ACE DATASET FACT SHEET
Aquatic Rare Species Richness

DS2748

SUBSETS BY TAXONOMIC GROUP

DS2749 – Rare Fish Richness
DS2750 – Aquatic Rare Amphibian Richness
DS2751 – Aquatic Rare Reptile Richness

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INTENT AND PURPOSE

Aquatic rare species richness is a measure of species biodiversity, and is one measurement used to describe the **distribution of overall species biodiversity in California** for the California Department of Fish and Wildlife (CDFW) Areas of Conservation Emphasis Project (ACE). Other measures of aquatic species biodiversity included in the ACE aquatic biodiversity summary are aquatic native species richness and aquatic irreplaceability. Here, rare species richness represents a count of the total number of rare aquatic species potentially present in each watershed based on documented species occurrence information. This dataset depicts the distribution of richness of **all aquatic species in the state, both common and rare**. The data can be used to **view patterns of species rarity**, and to **identify areas of highest rarity richness** across the state. Users can **view a list of species** that contribute to the richness counts for each watershed.

The **aquatic rare species richness summary** depicts relative diversity within watersheds across the state. To correct for differences in the number of taxa per taxonomic group, the data was normalized by taxonomic group (see Data Sources and Models Used, below). The **aquatic native species richness by taxonomic group** layers give a statewide overview of richness for each individual taxonomic group, showing counts of species per watershed for aquatic amphibians, fish, and aquatic reptiles.

Areas of Conservation Emphasis

The separate Aquatic Biodiversity datasets were a new addition to ACE in 2017. The previous version of ACE (ACE-II) combined aquatic information, including fish distribution data, in the terrestrial hexagons, and did not include aquatic invertebrate data. ACE version 3 models aquatic data by watershed (National Hydrography Dataset at the HUC 12 level (HUC 12) rather than by hexagon.

Further work developing the ACE Aquatic data will continue in 2018 (ACE 3, phase 2). This includes continuing to compile and incorporate new aquatic species distribution and occurrence information as it becomes available, and further refining the aquatic species list.

DATA SOURCES AND MODELS USED

For ACE version 3, aquatic rare species richness was based on documented occurrence data for aquatic amphibians (n=36), fish (n=90), and aquatic reptiles (n=12). Taxa were defined and aggregated at the taxonomic unit at which they are listed and tracked by the California Natural Diversity Database (CNDDB), which may be by species, subspecies, distinct population segment (DPS), or evolutionarily significant unit (ESU). Aquatic invertebrates were included in the overall native richness counts but not in the aquatic rarity counts because much of the aquatic invertebrate occurrence data was only available at the taxonomic level of family, while rarity is usually designated at the level of species or subspecies. Data for aquatic members of other taxonomic groups, including plants, mammals, and birds, have not yet been included in ACE.

Data Sources

Aquatic rare species location data were derived from available documented, mapped species occurrences. Sources included "presumed extant" California Natural Diversity Database (CDFW 2017) records (excluding extirpated and possibly extirpated records); additional museum records from the California Academy of Sciences, the Museum of Vertebrate Zoology at UC Berkeley; and additional datasets from the CDFW BIOS online map viewer (https://www.wildlife.ca.gov/Data/BIOS), used with permission from the contributors. All documented occurrences with accuracy ±1 mile or better were included in order to incorporate as many known occurrences as possible. Aquatic rare species data was not buffered by 1 mile as the terrestrial rare species data was. No cut-off date of observation was used, based on the assumption that occurrences still may be present if the habitat has not been modified and the occurrences have not been documented as extirpated. Each species was counted for each HUC12 watershed(s) with which its occurrence locations intersected.

Data Processing Steps and Ranking Criteria

Data normalization by taxonomic group corrected for any bias caused by differences in the number of taxa per taxonomic group. Due to large differences in total numbers of species between taxonomic groups, the sum of total species richness based on raw counts of species resulted in richness maps highly skewed toward the taxonomic group(s) with the largest numbers of species. In order to give each taxonomic group equal weight in the final model output, the taxa counts were normalized (scaled from zero to one): The count in each watershed for a given taxonomic group was divided by the maximum value for that taxonomic group across the state. Aquatic data was not normalized by ecoregion as the terrestrial data was. Statewide normalized values for each taxonomic group were summed by watershed to create the Aquatic Rare Species Richness summary.

Data processing steps:

1. **Rare species richness counts**: The number of taxa per HUC 12 watershed was counted by taxonomic group: **aquatic amphibians, fish, and aquatic reptiles**. Any taxon with a documented occurrence intersecting the watershed was counted as present for the watershed.
2. **Normalized richness:** The counts by taxonomic group per HUC 12 watershed were normalized (scaled from zero to one) statewide.
3. **Rare species richness summary**: The normalized richness values were summed across taxonomic groups by watershed to produce the Aquatic Rare Species Richness Summary.
4. **Final ranking**: To display the relative richness values, the rare species richness summary was ranked from 1-5 using 5 quantiles (i.e., the 20% of watersheds with the highest scores were given a 5, the 20% of watersheds with the lowest scores were given a 1).

