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Census of Environment: Spatial information products

Ocean and Coastal Ecosystem Extent: Data Product Specification

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Table of contents

1. Overview	5
1.1 Title	5
1.2 Reference date	5
1.3 Responsible party	5
1.4 Language	5
1.5 Terms and definitions	5
1.6 Abbreviations and acronyms	5
1.7 Informal description of the data product	5
2. Specification scope	6
2.1 Scope identification	6
2.2 Level	6
2.3 Level name	6
2.4 Level description	6
2.5 Extent	6
2.6 Coverage	7
3. Data product identification	8
4. Data content and structure	9
4.1 Description	9
4.2 Feature information	9
4.3 Coverage information	9
4.4 Reference to the specification scope	10
5. Reference systems	11
5.1 Spatial reference system	11
5.2 Linear reference system	11
5.3 Temporal reference system	11
5.4 Reference to specification scope	11
6. Data quality	11
6.1 Completeness	11
6.2 Logical consistency	12
6.3 Positional accuracy	12
6.4 Temporal accuracy	12
6.5 Thematic accuracy	12
7. Data capture	13
7.1 Description	13
7.2 Reference to the specification scope	13

8. Data maintenance	13
8.1 Description.....	13
8.2 Reference to the specification scope	13
9. Portrayal	13
10. Data product delivery	13
10.1 Delivery format information	13
10.2 Delivery medium information for static files	14
10.3 Reference to specification scope	14
11. Additional information	14
12. Metadata	14
12.1 Reference to specification scope	14

1. Overview

1.1 Title

Ocean and coastal ecosystem extent: Data product specifications

1.2 Reference date

December 16, 2024

1.3 Responsible party

Census of Environment

Environment Accounts and Statistics Division, Statistics Canada

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Email: statcan.environ-environ.statcan@statcan.gc.ca

1.4 Language

eng – English

fra – French

1.5 Terms and definitions

Bathymetry: The measurement of water depth in oceans and other large water bodies.

Biome: A large naturally occurring community of flora and fauna creating a major area of habitat (e.g., Marine shelf biome, Pelagic ocean waters biome).

Ecosystem functional groups: Groups of related ecosystems within a biome that share similar roles or functions.

Ecotone: A transitional area between two different ecosystems, where the characteristics of both ecosystems mix, creating an environment that supports plants and animals from both ecosystems.

Exclusive economic zone: The ocean area up to 200 nautical miles from a country's coastline, where countries have special rights with respect to marine resources.

1.6 Abbreviations and acronyms

CoE	Census of Environment
EEZ	Exclusive economic zone
GEBCO	General Bathymetric Chart of the Oceans
GeoTIFF	Geographic Tagged Image File Format
ISO	International Organization for Standardization
SEEA	System of Environmental Economic Accounting

1.7 Informal description of the data product

This product contains two raster datasets. One covers ocean floor and salt marsh ecosystem areas, while the other contains ocean water depths by class. Mapping the extent of ocean ecosystems is the first stage in creating spatially explicit accounts, to help understand the ocean and coastal ecosystems of Canada. The files contain the best representations of ecosystem extent that were available to the Census of Environment (CoE) as of 2023.

The files cover the area from the coastline, defined by Statistics Canada's 2021 Census of Population ([Statistics Canada, 2021, 2021 Census – Boundary files](#)), to the outer boundary of Canada's exclusive economic zone (EEZ) ([Fisheries and Oceans Canada, 2016, Federal Marine Bioregions](#)).

This product supplements Statistics Canada's tabular estimates of ocean and coastal ecosystem extent by providing users with spatial data for visualization and spatial analytical uses. Depth layers in the extent table ([Ocean and coastal ecosystem extent account](#)) can be constructed from these spatial files by merging all depth classes of the same or greater depth.

These datasets are released as part of a suite of products associated with the CoE. The CoE organizes data related to Canada's natural environment based on the [System of Environmental Economic Accounting](#) (SEEA) international statistical standard, including the SEEA Central Framework and the SEEA Ecosystem Accounting, which takes a spatial approach to accounting for ecosystems and natural capital. Ecosystem classifications link to the [International Union for Conservation of Nature Global Ecosystem Typology](#).

The datasets will be updated on an occasional basis.

2. Specification scope

In these specifications, only one scope is used.

2.1 Scope identification

Main

2.2 Level

Series

2.3 Level name

Main scope of the ocean and coastal ecosystem extent series

2.4 Level description

Gridded datasets of ocean and coastal ecosystem extent for ocean and coastal areas of Canada.

