27-29 May 2024

imdis

International conference on **M**arine **D**ata and **I**nformation **S**ystems

SeaDataNet AISBL · Havforskningsinstituttet · Ifremer · MARIS · MEDIN · National Oceanography Centre · INGV · iMagine · IODE · eosc Blue-Cloud2026

of freshwater spawning fishes, ate feeding migrations to the d Savvaitova, 2008). Among tta is a widely distributed, known to display a continuum rom freshwater residency and rt and long-distance marine in populations (Cucherousset lel Villar-Guerra et al., 2014; al., 2016; Bordeleau et al., anadromous brown trout can e feeding migrations during its ; Thorstad et al., 2016), where n marine migratory seasons ning and overwintering with et al., 2017) that have limited nutsen et al., 2001). While the ory continuum have remained scientific evidence indicates a nd nutritional state, metabolic n et al., 2006; Wysujack et al., y et al., 2015; Bordeleau et al., dual variability in migratory vidual behavioral flexibility to nsequences in terms of growth, in obscure. Beyond the role of

MATERIALS AND METHODS

Study Area

The study was conducted in two fjord systems in central and northern parts of Norway (**Figure 1**). The Hemnfjord system consists of two interconnected fjords with more than 60 km^2 surface area and about 65 km of shoreline and is connected to the open sea by a 36 km long strait (**Figure 1**, Eldøy et al., 2015). The Tosenfjord system consist of two interconnected fjords with about 150 km^2 surface area and more than 270 km of shore line, connected to the open sea by a 15 km long strait (**Figure 1**). Several watercourses with partially anadromous populations of brown trout drain into both fjord systems. The Hemnfjord study area is described in detail by Eldøy et al. (2015, 2017) and Flaten et al. (2016), while the Tosenfjord study area is described by Bordeleau et al. (2018).

Environmental Variables

Both fjord systems had aquaculture facilities with farmed salmon in open net pens during the study periods. Sea temperature and salmon lice count data from the salmon farms was downloaded from the Norwegian Fish Health Database (www.barentswatch.no), and all available recordings from marine aquaculture locations in the two fjord systems were combined. Data on sea temperatures and salmon lice counts (here shown as counts of all life stages combined) in the farms located within each fjord system revealed seasonal and annual variations