HOW TO USE THE DATA LAYER

The aquatic rare species richness maps can be used to view and explore how aquatic rare species diversity is distributed across the state. The user can choose the view that best meets their needs: whether that be patterns of overall diversity shown by the species richness summary, or diversity by individual taxonomic group. By selecting a watershed in the viewer, the user can see the number of rare terrestrial vertebrate species counted in the watershed, the relative rank of the watershed compared to the rest of the state, and view a list of species potentially present. Note that because the rare species data is based on documented occurrences, the values shown are influenced by level of survey effort in a given area.

Frequent uses of this group of datasets include:

-   Identify the number of rare species potentially present within a watershed based on documented species occurrences (using the Identify Features tool or GIS attribute table)

- Obtain a list of those potentially present species (using the Identify Features tool on the Species List dataset in the ACE viewer)
- View relative richness across the state for a given taxonomic group (viewing Rare Species Richness by taxonomic group)
- Identify the highest rarity areas in the state for a given taxonomic group (using the Identify Features tool or GIS attribute table to obtain statewide normalized values and ranks for each taxonomic group)
- View relative overall aquatic rare species richness across the state (viewing Rare Species Richness Summary)
- Identify the highest overall aquatic rare species richness areas in the state (Rank 5 watersheds in Rare Species Richness Summary)

Field Definitions

Using the *Identify Features* or *Select* tool in the ACE viewer, users can obtain a table of information (i.e., attribute table) for a watershed or area of interest. The ACE viewer allows the user to print the table or save it as a spreadsheet (.csv file). The definitions below describe the attribute table fields for this dataset.

Field	Definition
Rare Fish Count	Count of rare fish taxa within the HUC 12 watershed based on documented occurrences. Taxa are defined and aggregated at the taxonomic unit at which they are listed and tracked by the California Natural Diversity Database (CNDDB), which may be by species, subspecies, distinct population segment (DPS), or evolutionarily significant unit (ESU). Taxa are not double counted within the HUC 12 watershed.
Rare Aquatic Amphibian Count	Count of rare aquatic amphibian taxa within the HUC 12 watershed based on documented occurrences. Taxa are defined and aggregated at the taxonomic unit at which they are listed and tracked by the California Natural Diversity Database (CNDDB), which may be by species, subspecies, distinct population segment (DPS), or evolutionarily significant unit (ESU). Taxa are not double counted within the HUC 12 watershed.
Rare Aquatic Reptile Count	Count of rare aquatic reptile taxa within the HUC 12 watershed based on documented occurrences. Taxa are defined and aggregated at the taxonomic unit at which they are listed and tracked by the California Natural Diversity Database (CNDDB), which may be by species, subspecies, distinct population segment (DPS), or evolutionarily significant unit (ESU). Taxa are not double counted within the HUC 12 watershed.
Rare Aquatic Species Weight	Sum of aggregated statewide normalized values for all rare aquatic taxa within each watershed. Final sum is scaled from zero to one statewide for ease of interpretation.

Field	Definition
Rare Aquatic Species Rank	Ranks of 1-5 assigned to the statewide normalized aquatic rare species richness values, with all zero values removed and remaining values broken into 5 quantiles, each containing the same number of HUC 12 watersheds.

DATA PRECISION AND LIMITATIONS

The rare species occurrence datasets compiled for use in ACE rely on voluntary submission of data to the Department. Surveys for rare species have not been conducted comprehensively across the entire landscape. Therefore, current maps of verified rare species occurrences are expected to be biased by level of survey effort and have **high rates of omission error** (locations where the species exists but is not documented). For this reason, counts of rare species richness would be expected to be *underestimates* in some watersheds, particularly those for which no survey data are available. Verified species occurrences mapped by CNDDB and museum data tend to be spatially biased toward areas with high levels of survey effort, which may result in particularly high rare species richness values in well-surveyed areas.

DATA ACCESS

All ACE datasets are available for viewing and download in BIOS. Detailed maps of species occurrences are available with a CNDDB subscription, and are not available in ACE.

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ACKNOWLEDGEMENTS

SELECTED PUBLICATIONS

California Department of Fish and Game (CDFG). 2010. Areas of Conservation Emphasis (ACE-II) Project Report. Sacramento, California.

California Department of Fish and Wildlife. 2015. California State Wildlife Action Plan, 2015 Update: A Conservation Legacy for Californians. Armand G. Gonzales and Junko Hoshi (editors). Prepared with assistance from Ascent Environmental, Inc., Sacramento, CA.

California Department of Fish and Wildlife (CDFW). 2017. California Natural Diversity Database (CNDDB). Accessed Sept 5, 2017. https://www.wildlife.ca.gov/Data/CNDDB

For additional information and a full list of ACE 3 Factsheets, see the ACE3 Technical Report.

Areas of Conservation Emphasis, CA Dept of Fish and Wildlife, www.wildlife.ca.gov/Data/Analysis/Ace