ACE DATASET FACT SHEET

Aquatic Native Species Richness

DS2743

DATA BY TAXONOMIC GROUP

DS2744 – Native Fish Richness
DS2745 – Native Aquatic Invertebrate Richness
DS2746 – Native Aquatic Amphibian Richness
DS2747 – Native Aquatic Reptile Richness

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INTENT AND PURPOSE

Aquatic native 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 rare species richness and aquatic irreplaceability. Here, native species richness represents a count of the total number of native aquatic species potentially present in each watershed based on species range and distribution 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 diversity**, and to **identify areas of highest native richness** across the state. Users can **view a list of species** that contribute to the richness counts for each watershed.

The **aquatic native 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,

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showing counts of species per watershed for aquatic amphibians, fish, aquatic invertebrates, and aquatic reptiles.

BACKGROUND INFORMATION

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 native species richness was based on distribution data for aquatic amphibians (n=36), fish (n=127), aquatic invertebrates (n=183 by Family), and aquatic reptiles (n=12). Data for aquatic members of other taxonomic groups, including plants, mammals, and birds, have not yet been included in ACE.

Data Sources

Amphibian and Reptile distribution data was based on California Wildlife Habitat Relationships (CWHR) Predicted Habitat Suitability models. These models represent potential suitable habitat within the range of each species based the CWHR species range, CWHR species habitat relationship table, and the best available habitat/landcover map (FVEG2015). All native aquatic amphibian and reptile species for which a CWHR Predicted Habitat Suitability Model was available were included in the counts. If any potentially suitable habitat for a species was mapped within a watershed, the species was counted as potentially present in the watershed. These species counts were based on full species only; counts did not consider subspecies or varieties because range maps were generally not available at the subspecific level. The CWHR Predicted Habitat Suitability Models for each species are available in BIOS.

Fish distribution data was based on fish ranges as mapped in Pisces (Santos et al. 2014, https://pisces.ucdavis.edu/). The Department is in the process of updating these range maps. If the species range intersected a watershed, the species was counted as potentially present in the watershed. Fish species counts were based on full species only; if separate ranges were available for subspecies, these were combined at the full species level before running the analysis. The Pisces range map for each species is available in BIOS.

Invertebrate distribution data was based on observation point data. Freshwater macroinvertebrate data were extracted from the California Environmental Data Exchange Network database (CEDEN, accessed September 15, 2017). Records were queried from four CEDEN "Projects" (NLA, SWAMP, DFW-ABL, and EMAP). Records primarily consist of data collected under the State Water Board's

Surface Water Ambient Monitoring Program (SWAMP) using the SWAMP Bioassessment Protocols (Ode et al. 2016). A small percentage of samples (i.e., less than 10%) were collected by other programs, but almost all of these followed the same sampling protocols. The vast majority of invertebrate identifications were performed by taxonomists at the DFW-Aquatic Bioassessment Laboratory following the procedures documented by the Southwest Association of Freshwater Invertebrate Taxonomists (SAFIT). The extracted records were screened to remove non-freshwater invertebrate taxa and non-native taxa.

Counts for invertebrates were done by family, due to the taxonomic level to which many of the invertebrate specimens were identified. If a data point was present in a watershed, the family was counted for that watershed.

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 species counts were normalized (scaled from zero to one): The count in each HUC 12 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 Native Richness values.

Data processing steps:

1. **Native species richness counts**: The number of species per watershed was counted by taxonomic group: **aquatic amphibians, fish, aquatic invertebrates, and aquatic reptiles**.
2. **Normalized richness:** The counts by taxonomic group per watershed were normalized (scaled from zero to one) statewide.
3. **Native species richness summary**: The normalized richness values were summed across taxonomic groups by watershed to produce the Aquatic Native Species Richness Summary**.**
4. **Final ranking**: To display the relative richness values, the native species richness summary was ranked from 1-5 using 5 quantiles. The 20% of watersheds with the highest scores were given a 5 (highest score), the 20% of watersheds with the lowest scores were given a 1, etc.

