

Appendix 10: Draft Dataset description – MRC Kayak

Puget Sound Vital Signs Floating kelp canopy area indicator: dataset description

Marine Resource Committees volunteer kayak monitoring (MRC-Kayak)
Last updated: May 23, 2022

1. Introduction

In 2020, the Puget Sound Partnership added a new *floating kelp canopy area* indicator to the [Puget Sound Vital Signs](#), in recognition that kelp forests are foundations for diverse and productive ecosystems. The indicator fills gaps in scientific information about the condition of floating kelp canopies. It also serves as a communications tool for sharing information with the public.

Floating kelp canopy area indicator results will be available on [Puget Sound Info – Vital Signs](#) in June 2023. Detailed indicator information will be available on the [Puget Sound Floating Kelp Hub Site](#).

Summarized indicator results will be presented on the web sites in a format targeted for broad audiences. In addition, three types of technical documents describe the indicator in detail: (1) indicator assessment procedures (Chapter 2 of the Phase 2 report), (2) sub-basin reports, (3) dataset descriptions which can be found on the [Puget Sound Floating Kelp Hub Site](#).

The purpose of dataset descriptions is to provide key information about datasets that are synthesized in the floating kelp canopy area indicator, including considerations related to dataset integration. Dataset descriptions are not meant to replace detailed metadata, which is available directly from the data owners/maintainers (links below).

This document describes the [Marine Resource Committees volunteer kayak monitoring](#) (Figure 1).