https://doi.org/10.3389/fevo.2019.00420

Hydroid growth and exposure

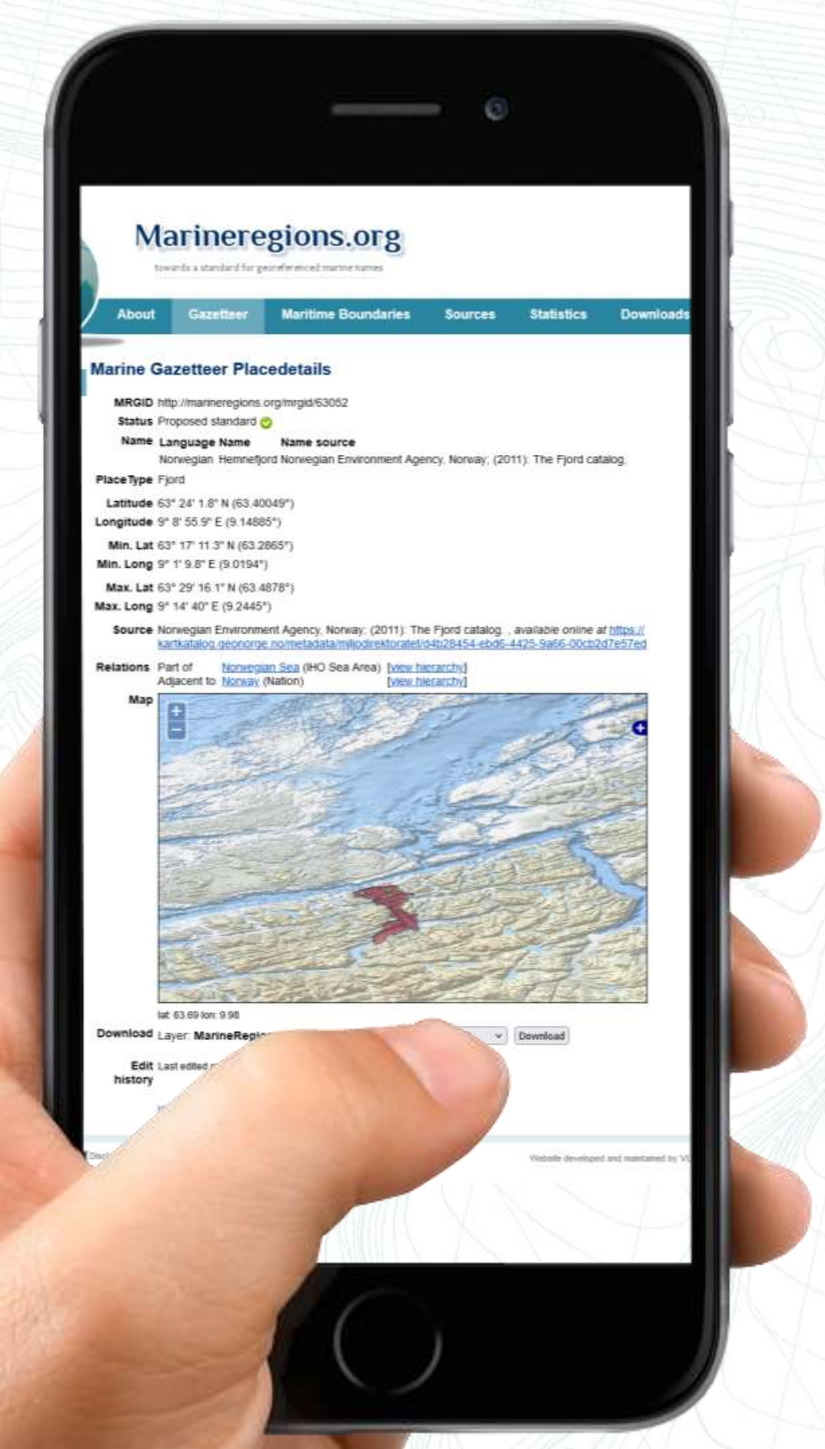
The aim was to create cleaning waste similar to that generated by *in-situ* high-pressure cleaning of fish cage nets. Based on field data on hydroid densities on fish cage nets ([21, 28]; SINTEF, unpublished data), combined with calculations of the water volume in an average sized fish farm cage (see S1 Appendix), a target concentration of 10 000 polyps per m^3 was chosen for the present study to simulate conditions encountered on many Norwegian salmon farms. The hydroid *E. larynx* was cultivated on net panels (n = 12, 60x40 cm, uncoated nylon, 25 mm half mesh, Egersund Net) fixed to PVC frames (6 frames, 2 panels per frame) placed at 3 m depth at a salmon farm (Måsøval fiskeoppdrett) in Hemnfjorden (Mid-Norway), for 6 weeks. One day prior to the start of the experiment, 10 net panels were collected from the farm and placed into 25 L buckets filled with seawater (2 panels per bucket). The samples were aerated during car transport to Solbergstrand laboratory, as well as after transfer to fresh seawater upon arrival.

The density of *E. larynx* on the net panels was approximately 112 500 polyps m^{-2} (based on polyp counts on representative net strands conducted under a dissecting microscope; n = 10). The physical condition of the colony was good with most polyps in a reproductive state and only very few that had shed their hydranths. Other species, including bryozoans and small algae, contributed to less than 5% of the biofouling cover.

Net panels with hydroids were mounted onto a wooden holding frame (Fig 2), which was then submerged into a large bucket with sea water. Biofouling was removed from the nets using a hand-held high-pressure cleaner supplying sea water with a pressure of 150 bar (Cocraft HHR 135, Clas Ohlson). The cleaner removed polyp heads and most stems effectively, but some remaining polyp stems had to be removed by hand. The cleaning waste was collected in the bucket and filtered through a 150 μm sieve to remove excess water. The approximate weight of the material in the sieve was recorded before the cleaning waste was divided into four equal parts and transferred to the experimental tanks designated for hydroid exposure.

Prior to exposure, the volume of water in each tank was set to 300 L and the water flow was turned off throughout the exposure period to ensure constant concentrations of cleaning waste

https://doi.org/10.1371/journal.pone.0199842



Marine Regions: An interoperable standard for georeferenced marine place names

IMDIS 2024, Bergen

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Correspondence: info@marineregions.org

