and sk'áam i hlt'ahldaláa · naaw k'aanaasga Sunflower Sea Stars for the one transect surveyed in PFM Subarea 2-76 (Table 7). Totals may not add up to exactly 100% due to rounding. 'Abundant' Pacific Geoduck were observed at 0% of the transects, 'Many' Pacific Geoduck were observed at 50% of the transects, 'Few' were observed at 20% of the transects, and no Pacific Geoduck were observed at 30% of the transects. 'Abundant' Red Sea Urchins were observed at 50% of the transects, 'Many' were observed at 30% of the transects, 'Few' Red Sea Urchins were observed at 0% of the transects, while no Red Sea Urchins were observed at 20% of the transects. 'Abundant' Green Sea Urchins were observed at 0% of the transects, 'Many' at 0% of the transects, 'Few' at 10% of the transects, and no Green Sea Urchins were observed at 90% of the transects. 'Abundant' Sunflower Sea Stars were observed at 0% of the transects, 'Many' at 0% of the transects, 'Few' at 0% of the transects, and no Sunflower Sea Stars were observed at 100% of the transects.

PFMA 2-77 (Chaahluu Kaahlíi Rennell Sound – Chaahluu Gwaayts'idaay Gapdal Clapp Basin)

Survey area description

PFM Subarea 2-77 includes the waters at the head of Chaahluu Kaahlíi Rennell Sound southeast of a line that runs from north-central Chaahluu Gwaay Shields Island to Dawson Head, then north to the north shore of Chaahluu Kaahlíi Rennell Sound. This subarea includes the bay on the northeast side of Chaahluu Gwaay Shields Island, Chaahluu GawGa Shields Bay, Chaahluu Gwaayts'idaay Clapp Islands, Chaahluu K'iidaay MacKenzie Passage, and Chaahluu Gwaayts'idaay Gapdal Clapp Basin. The total shoreline length of PFM Subarea 2-77 is 30.70 km (Table 1).

Yáanu · Giinu Sea Cucumber

A total of 11 transects were completed and 4 transects were skipped within PFM Subarea 2-77. Transects 669, 670, 677 and 678 were skipped due to time constraints. Densities were very low and ranged from 0.00 to 1.75 c/m-sh. A total of 0 of the 11 (0%) transects surveyed had a density greater than 2.50 c/m-sh (the commercial fishery threshold) (Figure 10).

The DFO Fisheries Management database has a total shoreline length for PFM Subarea 2-77 of 26,242 m, of which 142 m is classified as “exposed” and 26,100 m is classified as “protected” by the BC Shorezone classification system. Four transects on protected shoreline were not completed, and as a result, 8,000 m of protected shoreline were removed for the biomass calculations (Tables 5 and 6). Therefore, the total shoreline length used for PFMA Subarea 2-68 biomass calculations was 142 m exposed and 18,100 m protected (Tables 5 and 6).

The mean yáanu · giinu Sea Cucumber density for PFM Subarea 2-77 was estimated to be 0.50 c/m-sh with a 90% LCB of 0.16 c/m-sh (Tables 2, 5 and 6). The mean juvenile density was estimated to be 0.00 c/m-sh (Table 3). No biological samples were collected from PFM Subarea 2-77, so the lowest PFM Subarea weight for the Chaahluu Kaahlíi Rennell Sound survey, 73 g from 2-68, was used for the biomass calculations.

The 90% LCB of the mean biomass estimate was 213 kg with both ¹Biomass_{CB} (equation 1) and ²Biomass_{CB} (equation 2). This is because the 90% LCB of the survey density estimate was less than the default value (2.50 c/m-sh) and therefore the default value was used in both cases (Duprey et al., 2011) (Table 5 and 6).

Stan · st'an Geoduck, gudangee · guuding.ngaay Red Sea Urchin, stuu · daws styuu Green Sea Urchin, and sk'áam i hlt'ahldaláa · naaw k'aanaasga Sunflower Sea Star abundance

Relative abundances were estimated for stan · st'an Pacific Geoduck, gudangee · guuding.ngaay Red Sea Urchins, stuu · daws styuu Green Sea Urchins, and sk'áam i hlt'ahldaláa · naaw k'aanaasga Sunflower Sea Stars for the 11 transects surveyed in PFM Subarea 2-77 (Table 7). Totals may not add up to exactly 100% due to rounding. 'Abundant' Pacific Geoduck were observed at 0% of the transects, 'Many' Pacific Geoduck were observed at 9% of the transects, 'Few' were observed at 18% of the transects, and no Pacific Geoduck were observed at 73% of the transects. 'Abundant' Red Sea Urchins were observed at 9% of the transects, 'Many' were observed at 9% of the transects, 'Few' Red Sea Urchins were observed at 0% of the transects, while no Red Sea Urchins were observed at 82% of the transects. 'Abundant' Green Sea Urchins were observed at 0% of the transects, 'Many' at 0% of the transects, 'Few' at 0% of the transects, and no Green Sea Urchins were observed at 100% of the transects. 'Abundant' Sunflower Sea Stars were observed at 0% of the transects, 'Many' at 0% of the transects, 'Few' at 0% of the transects, and no Sunflower Sea Stars were observed at 100% of the transects.

PFMA 2-80, 2-81, 2-82, 2-83, 2-84 (Chaahluu Kaahlii Rennell Sound – T'aat'uu GawGaay Tartu Inlet and K'aang Gwaay GawGaay Seal Inlet)

Survey area description

PFM Subarea 2-80 includes the waters at the southern end of T'aat'uu GawGaay Tartu Inlet inside bounding lines that run between T'aat'uu Kun Tartu Point and Kunjuu Gwa Kun Clonard Point, and between the east and west shores halfway up the inlet. The total shoreline length of PFM Subarea 2-80 is 9.10 km (Table 1).

PFM Subarea 2-81 includes the waters at the northern end of T'aat'uu GawGaay Tartu Inlet north of a bounding line that runs between the east and west shores halfway up the inlet. This subarea includes an estuary at the head of T'aat'uu GawGaay Tartu Inlet. The total shoreline length of PFM Subarea 2-81 is 10.73 km (Table 1).

PFM Subarea 2-82 includes the waters at the southern end of K'aang Gwaay GawGaay Seal Inlet inside bounding lines that run between Sk'waa K'aadangs Skwakadane Point and K'aang Gwaay Kun Seal Point and between two heads of land on the east and west shores at the first major narrowing of the inlet. This subarea includes Taws Gwaay Lauder Island and several small islands and bays. The total shoreline length of PFM Subarea 2-82 is 22.43 km (Table 1).

PFM Subarea 2-83 includes the waters of K'aang Gwaay GawGaay Seal Inlet inside bounding lines that run between two heads of land on the east and west shores at the first major narrowing of the inlet and between a pronounced point on the eastern shore due west to the western shore, just before the inlet bends in an eastward direction. The total shoreline length of PFM Subarea 2-83 is 7.60 km (Table 1).

PFM Subarea 2-84 includes the waters of K'aang Gwaay GawGaay Seal Inlet northeast of a bounding line that runs between a pronounced point on the eastern shore due west to the western shore, just before the inlet bends in an eastward direction. This subarea includes several small islands and two large estuaries at

the head of *K'aang Gwaay Gwaay Seal Inlet*. The total shoreline length of PFM Subarea 2-84 is 11.67 km (Table 1).

Yáanu · Giinu Sea Cucumber

The transects within PFM Subareas 2-80, 2-81, 2-82, 2-83, and 2-84 were combined into one analysis area because 5 transects were completed in PFM Subarea 2-80, 4 transects were completed in PFM Subarea 2-81, 11 transects were completed in PFM Subarea 2-82, 4 transects were completed in PFM Subarea 2-83, and 4 transects were completed in 2-84. Given the low number of transects completed, caution is required when interpreting results. One transect was skipped in PFM Subarea 2-81 and 2 transects were skipped in 2-84 due to time constraints. Densities ranged from 0.00 to 26.25 c/m-sh. A total of 15 of the 28 (54%) transects surveyed had a density greater than 2.50 c/m-sh (the commercial fishery threshold) (Figure 11).

Based on the DFO Fisheries Management database and the BC Shorezone classification system, the total shoreline lengths of PFM subareas in this analysis area are 7,526m (all exposed), 6,787 (1,631m exposed and 5,156m protected), 16,749m (16,112m exposed and 637m protected), 5,040 m (48m exposed and 4992 protected), and 4603m (all protected) for PFM Subareas 2-80, 2-81, 2-82, 2-83 and 2-84, respectively. One transect on protected shoreline was not completed in 2-81 so 2,000 m protected shoreline were removed, and the total shoreline lengths used for PFMA Subarea 2-81 biomass calculations were 1,631 m exposed and 3,156 m protected (Tables 5 and 6). Two transects on protected shoreline were not completed in 2-84 so 4,000 m protected shoreline were removed, and the total shoreline length used for PFMA Subarea 2-84 biomass calculations was 603 m protected shoreline (Tables 5 and 6).

The mean *yáanu · giinu Sea Cucumber* density for the analysis area was estimated to be 5.59 c/m-sh with a 90% LCB of 3.50 c/m-sh (Tables 2, 5 and 6). The mean juvenile density for the analysis area was estimated to be 0.05 c/m-sh with a 95% LCB of 0.00 c/m-sh (Table 3). The average weights for the biological sample transects in this analysis area were as follows: 85 g in PFM subarea 2-81 (n=1, transect 641), 166 g in PFM subarea 2-82 (n=1, transect 616), and 124 g in PFM subarea 2-83 (n=1, transect 618; Table 4). Since no biological samples were collected from PFM Subareas 2-80 and 2-84, the lowest mean weight for the *Chaahlu Kahlí Rennell Sound* survey, 73 g from PFM Subarea 2-68, was used for biomass calculations for those two PFM Subareas.

For PFM Subarea 2-80, the 90% LCB of the mean biomass estimate was 1,373 kg when the exposed shoreline was given the default value of 2.50 c/m-sh (Duprey et al., 2011) (Table 5) and was 1,923 kg when the exposed shoreline was given the 90 % LCB of the survey density estimate (note that all of the shoreline was classified as exposed) (Table 6).

For PFM Subarea 2-81, the 90% LCB of the mean biomass estimate was 1,285 kg when the exposed shoreline was given the default value of 2.50 c/m-sh (Duprey et al., 2011) (Table 5) and was 1,424 kg when the exposed shoreline was given the 90 % LCB of the survey density estimate (Table 6).

For PFM Subarea 2-82, the 90% LCB of the mean biomass estimate was 7,057 kg when the exposed shoreline was given the default value of 2.50 c/m-sh (Duprey et al., 2011) (Table 5) and was 9,731 kg when the exposed shoreline was given the 90 % LCB of the survey density estimate (note that almost all of the shoreline, 96%, was classified as exposed) (Table 6).

For PFM Subarea 2-83, the 90% LCB of the mean biomass estimate was 2,181 kg when the exposed shoreline was given the default value of 2.50 c/m-sh (Duprey et al., 2011) (Table 5) and was 2,187 kg when the exposed shoreline was given the 90 % LCB of the survey density estimate (Table 6).

For PFM Subarea 2-84, the 90% LCB of the mean biomass estimate was 154 kg when the exposed shoreline was given the default value of 2.50 c/m-sh (Duprey et al., 2011) (Table 5) and was the same value when the exposed shoreline was given the 90 % LCB of the survey density estimate, because none of the shoreline was classified as exposed (Table 6).

Stan · st'an Geoduck, gudangee · guuding.ngaay Red Sea Urchin, stuu · daws styuu Green Sea Urchin, and sk'áam i hlt'ahldaláa · naaw k'aanaasga Sunflower Sea Star abundance

Relative abundances were estimated for stan · st'an Pacific Geoduck, gudangee · guuding.ngaay Red Sea Urchins, stuu · daws styuu Green Sea Urchins, and sk'áam i hlt'ahldaláa · naaw k'aanaasga Sunflower Sea Stars for the 5 transects surveyed in PFM Subarea 2-80 (Table 7). Totals may not add up to exactly 100% due to rounding. 'Abundant' Pacific Geoduck were observed at 0% of the transects, 'Many' Pacific Geoduck were observed at 0% of the transects, 'Few' were observed at 0% of the transects, and no Pacific Geoduck were observed at 100% of the transects. 'Abundant' Red Sea Urchins were observed at 100% of the transects, 'Many' were observed at 0% of the transects, 'Few' Red Sea Urchins were observed at 0% of the transects, while no Red Sea Urchins were observed at 0% of the transects. 'Abundant' Green Sea Urchins were observed at 0% of the transects, 'Many' at 0% of the transects, 'Few' at 0% of the transects, and no Green Sea Urchins were observed at 100% of the transects. 'Abundant' Sunflower Sea Stars were observed at 0% of the transects, 'Many' at 0% of the transects, 'Few' at 0% of the transects, and no Sunflower Sea Stars were observed at 100% of the transects.

Relative abundances were estimated for stan · st'an Pacific Geoduck, gudangee · guuding.ngaay Red Sea Urchins, stuu · daws styuu Green Sea Urchins, and sk'áam i hlt'ahldaláa · naaw k'aanaasga Sunflower Sea Stars for the 4 transects surveyed in PFM Subarea 2-81 (Table 7). Totals may not add up to exactly 100% due to rounding. 'Abundant' Pacific Geoduck were observed at 25% of the transects, 'Many' Pacific Geoduck were observed at 25% of the transects, 'Few' were observed at 0% of the transects, and no Pacific Geoduck were observed at 50% of the transects. 'Abundant' Red Sea Urchins were observed at 50% of the transects, 'Many' were observed at 0% of the transects, 'Few' Red Sea Urchins were observed at 0% of the transects, while no Red Sea Urchins were observed at 50% of the transects. 'Abundant' Green Sea Urchins were observed at 0% of the transects, 'Many' at 0% of the transects, 'Few' at 0% of the transects, and no Green Sea Urchins were observed at 100% of the transects. 'Abundant' Sunflower Sea Stars were observed at 0% of the transects, 'Many' at 0% of the transects, 'Few' at 0% of the transects, and no Sunflower Sea Stars were observed at 100% of the transects.

Relative abundances were estimated for stan · st'an Pacific Geoduck, gudangee · guuding.ngaay Red Sea Urchins, stuu · daws styuu Green Sea Urchins, and sk'áam i hlt'ahldaláa · naaw k'aanaasga Sunflower Sea Stars for the 11 transects surveyed in PFM Subarea 2-82 (Table 7). Totals may not add up to exactly 100% due to rounding. 'Abundant' Pacific Geoduck were observed at 27% of the transects, 'Many' Pacific Geoduck were observed at 9% of the transects, 'Few' were observed at 9% of the transects, and no Pacific Geoduck were observed at 55% of the transects. 'Abundant' Red Sea Urchins were observed at 91% of the transects, 'Many' were observed at 9% of the transects, 'Few' Red Sea Urchins were observed at 0% of the transects, while no Red Sea Urchins were observed at 0% of the transects. 'Abundant' Green Sea Urchins were observed at 9% of the transects, 'Many' at 0% of the transects, 'Few' at 36% of the transects, and no Green Sea Urchins were observed at 55% of the transects. 'Abundant' Sunflower Sea Stars were observed at 0% of the transects, 'Many' at 0% of the transects, 'Few' at 0% of the transects, and no Sunflower Sea Stars were observed at 100% of the transects.

Relative abundances were estimated for stan · st'an Pacific Geoduck, gudangee · guuding.ngaay Red Sea Urchins, stuu · daws styuu Green Sea Urchins, and sk'áam i hlt'ahldaláa · naaw k'aanaasga Sunflower Sea Stars for the 4 transects surveyed in PFM Subarea 2-83 (Table 7). Totals may not add up to exactly 100%

due to rounding. ‘Abundant’ Pacific Geoduck were observed at 0% of the transects, ‘Many’ Pacific Geoduck were observed at 0% of the transects, ‘Few’ were observed at 50% of the transects, and no Pacific Geoduck were observed at 50% of the transects. ‘Abundant’ Red Sea Urchins were observed at 75% of the transects, ‘Many’ were observed at 25% of the transects, ‘Few’ Red Sea Urchins were observed at 0% of the transects, while no Red Sea Urchins were observed at 0% of the transects. ‘Abundant’ Green Sea Urchins were observed at 0% of the transects, ‘Many’ at 0% of the transects, ‘Few’ at 50% of the transects, and no Green Sea Urchins were observed at 50% of the transects. ‘Abundant’ Sunflower Sea Stars were observed at 0% of the transects, ‘Many’ at 0% of the transects, ‘Few’ at 0% of the transects, and no Sunflower Sea Stars were observed at 100% of the transects.

Relative abundances were estimated for *stan · st'an Pacific Geoduck*, *gudangee · guuding.ngaay Red Sea Urchins*, *stuu · daws styuu Green Sea Urchins*, and *sk'áam i hlt'ahldaláa · naaw k'aanaasga Sunflower Sea Stars* for the 4 transects surveyed in PFM Subarea 2-84 (Table 7). Totals may not add up to exactly 100% due to rounding. ‘Abundant’ Pacific Geoduck were observed at 0% of the transects, ‘Many’ Pacific Geoduck were observed at 0% of the transects, ‘Few’ were observed at 25% of the transects, and no Pacific Geoduck were observed at 75% of the transects. ‘Abundant’ Red Sea Urchins were observed at 0% of the transects, ‘Many’ were observed at 0% of the transects, ‘Few’ Red Sea Urchins were observed at 0% of the transects, while no Red Sea Urchins were observed at 100% of the transects. ‘Abundant’ Green Sea Urchins were observed at 0% of the transects, ‘Many’ at 0% of the transects, ‘Few’ at 0% of the transects, and no Green Sea Urchins were observed at 100% of the transects. ‘Abundant’ Sunflower Sea Stars were observed at 0% of the transects, ‘Many’ at 0% of the transects, ‘Few’ at 0% of the transects, and no Sunflower Sea Stars were observed at 100% of the transects.

Difference in Biomass Between Equations 1 and 2

Replacing the 2.50 c/m-sh constant used for exposed shoreline (¹Biomass_{CB}) with surveyed densities (²Biomass_{CB}) resulted in increases in biomass of 6% on average (range 0 – 46%) over all surveys. Equation 2 resulted in increases in biomass greater than 1% for 11 of the surveyed 32 PFM Subareas. In those 11 PFM Subareas, exposed shoreline accounted for 44% on average of the total shoreline.

In the *K'uuna Gwaay.yaay Louise Island* survey, all four surveyed PFM Subareas had 0% difference in biomass when equation 2 was applied. Two PFM Subareas had 0 m of exposed shoreline (2-4 and 2-5), 2-3 had a 90% LCB of the density estimate lower than the default value (and therefore used in both equation 1 and equation 2), and in 2-6 the difference in biomass between the two equations was negligible.

In the Gwaii Haanas 2-11 & 2-13 survey, PFM Subarea 2-11 had 32% of its total shoreline classified as exposed, resulting in an 18% increase in biomass when equation 2 was used. In PFM Subarea 2-13, 2% of its total shoreline was classified as exposed, resulting in a 2% increase in biomass when equation 2 was used.

In the Gwaii Haanas 2-10 & 2-15 survey, PFM Subarea 2-10 had 11% of its total shoreline classified as exposed, resulting in a 7% increase in biomass when equation 2 was used. In PFM Subarea 2-15, 15% of its total shoreline was classified as exposed, resulting in an 11% increase in biomass when equation 2 was used.

In the *Kaysuun Kaahlíi Englefield Bay* survey two of the ten surveyed PFM Subareas had differences between the two equations greater than 0%. In PFM Subarea 2-51, 96% of its total shoreline was

classified as exposed, resulting in a 46% increase in biomass when equation 2 was used. In PFM Subarea 2-53, 12% of its total shoreline was classified as exposed, resulting in a 6% increase in biomass when equation 2 was used. The remaining eight PFM Subareas either had no exposed shoreline (2-54, 2-55, 2-56, and 2-57), 90% LCB of the density estimate lower than the default value and therefore used in both equations (2-52 and 2-60), or the difference in biomass between the two equations was negligible (2-58 and 2-59).

