

RAM Legacy Stock Boundary Database Guide

I delineated the spatial boundaries of the 685 non-salmon stocks in the RAM Legacy Stock Assessment Database (RAMLDB v3.8; Ricard et al. 2012) and 211 of the 370 marine fish stocks in the original Ram Myers stock-recruit database (RAMSR; Myers et al. 1995) by either (1) merging the statistical/management areas used to define the assessment area; (2) digitizing the assessment area directly from the stock assessment; or (3) clipping the managing country's exclusive economic zone or the managing agency's area of competence to the geographical reference points provided in the stock assessment. In the USA and Australia, I used information on the geographic distribution of each species to further constrain stock boundaries. Country-specific delineation methods are summarized in **Table 1** and are discussed in more detail below.

GIS shapefiles and images of each stock boundary are available for download here:

<https://marine.rutgers.edu/~cfree/ram-legacy-stock-boundary-database/>

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Database structure

The RAMLDB stock boundaries are available as ESRI shapefiles with WGS 1984 projections. The attribute table for each shapefile includes the following information:

1. **ASSESSID:** RAMLDB assessment id
2. **STOCKID:** RAMLDB stock id
3. **STOCKID_RAMSR:** RAMSR stock id (if applicable)
4. **MGMT:** Management agency
5. **ASSESSOR:** Assessment agency
6. **COUNTRY:** Country (or multinational RFMO)
7. **REGION:** Region
8. **AREA:** Area
9. **AREA_CODE:** RAMLDB area code
10. **STOCKLONG:** Stock name (species common name + area name)
11. **SPECIES:** Species scientific name
12. **COMM_NAME1:** Species common name
13. **COMM_NAME2:** Species common name (alternative)
14. **SHP_SOURCE:** Original shapefile source
15. **SHP_PATH:** Original shapefile name
16. **ZONE_COL:** Column in the shapefile listing zones
17. **ZONES:** Zones in the shapefile defining the stock boundary
18. **NOTES:** Notes on delineating the stock boundary from the original shapefile

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1. United States

I delineated stock boundaries for US managed fish stocks using a combination of Essential Fish Habitat (EFH) and fisheries management/statistical area GIS layers. The mapping of Essential Fish Habitat, the habitat required for a fish species to complete its entire life cycle, is mandated for all federally-managed fish species (MSFCA §600.805) and has been conducted for approximately 1,000 fish species using the best available species- and life-stage-specific information on depth, substrate, temperature, and habitat preferences.

For each stock, I merged the EFH layers of all life stages (e.g., eggs, larvae, juvenile, adult, etc.) and clipped the merged EFH layer to the fisheries management or statistical areas described by the stock assessment. The EFH layers were all accessed through the NOAA EFH Text Descriptions & GIS Data Inventory website (NOAA 2017). The relevant fisheries management or statistical areas were collected from regional Fishery Management Council (FMC) or NOAA Science Center websites or derived from the stock assessment represented in the RAMLDB. I provide a detailed description of this process for each region below.

New England/Mid-Atlantic: EFH information in New England and the Mid-Atlantic is species-specific. When necessary, EFH information was clipped to the Georges Bank, Gulf of Maine, or Southern New England/Mid-Atlantic management areas.

Southeast/Gulf of Mexico: EFH information in the Southeast and Gulf of Mexico is for larger taxonomic groupings (e.g., snapper-grouper complex, reef fish, coastal migratory pelagics, shrimp, lobster, coral, etc.). When necessary, EFH information was clipped to either the Southeast or the Gulf of Mexico or combined for the two regions.

West Coast: EFH information on the West Coast is also for larger taxonomic groupings (e.g., groundfish, coastal migratory pelagics, etc.). When necessary, EFH information was clipped to the lines of latitude used to delineate West Coast stocks. For example, West Coast stocks are frequently delineated using the International North Pacific Fisheries Commission (INPFC) statistical areas, state/national borders, and Point Conception, CA.

Alaska: EFH information in Alaska is species-specific. When necessary, EFH information was clipped to the Gulf of Alaska, Aleutian Islands, or Eastern Bering Sea regions using a modified version of the Marine Ecoregions of the World (MEOW; Spalding et al. 2007) dataset. We used the MEOW dataset rather than the Large Marine Ecoregion (LME; NOAA 2017) or High Seas Areas (HSA; IHO 2017) datasets because these three regions all share borders in the MEOW dataset but are either omitted or disjoint in the other two datasets.