VLIZ

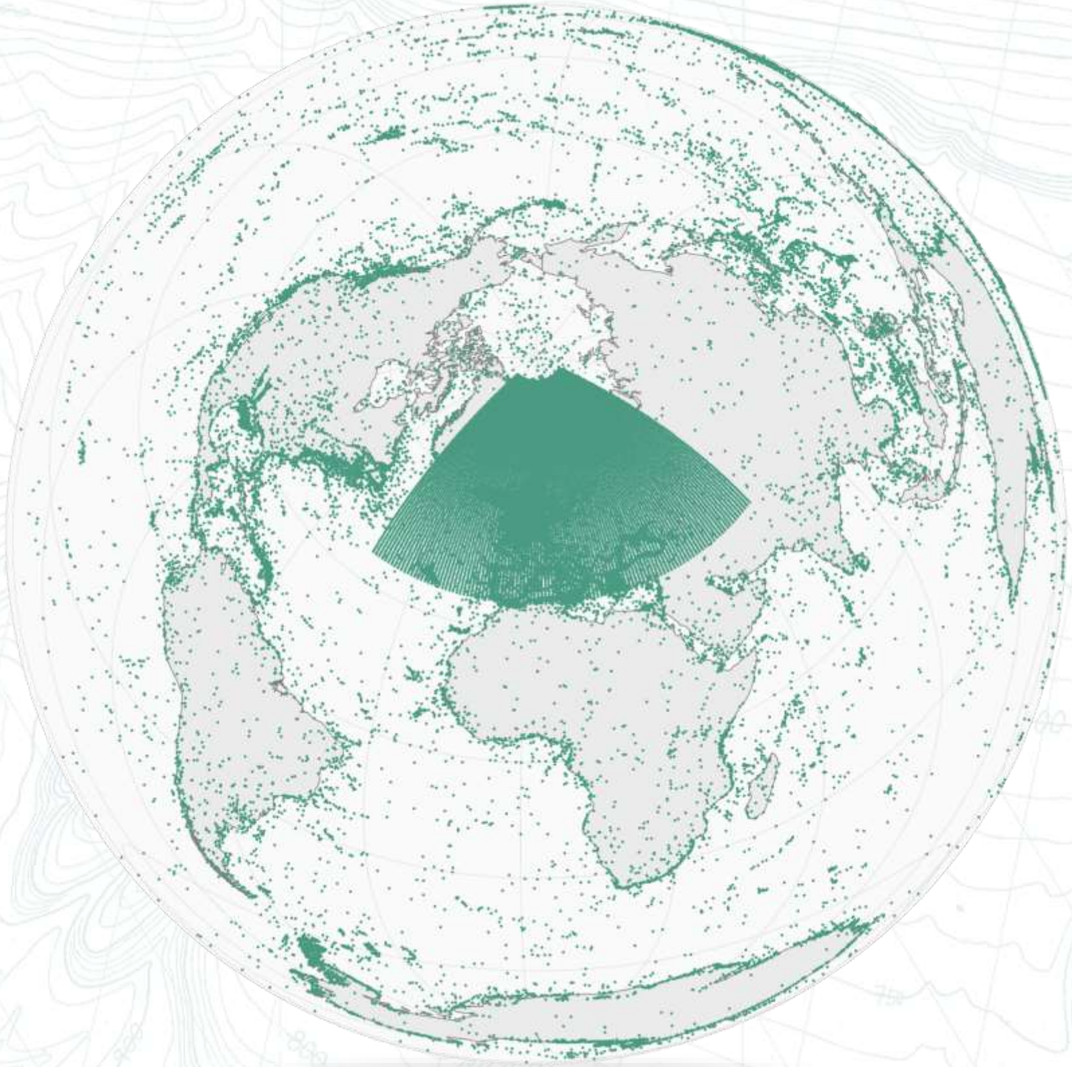
Marineregions.org
towards a standard for georeferenced marine names

