Terrestrial Rare Species Richness

DS2709

DATA BY TAXONOMIC GROUP

DS2710 – Rare Plant Richness
DS2711 – Rare Bird Richness
DS2712 – Rare Mammal Richness
DS2713 – Rare Amphibian Richness
DS2714 – Rare Reptile Richness

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INTENT AND PURPOSE

Rare species richness is a measure of the diversity of rare species in the landscape, and is one measurement used to describe the **distribution of overall species biodiversity in California** for the California Department of Fish and Wildlife's (CDFW) Areas of Conservation Emphasis Project (ACE). Other measures of terrestrial species biodiversity included in the ACE terrestrial biodiversity summary are native species richness and terrestrial endemism. Here, rare species richness represents a count of the total number of rare terrestrial species potentially present in each hexagon based on documented species occurrence information. The data can be used to **view patterns of species rarity**, and to **identify areas of high rarity richness** across the state and in each ecoregion. Users can **view a list of species** that contribute to the richness counts for each hexagon.

The **rare species richness summary** depicts relative rare species diversity within each ecoregion across the state, so that areas of highest diversity within each ecoregion are highlighted. To achieve this, the

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data in the summary layer was normalized by taxonomic group and by ecoregion (see Data Sources and Models Used, below). The **rare species richness by taxonomic group** layers give a statewide overview of rarity for each individual taxonomic group, showing counts of species per hexagon for amphibians, birds, mammals, plants, and reptiles.

BACKGROUND INFORMATION

The difference between this rare species richness dataset and the previous version of ACE (ACE-II) is that this dataset only includes terrestrial species; fish are now included in a separate aquatic rare species richness dataset.

The previous version of ACE (ACE-II) included two different rare species richness maps: statewide richness and richness by ecoregion. The new viewer displays only the rare species richness summary normalized by ecoregion, since this dataset is the scale most relevant for most planning processes in California. The statewide rare species richness summary not normalized by ecoregion (highlighting high richness areas on a statewide basis, not by ecoregion) is not shown in the ACE viewer but is still available as a separate layer in BIOS (ds1333), and the relative statewide values are available in the ACE rare species richness GIS attribute table.

DATA SOURCES AND MODELS USED

Rare species included in this ACE version 3 analysis included State and Federally-listed species, Species of Special Concern (SSC), fully-protected species, and California Rare Plant Rank (CRPR) 1B and 2 rare plants. This list includes all species that were defined as Species of Greatest Conservation Need (SGCN) in the State Wildlife Action Plan (SWAP; CDFW 2015) based on their rarity status. Rare species richness counts were conducted for amphibians (n=34), birds (n=100), mammals (n=94), plants (n=1672), and reptiles (n=36) at the taxonomic level treated as special status (e.g., species, subspecies, ecologically significant unit).

Source Data

Terrestrial rare species location data were derived from available documented, mapped species occurrences. Sources included "presumed extant" California Natural Diversity Database 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 the Consortium of California Herbaria (from years 1999-2009); 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. 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. A one mile buffer was added to all occurrence points and polygons to standardize accuracy.

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 raw sum of total species richness based on 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 hexagon for a given taxonomic group was divided by the maximum value for that taxonomic group. To identify and highlight areas of greatest richness within each ecoregion, the count for each taxonomic group was divided by the maximum value for that taxonomic group within each ecoregion (ecoregional normalization). The ecoregionally normalized values identify the areas of greatest species richness within each ecoregion, and were summed to create the Rare Species Richness Summary. Statewide normalized values (the count for each taxonomic group was divided by the maximum value for that taxonomic group across the state), which give a picture of relative diversity on a statewide basis, were also produced and are available in the GIS attribute table for reference.