2.5 Extent

2.5.1 Description

This product provides two two-dimensional datasets:

- The ocean floor and coastal ecosystem extent dataset covers all of the Canadian ocean floor area and adjacent coastal areas where salt marsh areas have been mapped for 2023.
- The ocean depth class dataset covers all Canadian ocean water areas for 2023.

2.5.2 Vertical extent

- The ocean floor and coastal ecosystem dataset is presented as a two-dimensional dataset at the level of the ocean floor and coastal land areas (no elevation).
- The two-dimensional ocean depth dataset provides bathymetry classed as five depth classes, ranging from Class 1, Abyssopelagic (waters deeper than 4 000 metres), to Class 5, Surface epipelagic (waters of up to 50 metres depth).

2.5.3 Horizontal extent

The horizontal extent for the ocean floor and coastal ecosystem dataset contains all areas between the EEZ outer boundary and Canada's coastline, as well as adjacent areas of salt marsh, a transitional marine–freshwater–terrestrial

ecosystem. The ocean depth class dataset includes all areas between the EEZ outer boundary and coastline. The coastline used is the 2021 Census of Population coastline ([Statistics Canada, 2021, 2021 Census – Boundary files](#)).

Map 1
Extent of Canadian ocean area



Source: Statistics Canada, Environment Accounts and Statistics Division.

Table 1
Longitude and latitude boundaries

	Ocean floor and coastal ecosystems	Ocean depth classes
	degrees	
West bounding longitude	-139	-139
East bounding longitude	-48	-48
South bounding latitude	40	40
North bounding latitude	86	86

2.5.4 Temporal extent

Datasets contain the best representation of spatial extent available to the CoE as of the end of 2023.

2.6 Coverage

The scope applies to all coverages.

3. Data product identification

Table 2
Data product identification for the ocean floor and coastal ecosystem dataset

Title	Ocean floor and coastal ecosystems
Alternate title	OCE_EOL_2023
Abstract	Ocean floor and coastal ecosystem classes by 30 metre x 30 metre cells
Purpose	This product provides users with spatial data on ocean floor and coastal ecosystems. Classes are consistent with the International Union for Conservation of Nature Global Ecosystem Typology. In particular, the raster classes seagrass meadow, kelp forest, cold water coral and sponge, and substrate types link to the M1 Marine shelf biome . Topological classes link to the M3 Deep sea floors biome , and salt marshes are included in MFT1.3 Coastal salt marshes and reedbeds .
Topic category	Environment, ocean floor
Spatial representation type	Grid
Spatial resolution	30 metres
Geographic description	Authority: International Organization for Standardization (ISO) ISO 3166-1:1997 Codes for the representation of names of countries and their subdivisions – Part 1: Country codes. Reference date of the ISO 3166-1 standard: 1997-10-01 Data type: Publication Code: CA – Canada Extent type code: inclusion
Specification scope	Main

Table 3
Data product identification for the ocean depth class dataset

Title	Ocean depth classes
Alternate title	ODC_CPO_2023
Abstract	Ocean depth classes by 30 metre x 30 metre cells
Purpose	This product provides users with geographic data on ocean depth layers. Depth classes are consistent with International Union for Conservation of Nature Global Ecosystem Typology, M2 Pelagic ocean waters biome . Class M2.1 has been split into a surface-level epipelagic and lower epipelagic class.
Topic category	Environment, marine waters
Spatial representation type	Grid
Spatial resolution	30 metres
Geographic description	Authority: International Organization for Standardization (ISO) ISO 3166-1:1997 Codes for the representation of names of countries and their subdivisions – Part 1: Country codes. Reference date of the ISO 3166-1 standard: 1997-10-01 Data type: Publication Code: CA – Canada Extent type code: inclusion
Specification scope	Main

4. Data content and structure

4.1 Description

This product is composed of two raster datasets that depict the ocean and coastal ecosystem extent in all areas between the EEZ outer boundary and Canadian coastline, as defined by the 2021 Census of Population. The ocean floor and coastal ecosystem raster also includes adjacent areas where coastal ecosystems have been mapped.

4.2 Feature information

Not applicable

4.3 Coverage information

4.3.1 Description

Technical description: The rasters contain delineations of ecosystem type at the end of 2023 at a 30 metre resolution. The ocean floor and coastal ecosystem dataset includes 18 different mutually exclusive classes of coastal and ocean floor ecosystems. The ocean depth class raster contains five classes for ocean depth.

Type of coverage content: thematicClassification

4.3.2 Coverage type

Continuous quadrilateral grid coverage

4.3.3 Specification

4.3.3.1 Domain extent

Refer to Section 2.5 of this document.