In the Chaahluu Kaahlíi *Rennell Sound* survey five of the 14 surveyed PFM Subareas had differences between the two equations which ranged from 1 - 35%. Of these, the percentage of total shoreline classified as exposed varied from 7 - 100%. In PFM Subarea 2-71, 81% of its total shoreline was classified as exposed, resulting in a 35% increase in biomass when equation 2 was used. In PFM Subarea 2-76, 7% of its total shoreline was classified as exposed, resulting in a 1% increase in biomass when equation 2 was used. In PFM Subarea 2-80, 100% of its total shoreline was classified as exposed, resulting in a 29% increase in biomass when equation 2 was used. In PFM Subarea 2-81, 34% of its total shoreline was classified as exposed, resulting in a 10% increase in biomass when equation 2 was used. In PFM Subarea 2-82, 96% of its total shoreline was classified as exposed, resulting in a 27% increase in biomass when equation 2 was used. The remaining nine PFM Subareas either had no exposed shoreline (2-68, 2-70, and 2-84), 90% LCB of the density estimate lower than the default value and therefore used in both equations (2-65, 2-73, 2-74, 2-75, and 2-77), or the difference in biomass between the two equations was negligible (2-84).

DISCUSSION

This report summarizes the findings from four [yáanu · ġiinu](#) Sea Cucumber surveys conducted along the coast of Haida Gwaii in 2023 and 2024. All of the components of adult [yáanu · ġiinu](#) Sea Cucumber biomass (density, weight, shoreline length, and biomass) are reported in the results, as are juvenile densities and relative abundances of [stan · st'an](#) Pacific Geoduck, [gudangee · guuding.ngaay](#) Red Sea Urchins, [stuu · daws styuu](#) Green Sea Urchins, and for 2024 surveys, [sk'áam i hlt'ahldaláa · naaw k'aanaasga](#) Sunflower Sea Stars. Estimated mean linear [yáanu · ġiinu](#) Sea Cucumber densities by PFM Subarea (or analysis area) were reported with their bootstrapped 90% lower confidence bound (LCB) of the density estimates to align with the management practice of this fishery. Notably, the 90% LCB of a density estimate must exceed a minimum threshold of 2.50 c/m-sh for an area to be considered for opening to commercial harvest, as per recommendations made in the Sea Cucumber Assessment Framework (Duprey et al., 2011). In this section, survey-based density estimates are discussed relative to the commercial fishery opening threshold. Other DFO reports summarizing Pacific Region Sea Cucumber surveys include a discussion of the survey density estimates relative to regional baseline densities, however Haida Gwaii does not have an established regional baseline density.

K'uuna Gwaay.yaay Louise Island – Hlkinul Kaahlíi Cumshewa Inlet (PFMA 2-3, 2-4, and 2-5) and Tlín Suu Selwyn Inlet (PFMA 2-6), March 2023

The bootstrapped 90% LCB density estimates of [yáanu · ġiinu](#) Sea Cucumber in the [K'uuna Gwaay.yaay Louise Island – Hlkinul Kaahlíi Cumshewa Inlet](#) survey were below the commercial fishery opening threshold in PFM Subareas 2-3 and 2-4, and were above the threshold at 3.67 c/m-sh in both

PFM Subareas 2-5 and 2-6. PFM Subarea average weight was relatively small in PFM Subarea 2-5 at 115 g, but PFM Subarea 2-6 had a larger average weight of 315 g.

Using biomass equation 2 did not result in any increases in biomass as two of the PFM Subareas did not have any exposed shoreline, and the other 2 had very negligible increases.

DFO logbook data indicate that these PFM Subareas were harvested in 1989-1995 (note that not all areas were harvested in all years), and that PFM Subarea 2-6 was also harvested in 2012. Xaayda GwaayGalang Ganga Kaaxaajuus the Council of the Haida Nation did not support the 2012 harvest.

These PFM Subareas were previously surveyed in 2012 and interannual comparisons of density and mean weight were conducted. For PFMA 2-3, 2-4, and 2-5, the adult Sea Cucumber mean density in 2023 was not significantly different than in 2012. For PFMA 2-6, the mean density in 2023 (4.98 ± 6.55 c/m-sh) was significantly lower than in 2012 (6.68 ± 6.57 c/m-sh). Enough data was only available for a comparison of mean weights for PFMA 2-6, and the mean weight in 2023 was not significantly different than in 2012.

Gwaii Haanas - Gandaawuu.ngaay Xyangs Juan Perez Sound (PFMA 2-11) and GaysiiGas K'iidsii Burnaby Strait (PFMA 2-13), August 2023

The Gwaii Haanas – Gandaawuu.ngaay Xyangs Juan Perez Sound and GaysiiGas K'iidsii Burnaby Strait survey took place inside both the Gwaii Haanas National Park Reserve and Haida Heritage Site Multiple Use Zones and Strict Protection Zones. The bootstrapped 90% LCB density estimates of yáanuu · giinuu Sea Cucumber in the Multiple Use Zones were above the commercial fishery opening threshold in PFM Subareas 2-11 and 2-13 at 5.59 c/m-sh, and 6.35 c/m-sh, respectively. The PFM Subarea 2-11 and 2-13 Multiple Use Zone mean weights were 216 g and 191 g, respectively. The Strict Protection Zone 9 in PFM Subarea 2-11 had a bootstrapped 90% LCB density estimate of yáanuu · giinuu Sea Cucumber of 4.35 c/m-sh and a mean weight of 364 g, and Strict Protection Zone 8 in PFM Subarea 2-13 had a very high bootstrapped 90% LCB density estimate of yáanuu · giinuu Sea Cucumber of 43.50 c/m-sh, but no biosamples were collected in this Zone to obtain a mean weight. Bootstrapped density estimates could not be generated for 2-13 Strict Protection Zone 7 because only one transect was surveyed.

Using biomass equation 2 resulted in an average 10.0% increase in the 90% LCB estimate of total biomass; a 18% increase in PFM Subarea 2-11 and a 2% increase in PFM Subarea 2-13.

DFO logbook data indicate that PFM Subarea 2-11 was harvested in 1989-1993, and PFM Subarea 2-13 was harvested 1990-1994 (not necessarily all years in ranges were harvested).

Gwaii Haanas - K'ing.gii Kaahlíi Darwin Sound (PFMA 2-10) and Sk'in Kaahlíi Skincuttle Inlet (PFMA 2-15), March 2024

The Gwaii Haanas – K'ing.gii Kaahlíi Darwin Sound and Sk'in Kaahlíi Skincuttle Inlet survey took place inside both the Gwaii Haanas National Park Reserve and Haida Heritage Site Multiple Use Zones and Strict Protection Zones. The bootstrapped 90% LCB density estimates of yáanuu · giinuu Sea Cucumber in the Multiple Use Zones were above the commercial fishery opening threshold in PFM Subareas 2-10

and 2-15 at 7.88 c/m-sh, and 9.05 c/m-sh, respectively. The PFM Subarea 2-10 and 2-15 Multiple Use mean weights were 215 g and 202 g, respectively. The Strict Protection Zone 10 in PFM Subarea 2-10 had a bootstrapped 90% LCB density estimate of *yáanuu · ġiinuu Sea Cucumber* of 7.16 c/m-sh and a mean weight of 412 g, Strict Protection Zone 6d in PFM Subarea 2-15 had a bootstrapped 90% LCB density estimate of *yáanuu · ġiinuu Sea Cucumber* of 2.08 c/m-sh and a mean weight of 316 g, and Strict Protection Zone 7 in PFM Subarea 2-15 had a bootstrapped 90% LCB density estimate of *yáanuu · ġiinuu Sea Cucumber* of 10.82 c/m-sh and a mean weight of 166 g.

Using biomass equation 2 resulted in an average 9.0% increase in the 90% LCB estimate of total biomass; a 7% increase in PFM Subarea 2-10 and an 11% increase in PFM Subarea 2-15.

DFO logbook data indicate that PFM Subarea 2-10 was harvested in 1989-1995, and PFM Subarea 2-15 was harvested 1989-1994 (not necessarily all years in ranges were harvested).

PFM Subareas 2-15 was previously surveyed in 2012. The mean density in 2024 (14.12 ± 12.41 c/m-sh) was significantly higher than in 2012 (6.46 ± 5.00 c/m-sh). No biological samples were collected in PFM 2-15 in 2012 therefore a comparison of mean weight was not possible. A notable observation of over a hundred < 1 cm juvenile *naaw k'anaasGa Sunflower Sea Stars* was recorded on transect 217 in PFM Subarea 2-10.

Duu Guusd West Coast Haida Gwaii – Kaysuun Kaahlíi Englefield Bay (PFMA 2-51, 2-52, 2-53, 2-54, 2-55, 2-56, 2-57, 2-58, 2-59 and 2-60), August 2024

The *Duu Guusd West Coast Haida Gwaii – Kaysuun Kaahlíi Englefield Bay* survey had many small PFM Subareas that were combined into analysis areas, and 14% of the shoreline surveyed was on exposed shoreline. The most exposed Subareas were 2-51 and 2-60, with 92% and 57% exposed shorelines, respectively (Table 9).

The 90% LCB of the estimated PFM Subarea or Analysis Area *yáanuu · ġiinuu Sea Cucumber* densities in the *Duu Guusd West Coast Haida Gwaii – Kaysuun Kaahlíi Englefield Bay* survey ranged from 0.22 c/m-sh to 5.02 c/m-sh, and PFM Subarea mean weights were small, ranging from 40 g to 181 g. The mean split weight of 40 g in PFM subarea 2-56 represents the smallest subarea split weight calculated among any of the Haida Gwaii surveys herein, and to our knowledge any Open Surveys published in BC to date. The small split weight is of particular note since the biological sampling protocol involves collecting only those Sea Cucumbers that are arbitrarily defined as adults (>15cm upon first observation), and samplers noted that several of the small collected individuals had gonads. These observations may have important implications for assumptions about size at maturity and therefore merit further investigation.

Using biomass equation 2 resulted in an average 5.3% increase in the 90% LCB estimate of total biomass in *Kaysuun Kaahlíi Englefield Bay*, and the average increase range was 0.0 to 46.2%. There was no difference in 6 of the 10 PFM Subareas because 4 of these PFM Subareas did not have any exposed shoreline, and an additional 2 of these PFM Subareas had 90% LCB survey densities that were lower than the default value of 2.50 c/m-sh.

This survey area had never been commercially harvested or surveyed using the standardized DFO Sea Cucumber survey protocol before.

Duu Guusd West Coast Haida Gwaii – Chaahluu Kaahlíi Rennell Sound (PFMA 2-65, 2-68, 2-70, 2-71, 2-73, 2-74, 2-75, 2-76, 2-77, 2-80, 2-81, 2-82, 2-83, and 2-84), August 2024

The Duu Guusd West Coast Haida Gwaii – Chaahluu Kaahlíi Rennell Sound survey also had many small PFM Subareas that were combined into analysis areas, and 44% of the shoreline surveyed was on exposed shoreline. The most exposed Subareas were 2-71, 2-73, 2-74, 2-75, 2-80, and 2-82, with 81%, 100%, 100%, 86%, 100%, and 96% exposed shorelines, respectively (Table 9).

The 90% LCB of the estimated PFM Subarea or Analysis Area yáanu · ġinu Sea Cucumber densities were relatively low, and ranged from 0.16 c/m-sh to 4.42 c/m-sh. The PFM Subarea mean weights were small, ranging from 73 g to 199 g.

Using biomass equation 2 resulted in an average 7.3% increase in the 90% LCB estimate of total biomass, and the average increase range was 0.0 to 35.1%. There was no difference in 8 of the 14 PFM Subareas because 3 PFM Subareas did not have any exposed shoreline, and 5 PFM Subareas had 90% LCB survey densities that were lower than the default value of 2.50 c/m-sh.

This survey area had never been commercially harvested or surveyed using the standardized DFO Sea Cucumber survey protocol before.

A notable observation of a huge patch of very densely aggregated live sand dollars was recorded between approximately 8 to 10 metres gauge depth on transect 653 in PFM Subarea 2-75.

Differences Between Biomass Equation 1 and 2

Conducting Sea Cucumber biomass surveys on the exposed coasts of Haida Gwaii presented a new challenge, wherein use of the traditional biomass equation used in previous reports ($^1\text{Biomass}_{\text{CB}}$) could result in over-reliance on the exposed shoreline density constant in the biomass equation rather than surveyed density estimates. This constant is largely arbitrary, as it was chosen to represent low density values observed in Sea Cucumber surveys in Alaska (Duprey et al., 2011). It is used due to the lack of sufficient Sea Cucumber density data over exposed shorelines in BC, which are challenging to survey safely. Based on previously established decision rules involving the precautionary approach (Duprey et al. 2011), the exposed shoreline density constant in the traditional biomass equation was only replaced with survey density estimates when the latter was lower than the exposed shoreline density constant (denoted by equation 1 $^1\text{Biomass}_{\text{CB}}$). While precautionary, this approach could lead to a significant underestimate of biomass in areas with large portions of exposed coastline and high Sea Cucumber densities. We therefore developed a second biomass calculation approach for consideration (denoted by equation 2 $^2\text{Biomass}_{\text{CB}}$), in which the exposed shoreline density constant was replaced by the surveyed density estimate. The rationale for developing equation 2 was primarily centered around using available survey data when it is available. Biomass estimates obtained using equation 1 are more precautionary, whereas those obtained using equation 2 are more representative of survey results. In this report, we are not recommending one equation over the other, as it is important to consider a number of factors, including sample size and the number of skipped transects. However, it was important to appropriately consider how the unique Haida Gwaii shoreline presented in this report could be represented in a more comprehensive way in the biomass calculations.

AFTERWORD

Completion of these surveys and this technical report advances the fulfillment of the good faith measures identified in the [Kwah.hlahl.dáyaa · Gaygahlda](#) [Changing Tide Framework for Reconciliation](#). This work is a testament to the power of collaboration between [Xaadée ‘Wáadluwaan Née · XaaydaGa ‘Waadluxan Naay](#) *the Council of the Haida Nation* and DFO, and embodies a commitment to cooperation, partnership and reconciliation.

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LITERATURE CITED

- Bazinet, A.C., Garner, G.D., Campbell, J.A., and Hansen, S.C. 2025. [Biomass Estimates for Giant Red Sea Cucumber \(*Apostichopus Californicus*, Stimpson, 1857\) as Determined Through Surveys Conducted from 2014 to 2020](#). Can. Tech. Rep. Fish. Aquat. Sci. 3665: xi + 77 p.
- Boutillier, J.A., Campbell, A., Harbo, R., and Neifer, S. 1998. Scientific advice for management of the Sea Cucumber (*Parastichopus californicus*) fishery in British Columbia. In: Invertebrate Working Papers reviewed by the Pacific Stock Assessment Review Committee (PSARC) in 1996. Edited by G.E. Gillespie and L.C. Walters. Can. Tech. Rep. Fish. Aquat. Sci. 2221. pp. 309-340.
- Brothers, C.J., Lee, R.W., and Nestler, J.R. 2015. [The uptake of dissolved organic material by the Sea Cucumber *Parastichopus californicus* \(Stimpson\) and its potential role in visceral regeneration](#). *Journal of Experimental Marine Biology and Ecology*, 469, 69-75.
- Cameron, J.L. 1985. Reproduction, development, processes of feeding and notes on the early life history of the commercial Sea Cucumber *Parastichopus californicus* (Stimpson). Doctoral dissertation. Simon Fraser University, Burnaby, British Columbia.
- Cameron, J.L., and Fankboner, P.V. 1984. Tentacle structure and feeding processes in life stages of the commercial Sea Cucumber *Parastichopus californicus* (Stimpson). *Journal of Experimental Marine Biology and Ecology*, 81(2), 193-209.
- Cameron, J.L., and Fankboner, P.V. 1986. Reproductive biology of the commercial Sea Cucumber *Parastichopus californicus* (Stimpson)(Echinodermata: Holothuroidea). I. Reproductive periodicity and spawning behavior. *Canadian Journal of Zoology*, 64(1), 168-175.
- Cameron, J.L., and Fankboner, P.V. 1989. [Reproductive biology of the commercial Sea Cucumber *Parastichopus californicus* \(Stimpson\) \(Echinodermata: Holothuroidea\). II. Observations on the ecology of development, recruitment, and the juvenile life stage](#). *Journal of Experimental Marine Biology and Ecology*, 127(1), 43-67.
- Cripps, K.E., and Campbell, A. 2000. Distribution and biomass of the red Sea Cucumber, *Parastichopus californicus* (Stimpson), found in inlets of north British Columbia. Can. Tech. Rep. Fish. Aquat. Sci. 2300: iii + 14p.
- da Silva, J., and Fankboner, P. 1986. [Movement and orientation patterns in the commercial Sea Cucumber *Parastichopus californicus* \(Stimpson\) \(Holothuroidea: Aspidochirotida\)](#). *Marine and Freshwater Behaviour and Physiology*, 12(2), 133-147.
- Department of Fisheries and Oceans, 1999. Giant Red Sea Cucumber. DFO Science Stock Status Report C6-10 (1999).
- Department of Fisheries and Oceans, 2002. Giant Red Sea Cucumber. DFO Science Stock Status Report C6-10 (2002).
- Department of Fisheries and Oceans. 2024. Pacific Region. [Integrated Fishery Management Plan. Sea Cucumber by Dive. October 1, 2024 to September 30, 2025](#).
- Department of Fisheries and Oceans. 2025. Pacific Region. [Integrated Fishery Management Plan. Sea Cucumber by Dive. October 1, 2025 to September 30, 2026](#).
- Duprey, N.M.T. 2011. [Sea Cucumber biomass estimations from surveys completed June 2009 to May 2010](#). Can. Manuscr. Rep. Fish. Aquat. Sci. 2954: viii + 97 p.
- Duprey, N.M.T. 2012. [Sea Cucumber biomass estimations from surveys completed June 2010 to May 2011](#). Can. Manuscr. Rep. Fish. Aquat. Sci. 2960: xi + 150 p.
- Duprey, N.M.T. 2014. [Biomass estimates for Sea Cucumbers \(*Parastichopus californicus*, *Cucumaria miniata*, *C. pallida*\) as determined through surveys conducted June 2011 to May 2012](#). Can. Manuscr. Rep. Fish. Aquat. Sci. 3017: xi + 155 p.
- Duprey, N.M.T., and Stanton, L.M. 2015. [Biomass estimates for Sea Cucumbers \(*Parastichopus californicus*, *Cucumaria miniata*, *C. pallida*\) as determined through surveys conducted June 2012 to May 2013](#). Can. Manuscr. Rep. Fish. Aquat. Sci. 3083: viii + 109p.