Data processing steps:

1. **Rare species richness counts**: The number of species per hexagon was counted by taxonomic group: **amphibians, birds, mammals, plants, and reptiles**. All species occurrences were buffered by one mile.
2. **Normalized richness:** The counts by taxonomic group per hexagon were normalized (scaled from zero to one) statewide [statewide richness] and ecoregionally [ecoregional richness].
3. **Rare species richness summary**: The ecoregional richness values were summed across taxonomic groups to produce the Rare Species Richness Summary. Statewide richness values are provided in the attribute table for reference, and a summarized version of these datasets is available separately in BIOS (ds1333).
4. **Final ranking**: To display the relative richness values, the rare species richness summary was ranked from 1-5 using 5 quantiles by ecoregion. The 20% of hexagons with the highest scores in each ecoregion were given a 5 (highest score), the 20% of hexagons with the lowest scores in each ecoregion were given a 1, etc. Note that due to differences in size between ecoregions, and differences in the number of species potentially occurring in each ecoregion, the number of hexagons ranked in each category (1-5) differs across ecoregions, and the number of species present in a hexagon with a given score also varies across ecoregions.

<div align="center">HOW TO USE THE DATA LAYER</div>

The rare species richness maps can be used to view and explore how rare species diversity is distributed across the state and within each ecoregion. The user can choose the view that best meets their needs: whether that be patterns of overall diversity by ecoregion shown by the rare species richness summary, or statewide patterns of diversity by individual taxonomic group. By selecting a hexagon in the viewer,

the user can see the number of rare species counted in the hexagon, the relative rank of the hexagon compared to the rest of the ecoregion and 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 hexagon based on documented species occurrences (using identify tool or GIS attribute table)
- Obtain a list of those potential species (using 'Identify Features' on Species List dataset in ACE viewer)
- View relative richness of rare species across the state for a given taxonomic group (viewing Rare Species Richness by taxonomic group)
- Identify the highest rarity areas in an ecoregion for a given taxonomic group (using Identify Features tool or GIS attribute table to obtain ecoregionally normalized values and ranks for each taxonomic group). Compare the ecoregional rank with the statewide rank (using Identify Features tool or GIS attribute table).
- View relative overall rare species richness within each ecoregion (viewing Rare Species Richness Summary).
- Identify the highest overall rare species richness areas within each ecoregion (Rank 5 hexagons in Rare Species Richness Summary).
- Identify where data may be lacking (viewing 'No Data' hexes).

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
Ecoregion Rare Species Rank	Ranks of 1-5 assigned to the ecoregionally normalized rare species richness values, with all zero values removed and remaining values broken into 5 quantiles, each containing the same number of hexagons.
Ecoregion Rare Species Weight	Sum of aggregated ecoregionally normalized rare species richness values across all taxonomic groups for each hexagon. Final sum is scaled from zero to one ecoregionally for ease of interpretation. This value, which ranges from zero to one, can be interpreted as the relative rare species richness value of the hexagon when compared with the rare species richness of all other hexagons in the ecoregion.

Field	Definition
Statewide Rare Species Rank	Ranks of 1-5 assigned to the statewide normalized rare species richness values, with all zero values removed and remaining values broken into 5 quantiles, each containing the same number of hexagons.
Statewide Rare Species Weight	Sum of aggregated statewide normalized rare species richness values across all taxonomic groups for each hexagon. Final sum is scaled from zero to one statewide for ease of interpretation. This value, which ranges from zero to one, can be interpreted as the relative rare species richness value of the hexagon when compared with the rare species richness of all other hexagons in the state.
RareCount	Total number of rare species with observations within the hexagon.
Rare Amphibian Count	Count of rare amphibian taxa per hexagon 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 hexagon.
Rare Reptile Count	Count of rare reptile taxa per hexagon 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 hexagon.
Rare Bird Count	Count of rare bird taxa per hexagon 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 hexagon.
Rare Mammal Count	Count of rare mammal taxa per hexagon 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 hexagon.
Rare Plant Count	Count of California Rare Plant Rank (CRPR) 1B and 2 rare plant taxa per hexagon 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 hexagon.

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 hexagons, 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.

All species occurrences were buffered by one mile before including in the ACE rare species counts.

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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GIS Scripting: Ryan Hill and Sandra Hill

Factsheet: Melanie Gogol-Prokurat

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