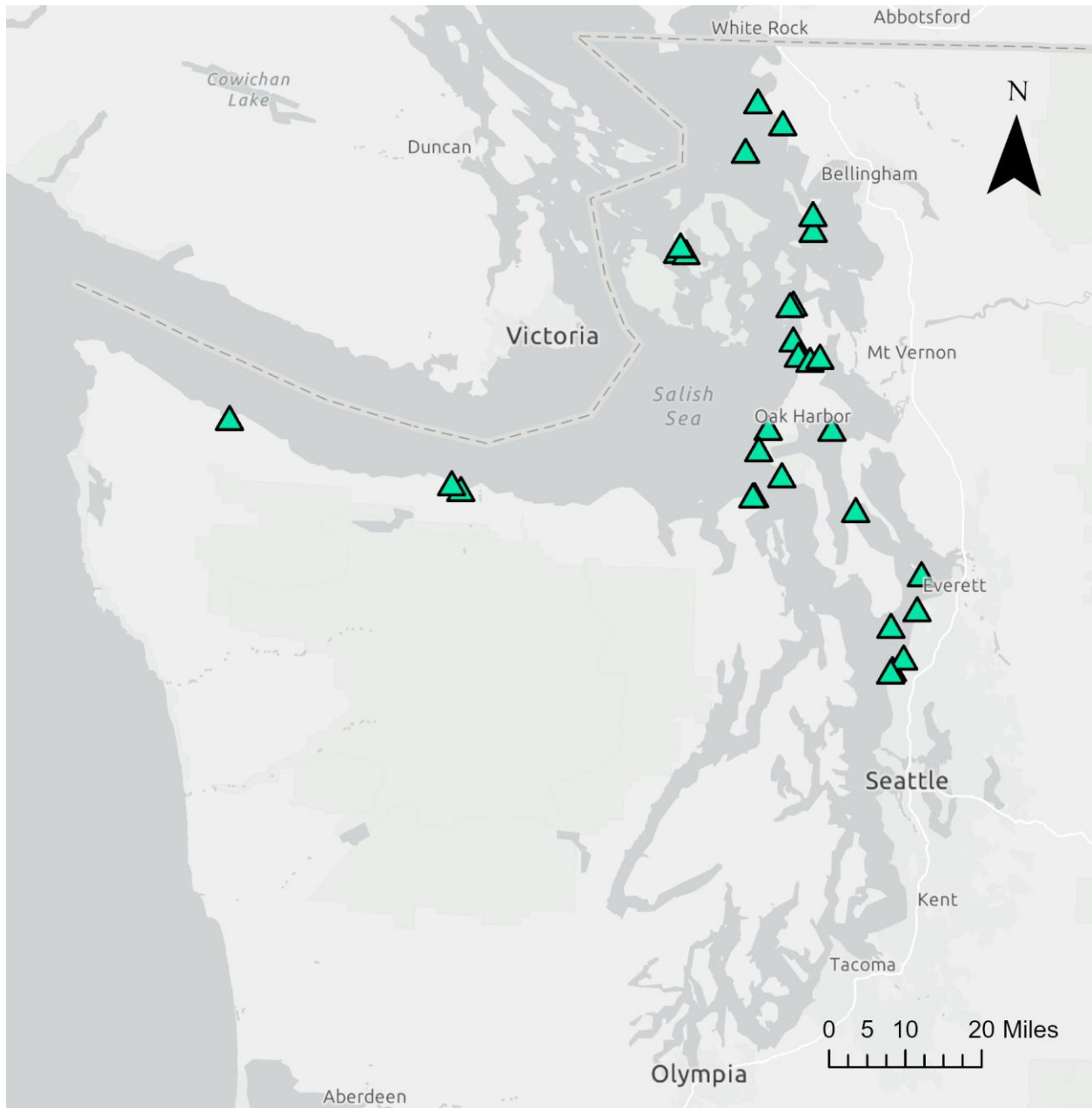


Figure 1. Map of Puget Sound with the MRC kayak monitoring sites represented as green triangles.

2. Dataset description

2.1 Summary

Volunteers with Marine Resources Committees (MRCs) and Northwest Straits Commission (NWSC) began surveying floating kelp beds in 2015 and in subsequent years have now surveyed beds in all seven counties in northern Washington (Clallam, Island, Skagit, Jefferson, San Juan, Snohomish, Whatcom).

Volunteers follow a kayak-based survey protocol to record the perimeter of floating kelp canopies with handheld GPS units at select sites.

The MRC site surveys range in temporal coverage. For this analysis we selected survey sites that had at least five years of data. Notably, some locations have multiple kelp “sites” that are surveyed. At some sites, volunteers survey kelp beds multiple times in a season, so only maximum observed extent per year is used in our analyses. Using these criteria, 17 sites were selected for use in indicator development.

2.2 Description

Spatial Extent:	Seven northern counties in Puget Sound that are within the Northwest Straits Initiative (Clallam, Island, Skagit, Jefferson, San Juan, Snohomish, Whatcom).
Metric(s)	Initial: bed perimeter (polygons) from locations with five or more years of surveys
Assessment Units	Multi-year monitoring sites, most sites are at the approximate scale of 1 km of shoreline (17 locations have been identified as of May 2022, a consolidation of 42 locations where volunteers have conducted kayak surveys)
Survey years	2015 – 2021 total, many sites span a subset of years.
Frequency	Annual
Methods summary	<p>Kayak-based delineation of bed perimeter with handheld GPS. Minimum thresholds for inclusion: canopy width > 5 m. Maximum distance among individuals (fronds or bulbs) for inclusion: 8 m between individuals (Bishop 2014, updated 2020).</p> <p>Volunteers collect data on additional parameters such as water temperature and kelp bed depth as well as visual observations and photo documentation following the monitoring protocol developed by the Northwest Straits</p>

	<p>Commission (NWSC) with guidance from scientists. The data are collected by volunteer kayakers and members of the Marine Resources Committees (MRCs). Datasets are available through the NWSC and individual MRCs. NWSC and MRC web sites:</p> <ul style="list-style-type: none"> - NWSC Kelp Monitoring - Clallam County - Island County - Jefferson County - San Juan County - Skagit County - Snohomish County - Whatcom County
Access	<p>All survey data are maintained by the Northwest Straits Commission and visible on SoundIQ. GPS data is available for download through SoundIQ or directly contacting the NWSC.</p> <p>The ArcGIS Online feature service is available at: https://www.arcgis.com/home/item.html?id=762bb0b250a64b519d67f0f6b123dba6</p> <p>Please contact the NWSC GIS Specialist (Suzanne Shull; sshull@padillabay.gov) or the Marine Program Manager (Dana Oster; oster@nwstraits.org) for questions or data inquires.</p> <p>MRC kayak protocol is available at: https://www.nwstraits.org/media/2937/kelp-protocol-may-2020-revised.pdf</p>

2.3 Considerations for integration in the Floating Kelp Canopy indicator

Kayak based kelp area surveys provide relatively high resolution data on kelp bed area at sites. The bed area estimate is the primary parameter considered in indicator analysis.