- Duprey, N.M.T., and Stanton, L.M. 2018. [Biomass estimates for Sea Cucumber \(*Parastichopus californicus*, *Cucumaria miniata*, *C. pallida*\) as determined through surveys conducted June 2013 to May 2014](#). Can. Manuscr. Rep. Fish. Aquat. Sci. 3112: x + 72 p.
- Duprey, N.M.T., Hand, C.M., Lochead, J., and Hajas, W. 2011. [Assessment framework for Sea Cucumber \(*Parastichopus californicus*\) in British Columbia](#). DFO Can. Sci. Advis. Sec. Res. Doc. 2010/105. 44 p.
- Ebert, T.A. 1996. Adaptive aspects of phenotypic plasticity in echinoderms. *Oceanologica Acta*, 19(3-4), 347-355.
- Fankboner, P.V., and Cameron, J.L. 1985. Seasonal atrophy of the visceral organs in a Sea Cucumber. *Canadian Journal of Zoology*, 63(12), 2888-2892.
- Fankboner, P.V. 2002. Seasonal visceral atrophy and response to salinity by *Parastichopus californicus* (Stimpson): Osmoregulation. *SPC Beche-de-mer Inf Bull*, 17, 22-26.
- Hajas, W., Hansen, C., and Lochead, J. 2023. [Updated Reference Points and Harvest Options for the Giant Red Sea Cucumber \(*Apostichopus californicus*\) Fishery in British Columbia using data from Experimental Fishing Areas](#). DFO Can. Sci. Advis. Sec. Res. Doc. 2023/020. vii + 58 p.
- Hand, C.M., Hajas, W., Duprey, N., Lochead, J., Deault, J., and Caldwell, J. 2009. [An evaluation of fishery and research data collected during the Phase 1 Sea Cucumber fishery in British Columbia 1998 to 2007](#). DFO Can. Sci. Advis. Sec. Res. Doc. 2008/065. 125 p.
- Hand, C.M., and Rogers, J. 1999. Sea Cucumber Phase 1 fishery progress report. DFO Can. Sci. Advis. Sec. Res. Doc. 1999/141. 26 p.
- Hannah, L., Duprey, N., Blackburn, J., Hand, C.M., and Pearce, C.M. 2012. Growth rate of the California Sea Cucumber *Parastichopus californicus*: measurement accuracy and relationships between size and weight metrics. *North American Journal of Fisheries Management*, 32(1), 167-176.
- Harrell Jr, F.E. 2020. Hmisc: Harrell Miscellaneous. R package version 4.4-2. Available: <https://cran.r-project.org/web/packages/Hmisc>
- Immura, K., and Kruse, G. 1990. Management of the Red Sea Cucumber in southeast Alaska: Biology, historical significance in Pacific coast fisheries, and regional harvest rate determinations. *Alaska Dep Fish Game* 1J90-31:32.
- Lambert, P. 1986. [Northeast Pacific holothurians of the genus *Parastichopus* with a description of a new species, *Parastichopus leukothele* \(Echinodermata\)](#). *Canadian Journal of Zoology*, 64(10), 2266-2272.
- Lambert, P. 1997. Sea Cucumbers of British Columbia, Southeast Alaska and Puget Sound. Royal British Columbia Museum Handbook. UBC Press. Vancouver, Canada.
- Larson, S.D., Hoyt, Z.N., Eckert, G.L., and Gill, V.A. 2013. [Impacts of sea otter \(*Enhydra lutris*\) predation on commercially important Sea Cucumbers \(*Parastichopus californicus*\) in southeast Alaska](#). *Canadian Journal of Fisheries and Aquatic Sciences*, 70(10), 1498-1507.
- Lochead, J., Ridings, P., and Hansen, S.C. 2023a. [Ensuring long-term sustainability of the fishery for *Apostichopus californicus* in British Columbia \(Canada\) through collaborative science and adaptive management](#). In: *The World of Sea Cucumbers*. Edited by A. Mercier, J.-F. Hamel, A. Suhrbier, C. Pearce. Academic Press. pp. 677-685.
- Lochead, J., Schwarz, C.J., Rooper, C., and Bureau, D. 2023b. [Recommendations on the design of a Multispecies Benthic Marine Invertebrate Dive Survey Program for Stock Monitoring in British Columbia](#). Can. Sci. Advis. Sec. Res. Doc. 2023/031. ix + 99 p.
- Margolin, A.S. 1976. [Swimming of the Sea Cucumber *Parastichopus californicus* \(Stimpson\) in response to sea stars](#). *Ophelia*, 15(2), 105-114.
- McEuen, F. S. 1988. Spawning behaviors of northeast Pacific Sea Cucumbers (Holothuroidea: Echinodermata). *Marine Biology*, 98(4), 565-585.
- Mortensen, T. 1921. Studies of the development and larval forms of echinoderms. Copenhagen, G.E.C. Gad.
- Mueller, K.W. 2016. Fishery biology of the Sea Cucumber *Parastichopus californicus*

- (Stimpson, 1857) from the San Juan Islands. Washington. Harvest Management Division Technical Report. October 2016. Lummi Natural Resources Department. Bellingham. Washington. 98 p.
- Nepkin, J., Gregr, E.J., St. Germain, C., Fields, C., and Finney, J.L. 2020. Development of a Species Distribution Modelling Framework and its Application to Twelve Species on Canada's Pacific Coast. DFO Can. Sci. Advis. Sec. Res. Doc. 2020/004. xii + 107 p.
- Perry, R.I., Walters, C.J., and Boutillier, J.A. 1999. A framework for providing scientific advice for the management of new and developing invertebrate fisheries. *Reviews in Fish Biology and Fisheries*, 9, 125-150.
- Phillips, A.C., and Boutillier, J.A. 1998. Stock assessment and quota options for the Sea Cucumber fishery. In: Invertebrate Working Papers reviewed by the Pacific Stock Assessment Review Committee (PSARC) in 1995. Part 2. Echinoderms. Edited by B.J. Waddell, G.E. Gillespie, and L.C. Walther. Can. Tech. Rep. Fish. Aquat. Sci. 2215. pp. 147-167.
- Purcell, S., Conand, C., Uthicke, S., and Byrne, M. 2016. Ecological Roles of Exploited Sea Cucumbers. *Oceanography and Marine Biology*, 54, 367–386. <https://doi.org/10.1201/9781315368597-8>
- R Core Team. 2021. R: A Language and Environment for Statistical Computing. Vienna, Austria. Retrieved from <https://www.R-project.org/>
- Stimpson, W. 1857. On the Crustacea and Echinodermata of the Pacific shores of North America. *Boston Journal of Natural History*, 6, 444-532, p 18-23.
- Strathmann, R. R. 1971. The feeding behavior of planktotrophic echinoderm larvae: Mechanisms, regulation, and rates of suspension feeding. *Journal of Experimental Marine Biology and Ecology*, 6(2), 109-160.
- Swan, E.F. 1961. Seasonal evisceration in the Sea Cucumber, *Parastichopus californicus* (Stimpson). *Science*, 133(3458), 1078-1079.
- Swanton, J.R. 1905. Haida Texts and Myths: Skidegate Dialect. Smithsonian Institution Bureau of American Ethnology. Bulletin 29.
- Ushey, K. 2021. renv: Project Environments. R package version 0.14.0. Available: <https://CRAN.R-project.org/package=renv>
- Weinrauch, A. M., and Blewett, T. A. 2019. Anoxia tolerance in the Sea Cucumbers *Parastichopus californicus* and *Cucumaria miniata* reflects habitat use. *Journal of Experimental Marine Biology and Ecology*, 520, 151-203.
- Woodby, D., Smiley, S., and Larson, R. 2000. Depth and habitat distribution of *Parastichopus californicus* near Sitka, Alaska. *Alaska Fishery Research Bulletin*, 7, 22-32.
- Xaadée 'Wáadluwaan Née · XaaydaGa 'Waadluxan Naay Council of the Haida Nation. 2007. Towards a Marine Use Plan for Haida Gwaii: A Discussion Paper.
- Xaadée 'Wáadluwaan Née · XaaydaGa 'Waadluxan Naay Council of the Haida Nation - Parks Canada. 2018. [Gwaii Haanas Gina 'Waadluxan KilGuhlGa Land-Sea-People Management Plan](#).
- Zhou, S., and Shirley, T.C. 1996. Habitat and depth distribution of the red Sea Cucumber *Parastichopus californicus* in a Southeast Alaska bay. *Alaska Fishery Research Bulletin*, 3(2), 123-131.

TABLES

Table 1. Total number of transects completed, skipped, and number of *yáanu* · *giinu* Sea Cucumber biosamples collected in each Pacific Fishery Management (PFM) Subarea during the 2023 to 2024 surveys. Analysis areas are created to pool density data from PFM Subareas with fewer than ten transects with nearby Subareas to ensure statistical defensibility.

MM/YY	Survey	PFM Subareas	Analysis Area	Shoreline Length (km)	Completed Transects	Skipped Transects	Number of Biosamples
03/23	K'uuna Gwaay.yaay Louise Island	2-3	2-3	62.00	13	17	1
		2-4	2-4	48.85	13	6	0
		2-5	2-5	24.99	10	0	1
		2-6	2-6	158.70	61	11	7
08/23	Gwaii Haanas	2-11	2-11	231.36	90	22	7
		2-13	2-13	78.36	23	11	1
03/24	Gwaii Haanas	2-10	2-10	117.72	51	6	6
		2-15	2-15	80.76	39	0	4
08/24	Kaysuun Kaahlii Englefield Bay	2-51	2-51 & 2-53	6.82	4	0	1
		2-52	2-52	22.96	10	1	0
		2-53	2-51 & 2-53	20.05	10	0	2
		2-54	2-54 & 2-55	10.87	5	0	0
		2-55	2-54 & 2-55	10.13	5	0	1
		2-56	2-56 & 2-57	19.38	10	0	1
		2-57	2-56 & 2-57	10.10	5	0	0
		2-58	2-58 & 2-59	15.53	8	0	1
		2-59	2-58 & 2-59	16.51	9	0	1
		2-60	2-60	19.95	10	0	1
08/24	Chaahluu Kaahlii Rennell Sound	2-65	2-65	29.84	15	0	2
		2-68	2-68	69.17	11	23	1
		2-70	2-70 & 2-71	22.81	8	3	1
		2-71	2-70 & 2-71	15.40	7	1	1
		2-73	2-73, 2-74 & 2-75	4.25	2	0	1
		2-74	2-73, 2-74 & 2-75	1.03	1	0	0
		2-75	2-73, 2-74 & 2-75	40.63	21	0	1
		2-76	2-76	20.66	10	0	1
		2-77	2-77	30.70	11	4	0
		2-80	2-80 to 2-84	9.10	5	0	0
		2-81	2-80 to 2-84	10.73	4	1	1
		2-82	2-80 to 2-84	22.43	11	0	1
		2-83	2-80 to 2-84	7.60	4	0	1
		2-84	2-80 to 2-84	11.67	4	2	0
					3817	1534	148

Table 2. Mean linear adult *yáanuu · giinuu* Sea Cucumber density estimates by PFM Subarea, with lower (LCB) and upper (UCB) 99%, 95%, 90%, and 75% confidence bounds (Sea Cucumbers per metre of shoreline: c/m-sh) from biomass surveys completed 2023 to 2024. Each PFM Subarea was analyzed separately except those shown with *, which indicates that the transects were pooled into analysis areas. For surveys in Gwaii Haanas National Park Reserve and Haida Heritage Site (Survey = Gwaii Haanas) PFM Subarea results are also provided for transects falling within the Strict Protection Zones where recreational and commercial harvest are not permitted and the Multiple Use Zones where recreational and commercial harvest are permitted.

Survey	PFM Subarea/Analysis Area	Completed Transects	Mean Density	Confidence Level	LCB	UCB
<i>K'uuna</i> <i>Gwaay.yaay</i> <i>Louise Island</i>	2-3	13	3.40	99	0.04	9.60
				95	0.40	7.85
				90	0.67	6.94
				75	1.06	5.71
	2-4	13	1.10	99	0.12	3.02
				95	0.21	2.48
				90	0.27	2.21
				75	0.40	1.79
	2-5	10	6.85	99	1.98	12.00
				95	3.02	10.88
				90	3.67	10.10
				75	4.53	9.22
	2-6	61	4.98	99	3.07	7.39
				95	3.47	6.74
				90	3.67	6.44
				75	4.02	5.94
Gwaii Haanas	2-10	51	10.51	99	7.38	14.21
				95	8.07	13.25
				90	8.38	12.79
				75	9.00	16.42
	2-10 Strict Protection Zone 10	8	12.19	99	4.78	20.28
				95	6.38	18.34
				90	7.16	17.25
				75	8.66	15.84
	2-10 Multiple Use Zone	43	10.20	99	6.81	14.38
				95	7.51	13.23
				90	7.88	12.74
				75	8.55	11.91
Gwaii Haanas	2-11	90	7.28	99	4.99	9.92
				95	5.49	9.22
				90	5.74	8.91
				75	6.19	8.40
	2-11 Strict Protection Zone 9	26	6.80	99	3.21	10.97
				95	3.98	9.90

Survey	PFM Subarea/Analysis Area	Completed Transects	Mean Density	Confidence Level	LCB	UCB
	2-11 Multiple Use Zone	64	7.47	90	4.35	9.45
				75	5.00	8.59
				99	4.58	10.78
				95	5.29	9.93
				90	5.59	9.50
				75	6.10	8.83
				99	5.74	31.84
				95	8.10	28.22
				90	9.25	26.35
				75	11.50	23.54
Gwaii Haanas	2-13	23	17.37	99	5.74	31.84
				95	8.10	28.22
				90	9.25	26.35
				75	11.50	23.54
	2-13 Strict Protection Zone 7	1	3.25	99	NA	NA
				95	NA	NA
				90	NA	NA
				75	NA	NA
	2-13 Strict Protection Zone 8	2	57.88	99	43.50	72.25
				95	43.50	72.25
				90	43.50	72.25
				75	43.50	72.25
	2-13 Multiple Use	20	14.03	99	3.44	28.89
				95	5.32	25.01
				90	6.35	23.11
				75	8.40	19.95
Gwaii Haanas	2-15	39	14.12	99	9.30	19.33
				95	10.37	17.99
				90	10.97	17.28
				75	11.86	16.42
	2-15 Strict Protection Zone 6d	3	12.25	99	0.50	31.00
				95	0.50	31.00
				90	2.08	22.42
				75	2.08	22.42
	2-15 Strict Protection Zone 7	15	15.57	99	8.23	22.95
				95	10.12	21.32
				90	10.82	20.18
				75	12.27	18.98
	2-15 Multiple Use Zone	21	13.36	99	6.79	20.95
				95	8.31	19.24
				90	9.05	18.12
				75	10.18	16.51
Kaysuun Kaahlii Englefield Bay	2-51 & 2-53*	14	7.34	99	3.91	11.20
				95	4.62	10.18
				90	5.02	9.73
				75	5.70	8.93

Survey	PFM Subarea/Analysis Area	Completed Transects	Mean Density	Confidence Level	LCB	UCB
	2-52	10	2.28	99	0.25	4.78
				95	0.65	4.10
				90	0.85	3.85
				75	1.23	3.33
	2-54 & 2-55*	10	6.55	99	2.10	12.65
				95	2.85	11.07
				90	3.30	10.35
				75	4.15	8.95
	2-56 & 2-57*	15	0.72	99	0.07	1.65
				95	0.17	1.43
				90	0.22	1.30
				75	0.35	1.10
	2-58 & 2-59*	17	5.81	99	2.12	11.53
				95	2.65	9.90
				90	3.04	9.06
				75	3.71	7.97
	2-60	10	3.20	99	0.98	6.45
				95	1.27	5.62
				90	1.50	5.18
				75	1.93	4.53
Chaahluu Kaahlui Rennell Sound	2-65	15	4.67	99	1.73	10.15
				95	2.15	8.53
				90	2.35	7.93
				75	2.77	6.67
	2-68	11	4.93	99	1.50	8.34
				95	2.32	7.59
				90	2.66	7.16
				75	3.34	6.55
	2-70 & 2-71*	15	7.47	99	2.98	13.00
				95	3.95	11.55
				90	4.42	10.82
				75	5.27	9.75
	2-73, 2-74 & 2-75*	24	4.58	99	1.82	9.22
				95	2.24	7.92
				90	2.44	7.27
				75	2.93	6.33
	2-76	10	5.72	99	1.77	10.00
				95	2.62	9.03
				90	3.02	8.60
				75	3.85	7.68
	2-77	11	0.50	99	0.00	1.07
				95	0.14	0.93
				90	0.16	0.86

Survey	PFM Subarea/Analysis Area	Completed Transects	Mean Density	Confidence Level	LCB	UCB
				75	0.27	0.75
	2-80, 2-81, 2-83 & 2-84*	28	5.59	99	2.59	9.43
				95	3.14	8.47
				90	3.50	7.94
				75	4.05	7.19

Table 3. Mean linear juvenile *yáanu* · *giinu* Sea Cucumber density estimates by PFM Subarea, with lower (LCB) and upper (UCB) 99% and 95% confidence bounds (Sea Cucumber per metre of shoreline: c/m-sh) from biomass surveys completed 2023 to 2024. Each PFM Subarea was analyzed separately except those shown with *, which indicates that the transects were pooled into analysis areas. For surveys in Gwaii Haanas National Park Reserve and Haida Heritage Site (Survey = Gwaii Haanas) PFM Subarea results are also provided for transects falling within the Strict Protection Zones where recreational and commercial harvest are not permitted and the Multiple Use Zones where recreational and commercial harvest are permitted. PFM Subareas with only one completed transect do not have calculated LCB and UCB values.

Year	Survey	PFM Subarea/Analysis Area	Completed Transects	Mean Density	Confidence Level	LCB	UCB
2023	<i>K'uuna</i> <i>Gwaay.yaay</i> <i>Louise Island</i>	2-3	13	0.04	99	0.00	0.15
					95	0.00	0.12
		2-4	13	0	99	0	0
					95	0	0
		2-5	10	0.10	99	0.00	0.33
					95	0.00	0.25
		2-6	61	0.04	99	0.00	0.08
					95	0.01	0.07
		2-11	90	0.03	99	0.00	0.07
					95	0.01	0.22
2023	Gwaii Haanas	2-11	26	0.04	99	0.00	0.11
		Strict Protection Zone 9			95	0.00	0.09
		2-11	64	0.02	99	0.00	0.07
		Multiple Use			95	0.00	0.05
		2-13	23	0.10	99	0.01	0.22
					95	0.02	0.18
		2-13	1	0	99	NA	NA
		Strict Protection Zone 7			95	NA	NA
		2-13	2	0.25	99	0.00	0.50
		Strict Protection Zone 8			95	0.00	0.50
		2-13	20	0.09	99	0.00	0.23
					95	0.01	0.19
		2-10	51	0.19	99	0.00	0.67
					95	0.00	0.52
2024	Gwaii Haanas	2-10	8	0.03	99	0.00	0.13
		Strict Protection Zone 10			95	0.00	0.09
		2-10	43	0.22	99	0.00	0.78
					95	0.00	0.60
		2-15	39	0.02	99	0.00	0.05
					95	0.00	0.04

Year	Survey	PFM Subarea/Analysis Area	Completed Transects	Mean Density	Confidence Level	LCB	UCB
2024	<i>Kaysuun Kaahlii Englefield Bay</i>	2-15	3	0	99	0	0
		Strict Protection Zone 6d			95	0	0
		2-15	15	0.02	99	0.00	0.07
		Strict Protection Zone 7			95	0.00	0.05
		2-15	21	0.02	99	0.00	0.07
		Multiple Use			95	0.00	0.06
		2-51 & 2-53*	14	0.04	99	0.00	0.14
					95	0.00	0.11
		2-52	10	0.08	99	0.00	0.18
					95	0.00	0.15
		2-54 & 2-55*	10	0	99	0	0
					95	0	0
		2-56 & 2-57*	15	0.05	99	0.00	0.17
					95	0.00	0.13
		2-58 & 2-59*	17	0.01	99	0.00	0.06
					95	0.00	0.04
		2-60	10	0	99	0	0
					95	0	0
	<i>Chaahluu Kaahlii Rennell Sound</i>	2-65	15	0.02	99	0.00	0.07
					95	0.00	0.05
		2-68	11	0	99	0	0
					95	0	0
		2-70 & 2-71*	15	0	99	0	0
					95	0	0
		2-73, 2-74 & 2-75*	24	0.01	99	0.00	0.04
					95	0.00	0.03
		2-76	10	0	99	0	0
					95	0	0
		2-77	11	0	99	0	0
					95	0	0
		2-80 to 2-84*	28	0.05	99	0.00	0.20
					95	0.00	0.15

Table 4. Estimated mean weight of *yáanuu · ġiinuu Sea Cucumber* from biosamples collected from 2023 to 2024. The “Subarea mean weight” is the mean weight of all the transects located within the PFM subarea, and is used for the biomass calculations. For surveys in Gwaii Haanas National Park Reserve and Haida Heritage Site (Survey = Gwaii Haanas) PFM Subarea results are also provided for transects falling within the Strict Protection Zones where recreational and commercial harvest are not permitted and the Multiple Use Zones where recreational and commercial harvest are permitted. Std. Dev. is standard deviation; SE is standard error.