Highly Migratory Species (HMS): EFH information on Highly Migratory Species is species-specific on both coasts. When necessary, EFH information was clipped to either the Southeast or Gulf of Mexico or combined for the two regions.

EFH information was unavailable for fourteen US-managed fish stocks. These stocks were delineated using only the statistical/management areas represented in the stock assessment:

1. Georges Bank – American lobster
2. Gulf of Maine – American lobster
3. Southern New England – American lobster
4. Gulf of Maine – Northern shrimp
5. Atlantic Coast – Striped bass
6. Atlantic Coast – Atlantic menhaden
7. Atlantic Coast – Weakfish
8. Chesapeake Bay – Blue crab
9. Mid-Atlantic Coast – Atlantic croaker
10. Gulf of Mexico – Gulf menhaden
11. AK Prince William Sound – Pacific herring
12. AK Sitka – Pacific herring
13. AK Togiak District – Pacific herring
14. Washington – Pacific geoduck

I did not delineate stock boundaries for the US Alaska salmon (n=190) or US West Coast salmon (n=24) stocks included in the RAMLBD.

2. Europe

The European stocks assessed by the International Council for the Exploration of the Sea (ICES), General Fisheries Commission for the Mediterranean (GFCM), and European Union Scientific, Technical, and Economic Committee for Fisheries (STECF) were delineated using the statistical areas described by the stock assessment (e.g., ICES IVa or GFCM 21). The statistical area layers were downloaded directly from the organizations' websites.

3. Canada

The Canadian stocks assessed by Fisheries and Oceans Canada (DFO) were delineated using the DFO, Northwest Atlantic Fisheries Organization (NAFO), or Pacific States Marine Fisheries Commission (PSMFC) statistical areas described by the stock assessment. The NAFO statistical areas were downloaded directly from the NAFO website. The DFO and PSMFC statistical areas were not available online and were either shared by DFO employees or were digitized directly from the stock assessment. I did not delineate stock boundaries for the Canada West Coast salmon stocks (n=122) included in the RAMLBD.

4. New Zealand

The New Zealand stocks assessed by the Ministry of Fisheries (MFish) were delineated using the Quota Management Areas (QMAs) used to define stocks and allocate quotas geographically. However, in many cases, the stock assessments describe only a portion of a given QMA and many boundaries were digitized to match the true scope the assessment. The QMA shapefiles were not available online and were shared by Dr. Phil Neubauer of Dragonfly Science.

5. Tuna RFMOs

The tuna, marlin, swordfish, and sailfish stocks are assessed by six Regional Fishery Management Organizations (RFMOs) and were delineated by clipping each RFMO's area of competence to the spatial domain of each stock assessment. The RFMO area of competences were downloaded from the FAO website and were clipped based on lines of latitude/longitude provided in the stock assessment or from maps digitized from the stock assessment.

6. West Africa

The West African stocks assessed by the Food and Agriculture Organization of the United Nations (FAO) were delineated using either (1) the full exclusive economic zones (EEZs) of the nations represented in the assessment or (2) the West African EEZ clipped by the lines of latitude bounding each assessment. The stocks managed by the FAO/CECAF Demersal Working Groups were generally delineated using the first method while the stocks managed by the FAO/CECAF Small Pelagics Working Group were generally delineated using the second method.

7. Australia

The Australian stocks assessed by the Australian Fisheries Management Authority (AFMA), South Australian Research and Development Institute (SARDI), and Department of Primary Industry and Fisheries (DPIF) were delineated by clipping modelled fish distributions from the Atlas of Living Australia (ALA) to the statistical/management areas represented in the stock assessment. Australian statistical/management areas were not available online and had to be digitized directly from the stock assessment. The modelled fish distributions are based on species-specific depth and distance from coast preferences.

8. Japan

The Japanese stocks assessed by the Fisheries Agency and Fisheries Research Agency of Japan (FAFRFJ) were delineated by either (1) digitizing the assessment area directly from the stock assessment or (2) clipping the Japanese EEZ to an area informed by both the distribution of the taxa on FishBase and the area information provided in the RAMLDB. For the latter method, I divided the Japanese EEZ into the five areas attributed to Japanese stocks in the RAMLDB – the Pacific Coast of Japan, Inland Sea of Japan, Sea of Japan, Tsushima Strait, and East China Sea – using the Large Marine Ecoregions (LME; NOAA 2017) GIS layer.