4.3.3.2 Range type

Table 4
Values for ocean floor and coastal ecosystem dataset

Label	Value	Definition
1	Salt marsh	Area dominated by marsh vegetation and pannes that undergo tidal flooding
2	Seagrass meadow	Area predominantly covered by seagrass
3	Salt marsh – seagrass ecotone	Area with mixed marsh vegetation and seagrass
4	Kelp forest	Area with extensive kelp canopy
5	Cold water coral and sponge	Area mapped or predictively modelled as containing cold water coral or sponge
11	Hard substrate	Area with no mapped biotic ecosystem type, where the predominant substrate is hard (e.g., rocky reefs, boulders)
12	Mixed substrate	Area with no mapped biotic ecosystem type, where the substrate is a mix of hard and soft substrates
13	Soft substrate	Area with no mapped biotic ecosystem type, where the predominant substrate is soft (e.g., sand or mud)
20	Plains	Areas that are predominantly flat and not mapped to a biotic or substrate class
21	Peaks	Areas surrounded in all directions by declines in elevation that are not mapped to a biotic or substrate class
22	Ridges	Areas including a narrow elevated strip with declines in elevation on both sides that are not mapped to a biotic or substrate class

Table 4
Values for ocean floor and coastal ecosystem dataset

Label	Value	Definition
23	Shoulders	Areas that are adjacent to flat areas on one side and decline in elevation on the other side that are not mapped to a biotic or substrate class
24	Spurs	Areas not mapped to a biotic or substrate class that are lateral ridges or tongues of land descending from a higher elevation
25	Slopes	Areas of steady decline in elevation that are not mapped to a biotic or substrate class
26	Hollows	Areas that are valleys descending to a flat area and not mapped to a biotic or substrate class
27	Footslopes	Areas that decline in elevation to a flat area and not mapped to a biotic or substrate class
28	Valleys and canyons	Areas including strips of flat land with increases in elevation on both sides that are not mapped to a biotic or substrate class
29	Pits	Areas that are surrounded by increases in elevation on all sides and not mapped to a biotic or substrate class

Note: For more information on topographic class designation, please see Jasiewicz, Jaroslaw and Tomasz F. Stepinski, 2013, "Geomorphons - a pattern recognition approach to classification and mapping of landforms," *Geomorphology*, Vol 182, pp 147-156.

Table 5
Values for ocean depth class dataset

Label	Value	Definition
1	Abyssopelagic	Water depth greater than 4 000 metres
2	Bathypelagic	Water depth between 1 000 metres and 4 000 metres
3	Mesopelagic	Water depth between 200 metres and 1 000 metres
4	Lower epipelagic	Water depth between 50 metres and 200 metres
5	Surface epipelagic	Water depth less than 50 metres

4.3.4 Common point rule

Not applicable

4.4 Reference to the specification scope

Main

5. Reference systems

5.1 Spatial reference system

Table 6
Spatial reference system

Projected coordinate system	NAD_1983_Albers
Geographic coordinate system	GCS_North_American_1983
Datum	D_North_American_1983
Spheroid	GRS_1980
Semimajor axis	6378137.0
Inverse flattening	298.257222101
Prime meridian	Greenwich (0,0)
Angular unit	Degree (0.0174532925199433)
Projection	Albers
False easting	6200000.0
False northing	3000000.0
Central meridian	-91.86666667
Standard parallel 1	49.0
Standard parallel 2	90.0
Latitude of origin	63.390675
Linear unit	Metres (1.0)

5.2 Linear reference system

Not applicable

5.3 Temporal reference system

Gregorian calendar

5.4 Reference to specification scope

Main

6. Data quality

6.1 Completeness

The ocean depth layer covers all areas between the EEZ outer boundary and coastline at a 30 metre resolution. The ocean floor and coastal ecosystem file covers all areas between the EEZ outer boundary and coastline and areas of adjacent coastal salt marsh at a 30 metre resolution.

6.1.1 Commission

Not applicable

6.1.2 Omission

The ocean floor and coastal ecosystem spatial dataset relies on the amalgamation of several other datasets. Mapping of biotic ecosystems is very limited in Arctic waters, and, in particular, kelp ecosystems are not included in the Arctic and Atlantic Oceans because of a lack of data.

6.2 Logical consistency

6.2.1 Conceptual consistency

For the ocean floor and coastal ecosystem raster, ecosystems have been mapped in a preferential order of biotic, substrate and topographic ecosystems. Where salt marsh and seagrass areas overlapped, an ecotone (transition zone) class was created. Overlapping biotic areas were preferentially mapped to salt marsh, seagrass, or salt marsh–seagrass ecotone, and then kelp.

6.2.2 Domain consistency

Verification and validation procedures ensure the range of values remains coherent.

6.2.3 Format consistency

The use of well-established commercial software to generate formats for dissemination supports proper format consistency.