Year	Survey	PFM Subarea	Transect no.	Cucumbers collected (n)	Average weight (g/cucumber)	Std. Dev.	Subarea mean weight $\pm$ SE (g/cucumber)
2023	K'uuna Gwaay.yaay Louise Island	2-3	15	25	231.1	90.8	231.1 $\pm$ NA
		2-5	58	26	114.6	47.9	114.6 $\pm$ NA
		2-6	66	25	379.1	95.8	314.8 $\pm$ 21.3
			80	26	267.9	77.8	
			86	25	329.1	72.2	
			99	26	250.7	62.4	
			107	24	275.8	75.3	
			117	25	397.2	79.5	
			131	24	303.9	82.3	
2003	Gwaii Haanas	2-11	265	25	214.4	54.4	226.9 $\pm$ 28.4
			301	25	174.8	64.7	
			310	25	164.6	39.3	
			321	24	262.4	73.4	
			345	25	363.9	95.1	
			361	25	178.1	60.5	
			362	25	300.1	79.8	
		2-11 Strict Protection Zone 9	345	25	363.9	95.1	363.9 $\pm$ NA
		2-11 Multiple Use	265	25	214.4	54.4	215.8 $\pm$ 22.4
			301	25	174.8	64.7	
			310	25	164.6	39.3	
			321	24	262.4	73.4	

Year	Survey	PFM Subarea	Transect no.	Cucumbers collected (n)	Average weight (g/cucumber)	Std. Dev.	Subarea mean weight $\pm$ SE (g/cucumber)
			361	25	178.1	60.5	
			362	25	300.2	79.8	
		2-13	448	25	191.0	50.0	191.0 $\pm$ NA
		2-13 Strict Protection Zone	-	-	-	-	-
		2-13 Multiple Use	448	25	191.0	50.0	191.0 $\pm$ NA
2024	Gwaii Haanas	2-10	208	25	246.6	88.8	247.5 $\pm$ 36.1
			227	26	206.5	59.4	
			236	26	152.8	74.2	
			245	26	209.8	52.9	
			258	26	411.7	109.0	
			260	25	257.4	55.7	
		2-10 Strict Protection Zone 10	258	26	411.7	109.0	411.7 $\pm$ NA
		2-10 Multiple Use	208	25	246.6	88.8	214.6 $\pm$ 18.4
			227	26	206.4	59.4	
			236	26	152.9	74.2	
			245	26	209.8	52.9	
			260	25	257.4	55.7	
			2-15	489	26	233.6	63.3
			503	26	316.1	87.2	
			508	25	169.8	57.2	
			525	26	165.7	48.5	
		2-15 Strict	503	26	316.1	87.2	316.1 $\pm$ NA

Year	Survey	PFM Subarea	Transect no.	Cucumbers collected (n)	Average weight (g/cucumber)	Std. Dev.	Subarea mean weight $\pm$ SE (g/cucumber)
2024	<u>Kaysuun</u> <u>Kaahlui</u> <i>Englefield Bay</i>	Protection Zone 6d					
		2-15 Strict Protection Zone 7	525	26	165.7	48.5	165.7 $\pm$ NA
		2-15 Multiple Use	489	26	233.6	63.3	201.7 $\pm$ 31.9
			508	25	169.8	57.2	
		2-51	810	25	181.0	56.9	181.0 $\pm$ NA
		2-53	824	25	85.0	26.7	130.54 $\pm$ 45.5
			883	25	176.0	92.2	
		2-55	851	25	170.4	60.2	170.4 $\pm$ NA
		2-56	841	25	39.8	27.7	39.8 $\pm$ NA
		2-58	859	25	79.2	41.8	79.2 $\pm$ NA
2024	<u>Chaahluu</u> <u>Kaahlui</u> Rennell Sound	2-59	864	25	119.6	47.1	119.6 $\pm$ NA
		2-60	880	25	95.8	29.5	95.8 $\pm$ NA
		2-65	776	25	83.2	23.2	113.5 $\pm$ 30.3
			784	25	143.8	37.6	
		2-68	754	25	72.6	21.3	72.6 $\pm$ NA
		2-70	727	25	108.0	34.6	108.0 $\pm$ NA
		2-71	732	25	198.9	35.3	198.9 $\pm$ NA
		2-73	694	25	157.9	45.0	157.9 $\pm$ NA
		2-75	656	25	128.6	40.9	128.6 $\pm$ NA
		2-76	685	25	146.9	38.9	146.9 $\pm$ NA
		2-81	641	25	84.9	82.4	84.9 $\pm$ NA
		2-82	616	25	166.4	31.4	166.4 $\pm$ NA
		2-83	618	25	124.4	42.0	124.4 $\pm$ NA

Table 5. *Yáanuu · Giinuu Sea Cucumber* biomass estimates from surveys conducted from 2023 to 2024 using equation 1 shown in Methods → Data Analysis → Biomass Estimates (i.e., applying the default 2.50 c/m-sh to the exposed shoreline, if the survey density estimate was higher). Biomass estimates are calculated at the PFM Subarea level, therefore confidence bound linear density estimates calculated at the analysis area level are applied to each of its' constituent PFM Subareas (Table 2). When biological sample transects were not collected from a PFM Subarea, the lowest $W_{t_{mean}}$ from the same survey was used, denoted as * (Duprey et al., 2011; Table 4). Shoreline lengths are reported in metres. For surveys in Gwaii Haanas National Park Reserve and Haida Heritage Site (Survey = Gwaii Haanas) PFM Subarea results are also provided for transects falling within the Strict Protection Zones where recreational and commercial harvest are not permitted and the Multiple Use Zones where recreational and commercial harvest are permitted. The shoreline values reported in Table 1 are used for survey planning purposes whereas the shoreline length values reported in this table are used for Fishery Management biomass calculations and exclude shoreline that was not surveyed.

Year	Survey	PFM Subarea	Analysis Area	Skipped Transects	Shoreline Length - exposed (m)	Shoreline Length – protected (m)	Shoreline Length – total (m)	Mean weight (g)	Conf Level	Density LCB (c/m-sh)	Density UCB (c/m-sh)	Total Biomass LCB (kg)	Total Biomass UCB (kg)
2023	<i>K'uuna Gwaay.yaay Louise Island</i>	2-3	2-3	17	700	27308	28008	231	99	0.04	9.60	259	60962
									95	0.40	7.85	2588	49923
									90	0.67	6.94	4335	44183
									75	1.06	5.71	6858	36424
		2-4	2-4	6	0	36846	36846	115*	99	0.12	3.02	508	12797
									95	0.21	2.48	890	10508
									90	0.27	2.21	1144	9364
									75	0.40	1.79	1695	7585
		2-5	2-5	0	0	24993	24993	115	99	1.98	12.00	5691	34490
									95	3.02	10.88	8680	31271
									90	3.67	10.10	10548	29029
									75	4.53	9.22	13020	26500
		2-6	2-6	11	405	136299	136704	315	99	3.07	7.39	132127	317603
									95	3.47	6.74	149301	289695
									90	3.67	6.44	157887	276815
									75	4.02	5.94	172914	255348
2023	Gwaii Haanas	2-11	2-11	22	60460	126903	187363	227	99	4.99	9.92	178058	320076

Year	Survey	PFM Subarea	Analysis Area	Skipped Transects	Shoreline Length - exposed (m)	Shoreline Length – protected (m)	Shoreline Length – total (m)	Mean weight (g)	Conf Level	Density LCB (c/m-sh)	Density UCB (c/m/sh)	Total Biomass LCB (kg)	Total Biomass UCB (kg)
									95	5.49	9.22	192461	299911
									90	5.74	8.91	199663	290981
									75	6.19	8.40	212626	276290
		2-11 Strict Protection Zone 9	2-11 Strict Protection Zone 9	14	60460	65316	125776	364	99	3.21	10.97	131336	315831
									95	3.98	9.90	149643	290391
									90	4.35	9.45	158440	279693
									75	5.00	8.59	173894	259246
		2-11 Multiple Use	2-11 Multiple Use	8	0	61587	61587	216	99	4.58	10.78	60927	143404
									95	5.29	9.93	70372	132097
									90	5.59	9.50	74363	126377
									75	6.10	8.83	81147	117464
		2-13	2-13	11	1205	55158	56363	191	99	5.74	31.84	61047	336015
									95	8.10	28.22	85910	297878
									90	9.25	26.35	98026	278177
									75	11.50	23.54	121730	248573
		2-13 Strict Protection Zone 7	2-13 Strict Protection Zone 7	7	0	10831	10831	191*	99	-	-	-	-
									95	-	-	-	-
									90	-	-	-	-
									75	-	-	-	-
		2-13 Strict Protection Zone 8	2-13 Strict Protection Zone 8	0	0	3202	3202	191*	99	43.50	72.25	26604	44187
									95	43.50	72.25	26604	44187
									90	43.50	72.25	26604	44187
									75	43.50	72.25	26604	44187
		2-13 Multiple Use	2-13 Multiple Use	4	1205	41125	42330	191	99	3.44	28.89	27596	227503
									95	5.32	25.01	42363	197026
									90	6.35	23.11	50454	182102

Year	Survey	PFM Subarea	Analysis Area	Skipped Transects	Shoreline Length - exposed (m)	Shoreline Length – protected (m)	Shoreline Length – total (m)	Mean weight (g)	Conf Level	Density LCB (c/m-sh)	Density UCB (c/m/sh)	Total Biomass LCB (kg)	Total Biomass UCB (kg)
									75	8.40	19.95	66556	157280
2024		2-10	2-10	6	11299	94417	105716	248	99	7.38	14.21	179865	339758
									95	8.07	13.25	195933	317145
									90	8.38	12.79	203167	306476
									75	9.00	12.07	217744	289597
		2-10 Strict Protection Zone 10	2-10 Strict Protection Zone 10	0	0	29739	29739	412	99	4.78	20.28	58567	248480
									95	6.38	18.34	78171	224710
									90	7.16	17.25	87728	211355
									75	8.66	15.84	106106	194079
		2-10 Multiple Use	2-10 Multiple Use	6	11299	75478	86777	215	99	6.81	14.38	116584	239429
									95	7.51	13.23	127944	220767
									90	7.88	12.74	133948	212815
									75	8.55	11.91	144821	199346
		2-15	2-15	0	11720	69036	80756	221	99	9.31	19.33	148482	301443
									95	10.37	17.99	164717	281008
									90	10.97	17.28	173813	270054
									75	11.86	16.42	187407	257054
		2-15 Strict Protection Zone 6d	2-15 Strict Protection Zone 6d	0	0	7046	7046	316	99	0.50	31.00	1113	69023
									95	0.50	31.00	1113	69023
									90	2.08	22.42	4631	49919
									75	2.08	22.42	4631	49919
		2-15 Strict Protection Zone 7	2-15 Strict Protection Zone 7	0	3907	30924	34831	166	99	8.23	22.95	43869	119433
									95	10.12	21.32	53571	111065
									90	10.82	20.18	57165	105213
									75	12.27	18.98	64608	99053

Year	Survey	PFM Subarea	Analysis Area	Skipped Transects	Shoreline Length - exposed (m)	Shoreline Length – protected (m)	Shoreline Length – total (m)	Mean weight (g)	Conf Level	Density LCB (c/m-sh)	Density UCB (c/m/sh)	Total Biomass LCB (kg)	Total Biomass UCB (kg)
2024	Kaysuun Kaahlii Englefield	2-15 Multiple Use	2-15 Multiple Use	0	7813	31066	38879	202	99	6.79	20.95	46555	135414
									95	8.31	19.24	56094	124683
									90	9.05	18.12	60737	117655
									75	10.18	16.51	67828	107551
		2-51	2-51 & 2-53	0	5023	437	5460	181	99	3.91	11.20	2582	3159
									95	4.62	10.18	2638	3078
									90	5.02	9.73	2670	3043
									75	5.70	8.93	2724	2979
		2-52	2-52	1	1087	11395	12482	40*	99	0.25	4.78	125	2287
									95	0.65	4.10	325	1977
									90	0.85	3.85	424	1864
									75	1.23	3.33	614	1627
		2-53	2-51 & 2-53	0	2278	16218	18496	131	99	3.91	11.20	9053	24541
									95	4.62	10.18	10562	22374
									90	5.02	9.73	11411	21418
									75	5.70	8.93	12856	19718
		2-54	2-54 & 2-55	0	0	10466	10466	40*	99	2.10	12.65	879	5296
									95	2.85	11.07	1193	4634
									90	3.30	10.35	1382	4333
									75	4.15	8.95	1737	3747
		2-55	2-54 & 2-55	0	0	8131	8131	170	99	2.10	12.65	2903	17486
									95	2.85	11.07	3939	15302
									90	3.30	10.35	4561	14306
									75	4.15	8.95	5736	12371
		2-56	2-56 & 2-57	0	0	17942	17942	40	99	0.07	1.65	50	1184

Year	Survey	PFM Subarea	Analysis Area	Skipped Transects	Shoreline Length - exposed (m)	Shoreline Length – protected (m)	Shoreline Length – total (m)	Mean weight (g)	Conf Level	Density LCB (c/m-sh)	Density UCB (c/m/sh)	Total Biomass LCB (kg)	Total Biomass UCB (kg)
									95	0.17	1.43	122	1026
									90	0.22	1.30	158	933
									75	0.35	1.10	251	789
		2-57	2-56 & 2-57	0	0	9996	9996	40*	99	0.07	1.65	28	660
									95	0.17	1.43	68	572
									90	0.22	1.30	88	520
									75	0.35	1.10	140	440
		2-58	2-58 & 2-59	0	100	14868	14968	79	99	2.12	11.53	2507	13563
									95	2.65	9.90	3132	11648
									90	3.04	9.06	3590	10661
									75	3.71	7.97	4377	9381
		2-59	2-58 & 2-59	0	175	15751	15926	120	99	2.12	11.53	4052	21846
									95	2.65	9.90	5061	18765
									90	3.04	9.06	5798	17177
									75	3.71	7.97	7065	15117
		2-60	2-60	0	10333	7643	17976	96	99	0.98	6.45	1691	7212
									95	1.27	5.62	2192	6603
									90	1.50	5.18	2589	6281
									75	1.93	4.53	3331	5804
	Chaahluu Kaahlili Rennell Sound	2-65	2-65	0	2492	21969	24461	114	99	1.73	10.15	4824	26131
									95	2.15	8.53	5995	22073
									90	2.35	7.93	6553	20571
									75	2.77	6.67	7648	17415
		2-68	2-68	23	0	3711	3711	73	99	1.50	8.34	406	2259
									95	2.32	7.59	628	2056

Year	Survey	PFM Subarea	Analysis Area	Skipped Transects	Shoreline Length - exposed (m)	Shoreline Length – protected (m)	Shoreline Length – total (m)	Mean weight (g)	Conf Level	Density LCB (c/m-sh)	Density UCB (c/m/sh)	Total Biomass LCB (kg)	Total Biomass UCB (kg)
									90	2.66	7.16	721	1940
									75	3.34	6.55	905	1774
		2-70	2-70 & 2-71	3	0	12077	12077	108	99	2.98	13.00	3887	16956
									95	3.95	11.55	5152	15065
									90	4.42	10.82	5765	14113
									75	5.27	9.75	6874	12717
		2-71	2-70 & 2-71	1	8764	2071	10835	199	99	2.98	13.00	5588	9718
									95	3.95	11.55	5988	9120
									90	4.42	10.82	6182	8819
									75	5.27	9.75	6532	8378
		2-73	2-73, 2-74 & 2-75	0	2705	0	2705	158	99	1.82	9.22	778	1068
									95	2.24	7.92	957	1068
									90	2.44	7.27	1043	1068
									75	2.93	6.33	1068	1068
		2-74	2-73, 2-74 & 2-75	0	1865	0	1865	73*	99	1.82	9.22	248	340
									95	2.24	7.92	305	340
									90	2.44	7.27	332	340
									75	2.93	6.33	340	340
		2-75	2-73, 2-74 & 2-75	0	28099	4593	32692	129	99	1.82	9.22	7675	14525
									95	2.24	7.92	9447	13755
									90	2.44	7.27	10290	13369
									75	2.93	6.33	10798	12812
		2-76	2-76	0	1334	18171	19505	147	99	1.77	10.00	5075	27202
									95	2.62	9.03	7489	24611
									90	3.02	8.60	8557	23462
									75	3.85	7.68	10774	21005

Year	Survey	PFM Subarea	Analysis Area	Skipped Transects	Shoreline Length - exposed (m)	Shoreline Length – protected (m)	Shoreline Length – total (m)	Mean weight (g)	Conf Level	Density LCB (c/m-sh)	Density UCB (c/m/sh)	Total Biomass LCB (kg)	Total Biomass UCB (kg)
		2-77	2-77	4	142	18100	18242	73*	99	0.00	1.07	0	1425
									95	0.14	0.93	186	1238
									90	0.16	0.86	213	1145
									75	0.27	0.75	360	999
		2-80	2-80 to 2-84	0	7526	0	7526	73*	99	2.59	9.43	1373	1373
									95	3.14	8.47	1373	1373
									90	3.50	7.94	1373	1373
									75	4.05	7.19	1373	1373
		2-81	2-80 to 2-84	1	1631	3156	4787	85	99	2.59	9.43	1041	2876
									95	3.14	8.47	1189	2619
									90	3.50	7.94	1285	2477
									75	4.05	7.19	1433	2275
		2-82	2-80 to 2-84	0	16112	637	16749	166	99	2.59	9.43	6960	7684
									95	3.14	8.47	7019	7582
									90	3.50	7.94	7057	7526
									75	4.05	7.19	7115	7447
		2-83	2-80 to 2-84	0	48	4992	5040	124	99	2.59	9.43	1618	5852
									95	3.14	8.47	1959	5258
									90	3.50	7.94	2181	4930
									75	4.05	7.19	2522	4466
		2-84	2-80 to 2-84	2	0	603	603	73*	99	2.59	9.43	114	415
									95	3.14	8.47	138	373
									90	3.50	7.94	154	350
									75	4.05	7.19	178	316

Table 6. *Yáanu · Giinuu* Sea Cucumber biomass estimates from surveys conducted from 2023 to 2024 using equation 2 shown in Methods → Data Analysis → Biomass Estimates (i.e., survey density estimate instead of the default 2.50 c/m-sh applied to the exposed shoreline). Biomass estimates are calculated at the PFM Subarea level, therefore confidence bound linear density estimates calculated at the analysis area level are applied to each of its' constituent PFM Subareas (Table 2). When biological sample transects were not collected from a PFM Subareas the lowest $W_{t_{mean}}$ from the same survey was used, denoted as * (Duprey et al., 2011; Table 4). Shoreline lengths are reported in metres. For surveys in Gwaii Haanas National Park Reserve and Haida Heritage Site (Survey = Gwaii Haanas) PFM Subarea results are also provided for transects falling within the Strict Protection Zones where recreational and commercial harvest are not permitted and the Multiple Use Zones where recreational and commercial harvest are permitted. The shoreline values reported in Table 1 are used for survey planning purposes whereas the shoreline length values reported in this table are used for Fishery Management biomass calculations and exclude shoreline that was not surveyed.