9. Chile

The Chilean stocks assessed by the South Pacific Regional Fisheries Management Organization (SPRFMO) were delineated using Chile's fishery management zones (1-5). These management zones are based on the EEZ of groupings of Chile's administrative regions.

10. South Africa

The South African stocks assessed by the Marine Resource Assessment and Management Group (MARAM) of the University of Cape Town were delineated by either (1) digitizing the assessment area directly from the stock assessment or (2) clipping the South African EEZ to lines of latitude/longitude provided in the stock assessment.

11. North Atlantic

The North Atlantic stocks assessed by the Northwest Atlantic Fisheries Organization (NAFO) and Transboundary Resource Assessment Committee (TRAC) were delineated using the NAFO statistical areas described by the stock assessment. The NAFO statistical areas were downloaded directly from the NAFO website.

12. Other countries

I delineated stocks assessed by Argentina (CFP), Russia (RFFA), Taiwan (IMARM), Peru (IMARPE), and Iran (CSERG) by digitizing the assessment areas directly from the stock assessments. I delineated stocks assessed by CCAMLR (Ross Sea Antarctic toothfish) and IPHC (North Pacific halibut) using the statistical areas described by the stock assessment. The statistical areas were downloaded from the FAO website. I did not delineate stock boundaries for the Russia/Japan salmon stocks (n=37) included in the RAMLDB.

RAMSR Stock Boundary Database

I delineated the spatial boundaries of 211 of the 370 marine fish stocks (295 anadromous and 112 freshwater fish stocks excluded) in the original Ram Myers stock-recruitment database (RAMSR; Myers et al. 1995) using a combination of (1) the RAMLDB stocks delineated above and (2) novel boundaries produced using the same general approaches as described above. I delineated the boundaries of the 136 stocks with >20 yr of biomass and recruitment data plus an extra 75 stocks. I will delineate the remaining stocks if/when time allows.

The RAMSR stock boundaries are available as ESRI shapefiles with WGS 1984 projections. The attribute table for each shapefile includes the following information:

1. **STOCKID_RAMSR:** RAMSR stock id
2. **STOCKID_RAMLDB:** RAMLDB stock id (if applicable)
3. **COUNTRY:** Country
4. **REGION:** Region
5. **AREA:** Area
6. **TYPE:** Type (marine/freshwater/anadromous)
7. **ORDER:** Order
8. **FAMILY:** Family
9. **COMMON_NAME:** Common name
10. **SCI_NAME:** Scientific name
11. **YR1:** First year in the time series
12. **YR2:** Last year in the time series
13. **N:** Number of years in the time series
14. **SHP_SOURCE:** Method for delineating the stock boundary

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Tables & Figures

Table 1. Stock boundary delineation methods for the 685 non-salmon stocks in the RAMLDB (v3.8).

Country/region	Management agencies	Total	General approach
USA	NMFS, AK-State, WA-State, MD-State	163	Fish distributions clipped to stat/mgmt areas
Europe	ICES, GFCM, STECF	157	Statistical/management areas
Canada	DFO	129	Statistical/management areas
New Zealand	MFish	49	Quota management areas (QMAs)
Tuna-RFMOs	ICCAT, IOTC, WCPFC, ISC, IATTC, CCSBT	40	Areas of competence clipped by lat/long
West Africa	FAO	36	EEZ clipped by nation groups/latitude
Australia	AFMA, SARDI, DPIF	24	Fish distributions clipped to stat/mgmt areas
Japan	FAFRFJ	23	Digitized from assessments, EEZ clipped by region
Chile	SPRFMO	20	EEZ clipped by regions/zones/areas
South Africa	DETMCM	15	EEZ clipped by latitude
North Atlantic	NAFO, TRAC	15	Statistical/management areas
Argentina	CFP	6	EEZ clipped by latitude
Russia	RFFA	3	Digitized from stock assessment
Taiwan	IMARM	1	Digitized from stock assessment
Peru	IMARPE	1	Digitized from stock assessment
Iran	CSEGR	1	Digitized from stock assessment
Antarctica	CCAMLR	1	Statistical/management areas (FAO 88.1 and 88.2)
North Pacific	IPHC	1	Area of competence

Figure 1. Examples of US-managed stock boundaries (coming soon).

Figure 2. Examples of non-US-managed stock boundaries (coming soon).