6.2.4 Topological consistency

Rasters were aligned with the CoE 30 metre grid. For the ocean floor and coastal ecosystem dataset, topological ecosystems were created using the geomorphon function in ArcGIS, based on the General Bathymetric Chart of the Oceans (GEBCO) 2023 grid (GEBCO Compilation Group, 2023, [GEBCO 2023 Grid](#)). The ocean depth class raster classifies the GEBCO 2023 grid into five classes. Both datasets were compared with other topographic datasets to ensure consistency of major features.

6.3 Positional accuracy

Unknown. The ocean floor and coastal ecosystem dataset has certain areas of weakness. Currently, there is no mapping of kelp on the Arctic or Atlantic Coast. Salt marsh patch size is known to be overestimated on the Pacific Coast. Topographic classes in this dataset, as well as the depth classes in the ocean depth class dataset, are dependent on the positional accuracy of the GEBCO 2023 grid (GEBCO Compilation Group, 2023, [GEBCO 2023 Grid](#)).

6.4 Temporal accuracy

Unknown. Information has been included from a range of years to create estimates of the extent of ecosystem types for reference year 2023.

6.5 Thematic accuracy

Unknown. For the ocean floor and coastal ecosystem raster, data were compiled from many datasets. Features were prioritized by their nature in the following order: biotic, substrate and topographic classes. Areas of known poor quality include the Arctic, where few data were available overall; the East Coast, where there was a lack of data on kelp extent; and the coastal salt marsh for British Columbia, which is overestimated. Topographic classes depend on the GEBCO 2023 grid (GEBCO Compilation Group, 2023, [GEBCO 2023 Grid](#)).

Data for the ocean depth class raster are based on the GEBCO 2023 grid. Errors in this grid vary by location, and the level of error in the five classes in this raster is unknown.

7. Data capture

7.1 Description

The ocean depth class raster was built from the GEBCO 2023 grid (GEBCO Compilation Group, 2023, [GEBCO 2023 Grid](#)) by classifying areas of pelagic ocean waters by depth according to five different depth classes. The raster was then reprojected to the CoE 30 metre grid.

The ocean and coastal ecosystem extent account was built as three layers. The first layer was created by combining many datasets to map biotic ecosystem type classes. The full list is available in the [Ocean and coastal ecosystem extent account](#). Areas where salt marsh and seagrass ecosystems overlapped were classed as an ecotone. These classes were given preference over kelp data and cold water coral and sponge data.

The second layer was created by combining substrate layers. The full list of reference datasets can be found in the [Ocean and coastal ecosystem extent account](#).

The third topographical layer was based on the GEBCO 2023 grid (GEBCO Compilation Group, 2023, [GEBCO 2023 Grid](#)) and was created using the geomorphon function in ArcGIS with a radius of 6 kilometres and a skip distance of 2.8 kilometres.

These three layers were then mosaicked, with priority given to the biotic layer, then the substrate class layer, and finally the topographic class layer.

7.2 Reference to the specification scope

Main

8. Data maintenance

8.1 Description

The data series is updated on an occasional basis.

8.2 Reference to the specification scope

Main

9. Portrayal

Not applicable

10. Data product delivery

10.1 Delivery format information

Geographic Tagged Image File Format (GeoTIFF)

10.1.1 Format name

GeoTIFF

10.1.2 Version

GeoTIFF 6.0

10.1.3 Specification

GeoTIFF is a format extension for storing georeference and geocoding information in a TIFF 6.0 compliant raster file by tying a raster image to a known model space or map projection.

10.1.4 File structure

Not applicable

10.1.5 Language

eng – English

10.1.6 Character Set

utf8

10.2 Delivery medium information for static files

10.2.1 Units of delivery

Each dataset is presented as a GeoTIFF providing the CoE's best estimate for the year.

Ocean depth column: ODC_CPO_YYYY.tif

Ocean and coastal ecosystem extent: OCE_EOL_YYYY.tif

10.2.2 Transfer size

The file size for the ocean and coastal ecosystem extent file is approximately 579 megabytes and the file size for the ocean depth column file is approximately 386 megabytes.

10.2.3 Medium name

File transfer

[Open Government of Canada website](#)

www.geo.ca

10.2.4 Other delivery information

Information regarding the use of the data is defined in the [Statistics Canada Open Licence](#).

10.3 Reference to specification scope

Main

11. Additional information

Statistics Canada also produces tabular estimates of ocean and coastal ecosystem extent. A link to this product and details on the method applied to generate tabular estimates can be found on the [Ocean and coastal ecosystem extent account](#) page of the *Methodological Guide: Canadian System of Environmental-Economic Accounting*.

12. Metadata

Not applicable

12.1 Reference to specification scope

Main