Year	Survey	PFM Subarea	Analysis Area	Skipped Transects	Shoreline Length - exposed (m)	Shoreline Length – protected (m)	Shoreline Length – total (m)	Mean weight (g)	Conf Level	Density LCB	Density UCB	Total Biomass (kg) LCB	Total Biomass (kg) UCB
2023	<i>K'uuna</i> <i>Gwaay.yaay</i> <i>Louise Island</i>	2-3	2-3	17	700	27308	28008	231	99	0.04	9.60	259	62111
									95	0.40	7.85	2588	50788
									90	0.67	6.94	4335	44901
									75	1.06	5.71	6858	36943
		2-4	2-4	6	0	36846	36846	115*	99	0.12	3.02	508	12797
									95	0.21	2.48	890	10508
									90	0.27	2.21	1144	9364
									75	0.40	1.79	1695	7585
		2-5	2-5	0	0	24993	24993	115	99	1.98	12.00	5691	34490
									95	3.02	10.88	8680	31271
									90	3.67	10.10	10548	29029
									75	4.53	9.22	13020	26500
		2-6	2-6	11	405	136299	136704	315	99	3.07	7.39	132200	318226
									95	3.47	6.74	149424	290236
									90	3.67	6.44	158037	277318
									75	4.02	5.94	173108	255787
2023		2-11	2-11	22	60460	126903	187363	227	99	4.99	9.92	212232	421911

Year	Survey	PFM Subarea	Analysis Area	Skipped Transects	Shoreline Length - exposed (m)	Shoreline Length – protected (m)	Shoreline Length – total (m)	Mean weight (g)	Conf Level	Density LCB	Density UCB	Total Biomass (kg) LCB	Total Biomass (kg) UCB
									95	5.49	9.22	233497	392140
									90	5.74	8.91	244130	378955
									75	6.19	8.40	263269	357264
		2-11 Strict Protection Zone 9	2-11 Strict Protection Zone 9	14	60460	65316	125776	364	99	3.21	10.97	146962	502234
									95	3.98	9.90	182214	453246
									90	4.35	9.45	199154	432644
									75	5.00	8.59	228912	393271
		2-11 Multiple Use	2-11 Multiple Use	8	0	61587	61587	216	99	4.58	10.78	60927	143404
									95	5.29	9.93	70372	132097
									90	5.59	9.50	74363	126377
									75	6.10	8.83	81147	117464
		2-13	2-13	11	1205	55158	56363	191	99	5.74	31.84	61793	342768
									95	8.10	28.22	87199	303798
									90	9.25	26.35	99579	283667
									75	11.50	23.54	123801	253416
		2-13 Strict Protection Zone 7	2-13 Strict Protection Zone 7	7	0	10831	10831	191*	99	-	-	-	-
									95	-	-	-	-
									90	-	-	-	-
									75	-	-	-	-
		2-13 Strict Protection Zone 8	2-13 Strict Protection Zone 8	0	0	3202	3202	191*	99	43.50	72.25	26604	44187
									95	43.50	72.25	26604	44187
									90	43.50	72.25	26604	44187
									75	43.50	72.25	26604	44187
		2-13 Multiple Use	2-13 Multiple Use	4	1205	41125	42330	191	99	3.44	28.89	27813	233577
									95	5.32	25.01	43012	202207
									90	6.35	23.11	51340	186845

Year	Survey	PFM Subarea	Analysis Area	Skipped Transects	Shoreline Length - exposed (m)	Shoreline Length – protected (m)	Shoreline Length – total (m)	Mean weight (g)	Conf Level	Density LCB	Density UCB	Total Biomass (kg) LCB	Total Biomass (kg) UCB
									75	8.40	19.95	67914	161296
2024		2-10	2-10	6	11299	94417	105716	248	99	7.38	14.21	193545	372573
									95	8.07	13.25	211537	347254
									90	8.38	12.79	219636	335309
									75	9.00	12.07	235958	316410
		2-10 Strict Protection Zone 10	2-10 Strict Protection Zone 10	0	0	29739	29739	412	99	4.78	20.28	58567	248480
									95	6.38	18.34	78171	224710
									90	7.16	17.25	87728	211355
									75	8.66	15.84	106106	194079
		2-10 Multiple Use	2-10 Multiple Use	6	11299	75478	86777	215	99	6.81	14.38	127055	268288
									95	7.51	13.23	140114	246833
									90	7.88	12.74	147018	237691
									75	8.55	11.91	159518	222206
		2-15	2-15	0	11720	69036	80756	221	99	9.31	19.33	166115	345043
									95	10.37	17.99	185106	321139
									90	10.97	17.28	195746	308325
									75	11.86	16.42	211648	293118
		2-15 Strict Protection Zone 6d	2-15 Strict Protection Zone 6d	0	0	7046	7046	316	99	0.50	31.00	1113	69023
									95	0.50	31.00	1113	69023
									90	2.08	22.42	4631	49919
									75	2.08	22.42	4631	49919
		2-15 Strict Protection Zone 7	2-15 Strict Protection Zone 7	0	3907	30924	34831	166	99	8.23	22.95	47585	132696
									95	10.12	21.32	58513	123271
									90	10.82	20.18	62561	116680
									75	12.27	18.98	70944	109741

Year	Survey	PFM Subarea	Analysis Area	Skipped Transects	Shoreline Length - exposed (m)	Shoreline Length – protected (m)	Shoreline Length – total (m)	Mean weight (g)	Conf Level	Density LCB	Density UCB	Total Biomass (kg) LCB	Total Biomass (kg) UCB
		2-15 Multiple Use	2-15 Multiple Use	0	7813	31066	38879	202	99	6.79	20.95	53326	164532
									95	8.31	19.24	65263	151102
									90	9.05	18.12	71075	142306
									75	10.18	16.51	79949	129662
2024	Kaysuun Kaahlii Englefield	2-51	2-51 & 2-53	0	5023	437	5460	181	99	3.91	11.20	3864	11069
									95	4.62	10.18	4566	10060
									90	5.02	9.73	4961	9616
									75	5.70	8.93	5633	8825
		2-52	2-52	1	1087	11395	12482	40*	99	0.25	4.78	125	2387
									95	0.65	4.10	325	2047
									90	0.85	3.85	424	1922
									75	1.23	3.33	614	1663
		2-53	2-51 & 2-53	0	2278	16218	18496	131	99	3.91	11.20	9474	27137
									95	4.62	10.18	11194	24666
									90	5.02	9.73	12163	23576
									75	5.70	8.93	13811	21637
		2-54	2-54 & 2-55	0	0	10466	10466	40*	99	2.10	12.65	879	5296
									95	2.85	11.07	1193	4634
									90	3.30	10.35	1382	4333
									75	4.15	8.95	1737	3747
		2-55	2-54 & 2-55	0	0	8131	8131	170	99	2.10	12.65	2903	17486
									95	2.85	11.07	3939	15302
									90	3.30	10.35	4561	14306
									75	4.15	8.95	5736	12371
		2-56	2-56 & 2-57	0	0	17942	17942	40	99	0.07	1.65	50	1184

Year	Survey	PFM Subarea	Analysis Area	Skipped Transects	Shoreline Length - exposed (m)	Shoreline Length – protected (m)	Shoreline Length – total (m)	Mean weight (g)	Conf Level	Density LCB	Density UCB	Total Biomass (kg) LCB	Total Biomass (kg) UCB
									95	0.17	1.43	122	1026
									90	0.22	1.30	158	933
									75	0.35	1.10	251	789
		2-57	2-56 & 2-57	0	0	9996	9996	40*	99	0.07	1.65	28	660
									95	0.17	1.43	68	572
									90	0.22	1.30	88	520
									75	0.35	1.10	140	440
		2-58	2-58 & 2-59	0	100	14868	14968	79	99	2.12	11.53	2507	13634
									95	2.65	9.90	3134	11706
									90	3.04	9.06	3595	10713
									75	3.71	7.97	4387	9424
		2-59	2-58 & 2-59	0	175	15751	15926	120	99	2.12	11.53	4052	22035
									95	2.65	9.90	5064	18920
									90	3.04	9.06	5810	17315
									75	3.71	7.97	7090	15232
		2-60	2-60	0	10333	7643	17976	96	99	0.98	6.45	1691	11131
									95	1.27	5.62	2192	9698
									90	1.50	5.18	2589	8939
									75	1.93	4.53	3331	7817
	Chaahluu Kaahlui Rennell Sound	2-65	2-65	0	2492	21969	24461	114	99	1.73	10.15	4824	28304
									95	2.15	8.53	5995	23786
									90	2.35	7.93	6553	22113
									75	2.77	6.67	7724	18600
		2-68	2-68	23	0	3711	3711	73	99	1.50	8.34	406	2259
									95	2.32	7.59	628	2056

Year	Survey	PFM Subarea	Analysis Area	Skipped Transects	Shoreline Length - exposed (m)	Shoreline Length – protected (m)	Shoreline Length – total (m)	Mean weight (g)	Conf Level	Density LCB	Density UCB	Total Biomass (kg) LCB	Total Biomass (kg) UCB
									90	2.66	7.16	721	1940
									75	3.34	6.55	905	1774
		2-70	2-70 & 2-71	3	0	12077	12077	108	99	2.98	13.00	3887	16956
									95	3.95	11.55	5152	15065
									90	4.42	10.82	5765	14113
									75	5.27	9.75	6874	12717
		2-71	2-70 & 2-71	1	8764	2071	10835	199	99	2.98	13.00	6425	28030
									95	3.95	11.55	8517	24904
									90	4.42	10.82	9530	23330
									75	5.27	9.75	11363	21023
		2-73	2-73, 2-74 & 2-75	0	2705	0	2705	158	99	1.82	9.22	778	3941
									95	2.24	7.92	957	3385
									90	2.44	7.27	1043	3107
									75	2.93	6.33	1252	2705
		2-74	2-73, 2-74 & 2-75	0	1865	0	1865	73*	99	1.82	9.22	248	1255
									95	2.24	7.92	305	1078
									90	2.44	7.27	332	990
									75	2.93	6.33	399	862
		2-75	2-73, 2-74 & 2-75	0	28099	4593	32692	129	99	1.82	9.22	7675	38883
									95	2.24	7.92	9447	33401
									90	2.44	7.27	10290	30660
									75	2.93	6.33	12357	26695
		2-76	2-76	0	1334	18171	19505	147	99	1.77	10.00	5075	28672
									95	2.62	9.03	7512	25891
									90	3.02	8.60	8659	24658
									75	3.85	7.68	11039	22020

Year	Survey	PFM Subarea	Analysis Area	Skipped Transects	Shoreline Length - exposed (m)	Shoreline Length – protected (m)	Shoreline Length – total (m)	Mean weight (g)	Conf Level	Density LCB	Density UCB	Total Biomass (kg) LCB	Total Biomass (kg) UCB
		2-77	2-77	4	142	18100	18242	73*	99	0.00	1.07	0	1425
									95	0.14	0.93	186	1238
									90	0.16	0.86	213	1145
									75	0.27	0.75	360	999
		2-80	2-80 to 2-84	0	7526	0	7526	73*	99	2.59	9.43	1423	5181
									95	3.14	8.47	1725	4653
									90	3.50	7.94	1923	4362
									75	4.05	7.19	2225	3950
		2-81	2-80 to 2-84	1	1631	3156	4787	85	99	2.59	9.43	1054	3837
									95	3.14	8.47	1278	3446
									90	3.50	7.94	1424	3231
									75	4.05	7.19	1648	2926
		2-82	2-80 to 2-84	0	16112	637	16749	166	99	2.59	9.43	7201	26219
									95	3.14	8.47	8730	23549
									90	3.50	7.94	9731	22076
									75	4.05	7.19	11260	19991
		2-83	2-80 to 2-84	0	48	4992	5040	124	99	2.59	9.43	1619	5893
									95	3.14	8.47	1962	5293
									90	3.50	7.94	2187	4962
									75	4.05	7.19	2531	4493
		2-84	2-80 to 2-84	2	0	603	603	73*	99	2.59	9.43	114	415
									95	3.14	8.47	138	373
									90	3.50	7.94	154	350
									75	4.05	7.19	178	316

Table 7. Relative abundance of *stan · st'an* Pacific Geoduck (*Panopea generosa*), *gudangee · guuding.ngaay* Red Sea Urchins (*Mesocentrotus franciscanus*), *stuu · daws styuu* Green Sea Urchins (*Strongylocentrotus droebachiesnsis*), and for 2024 surveys *sk'áam i hlt'ahldaláa · naaw k'aanaas* Ga Sunflower Stars (*Pycnopodia helianthoides*) by PFM Subarea from surveys completed in 2023 to 2024. The relative abundance of each species observed while swimming the Sea Cucumber transect was assigned one of the following categories: Absent = 0 animals, Few = 1-10 animals, Many = 11-100 animals, Abundant = 101+ animals. Values reported in the Absent, Few, Many, and Abundant columns represent the percentage of PFM subarea transects in each abundance category. Total may not add up to 100% due to rounding.

Year	Survey	PFM Subarea	Completed Transects	Species	Absent	Few	Many	Abundant
2023	K'uuna Gwaay.yaay Louise Island	2-3	13	Pacific Geoduck	69%	23%	8%	0%
				Red Sea Urchins	69%	0%	8%	23%
				Green Sea Urchins	100%	0%	0%	0%
		2-4	13	Pacific Geoduck	92%	0%	8%	0%
				Red Sea Urchins	69%	23%	8%	0%
				Green Sea Urchins	77%	23%	0%	0%
		2-5	10	Pacific Geoduck	90%	10%	0%	0%
				Red Sea Urchins	40%	40%	0%	20%
				Green Sea Urchins	80%	20%	0%	0%
		2-6	61	Pacific Geoduck	82%	13%	5%	0%
				Red Sea Urchins	44%	20%	16%	20%
				Green Sea Urchins	67%	23%	10%	0%
2023	Gwaii Haanas	2-11	90	Pacific Geoduck	78%	16%	2%	3%
				Red Sea Urchins	13%	4%	7%	74%
				Green Sea Urchins	46%	18%	23%	12%
		2-13	23	Pacific Geoduck	74%	13%	0%	4%
				Red Sea Urchins	43%	13%	9%	26%
				Green Sea Urchins	83%	0%	9%	0%
2024	Gwaii Haanas	2-10	51	Pacific Geoduck	84%	8%	8%	0%
				Red Sea Urchins	24%	8%	18%	51%
				Green Sea Urchins	65%	18%	8%	10%
				Sunflower Stars	67%	4%	0%	2%
		2-15	39	Pacific Geoduck	69%	21%	5%	5%
				Red Sea Urchins	38%	5%	13%	44%
				Green Sea Urchins	49%	18%	26%	8%
				Sunflower Stars	97%	3%	0%	0%
	Kaysuun Kaahlíi Englefield Bay	2-51	4	Pacific Geoduck	75%	0%	25%	0%
				Red Sea Urchins	0%	0%	0%	100%
				Green Sea Urchins	0%	75%	25%	0%
				Sunflower Stars	100%	0%	0%	0%
		2-52	10	Pacific Geoduck	80%	10%	10%	0%

Year	Survey	PFM Subarea	Completed Transects	Species	Absent	Few	Many	Abundant
2024	Chaahluu Kaahlui Rennell Sound	2-53	10	Red Sea Urchins	50%	0%	20%	30%
				Green Sea Urchins	80%	10%	10%	0%
				Sunflower Stars	100%	0%	0%	0%
				Pacific Geoduck	50%	20%	0%	30%
				Red Sea Urchins	0%	0%	0%	100%
				Green Sea Urchins	40%	60%	0%	0%
				Sunflower Stars	100%	0%	0%	0%
		2-54	5	Pacific Geoduck	40%	40%	20%	0%
				Red Sea Urchins	20%	0%	20%	60%
				Green Sea Urchins	80%	20%	0%	0%
				Sunflower Stars	100%	0%	0%	0%
		2-55	5	Pacific Geoduck	80%	0%	20%	0%
				Red Sea Urchins	20%	0%	20%	60%
				Green Sea Urchins	80%	20%	0%	0%
				Sunflower Stars	100%	0%	0%	0%
		2-56	10	Pacific Geoduck	90%	0%	0%	10%
				Red Sea Urchins	70%	0%	20%	10%
				Green Sea Urchins	90%	0%	0%	10%
				Sunflower Stars	100%	0%	0%	0%
		2-57	5	Pacific Geoduck	80%	0%	20%	0%
				Red Sea Urchins	80%	0%	0%	20%
				Green Sea Urchins	100%	0%	0%	0%
				Sunflower Stars	100%	0%	0%	0%
		2-58	8	Pacific Geoduck	88%	12%	0%	0%
				Red Sea Urchins	25%	38%	0%	38%
				Green Sea Urchins	100%	0%	0%	0%
				Sunflower Stars	88%	12%	0%	0%
		2-59	9	Pacific Geoduck	89%	0%	0%	11%
				Red Sea Urchins	0%	11%	11%	78%
				Green Sea Urchins	78%	11%	0%	11%
				Sunflower Stars	100%	0%	0%	0%
		2-60	10	Pacific Geoduck	100%	0%	0%	0%
				Red Sea Urchins	0%	0%	0%	100%
				Green Sea Urchins	80%	20%	0%	0%
				Sunflower Stars	100%	0%	0%	0%
		2-65	15	Pacific Geoduck	93%	7%	0%	0%
				Red Sea Urchins	20%	7%	20%	53%
				Green Sea Urchins	87%	7%	7%	0%
				Sunflower Stars	100%	0%	0%	0%
		2-68	11	Pacific Geoduck	91%	9%	0%	0%

Year	Survey	PFM Subarea	Completed Transects	Species	Absent	Few	Many	Abundant
				Red Sea Urchins	9%	0%	18%	73%
				Green Sea Urchins	36%	36%	27%	0%
				Sunflower Stars	100%	0%	0%	0%
	2-70		8	Pacific Geoduck	50%	12%	0%	38%
				Red Sea Urchins	25%	12%	12%	50%
				Green Sea Urchins	88%	12%	0%	0%
				Sunflower Stars	100%	0%	0%	0%
	2-71		7	Pacific Geoduck	57%	0%	14%	29%
				Red Sea Urchins	14%	0%	0%	86%
				Green Sea Urchins	100%	0%	0%	0%
				Sunflower Stars	100%	0%	0%	0%
	2-73		2	Pacific Geoduck	100%	0%	0%	0%
				Red Sea Urchins	0%	0%	0%	100%
				Green Sea Urchins	50%	50%	0%	0%
				Sunflower Stars	100%	0%	0%	0%
	2-74		1	Pacific Geoduck	100%	0%	0%	0%
				Red Sea Urchins	0%	0%	0%	100%
				Green Sea Urchins	100%	0%	0%	0%
				Sunflower Stars	100%	0%	0%	0%
	2-75		21	Pacific Geoduck	76%	5%	10%	10%
				Red Sea Urchins	5%	0%	5%	90%
				Green Sea Urchins	81%	19%	0%	0%
				Sunflower Stars	95%	5%	0%	0%
	2-76		10	Pacific Geoduck	30%	20%	50%	0%
				Red Sea Urchins	20%	0%	30%	50%
				Green Sea Urchins	90%	10%	0%	0%
				Sunflower Stars	100%	0%	0%	0%
	2-77		11	Pacific Geoduck	73%	18%	9%	0%
				Red Sea Urchins	82%	0%	9%	9%
				Green Sea Urchins	100%	0%	0%	0%
				Sunflower Stars	100%	0%	0%	0%
	2-80		5	Pacific Geoduck	100%	0%	0%	0%
				Red Sea Urchins	0%	0%	0%	100%
				Green Sea Urchins	100%	0%	0%	0%
				Sunflower Stars	100%	0%	0%	0%
	2-81		4	Pacific Geoduck	50%	0%	25%	25%
				Red Sea Urchins	50%	0%	0%	50%
				Green Sea Urchins	100%	0%	0%	0%
				Sunflower Stars	100%	0%	0%	0%
	2-82		11	Pacific Geoduck	55%	9%	9%	27%

Year	Survey	PFM Subarea	Completed Transects	Species	Absent	Few	Many	Abundant
				Red Sea Urchins	0%	0%	9%	91%
				Green Sea Urchins	55%	36%	0%	9%
				Sunflower Stars	100%	0%	0%	0%
		2-83	4	Pacific Geoduck	50%	50%	0%	0%
				Red Sea Urchins	0%	0%	25%	75%
				Green Sea Urchins	50%	50%	0%	0%
				Sunflower Stars	100%	0%	0%	0%
		2-84	4	Pacific Geoduck	75%	25%	0%	0%
				Red Sea Urchins	100%	0%	0%	0%
				Green Sea Urchins	100%	0%	0%	0%
				Sunflower Stars	100%	0%	0%	0%

Table 8: Density categories indicate ranges of observed *yáanuu · ǵiinuu Sea Cucumber* densities as depicted on the *yáanuu · ǵiinuu Sea Cucumber* density maps (Figures 2-11). These ranges were chosen for their relevance to stock assessment benchmarks.

Density Category	Category Relevance
0	Absence of <i>yáanuu · ǵiinuu Sea Cucumbers</i>
0.01-1.90	Regional baseline for West Coast Vancouver Island is 1.90 c/m-sh
1.91-2.50	Commercial opening threshold is 2.50 c/m-sh
2.51-4.10	Regional baseline for East Coast Vancouver Island is 4.10 c/m-sh
4.11-6.00	Regional baseline for North Coast and Central Coast is 6.00 c/m-sh
6.01-10.00	Arbitrary cut-off
10.01-map maximum	Indicates the maximum density observed for each map

Table 9. *Yáanu · Giinuu Sea Cucumber* biomass estimates from surveys conducted from 2023 to 2024 using equation 1 shown in Methods → Data Analysis → Biomass Estimates (i.e., applying the default 2.50 c/m-sh to the exposed shoreline, if the survey density estimate was higher) and equation 2 in Methods → Data Analysis → Biomass Estimates (i.e., applying the survey density to all the exposed shoreline), and the percent difference (% diff) between the two estimates.