LifeWatch BELGIUM

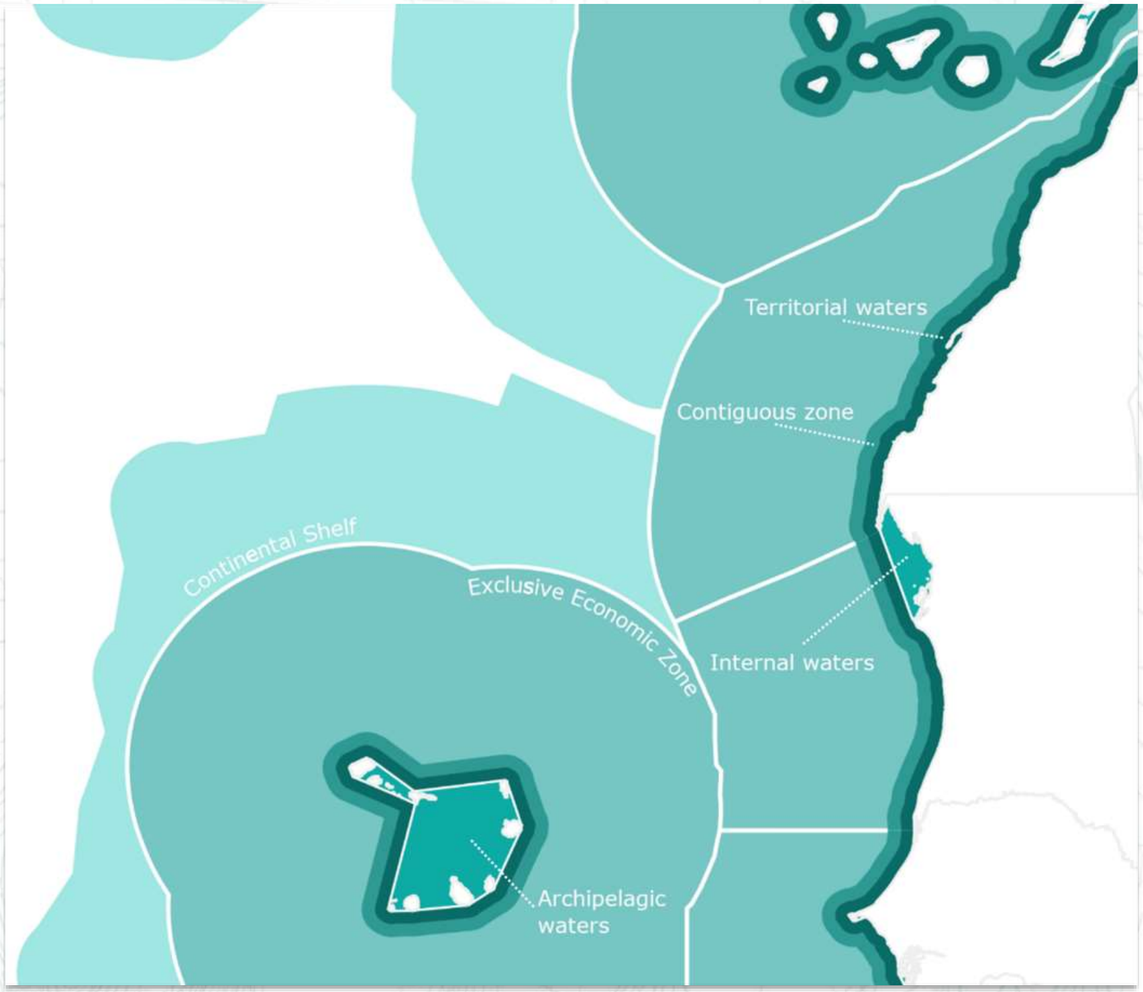
2021 2030 United Nations Decade of Ocean Science for Sustainable Development

What is Marine Regions?

A georeferenced **gazetteer** of marine places.



Data products: maps ready to be used in the web and in Geographical Information Systems.



Marine Gazetteer Placedetails

MRGID http://marineregions.org/mrgid/63052

Status Proposed standard

Name

Language	Name	Name source
Norwegian	Hemnefjord	Norwegian Environment Agency, Norway; (2011): The Fjord catalog.

PlaceType Fjord

Latitude 63° 24' 1.8" N (63.40049°)

Longitude 9° 8' 55.9" E (9.14885°)

Min. Lat 63° 17' 11.3" N (63.2865°)

Min. Long 9° 1' 9.8" E (9.0194°)

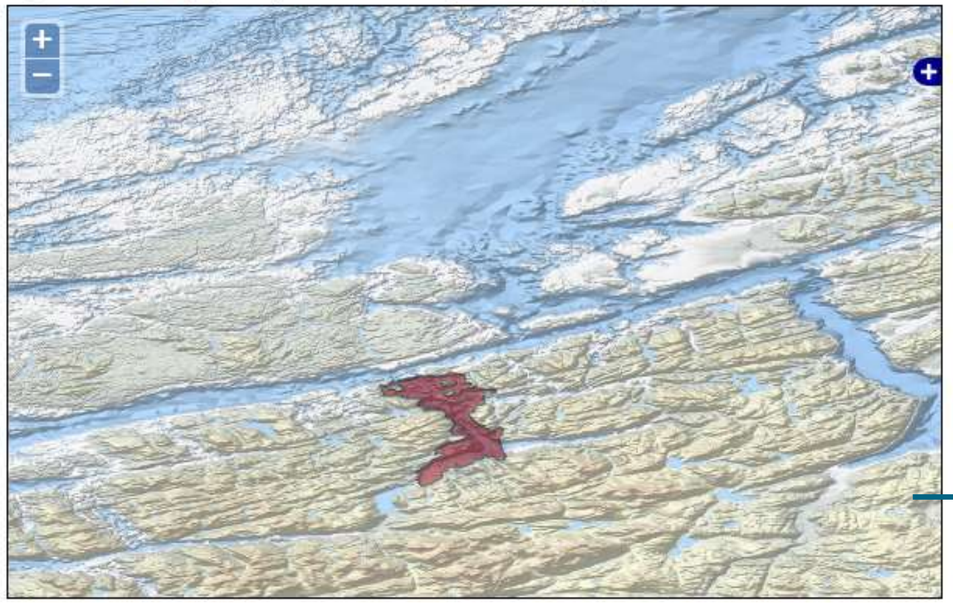
Max. Lat 63° 29' 16.1" N (63.4878°)