Research has shown that environmental factors affect the extent of visible floating kelp canopies (Britton Simmons et al, 2008). So, sea-state, tide height, and current stage are considered during data interpretation.

2.3.1 Determining data to include in VS

The MRC kelp dataset includes data from a variety of sites with varying years of data so sites were evaluated for inclusion in the vital sign on a case by case basis. To determine the MRC kelp data to use for the vital sign indicator, several factors were considered, including (1) data collection protocols were consistent between surveys and (2) the multiyear site survey extent was confirmed with MRC volunteers (Table 1).

For an initial review, DNR assessed each individual survey polygon at 17 priority sites and developed review questions, on both the individual surveys and the sites in general. DNR then met with small groups of volunteers from each MRC to discuss each survey and site to gain insights into site and survey conditions, methods and uncertainties about the data. There were also discussions about surveys that seemed anomalous compared to the other surveys collected and whether to exclude the surveys from inclusion in the vital sign and analyses. In each meeting, MRC volunteers and DNR worked to delineate a “site extent” for each site, defined as the area that had been consistently surveyed for floating kelp each year.

After the meetings, the site extents were refined and sent to the volunteers for final confirmation of the accuracy of the alongshore extent. The site extents were used to create a polygon feature class in ArcGIS Pro, and the features were added to the DNR working database and used to clip comparable data out of the full MRC dataset to include in the Vital Sign dataset (see database structure section below). After the 2022 field season, each site extent will be reassessed and adjusted as necessary.

Table 1. Complete list of MRC kayak survey sites with the years surveyed, whether the site has been reviewed for the Vital Sign and the inclusion status.

Bed Name	2015	2016	2017	2018	2019	2020	2021	Reviewed?	VS Status
Ebey's Landing	x	x	x	x	x	x	x	Yes	Included
Edmonds	x	x	x	x	x	x	x	Yes	Included
Meadowdale	x	x	x	x	x	x	x	Yes	Included
Mukilteo	x	x	x	x	x	x	x	Yes	Included
North Beach Main	x	x	x	x	x	x	x	Yes	Included
Polnell Point		x	x	x	x	x	x	Yes	Included
Lummi SW		x	x	x	x	x	x	Yes	Included
Coffin Rocks		x	x	x	x	x	x	Yes	Included
Freshwater Bay		x	x	x	x	x	x	Yes	Included
Observatory Point		x	x	x	x	x	x	Yes	Included
Biz Point			x	x	x	x	x	Yes	Included
Cherry Pt-Gulf Rd			x	x	x	x	x	Yes	Included
Hat Island			x	x	x	x	x	Yes	Included
Possession Point			x	x	x	x	x	Yes	Included
Shannon Point East			x	x	x	x	x	Yes	Included
Shannon Point West			x	x	x	x	x	Yes	Included
Clallam Bay			x	x	x	x	x	Yes	Included
Aiston Preserve				x	x	x	x	No	Pending
Camano Island SP - Lowell		x	x			x	x	No	Pending
Hoypus Point		x	x	x			x	No	Pending
Point Whitehorn		x			x	x	x	No	Pending
Alden Bank				x	x	x		No	Pending
Ben Ure		x	x	x				No	Pending
Pole Pass	x	x	x					No	Pending
North Beach West	x				x		x	Yes	Excluded
Fawn Island		x	x					No	Pending
Reef Island		x	x					No	Pending
Camano Island 2		x						No	Pending
Freshwater Bay 3				x				Yes	Excluded
Hastie Lake	x							Yes	Excluded
Libbey Beach	x							Yes	Excluded
North Beach 2					x			Yes	Excluded
Years of data:	7 years	6 years	5 years	4 years	3 years	2 years	1 year		

2.3.2 Site extent polygon descriptions

Biz Point: The polygon extends from the standardized shoreline created by the NWSC to the 60ft bathymetry line and runs from the northern guide points provided by NWSC into Telegraph Bight. The south end of the polygon extends beyond the southern guide points because kelp is expanding into Telegraph Bight.

Cherry Point: The polygon extends from the mean high tide line to the 30ft bathymetry line, The northern boundary is the NWSC's northern guideline and the southern end of the polygon ends just past the maximum extent of the 2019 survey.

Clallam Bay: The polygon extends from the mean high tide line to the 30ft bathymetry line and the NWSC guidelines are used as the east and west polygon boundaries.