Survey	PFM Subarea	Analysis Area	Total Shoreline Length (m)	Exposed Shoreline Length (m)	% Exposed Shoreline	Density 90 %LCB (c/m-sh)	Equation 1 Total Biomass (kg) LCB	Equation 2 Total Biomass (kg) LCB	% Difference between Eq 1 and Eq 2
<i>K'uuna</i>	2-3	2-3	28008	700	2	0.67	4435	4435	0
<i>Gwaay.yaay</i>	2-4	2-4	36846	0	0	0.27	1144	1144	0
<i>Louise Island</i>	2-5	2-5	24993	0	0	3.67	10548	10548	0
	2-6	2-6	136704	405	0	3.67	157887	158037	0
Gwaii Haanas	2-10	2-10	105,716	11299	11	8.38	203167	219636	7
	2-11	2-11	187363	60460	32	5.74	199663	244130	18
	2-13	2-13	56363	1205	2	9.25	98026	99579	2
	2-15	2-15	80756	11720	15	10.97	173813	195746	11
<i>Kaysuun</i>	2-51	2-51 & 2-53	5460	5023	92	5.02	2670	4961	46
<i>Kaahlíi</i>	2-52	2-52	12482	1087	9	0.85	424	424	0
Englefield Bay	2-53	2-51 & 2-53	18496	2278	12	5.02	11411	12163	6
	2-54	2-54 & 2-55	10466	0	0	3.3	1382	1382	0
	2-55	2-54 & 2-55	8131	0	0	3.3	4561	4561	0
	2-56	2-56 & 2-57	17942	0	0	0.22	158	158	0
	2-57	2-56 & 2-57	9996	0	0	0.22	88	88	0
	2-58	2-58 & 2-59	14968	100	1	3.04	3590	3595	0
	2-59	2-58 & 2-59	15926	175	1	3.04	5798	5810	0
	2-60	2-60	17976	10333	57	1.5	2589	2589	0
<i>Chaahluu</i>	2-65	2-65	24461	2492	10	2.35	6553	6553	0
<i>Kaahlíi</i>	2-68	2-68	3711	0	0	2.66	721	721	0
Rennell Sound	2-70	2-70 & 2-71	12077	0	0	4.42	5765	5765	0
	2-71	2-70 & 2-71	10835	8764	81	4.42	6182	9530	35
	2-73	2-73, 2-74 & 2-75	2705	2705	100	2.44	1043	1043	0

2-74	2-73, 2-74 & 2-75	1865	1865	100	2.44	332	332	0
2-75	2-73, 2-74 & 2-75	32692	28099	86	2.44	10290	10290	0
2-76	2-76	19505	1334	7	3.02	8557	8659	1
2-77	2-77	18242	142	1	0.16	213	213	0
2-80	2-80 to 2-84	7526	7526	100	3.5	1373	1923	29
2-81	2-80 to 2-84	4787	1631	34	3.5	1285	1424	10
2-82	2-80 to 2-84	16749	16112	96	3.5	7057	9731	27
2-83	2-80 to 2-84	5040	48	1	3.5	2181	2187	0
2-84	2-80 to 2-84	603	0	0	3.5	154	154	0

FIGURES

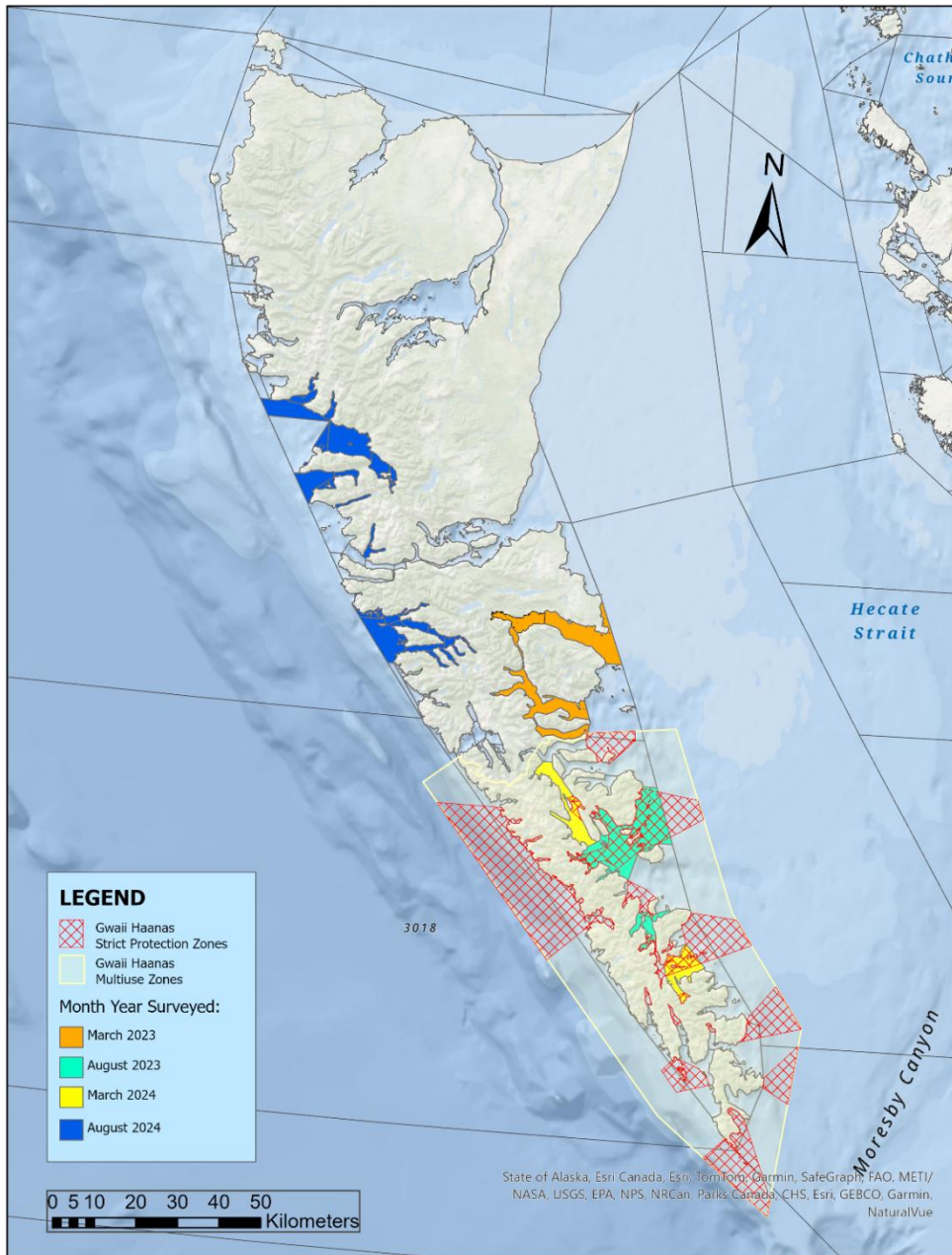


Figure 1. Locations of Gwaii Haanas Strict Protection Zones, Gwaii Haanas Multiple Use Zones, and *yáanuu · giinuu* Sea Cucumber survey locations, months and years, conducted in Haida Gwaii in 2023 and 2024. Biomass surveys were conducted in *Hl'kinul Kaahlíi Cumshewa* and *Tlín Suu Selwyn Inlets* (PFMA 2-3, 2-4, 2-5 and 2-6) in March 2023, in portions of Gwaii Haanas including *Gandaawuu.ngaay Xyangs Juan Perez Sound* (PFMA 2-11) and *GaysiiGas K'iidsii Burnaby Strait* (PFMA 2-13) in August 2023, in portions of Gwaii Haanas including *K'ing.gii Kaahlíi Darwin Sound* (PFMA 2-10) and *Sk'in Kaahlíi Skincuttle Inlet* (PFMA 2-15) in March 2024, and in portions of *Duu Guusd West Coast Haida Gwaii* including *Chaahluu Kaahlíi Rennell Sound* (PFMA 2-65, 2-68, 2-70 to 2-77, 2-80 to 2-84) and *Kaysuun Kaahlíi Englefield Bay* (PFMA 2-51 to 2-60) in August 2024.

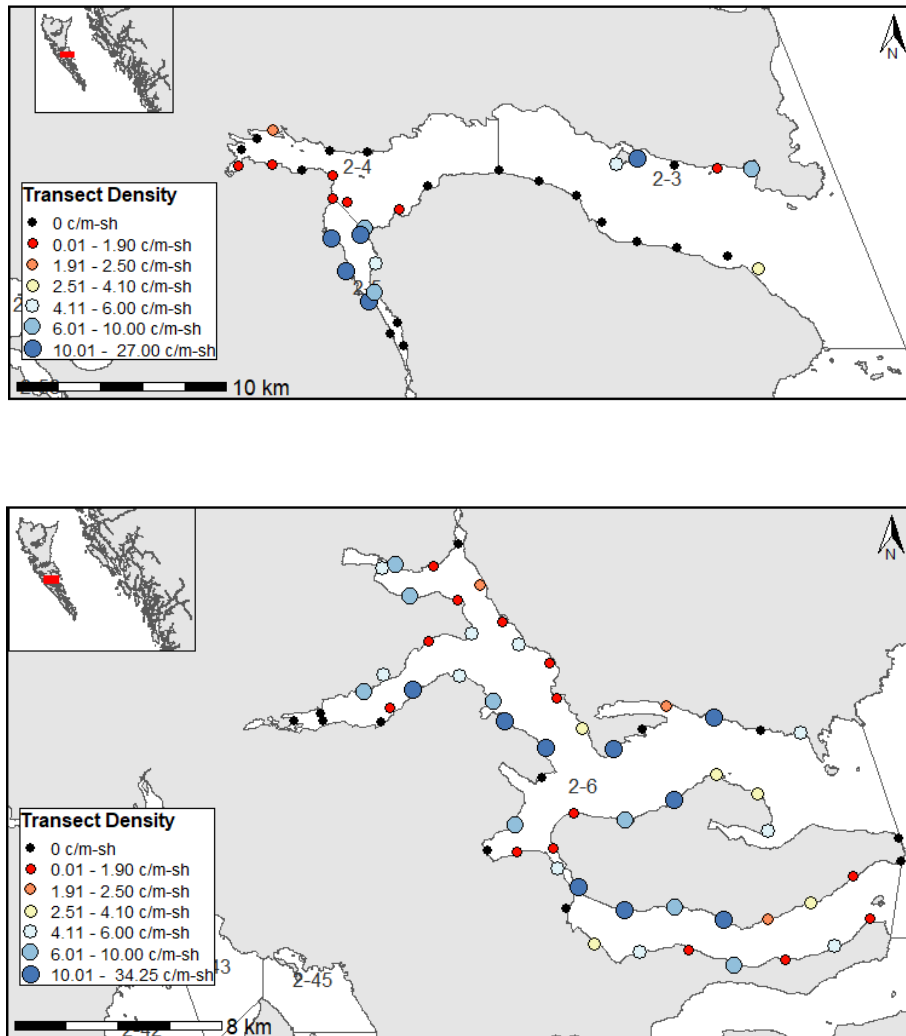


Figure 2. 90% LCB of the linear mean density (*yáanuu · ǵiinuu* Sea Cucumbers per metre of shoreline; c/m-sh), of adult *yáanuu · ǵiinuu* Sea Cucumbers in PFMA 2-3, 2-4, 2-5, and 2-6, surveyed as part of *K'uuna Gwaay.yaay* Louise Island survey (see survey location in upper left corner) in March 2023. Each dot indicates the position of surveyed transects and scaled symbols for density (Table 8).

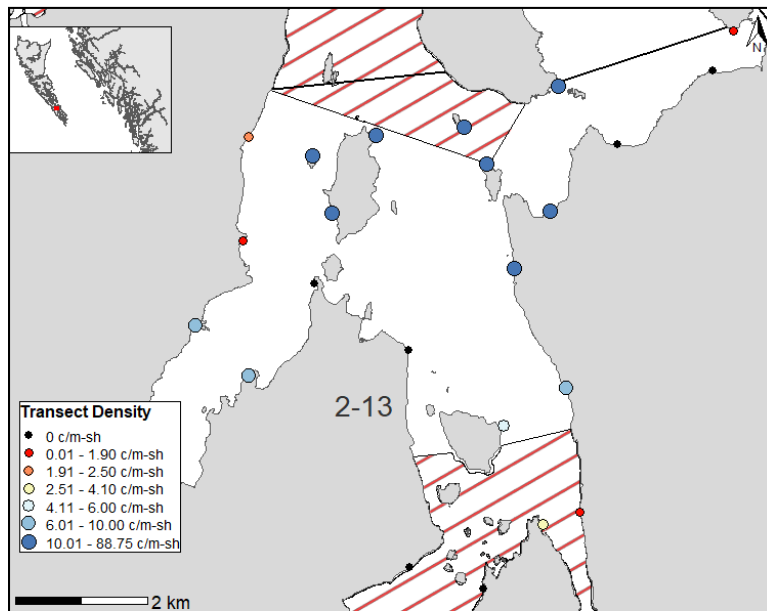
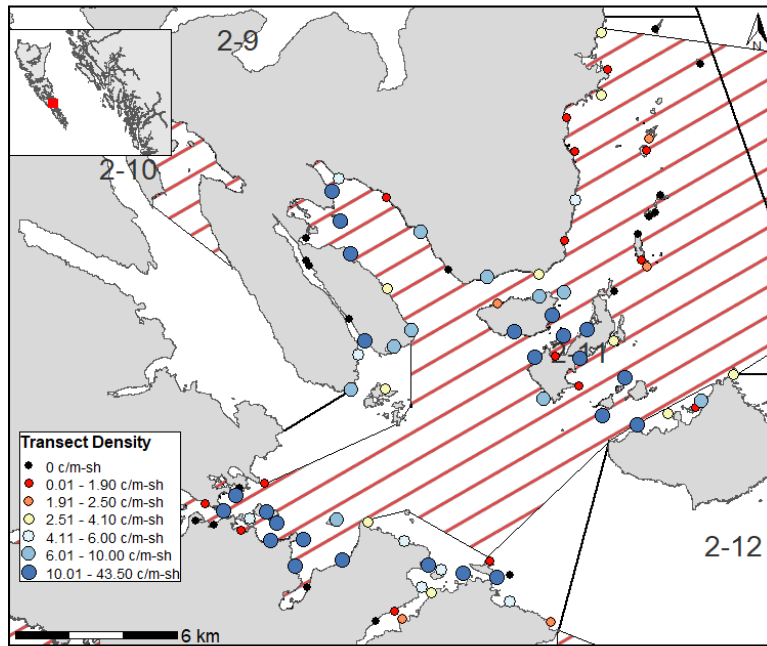


Figure 3. 90% LCB of the linear mean density (*yáanu* · *giinu* Sea Cucumbers per metre of shoreline; c/m-sh), of adult *yáanu* · *giinu* Sea Cucumbers in PFMA 2-11 (*Gandaawuu.ngaay Xyangs Juan Perez Sound*) and 2-13 (*GaysiiGas K'iidsii Burnaby Strait*), surveyed as part of the Gwaii Haanas survey in August 2023 (see survey location in upper left corner). Each dot indicates the position of surveyed transects and scaled symbols for density (Table 8). The red hatched polygons show the Gwaii Haanas Strict Protection Zones.

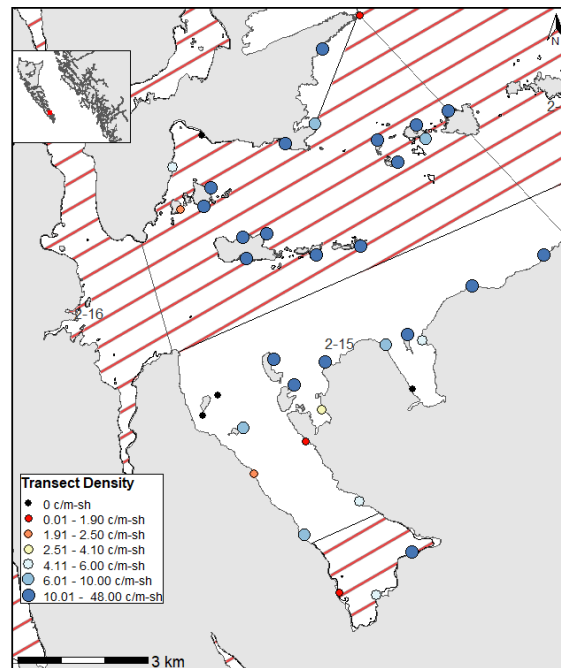
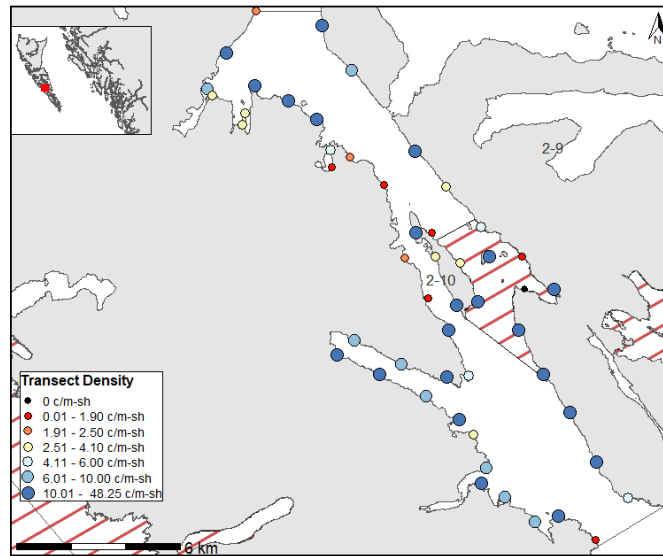


Figure 4. 90% LCB of the linear mean density (*yáanuu* · *giinuu* Sea Cucumbers per metre of shoreline; c/m-sh), of adult *yáanuu* · *giinuu* Sea Cucumbers in PFMA 2-10 and 2-15, surveyed as part of the Gwaii Haanas, 2-10 (*K'ing.gii Kaahlíi Darwin Sound*) and 2-15 (*Sk'in Kaahlíi Skincuttle Inlet*), (see survey location in upper left corner) in March 2024. Each dot indicates the position of surveyed transects and scaled symbols for density (Table 8). The red hatched polygons show the Gwaii Haanas Strict Protection Zones.

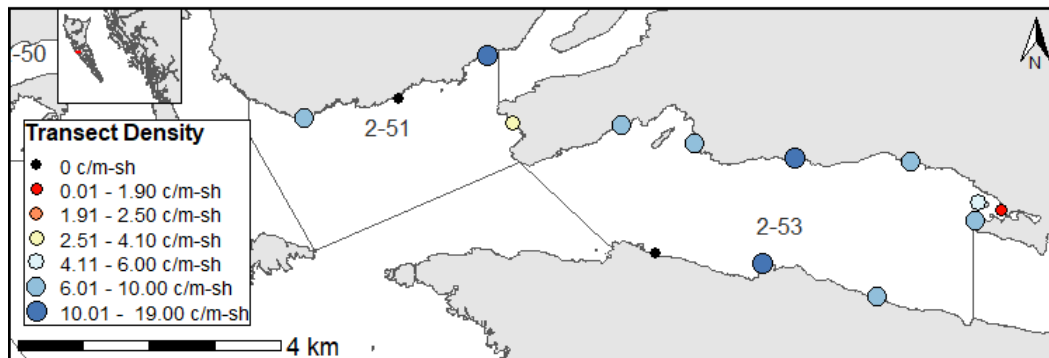
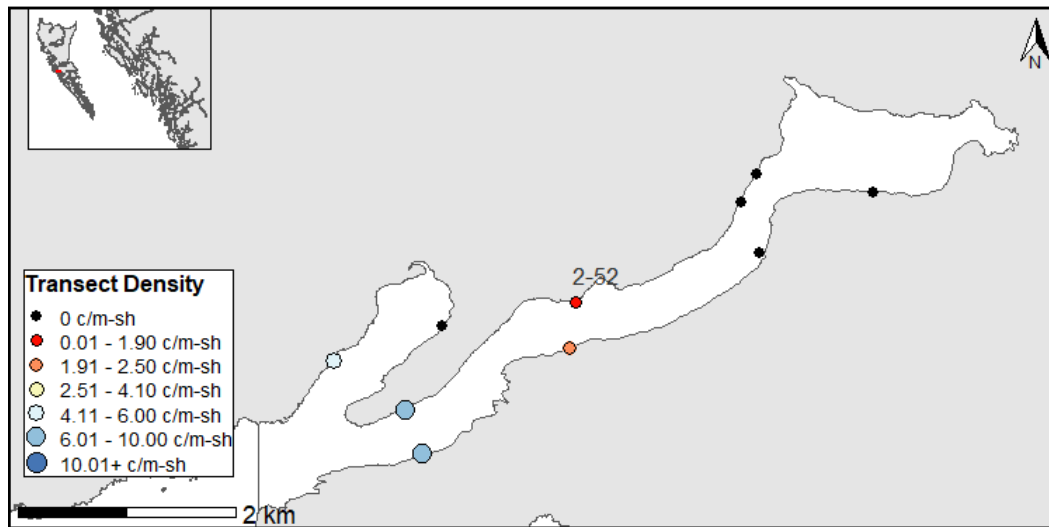


Figure 5. 90% LCB of the linear mean density (*yáanu · giinu Sea Cucumbers* per metre of shoreline; c/m-sh), of adult *yáanu · giinu Sea Cucumbers* in PFMA 2-51, 2-52, and 2-53, surveyed as part of the *Kaysuun Kaahlíi Englefield Bay* survey (see survey location in upper left corner) in August 2024. Each dot indicates the position of surveyed transects and scaled symbols for density (Table 8).