Max. Long 9° 14' 40" E (9.2445°)

Source Norwegian Environment Agency, Norway; (2011): The Fjord catalog. , *available online at* https://kartkatalog.geonorge.no/metadata/miljodirektoratet/d4b28454-ebd6-4425-9a66-00cb2d7e57ed

Relations Part of Norwegian Sea (IHO Sea Area) [view hierarchy]
Adjacent to Norway (Nation) [view hierarchy]

Map



lat: 63.69 lon: 9.98

Download Layer: **MarineRegions:gazetteer_polygon** - format: GML3 Download

Edit history Last edited on 2020-06-22 09:57:10 by Lonneville Britt

MRGID: unique, persistent, resolvable

placetype: contextual information

location: coordinates + geometry (if available)

source: gazetteers, ecological classifications,...

relations: hierarchical structure + others

Now availiable as Linked Data!

```
@prefix mr: <http://marineregions.org/ns/ontology#> .

@prefix mrt: <http://marineregions.org/ns/placetypes#> .

<http://marineregions.org/mrgid/63052>

  a mr:MRGeoObject, mrt:Fjord ;

  mr:hasGeometry

    <http://marineregions.org/mrgid/63052/geometries?so...

  dcat:bbox "<http://www.opengis.net/def/crs/OGC/1.3/CRS84>...

  dcat:centroid "<http://www.opengis.net/def/crs/OGC/1.3/C...

  prov:hadPrimarySource <https://kartkatalog.geonorge.no/m...

  mr:isAdjacentTo <http://marineregions.org/mrgid/2252> ;

  mr:isPartOf <http://marineregions.org/mrgid/2353> ;

  dc:modified "2023-05-20T16:35:00Z"^^xsd:dateTime ;

  skos:prefLabel "Hemnefjord"@no ;
```

MRGID: unique, persistent, resolvable

placetype: contextual information

location: coordinates + geometry (if available)

source: gazetteers, ecological classifications,...

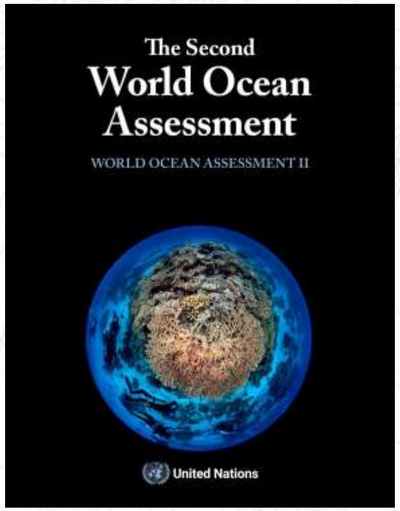
relations: hierarchical structure + others

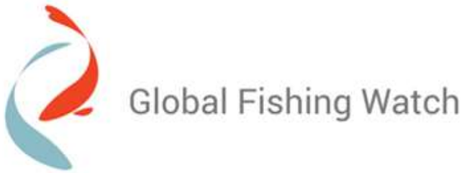
https://marineregions.org/mrgid/63052.ttl

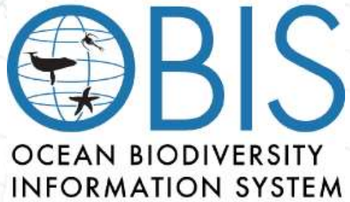
Hierarchical structure

```
<http://marineregions.org/mrgid/2421>
  a mr:MRGeoObject, mrt:SandbankSystem ;
    mr:hasGeometry <http://marineregions.org/mrgid/2421/geometries?source=63&attributeValue=2424> ;
  mr:isPartlyPartOf <http://marineregions.org/mrgid/3293>;
  skos:prefLabel "Flemish Banks"@en ;
  prov:hadPrimarySource <http://www.fao.org/3/CA2741EN/ca2741en.pdf> .

<http://marineregions.org/mrgid/3293>
  a mr:MRGeoObject, mrt:EEZ ;
    mr:isPartOf <http://marineregions.org/mrgid/2350> ;
  skos:prefLabel "Belgian Exclusive Economic Zone"@en ;

<http://marineregions.org/mrgid/2350>
  a mr:MRGeoObject, mrt:IHOSeaArea ;
  skos:prefLabel "North Sea"@en .
```

Who is using Marine Regions?