Coffin Rocks: Unlike site extent polygons at other sites, the polygon at Coffin Rocks does not follow any bathymetry lines or shorelines but is a large circle around the kelp bed incorporating the rock outcrop at the center.

Ebey's Landing: The polygon extends along the shoreline from the northern guideline to the maximum extent of the 2018 survey on the southern side of the bed. In 2019, 2020 and 2021, the bed grew farther to the south than in previous years and merged with another bed. For that reason, the southern end of the polygon stops at the maximum extent of the 2018 survey. The shoreward edge of the polygon closely follows the survey lines on the northern portion of the site because there are rocks and kelp in the shallows that they surveyors avoid. On the south end of the site, the shoreward polygon edge extends to the mean high tide line. The deep edge of the polygon follows the 40ft bathymetry line.

Edmonds North: The polygon extends from the mean high tide line to the 30ft bathymetry line. The length (north-south) of the polygon was determined by the largest extent of the kelp beds.

Edmonds Dive Park: The polygon runs shoreward from the breakwater to the Edmonds North polygon and extends from the mean high tide line to the 30ft bathymetry line. This kelp bed has a separate polygon than the two beds to the north because the Edmonds Dive Park bed has been surveyed since 2017 and the other beds have been surveyed since 2015.

Freshwater Bay: The polygon extends from the mean high tide line to the 30ft bathymetry line and the west boundary aligns with the west NWSC guideline and the east polygon boundary is just east of the west guideline. The 2018 survey will be excluded from the multiyear dataset because volunteers were not confident the kelp was fully mapped on the east side of the site and is therefore incomplete.

Hat Island: The polygon extends from the mean high tide line to the 30ft bathymetry line. The polygon extends up the NE side of the island to a sandy point and extends to the west just around the southern point of the island.

Lummi SW: Due to shallow rocks, the polygon follows the shoreward side of the survey lines and extends to the 20ft bathymetry line. The polygon uses the guidelines provided by the NWSC as the east and west boundaries. The 2016 survey will be excluded because volunteers are uncertain of the full survey extent and are not confident it can be accurately compared to subsequent years.

Meadowdale: The polygon extends from the mean high tide line to the 30ft bathymetry line. The north end of the polygon is at the south end of Meadowdale Beach Park and the polygon extends south along the shoreline all the way to the north boundary of the Edmonds North polygon.

Mukilteo: The polygon extends from the mean high tide line to the 30ft bathymetry line and runs north-south from the Mukilteo boat launch in the north end to the first house on the beach in the south.

North Beach Main: The polygon extends along the shoreline from the east guideline to the west guideline of the main bed and from the mean high tide line to the 40ft bathymetry line. The 2015 survey will be excluded from analysis because it was surveyed at high tide and is not comparable to subsequent surveys.

Observatory Point: The polygon runs from the guideline inside Freshwater Bay to the outer rock on Observatory Point and extends from the mean high tide line to offshore of the survey lines. Bathymetry lines were not used to determine the deep side of the polygon because the bathymetry lines do not come into the bay.

Polnell Point: The northwest end of the polygon extends from the mean high tide line to the 30ft bathymetry line and cuts off the largest survey extents because the north end of the bed cannot be surveyed consistently every year. Near the point, the shoreward edge of the polygon follows the survey lines due to rocks and seals that the surveyors avoid, and extends to the 40ft bathymetry line. The polygon extends to the northeast to a small shoal.

Possession Point: On the northeast side of the site, the polygon starts at the eastern guideline and extends from the mean high tide line to the 40ft bathymetry line. At the main bed, the shoreward side of the polygon follows the survey lines and the deep edge extends to the 40ft bathymetry line. On the west side of the site, the polygon ends at the maximum extent of the 2018 survey. 2018 was the last year before the east and west kelp beds merged and surveyors only mapped the east bed prior to 2019.

Shannon Point East: The polygon runs east from the Shannon Point navigation marker to the guideline at the west end of the ferry parking lot and extends from the mean high tide line to the 30ft bathymetry line.

Shannon Point West: The polygon runs west from the Shannon Point navigation marker to the boat launch at Washington Park and extends from the mean high tide line to the 30ft bathymetry line.