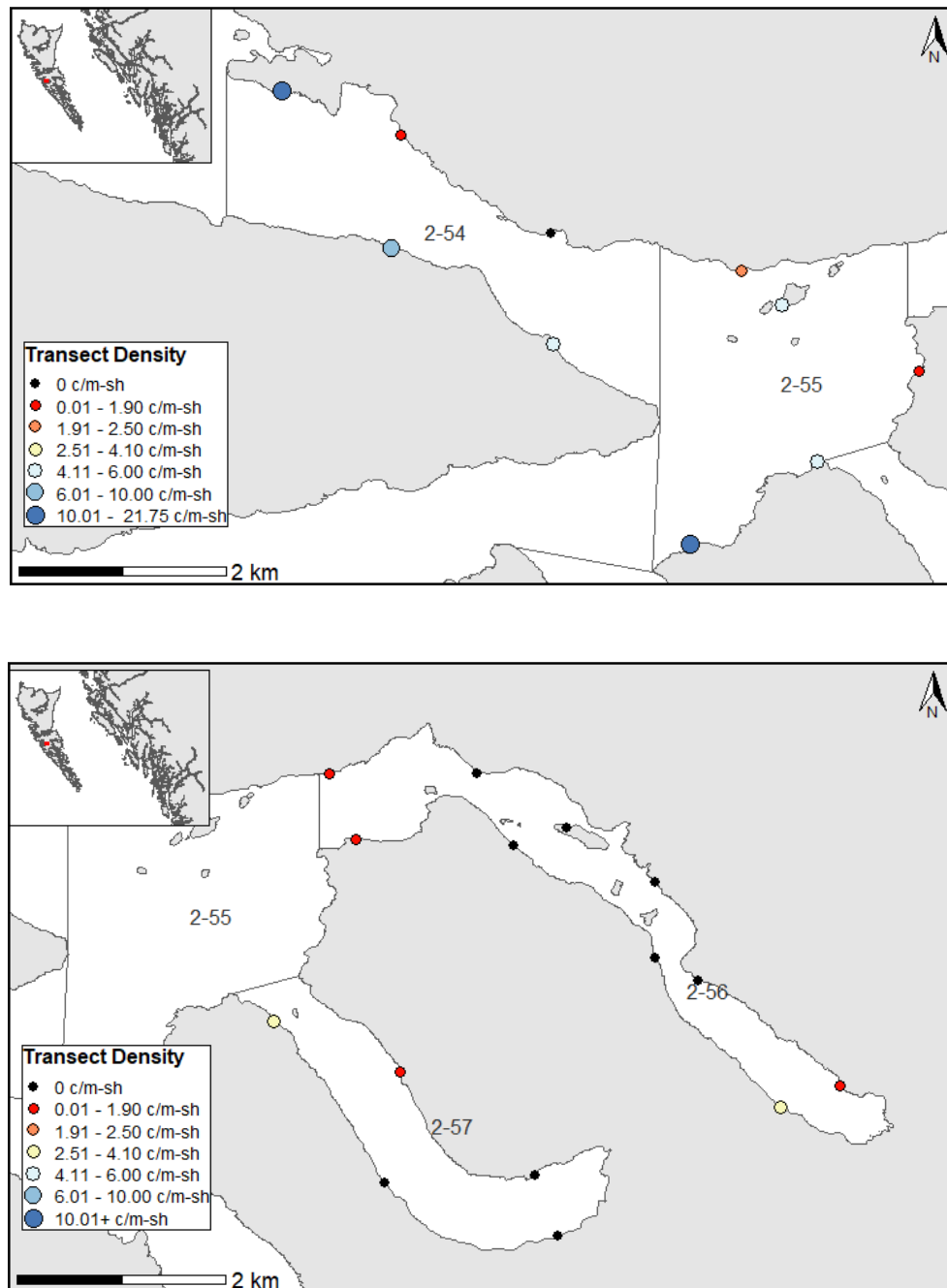


Figure 6. 90% LCB of the linear mean density (*yáanu* · *giinu* *Sea Cucumbers* per metre of shoreline; c/m-sh), of adult *yáanu* · *giinu* *Sea Cucumbers* in PFMA 2-54, 2-55, 2-56, and 2-57, surveyed as part of the *Kaysuun Kaahlii Englefield Bay* survey (see survey location in upper left corner) in August 2024. Each dot indicates the position of surveyed transects and scaled symbols for density (Table 8).

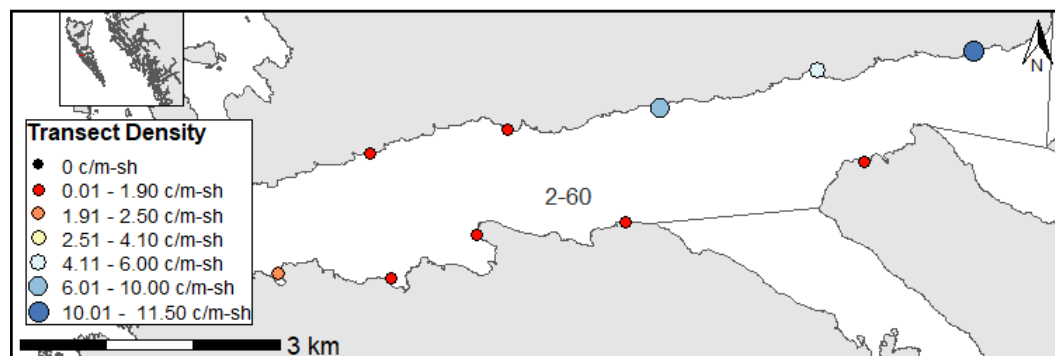
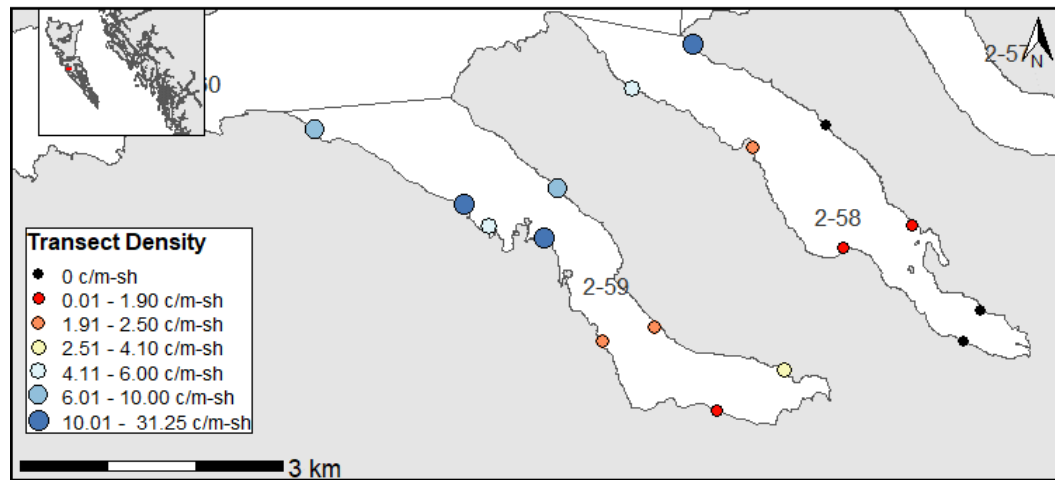


Figure 7. 90% LCB of the linear mean density (yáanu · ġiinuu Sea Cucumbers per metre of shoreline; c/m-sh), of adult yáanu · ġiinuu Sea Cucumbers in PFMA 2-58, 2-59, and 2-60, surveyed as part of the Kaysuun Kaahlíi Englefield Bay survey (see survey location in upper left corner) in August 2024. Each dot indicates the position of surveyed transects and scaled symbols for density (Table 8).

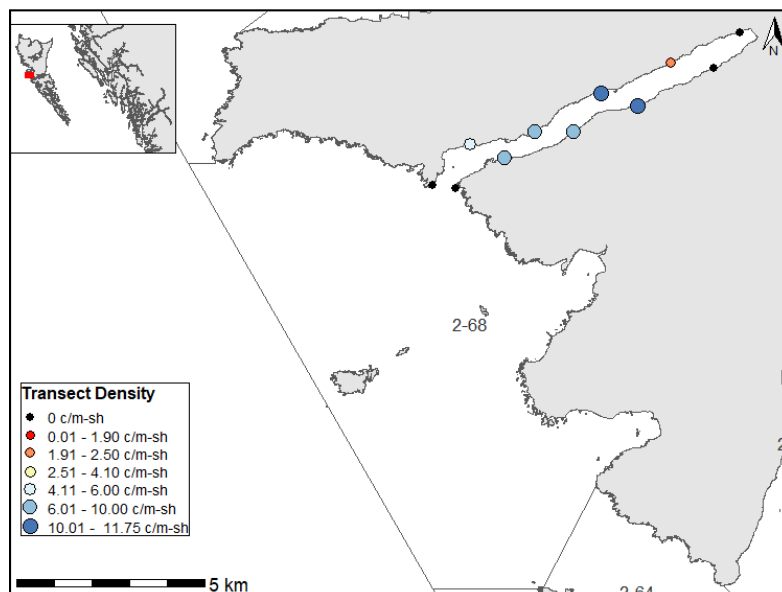
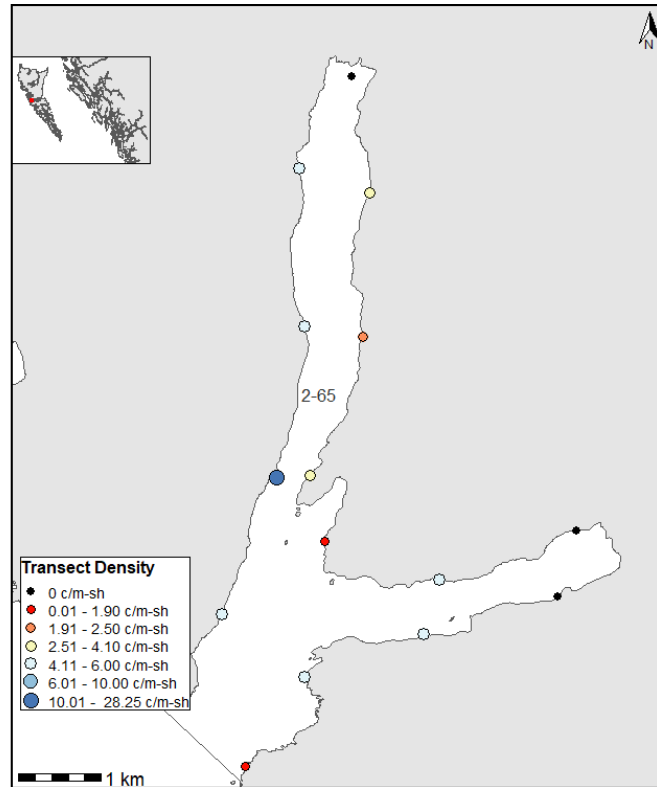


Figure 8. 90% LCB of the linear mean density (yáanuu · ġiinuu Sea Cucumbers per metre of shoreline; c/m-sh), of adult yáanuu · ġiinuu Sea Cucumbers in PFMA 2-65 and 2-68, surveyed as part of the Chaahluu Kaahlii Rennell Sound survey (see survey location in upper left corner) in August 2024. Each dot indicates the position of surveyed transects and scaled symbols for density (Table 8).

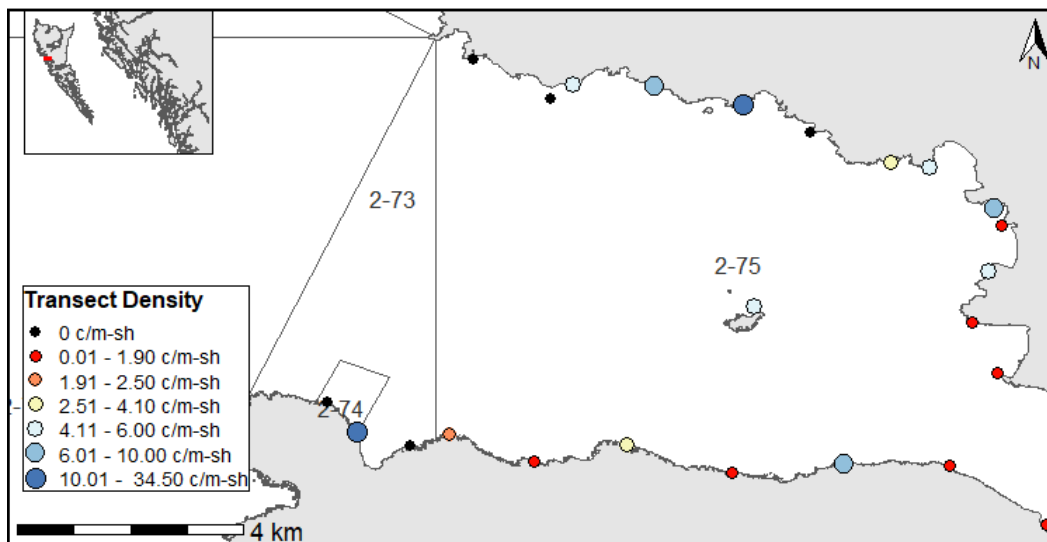
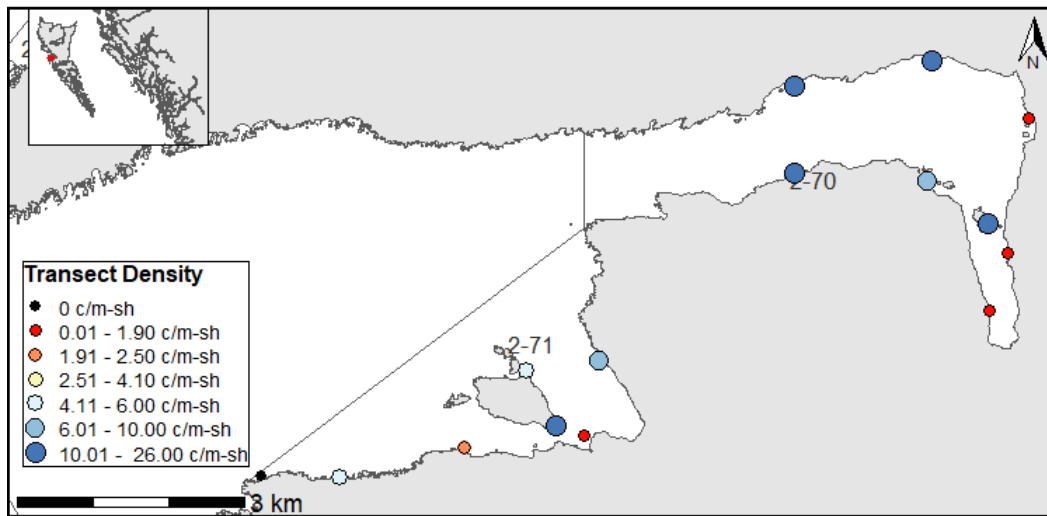


Figure 9. 90% LCB of the linear mean density (yáanuu · ġiinuu Sea Cucumbers per metre of shoreline; c/m-sh), of adult yáanuu · ġiinuu Sea Cucumbers in PFMA 2-70, 2-71, 2-72, 2-73, 2-74, and 2-75, surveyed as part of the Chaahluu Kaahlii Rennell Sound survey (see survey location in upper left corner) in August 2024. Each dot indicates the position of surveyed transects and scaled symbols for density (Table 8).

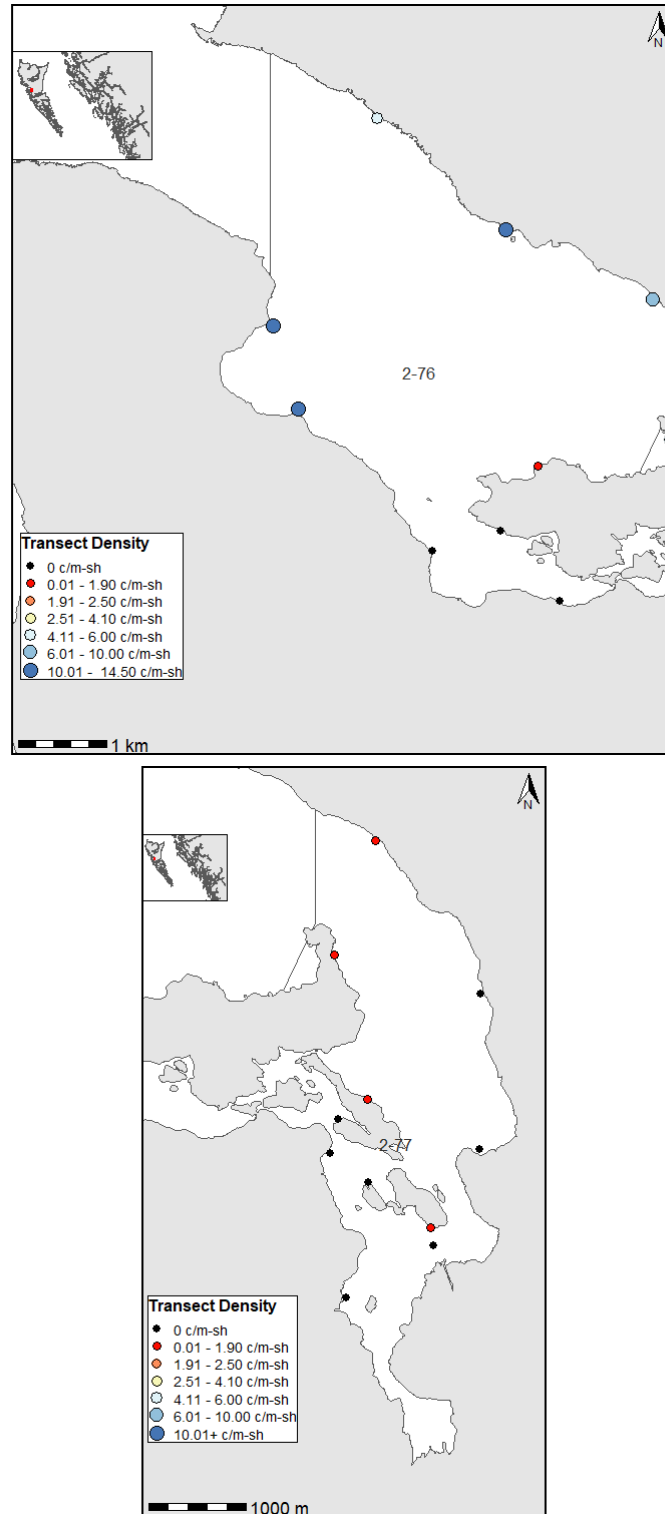


Figure 10. 90% LCB of the linear mean density (yáanu · ġiinu Sea Cucumbers per metre of shoreline; c/m-sh), of adult yáanu · ġiinu Sea Cucumbers in PFMA 2-76 and 2-77, surveyed as part of the Chaahluu Kaahlii Rennell Sound survey (see survey location in upper left corner) in August 2024. Each dot indicates the position of surveyed transects and scaled symbols for density (Table 8).