- **Scientific users**

  Aarhus University | Akvaplan-niva | Australian Antarctic Division | Australian National University | AWI | Bangor University | Cardiff University | CEFAS | CRIMARIO2 | CSIRO | CNRS | Columbia University | Dalhousie University | DHI | Duke University | EarthScope-Oceans | Free University of Brussels | Fort Lewis College | Ghent University | Global Biodiversity Information Facility | Heidelberg University | Hokkaido University | IFREMER | IMARES | Indian National Centre for Ocean Information Services | Institute of Marine Research - Havforskningsinstituttet | Irish Marine Institute | James Cook University | Kenya Marine and Fisheries Research Institute | Leibniz Institute of Marine Sciences | Marine and Environmental Sciences Centre | NIOZ | Pacific Community | Plymouth Marine Laboratory | Project Drawdown | Royal United Services Institute for Defence and Security Studies | Scripps Institution of Oceanography | Universidad Nacional Autónoma de México | University of Delaware | University of Hawaii | University of Tasmania, Australia | University of the West Indies | University of Washington | U.S. Geological Survey | Woods Hole Oceanographic Institution
  ...

- **Governmental users**

  Agence des aires marines protégées | Armada Española | British Antarctic Survey | Canadian Coast Guard | Danish Defence Intelligence Service | Department of Agriculture, Forestry and Fisheries South Africa | European Maritime Safety Agency | Eurostat-GISCO | Fisheries and Oceans Canada | US Environmental Protection Agency | European Environmental Agency | FAO Fisheries and aquaculture department | Geoscience Australia | Italian Navy Hydrographic Institute | Korean Fisheries Monitoring Center | UNEP/GRID-Arendal | International Astronautical Federation | Ministry of Foreign Affairs - Hellinic Republic | National Oceanic and Atmospheric Administration | National Renewable Energy Laboratory | Pacific Islands Forum Fisheries Agency | Space and Naval Warfare Systems Command | Swedish Agency for Marine and Water Management (Havs- och vattenmyndigheten) | UK Space Agency | UNEP-WCMC | US Coast Guard | US Department of Veterans Affairs | US Fleet Forces Command | International Seabed Authority
  ...

- **Private users (marine consultant, offshore activities, maritime surveillance, fisheries)**

  http://www.4coffshore.com | http://www.aereonmarine.com | http://www.apgeophysics.com | http://www.arcadisbelgium.be | http://www.asascience.com | http://www.barrowscompany.com | https://www.belgianoffshoreplatform.be | http://www.bhpbilliton.com | http://www.bp.com | https://www.cgg.com | https://www.cls.fr | http://www.control-risks.com | http://www.dongenergy.com | http://earthx.com | https://www.equinor.com | http://www.esri.com | http://www.exxonmobil.com | http://www.fmglobal.com | https://ihsmarkit.com | https://www.jandenul.com | https://www.lighthouse-geo.com | https://maas-se.nl | http://www.maplecroft.com | http://www.mdacorporation.com | http://www.mcmurdogroup.com | http://www.nautoshark.com | https://www.nkt.com | https://www.omv.com | http://www.ophir-energy.com | http://www.pelagian.co.uk | https://www.pwc.com/ | http://www.ramboll.com | http://www.saic.com | https://www.scanreach.com | http://www.shell.com | http://www.statoil.com | https://www.telstra.com.au | https://travel.saga.co.uk | https://www.vneonline.com | https://voyagerww.com
  ...