HOW TO USE THE DATA LAYER

The aquatic native species richness maps can be used to view and explore how aquatic diversity, including common and rare species, 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 terrestrial vertebrate species with potential habitat in the watershed, the relative rank of the watershed compared to the rest of the state, and view a list of species potentially present.

Frequent uses of this group of datasets include:

- Identify the number of species potentially present within a watershed based on species range and distribution information (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)
- Overlay BIOS layers of Predicted Habitat Distribution models or Range Maps for individual species, to obtain a finer-grain view of species distributions in the landscape
- View relative richness across the state for a given taxonomic group (viewing Native Richness by taxonomic group)
- Identify the highest richness 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 native richness across the state (viewing Native Richness Summary)
- Identify the highest overall aquatic native richness areas in the state (Rank 5 watersheds in Native 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 hexagon or area of interest. The ACE viewer allows the user to print the table or save as a spreadsheet (.csv file). The definitions below describe the attribute table fields for this dataset.

Field	Definition
Native Fish Count	Count of native fish ranges that intersect each HUC 12 watershed. Fish taxa are aggregated to full species level before counting.
Native Aquatic Invertebrate Count	Count of native aquatic invertebrate taxa that occur within the HUC 12 watershed based on stream survey data.
Native Aquatic Amphibian Count	Count of native aquatic amphibian potential habitat models that intersect the HUC 12 watershed.
Native Aquatic Reptile Count	Count of native aquatic reptile potential habitat models that intersect the HUC 12 watershed.
Native Aquatic Species Weight	Sum of aggregated statewide normalized values for all native aquatic taxonomic groups for each HUC12 watershed, scaled from zero to one statewide for ease of interpretation.

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

DATA PRECISION AND LIMITATIONS

This dataset is meant to represent broadscale patterns of species richness and diversity in the landscape, and is limited by the accuracy and scale of the input data. The final maps show native richness by watershed. However, the species counted within each watershed do not necessarily occur across the entire watershed, and their occupied habitat is limited to suitable habitat types within the watershed.

Because the range and distribution data used are coarse-scale and have been designed to prioritize commission error (predicting presence when the species is absent) over omission error (predicting absence when the species is present), we expect the result will generally *overestimate* species richness. Therefore, the native richness values per watershed represent generalizations of the distribution of diversity throughout the state, but are not meant to represent actual number of species present per watershed at a given point in time. The list of potential species in each watershed includes all species that could potentially occur within the area, but it is unlikely that all of those species would be found in an area at a given point in time.

The CWHR predicted habitat models were based on expert-opinion species-habitat relationship tables, which may vary in accuracy based on the how well-studied a species is. The species-habitat relationship tables were made spatial by applying the information to the "best available" vegetation map. This data was represented in raster format with a pixel size of 30 meters. In the case of species that rely on habitat types that are difficult to map at this scale, such as riparian or wetland habitat types, the amount of representative habitat may be underestimated or inaccurately mapped due to aggregation into pixels with a majority type not used by the species. In addition, the vegetation datasets used to develop FVEG2015 vary in age and accuracy. Information on vegetation map age and data source are available in the attribute table of the FVEG map. The predicted habitat models were based on landcover only, and did not consider other variables such as patch size and distance to water that may influence where a species occurs in the landscape. In addition, if the aquatic habitats used by a species are not well represented in vegetation maps, the predicted habitat models based on vegetation may inaccurately predict their distributions.

The distribution data for aquatic macroinvertebrates is based on field sampling data, and is therefore limited to those watershed where samples have been collected. The number of species identified as present per watershed may be influenced by the level of survey effort within a watershed.

DATA ACCESS

All datasets are available for viewing and download in BIOS.

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CWHR Predicted Habitat Suitability Models: Sandra Hill and Melanie Gogol-Prokurat, Conservation Analysis Unit

GIS Scripting: Ryan Hill and Sandra Hill

Factsheet: Melanie Gogol-Prokurat

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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