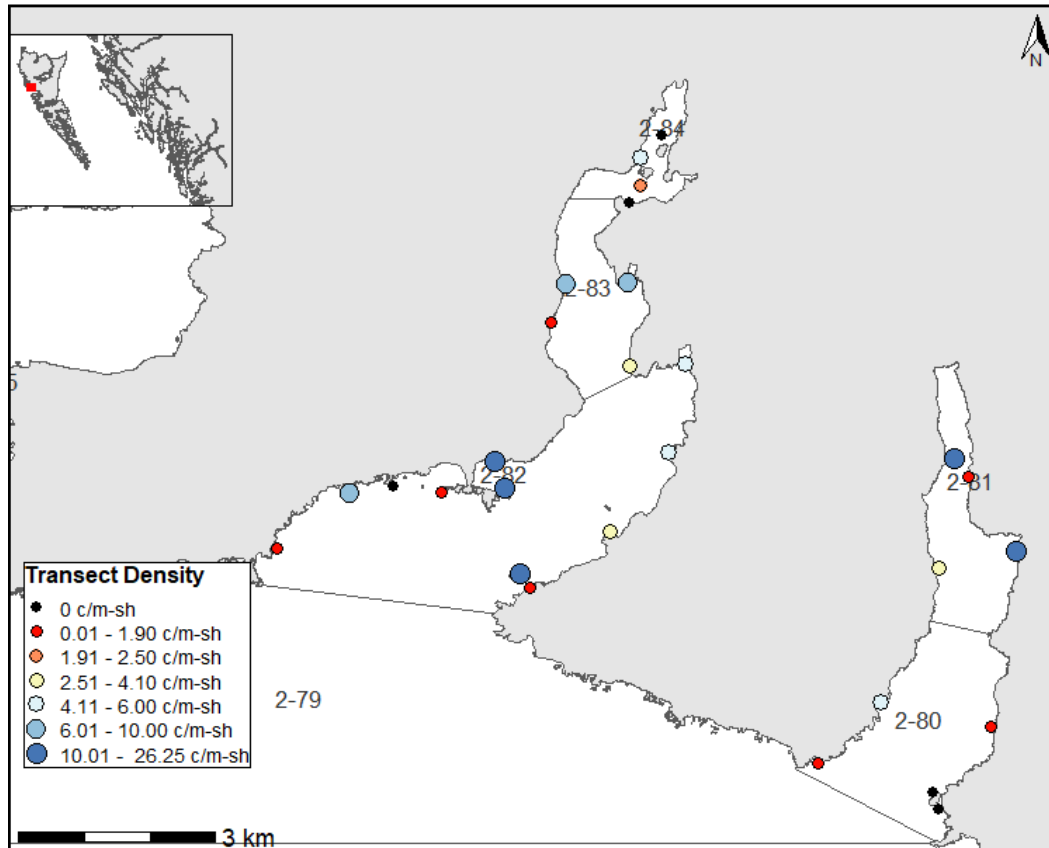


Figure 11. 90% LCB of the linear mean density (*yáanuu* · *giinuu* Sea Cucumbers per metre of shoreline; c/m-sh), of adult *yáanuu* · *giinuu* Sea Cucumbers in PFMA 2-80, 2-81, 2-83, and 2-84, surveyed as part of the *Chaahluu Kaahlili Rennell Sound* survey (see survey location in upper left corner) in August 2024. Each dot indicates the position of surveyed transects and scaled symbols for density (Table 8).

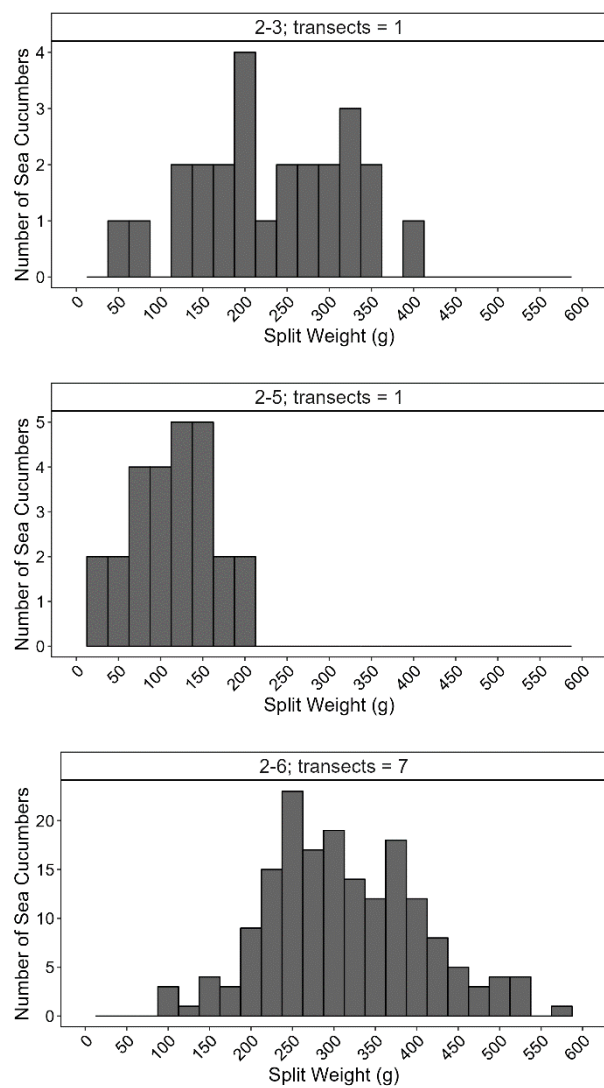


Figure 12. Split weight (grams) histograms and number of transects sampled (n) for *yáanuu · Giinuu* Sea Cucumbers biosamples from Pacific Fishery Management Subareas 2-3, 2-5, and 2-6 (transects = number of transects sampled).

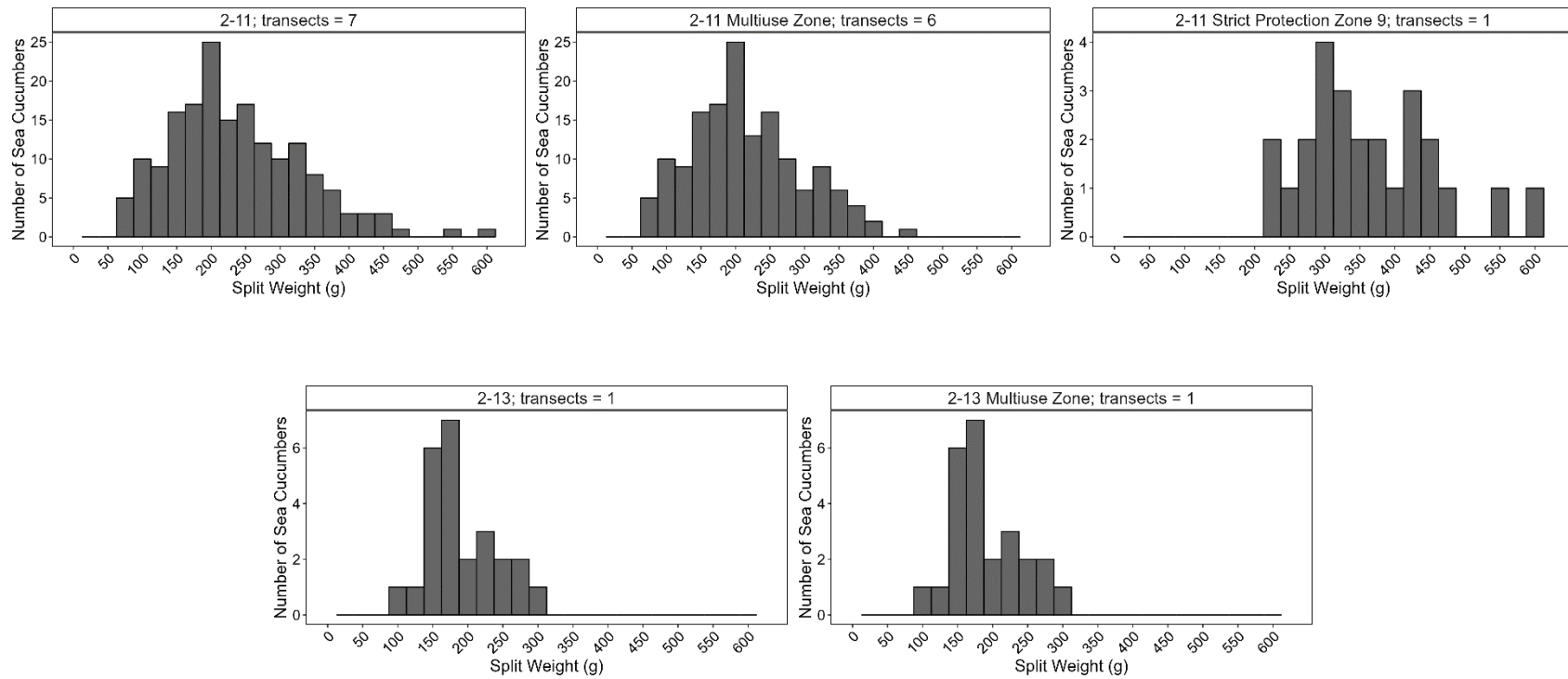


Figure 13. Split weight (grams) histograms and number of transects sampled for *yáanuu · ǵiĩnuu* Sea Cucumber biosamples from Pacific Fishery Management Subareas 2-11, 2-11 Gwaii Haanas Multiple Use Zone, 2-11 Strict Protection Zone 9, 2-13, and 2-13 Gwaii Haanas Multiple Use Zone.

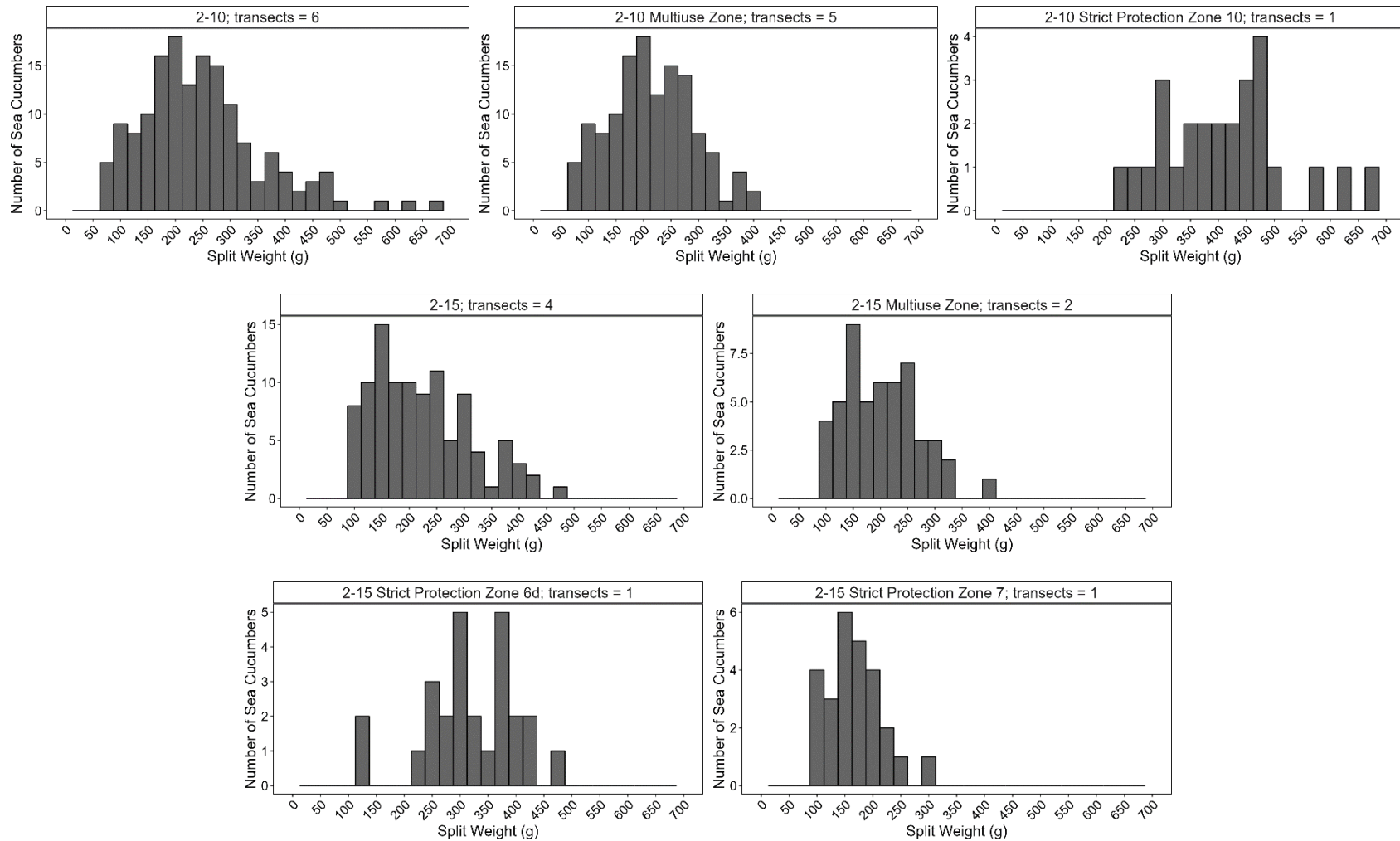


Figure 14. Split weight (grams) histograms and number of transects sampled for *yáanuu · ġiinuu Sea Cucumber* biosamples from Pacific Fishery Management Subareas 2-10, 2-10 Gwaii Haanas Multiple Use Zone, 2-10 Strict Protection Zone 10, 2-15, 2-15 Gwaii Haanas Multiple Use Zone, 2-15 Strict Protection Zone 6d and 2-15 Strict Protection Zone 7.

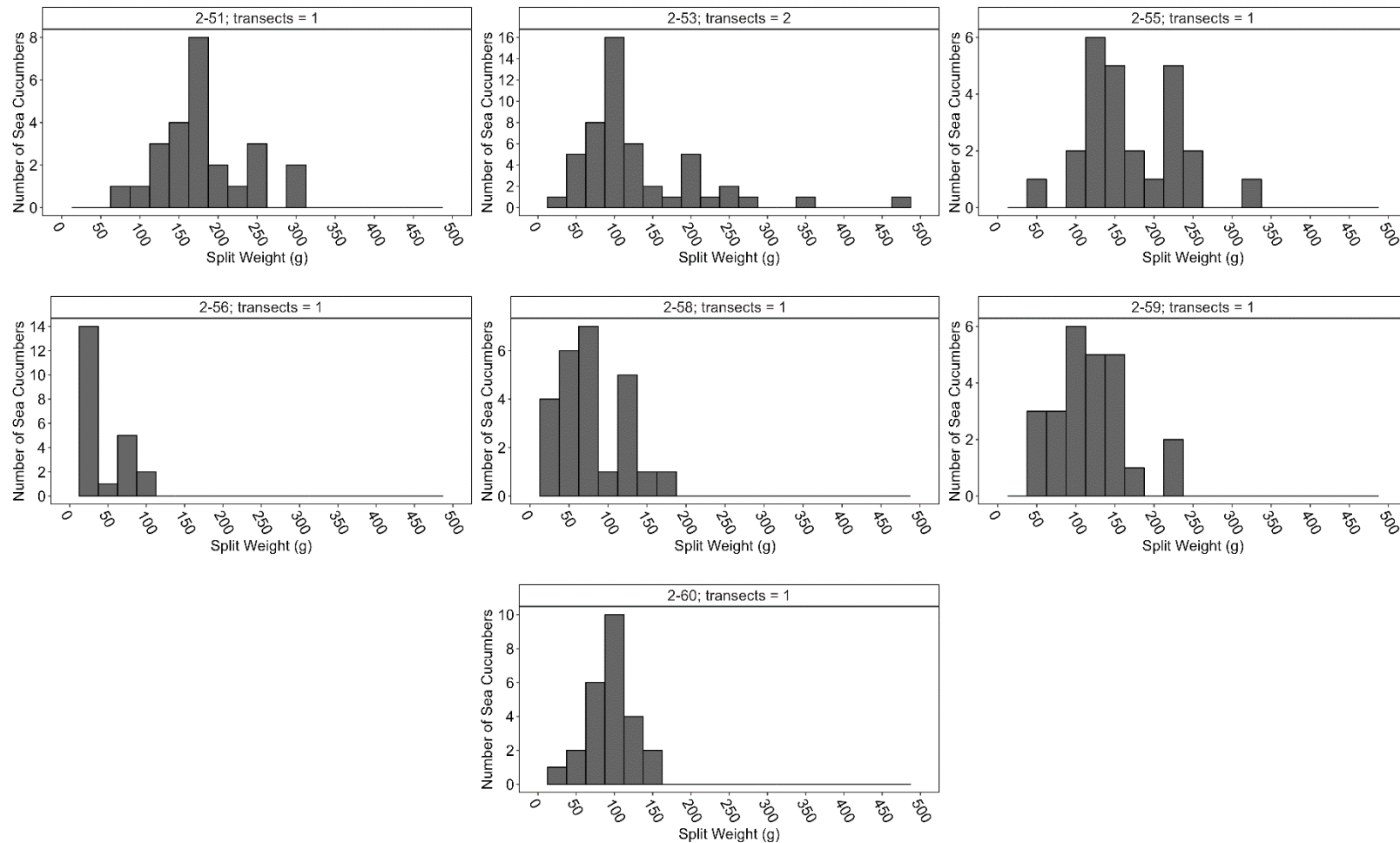


Figure 15. Split weight (grams) histograms and number of transects sampled for [yáanuu · ǵiinuu](#) *Sea Cucumber* biosamples from Pacific Fishery Management Subareas 2-51, 2-53, 2-55, 2-56, 2-58, 2-59, and 2-60 (i.e. [Kaysuun Kaahlíi](#) Englefield Bay).

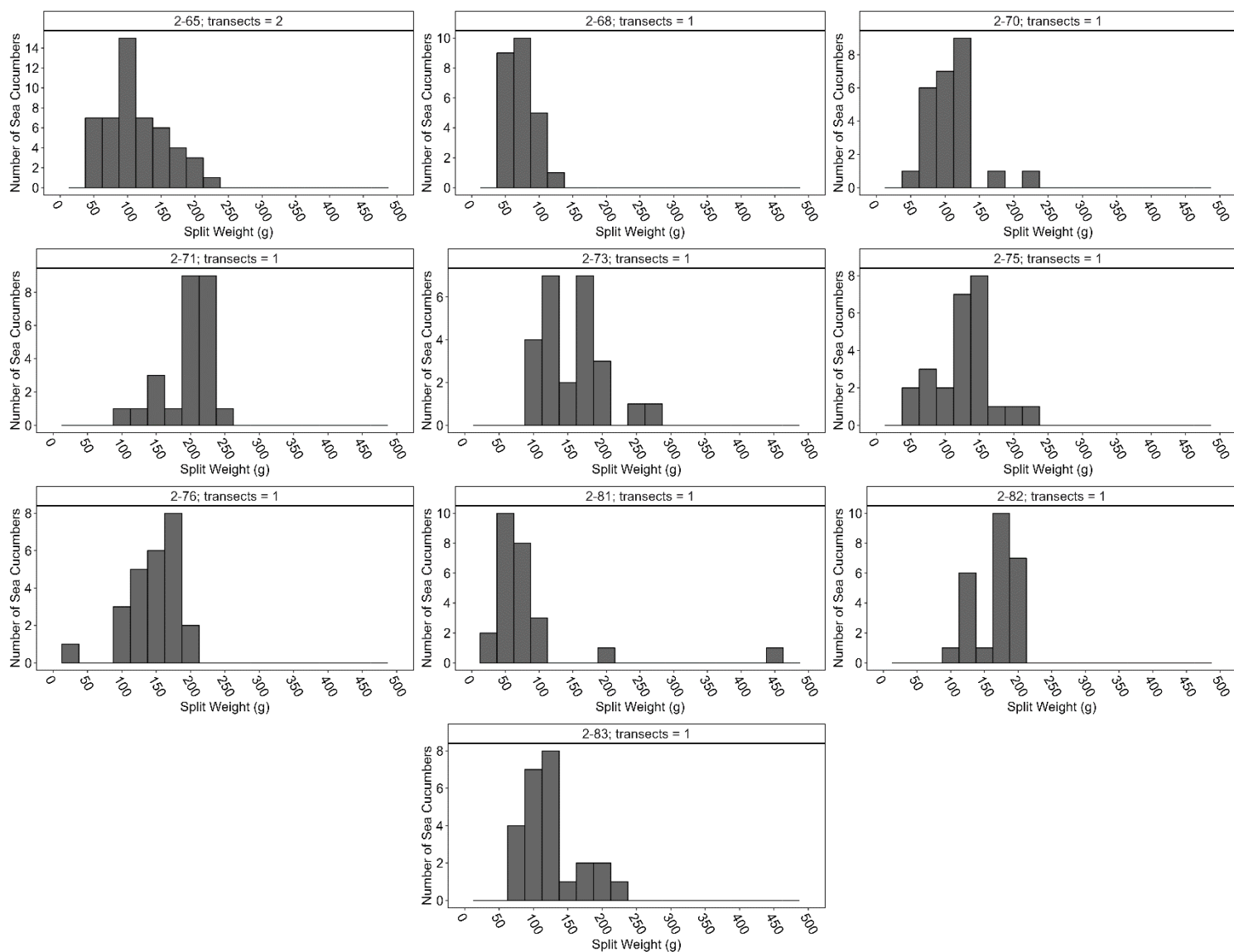


Figure 16. Split weight (grams) histograms and number of transects sampled for *yáanu · ǵiinuu* Sea Cucumber biosamples from Pacific Fishery Management Subareas 2-65, 2-68, 2-70, 2-71, 2-73, 2-75, 2-76, 2-81, 2-82, and 2-83 (i.e., *Chaahluu Kaahlíi* Rennell Sound).