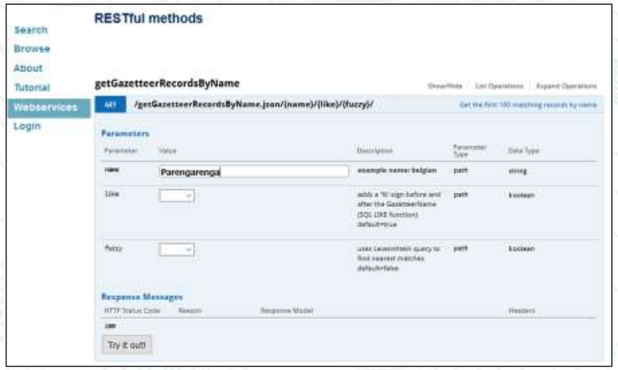
- **NGO's**

  http://www.abcbirds.org/ | http://www.birdlife.org/ | http://www.conservation.org/ | http://www.greenpeace.org/ | http://www.ifaw.org | http://www.iucn.org/ | http://www.nature.org/ | https://oceana.org | http://www.worldfishcenter.org/ | http://www.wwf.org/
  ...

- **Press**

  Bloomberg | Reuters | The New York Times |
  ...

https://www.marineregions.org/stats_users.php



OGC®

Making location count.

```
library(mregions2)

gaz_search_by_type("Fjord")
#> # A tibble: 179 × 14
#> MRGID placeType latitude longitude preferredGazetteerName
#>     <int> <chr>        <dbl>     <dbl> <chr>
#>   1  2504 Fjord         57.0      9.18 Limfjorden
#>   2  2508 Fjord         56.0     10.2  Norsminde fjord
#>   3  3374 Fjord         62.5      6.73 Storfjorden
#> # ℹ 176 more rows
#> # ℹ 9 more variables: preferredGazetteerNameLang <chr>, status <chr>,
#>   accepted <int>, gazetteerSource <chr>, minLatitude <dbl>,
#>   minLongitude <dbl>, maxLatitude <dbl>, maxLongitude <dbl>,
#>   precision <int
```

R

Sharing data

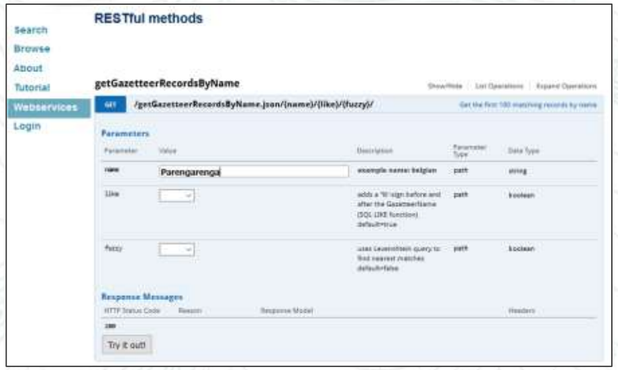
```r
library(mregions2)

# Get a gazetteer record. Uses REST services.
fjord <- gaz_search("Hemnefjord") %>% gaz_geometry()

fjord
#> Simple feature collection with 1 feature and 13 fields
#> Geometry type: MULTIPOLYGON
#> Dimension:     XY
#> Bounding box:  xmin: 9.019378 ymin: 63.28648 xmax: 9.244452 ymax: 63.48781
#> Geodetic CRS:  WGS 84
#> # A tibble: 1 × 14
#>   MRGID gazetteerSource    placeType latitude longitude minLatitude
#>   <int> <chr>              <chr>        <dbl>     <dbl>       <dbl>
#> 1 63052 "Norwegian Enviro… Fjord         63.4      9.15        63.3
#> # ℹ 6 more variables: minLongitude <dbl>, maxLatitude <dbl>,
#> #   maxLongitude <dbl>, preferredGazetteerName <chr>,
#> #   preferredGazetteerNameLang <chr>, the_geom <MULTIPOLYGON [°]>
```

```r
library(rdflib)

# Get as RDF. Uses content negotiation to request content-type = text/turtle
fjord_rdf <- gaz_search(63052, rdf = TRUE)

# You can apply SPARQL queries
sparql <- "
  SELECT ?p ?o
  WHERE {
    <http://marineregions.org/mrgid/63052> ?p ?o
}"

rdf_query(fjord_rdf, query = sparql)
#>  # A tibble: 10 × 2
#>   p                                                o
#>   <chr>                                            <chr>
#> 1 http://marineregions.org/ns/ontology#isAdjacentTo http://marineregions.org/
#> 2 http://www.w3.org/ns/dcat#centroid               <http://www.opengis.net/
#> 3 http://purl.org/dc/terms/modified                2023-05-20T16:35:00Z
#> # ℹ 7 more rows
```

```r
# Create a Leaflet map that uses OGC WMS and accepts CQL filters
mrp_view("eez", cql_filter = "sovereign1 = 'Norway'")
```


```r
# Download a full layer using OGC WFS
mrp_get("eez")
#> Simple feature collection with 285 features and 31 fields
#> Geometry type: MULTIPOLYGON
#> Dimension:     XY
#> Bounding box:  xmin: -180 ymin: -62.78834 xmax: 180 ymax: 86.99401
#> Geodetic CRS:  WGS 84
#> # A tibble: 285 × 32
#>   mrgid geoname      mrgid_ter1 pol_type mrgid_sov1 territory1
#>   <int> <chr>             <int> <chr>         <int> <chr>
#> 1  8444 United Stat…       8670 200NM          2204 American …
#> 2  8379 British Exc…       8620 200NM          2208 Ascension
#> 3  8446 New Zealand…       8672 200NM          2227 Cook Isla…
#> # ℹ 282 more rows
#> # ℹ 26 more variables: iso_ter1 <chr>, sovereign1 <chr>,
#> #   mrgid_ter2 <int>, mrgid_sov2 <int>, …

# And it is also cached!
mrp_get("eez")
#> Cache is fresh. Reading: /tmp/RtmptUIPVz/eez-2a8cde42/eez.shp
#> (Last Modified: 2024-05-16 08:56:34.069465)
```