2.3.3 MRC sites that are pending or excluded from Vital Sign

Aiston Preserve: This is a pending vital sign site. The site has four years of data (2018-2021) and there are plans to survey the site in 2022. It is being considered for inclusion in the vital sign dataset because of the limited data available in North Puget Sound sub-basin and the recent removal of an overwater structure that could benefit kelp growth.

Alden Bank: This is a pending vital sign site. There is some uncertainty in the bed footprint and in methods used to collect the perimeter. In 2018 and 2019, perimeters were collected by kayak and in 2020 the perimeter collected by tugboat. Aerial imagery is also collected for this site but the kayak/boat-collected perimeter do not match well to the imagery collected by volunteer pilot, Gregg Ridder. The blue water (site is not along a shoreline) conditions at this large isolated bed may make it difficult to collect accurate perimeters by kayak or boat.

Ben Ure: This is a pending vital sign site. The site was last surveyed in 2018 and has three years of data (2016-2018). However, it is being considered for inclusion in the vital sign dataset because there is limited kelp data in the Saratoga/Whidbey sub-basin.

Camano Island: This is a pending vital sign site. The site was last surveyed in 2021 and has four years of data (2016-2017, 2020-2021). There are plans to survey the site in 2022. It is being considered for inclusion in the vital sign dataset because there is limited kelp data in the Saratoga/Whidbey sub-basin.

Fawn Island: This site was last surveyed in 2017 and likely won't be surveyed again. It has two years of data (2016-2017), which is often insufficient for determining change but may be helpful to support other datasets.

Hastie Lake: This site was surveyed in 2015 and it was decided that the conditions were not good for kayak surveys. Surveyors did not return to the site.

Hoypus Point: This is a pending vital sign site. The site was last surveyed in 2021 and has four years of data (2016-2018, 2021) and there are plans to survey the site in 2022. It is being considered for inclusion in the vital sign dataset because there is limited kelp data in the Saratoga/Whidbey sub-basin.

Libbey Beach: This site was surveyed in 2015 and it was decided that the conditions were not good for kayak surveys. Surveyors did not return to the site.

North Beach West: This site was surveyed twice (2016 and 2019) and the area surveyed differs between years. This area was mainly surveyed in response to a proposal to move an outflow pipe. It would be best to use the North Beach Main site for long-term data.

Pole Pass: This site was last surveyed in 2017 and likely won't be surveyed again. There are three years of data (2015-2017), which is often insufficient for determining change but may be helpful to support other datasets.

Point Whitehorn: This is a pending vital sign site. It has an inconsistent bed footprint, some years the bed mapped is larger and other years it is much smaller. This could be in part due to the challenging conditions (swell, wind, changing substrate) the surveyors encounter. There is some uncertainty in what would be a consistently mapped area (smaller to be very confident the area has been mapped every year or slightly larger to capture a little of the variability seen on the deeper edge of the bed).

Reef Island: This site was last surveyed in 2017 and likely won't be surveyed again. It has two years of data (2016-2017), which is often insufficient for determining change but may be helpful to support other datasets.

2.3.4 Description of database structures

Figure 1 provides a visual of how data flows from collection by MRC volunteers, ingestion to the online webform KoboToolBox, to NWSC data processing, and on to DNRs working database, and finally to the vital sign database process. Not captured in the visual, but critical to this community science effort is the iterative process of data cleaning and verification with volunteers each survey season to confirm data cleaning reflects field observations.

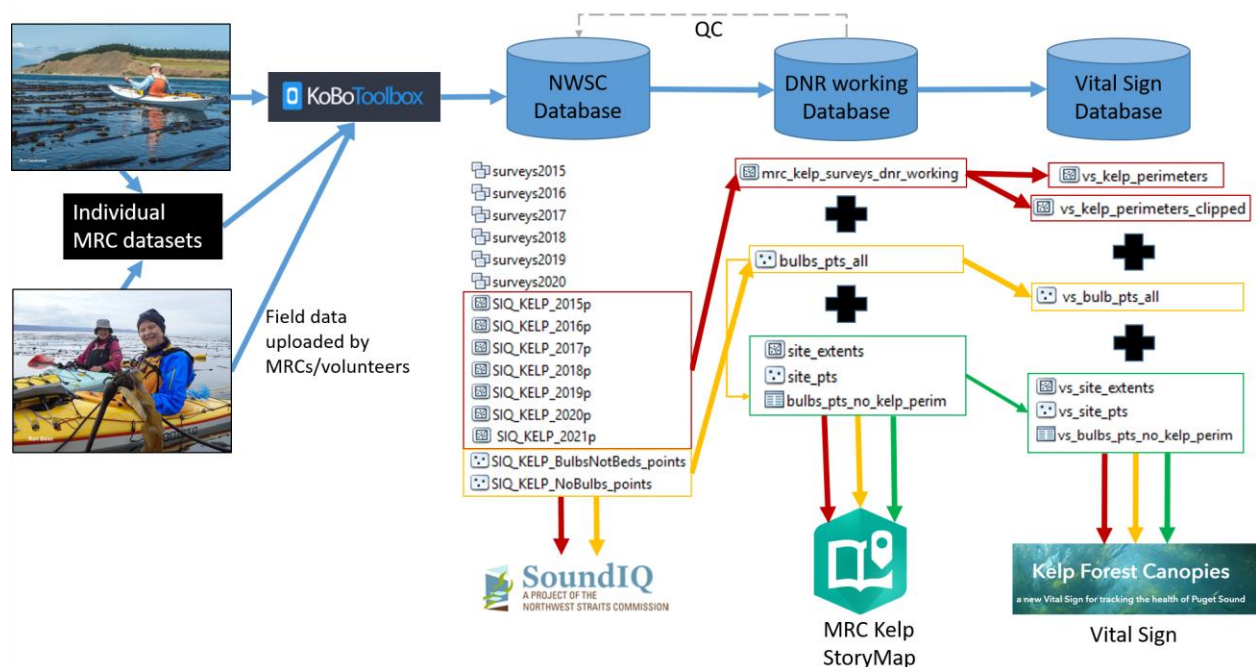


Figure 1. Flow chart of MRC kelp dataset from field collection to Vital Sign database

2.3.5 Northwest Straits Commission Database

The data collected by MRC volunteers includes: floating kelp perimeter data, field datasheet information and photos . Volunteers upload data to a KoboToolbox database. Data are downloaded from KoboToolbox, cleaned, converted from track points to polygons, attributed with the field data and formatted by the Northwest Straits Commission (NWSC) to create a geodatabase for publishing to NWSC mapping application SoundIQ. The NWSC geodatabase includes:

1. A feature dataset for each year (e.g. surveys2015). Each feature dataset contains a set of kelp perimeters (polygon feature classes) that include a polygon feature for each location and survey date (e.g. Ebeys_Landing_Aug_15_2015).
2. Annual polygon features that include all kelp perimeter features merged by year (e.g. SIQ_KELP_2015p).
3. Two point feature classes:
 - a. SIQ_KELP_BulbsNotBeds_points includes point features where no conspicuous bed was present but individual bulbs were found.
 - b. SIQ_KELP_NoBulbs includes point features where kelp was absent (no bulbs or beds present).

2.3.6 DNR Working Database

In the DNR working database, the NWSC database was restructured, edited and merged for manipulation, analysis and visualization. New feature classes were also added in the DNR database to better define sites and survey areas.

From the NWSC database, all the annual polygon features (e.g. SIQ_KELP_2015p) were merged into a single feature class (i.e. mrc_kelp_surveys_dnr_working) and all the existing fields were retained (Table 2). After 2021, the annual features should be appended to the master mrc_kelp_surveys_dnr_working feature class. Additional fields were added to standardize the formatting and allow for easy grouping (Table 3).

The two point feature classes in the NWSC database, SIQ_KELP_BulbsNotBed and SIQ_KELP_NoBulbs, had attribute tables with different formats so the attribute tables for each were exported to .csv files and read into R. Using R, the two attribute tables were reformatted to match each other and subsequently merged to create a single table, bulb_pts_all. A new field was

added (kelp_obs) to distinguish points with no kelp from points with bulbs. The bulb_pts_all table is a record of every waypoint taken for bulbs and no bulbs and includes instances with duplicate site_code/svy_date when multiple points were taken (Table 4). The table was imported into ArcGIS Pro to create a point feature class.