https://github.com/lifewatch/mregions2



OGC®

Making location count.

```r
library(mregions2)

gaz_search_by_type("Fjord")
#> # A tibble: 179 × 14
#> MRGID placeType latitude longitude preferredGazetteerName
#>     <int> <chr>        <dbl>     <dbl> <chr>
#>   1  2504 Fjord         57.0      9.18 Limfjorden
#>   2  2508 Fjord         56.0     10.2  Norsminde fjord
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#> # ℹ 176 more rows
#> # ℹ 9 more variables: preferredGazetteerNameLang <chr>, status <chr>,
#>   accepted <int>, gazetteerSource <chr>, minLatitude <dbl>,
#>   minLongitude <dbl>, maxLatitude <dbl>, maxLongitude <dbl>,
#>   precision <int
```

```
<https://www.marineregions.org/feed.ttl?page=2024-05-10T09%3A00%3A00Z%2F2024-05-10T10%3A00%3A00Z>
        a tree:Node ;
        tree:relation [ tree:node <https://www.marineregions.org/feed.ttl?page=2024-05-04T02%3A00%3A00Z%2F2024-05-04T03%3A00%3A00Z> ] ;
        ldes:retentionPolicy [
                a ldes:LatestVersionSubset ;
                ldes:amount 1 ;
                ldes:versionKey ( dc:isVersionOf )
] .
```

Linked Data Event Stream (LDES) https://www.marineregions.org/feed

Sharing data

Live replication with LDES feeds


```
...

<http://marineregions.org/feed?page=2021-09-07T09:00:00Z/2021-09-07T10:00:00Z>
  a tree:Node ;
  tree:relation [ tree:node <http://marineregions.org/feed?page=2021-09-06T12:00:00Z/2021-09-06T13:00:00Z> ] ;
  ldes:retentionPolicy [
       a ldes:LatestVersionSubset ;
       ldes:amount 1 ;
       ldes:versionKey ( dc:isVersionOf )
  ] .

...

<http://marineregions.org/mrgid/35127?t=1631005686>
  dc:isVersionOf <http://marineregions.org/mrgid/35127> ;
  dc:modified "2021-09-07T09:08:06Z"^^xsd:dateTime .

<http://marineregions.org/mrgid/58739?t=1631005686>
  dc:isVersionOf <http://marineregions.org/mrgid/58739> ;
  dc:modified "2021-09-07T09:08:06Z"^^xsd:dateTime .
```

- Collection of **immutable** objects
- Specification: https://w3id.org/ldes/specification
- Marine Regions LDES: http://marineregions.org/feed

Take home messages

Marine Regions is a **global standard** of marine georeferenced place names

Use it:
- for your own information
- In your research
- In your online viewer through OGC WMS

Or replicate the whole database via LDES and add to your RDF knowledge graph.

License CC-BY: Free for all – Just cite us ☺

Marine Regions Data Management Team
Salvador J. **Fernández Bejarano**, Britt **Lonneville**, Lawrence **Whatley**, Bart **Vanhoorne**, Lennert **Schepers**

Questions? info@marineregions.org

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towards a standard for georeferenced marine names

LifeWatch
BELGIUM

2021 2030 United Nations Decade of Ocean Science for Sustainable Development

27-29 May 2024

imdis

International conference on **M**arine **D**ata and **I**nformation **S**ystems

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