A second bulb point table was created by filtering the bulb_pts_all table in R (using anti-join with the kelp perimeter table) to include only surveys with no kelp perimeters recorded at the site (Table 5). This second table, bulb_pts_no_kelp_perim, is exclusive from the kelp perimeter data and contains one record for each site and survey date that had either no kelp or only bulbs present without any corresponding perimeter, representing zero acres of kelp. It can be merged with the attribute table of the kelp perimeter feature class to produce a full dataset for analysis. The table was imported in ArcGIS Pro as a table with no spatial component.

There are two feature classes in the DNR geodatabase that were created by DNR and are not part of the NWSC database. The first is a point feature class called site_pts. Broad polygons were created around each site and converted to point features on the polygon centroid (Table 6). These points are used to identify each site location surveyed by the MRC volunteers and a field was included to indicate if a site is considered a vital sign site or not.

The second feature class created by DNR is site_extents, which consists of polygons that denote the area of each site that was consistently surveyed each year (Table 7). The polygons were defined and made in consultation with MRC volunteers that have knowledge of survey methods and site characteristics. The site_extents feature class is used to clip comparable survey data for inclusion in vital sign analyses.

2.3.7 Vital Sign Database

The vital sign database was populated by referencing the DNR working database and executing a python script. The only feature class that underwent structural changes to the tabular data was vs_kelp_perimeters. All other tables and feature classes were copied to the vital sign database and renamed (vs_survey_extents, vs_site_pts, vs_bulb_pts_all, vs_bulb_pts_no_kelp_perim).

To create the vs_kelp_perimeters feature class the python script copied the features from the dnr_working_db and then formatted and tidied the survey data in the following ways: (1) executed a spatial join to site_pts to relate site_code to each perimeter, (2) executed a spatial join to site_extents to relate site_extent value to each perimeter, (3) deleted nonessential fields to streamline dataset, (4) added and populated a kelp_acreage field, and (5) reordered fields. The output of this script was the vs_kelp_perimeters polygon feature class (Table 8). To isolate only the surveys suitable for inclusion in the vital sign, the vs_kelp_perimeters feature class was then clipped using the vs_site_extents feature class to create vs_kelp_perimeters_clipped feature class. Only perimeters within the vs_site_extent polygons and suitable for analysis were used to populate the vs_kelp_perimeters_clipped feature class.

2.3.8 Tables

Table 2. Fields retained from NWSC data in mrc_kelp_survey_dnr_working

Field name	Field type	Field description
BedName	Text	Name given to kelp bed by MRC volunteers
SurveyDate	Text	Date of survey
Acres	Double	Bed area in acres
Miles	Double	Perimeter of polygon in miles
County	Text	County survey occurred in
Location	Text	Location of kelp bed
Bulb_m2	Double	Density of bulbs per meter squared
WaTemp	Double	Water temperature (°C)
Wx	Text	Weather during survey
TideStation	Text	Tide station used to get tidal height
Obs	Text	Observations
Notes	Text	Notes
ToBe	Text	URL for photo taken of kelp bed towards the shore
ToWa	Text	URL for photo taken of kelp bed towards the water
BeL	Text	URL for photo taken of kelp bed with beach to the left
BeR	Text	URL for photo taken of kelp bed with beach to the right
CorrDepShor	Double	Corrected depth on the shore edge of the bed (m, MLLW)
CorrDepShore	Double	Corrected depth on the shore edge of the bed (m, MLLW)
CorrDepWa	Double	Corrected depth on the water edge of the bed (m, MLLW)
TidalHt_meters	Double	Tidal height in meters
TidalHt_meter	Double	Tidal height in meters
Obs2	Text	Additional observations
URL	Text	URL
WaTemp1	Double	Water Temperature (°C)
WaTemp2	Double	Water Temperature (°C)

Table 3. Standardized fields added by DNR in mrc_kelp_surveys_dnr_working

Field name	Field type	Field description
site_name	Text, Length: 20	Site name (derived from mrc bed name field)
svy_day	Short	Day of survey (derived from survey date)
svy_mon	Short	Month of survey (derived from survey date)
svy_yr	Short	Year of survey (derived from survey date)
svy_date	Text, Length: 8	Date of survey (concat DDMMYYYY)
visit_num+	Short	Site visit number (incrementing integer, starts at 1 year)

		year)
svy_num+	Short	Survey number (incrementing integer, starts at 1 each visit)
analyze+	Short	Flag field used by DNR to track perimeters suitable for inclusion in analyses (0 = no, 1 = yes)
notes_dnr+	Text, Length: 100	Note field used by DNR

+ = populated by DNR

Table 4. Fields in bulb_pts_all and vs_bulb_pts_all

Field name	Field type	Field description
BedNameMRC	Text, Length: 25	MRC Bed Name
site_code+	Text, Length: 8	Unique code used to identify sites (DNR)
svy_date	Text, Length: 8	Day of survey (derived from survey date)
svy_yr	Short	Year of survey (derived from survey date)
svy_mon	Short	Month of survey (derived from survey date)
svy_day	Short	Day of survey (derived from survey date)
County	Text, Length: 25	County survey occurred in
kelp_obs+	Text, Length: 25	Note associated with pt: either no bulbs or bulbs not bed
Lat	Double	Latitude
Lon	Double	Longitude

+ = populated by DNR

Table 5. Fields in bulb_pts_no_kelp_perim and vs_bulb_pts_no_kelp_perim

Field name	Field type	Field description
site_code	Text, Length: 8	Unique code used to identify sites (DNR)
svy_date	Text, Length: 8	Date of survey (concat DDMMYYYY)
svy_day	Short	Day of survey (derived from survey date)
svy_mon	Short	Month of survey (derived from survey date)
svy_yr	Short	Year of survey (derived from survey date)
visit_num+	Short	Site visit number (incrementing integer, starts at 1 year year)
svy_num+	Short	Survey number (incrementing integer, starts at 1 each visit)
kelp_obs+	Text, Length: 25	Note associated with pt: either no bulbs or bulbs not bed
svy_area_ac	Float	Survey area in acres
site_extent+	Text, Length: 15	Concatenation of site_code and extent_num used to relate survey_extents to kelp_perimeters

analyze+	Short	Flag field used by DNR to track perimeters suitable for inclusion in analyses (0 = no, 1 = yes)
notes_dnr+	Text, Length: 100	Note field used by DNR

+ = populated by DNR

Table 6. Fields in site_pts and vs_site_pts

Field name	Field type	Field description
site_code+	Text, Length: 8	Unique code used to identify sites (DNR)
site_location+	Text, Length: 25	Site location, used to provide a detailed description of site_code (DNR)
vital_sign+	Short	Flag field used to indicate whether or not site is a 'vital sign' site (0 = no, 1 = yes)
lat	Double	Latitude
lon	Double	Longitude

+ = populated by DNR

Table 7. Fields in site_extent and vs_site_extent

Field name	Field type	Field description
site_code+	Text, Length: 8	Unique code used to identify sites (DNR)
site_location+	Text, Length: 25	Site location, used to provide a detailed description of site_code (DNR)
extent_num+	Short	Incrementing integer used to track and relate site_extents to a site (site_code) and survey (kelp_perimeter)
site_extent	Text, Length: 15	Concatenation of site_code and extent_num used to relate survey_extents to kelp_perimeters

+ = populated by DNR

Table 8. Fields in vs_kelp_perimeters and vs_kelp_perimeters_clipped.

Field name	Field type	Field description
site_code	Text, Length: 20	Unique code used to identify sites (DNR)
svy_date	Text, Length: 8	Date of survey (concat DDMMYYYY)
svy_day	Short	Day of survey (derived from survey date)
svy_mon	Short	Month of survey (derived from survey date)
svy_yr	Short	Year of survey (derived from survey date)
visit_num	Short	Site visit number (incrementing integer, starts at 1 year year)
svy_num	Short	Survey number (incrementing integer, starts at 1 each visit)
svy_area_ac	Float	Survey area in acres

site_extent	Text, Length: 15	Concatenation of site_code and extent_num used to relate survey_extents to kelp_perimeters
analyze	Short	Flag field used by DNR to track perimeters suitable for inclusion in analyses (0 = no, 1 = yes)
notes_dnr	Text, Length: 100	Note field used by DNR

2.4 References

Bishop, E. (2014). *A kayak-based survey protocol for Bull Kelp in Puget Sound*. Updated 2020. Northwest Straits Commission. <https://www.nwstraits.org/media/2937/kelp-protocol-may-2020-revised.pdf>

Britton-Simmons, K., Eckman, J.E., & Duggins, D.O. (2008). Effect of tidal currents and tidal stage on estimates of bed size in the kelp *Nereocystis leutkeana*. *Marine Ecology Progress Series*, 355, 95-105.