

## **Utilizing the California Natural Diversity Database to aid in plant conservation: a case study from the California desert**

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The California Natural Diversity Database (CNDDDB) inventories the status and locations of rare taxa and natural communities within California. Due to the fast-tracking of renewable energy projects within the desert regions of California, there has been concern over how best to balance the need for renewable energy development with the conservation of desert biological resources. With this in mind, the CNDDDB botany program, in conjunction with the California Native Plant Society (CNPS), has made an effort since 2008 to determine the status of many plant taxa in the desert regions of California. CNDDDB staff have also made an effort to enter all available information for rare plant taxa from the desert regions into the CNDDDB. This has resulted in an approximate 50% increase in the number of CNDDDB rare plant occurrences known from desert regions, and updating the CNDDDB has resulted in a more complete picture of the status of rare taxa in the desert regions of California. This information can be used to aid in plant conservation and management, especially within the area covered by the Desert Renewable Energy Conservation Plan.

Key words: California Native Plant Society, California Natural Diversity Database, conservation, Desert Renewable Energy Conservation Plan, rare plants, status

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The California Natural Diversity Database (CNDDDB) is a program that inventories the status and locations of rare plants, animals, and natural communities throughout California. The CNDDDB is part of an international network of natural heritage programs that were originally developed by The Nature Conservancy in the 1970s (Bittman 2001). The CNDDDB was created in 1979 and has been housed within the California Department of Fish and Wildlife (CDFW) since 1981 (York et al. 1982). The CNDDDB is currently part of the Biogeographic Data Branch of the CDFW.

The CNDDDB compiles data-rich occurrence records and spatial features for the rarest taxa in California. Data are submitted by a wide variety of people and organizations including environmental consultants, state agencies, federal agencies, and non-profit organizations. While the CNDDDB has been working to inventory rare plant taxa for over 30 years, plant taxa present in the desert regions of California have been somewhat neglected in order to concentrate both survey and data entry efforts in areas of the state experiencing the greatest development pressures. However, in November 2008, the Governor of California issued Executive Order S-14-08 requiring an increase in the amount of electricity generated by renewable resources (Office of the Governor 2008). As a result, the Desert Renewable Energy Conservation Plan (DRECP) was established to help streamline the regulatory process for renewable energy development, while at the same time providing for protection and conservation of desert ecosystems and species (Dudek and ICF International 2011).

One of the main goals of the DRECP is to provide for the long-term conservation and management of covered species (Dudek and ICF International 2011). Covered plant species within the DRECP could potentially include those that are officially listed as rare, threatened, or endangered (under the Native Plant Protection Act, California Endangered Species Act, or the Federal Endangered Species Act), as well as species that are in the California Native Plant Society's (CNPS) *Inventory of Rare and Endangered Plants of California* (CNPS 2014a) or in the CNDDDB's *Special Vascular Plants, Bryophytes, and Lichens List* (CNDDDB 2014, Dudek and ICF International 2011).

As a result of the DRECP, CNDDDB staff have concentrated efforts on updating the rare plant information for the desert regions so that the highest quality data would be available. One aspect of this effort involves reviewing the status of plant taxa from the desert regions in conjunction with CNPS staff. In addition, CNDDDB staff have made an effort to enter all of the rare plant data that had been in the CNDDDB backlog for the DRECP area, and to enter incoming data for the same region in a timely manner. By inventorying and documenting rare plant taxa present in a particular area, better conservation and management decisions can be made to avoid or mitigate impacts to those taxa. The intent of this article is to describe the progress that has been made since 2008 in assigning a rarity status to desert plant taxa and in updating CNDDDB rare plant data for the DRECP area.

## MATERIALS AND METHODS

*Study area.*—The boundary of the DRECP area (Figure 1) was designed to encompass the majority of the Mojave and Sonoran deserts in California and includes portions of seven California counties (Imperial, Inyo, Kern, Los Angeles, Riverside, San Bernardino, and San Diego) (Dudek and ICF International 2011). The DRECP covers an area of about 9 million ha and includes regions in California where renewable energy development could potentially occur (Dudek and ICF International 2011).

*CNDDDB Data.*—The CNDDDB tracks all taxa that have a CNPS California Rare Plant Rank (CRPR) but only maps data for CRPR 1 and 2 taxa into its Geographic Information System (GIS) due to staffing limitations (see Table 1 for CRPR categories). CNDDDB plant data reviewed in this article are restricted to CRPR 1 and 2 taxa so that GIS data would be available to use in queries. All CNDDDB data used in this article are from CNDDDB GIS data made available to CNDDDB users in January 2008 and January 2013. January 2008 was used as a baseline for all queries since it was not until later in 2008 that CNDDDB staff began a



**FIGURE 1.**—Location of the area covered by the Desert Renewable Energy Conservation Plan (DRECP; Dudek and ICF International 2011). The DRECP boundary was used when querying for rare plant taxa and occurrences within the California Natural Diversity Database.

**TABLE 1.**—Number of California Native Plant Society (CNPS) rare plant taxa known from within the Desert Renewable Energy Conservation Plan area in California, January 2008 and January 2013; only CNPS California Rare Plant Rank 1 and 2 taxa are included.

California Rare Plant Rank <sup>a</sup>	Number of CNPS rare plant taxa known from within the DRECP area	
	January 2008	January 2013
1 (including 1A and 1B)	125	135
2 (including 2A and 2B)	127	144
Total	252	279

<sup>a</sup> CRPR 1A: Plants presumed extirpated in California and either rare or extinct elsewhere  
 CRPR 1B: Plants rare, threatened, or endangered in California and elsewhere  
 CRPR 2A: Plants presumed extirpated in California, but more common elsewhere  
 CRPR 2B: Plants rare, threatened, or endangered in California, but more common elsewhere

concerted effort to update rare plant taxa within the area delineated by the DRECP. GIS data distributed in January 2013 were used as a “post-DRECP” dataset. Work to update rare plant taxa within the DRECP area is an ongoing process, and CNDDDB plant GIS data distributed in January 2013 mark five years of data entry effort.

*Reviewing rarity status.*—CNPS and CNDDDB staff regularly review taxa for inclusion in the *Inventory of Rare and Endangered Plants of California* (CNPS 2014) and *Special Vascular Plants, Bryophytes, and Lichens List* (CNDDDB 2014a). In order to reduce duplication, staff from both organizations work collaboratively to review the status of rare plant taxa. CNPS staff take the lead on preparing status review documents, which are detailed summaries of plant taxa under review. These documents are sent out to groups of local botanical experts and taxonomists for comments and additional information. CNPS and CNDDDB staff then review all of the information gathered regarding rarity of the plant and assign it to a CRPR (CNPS’s rarity ranking system) and a Natural Heritage Conservation Rank (CNDDDB’s rarity ranking system), if appropriate.

In 2008, CNPS and CNDDDB staff began emphasizing status reviews for desert plant taxa due to growing concerns about the impacts future solar energy projects could have. While both CRPR and Natural Heritage Conservation Ranks are valuable assessments of rarity, CRPRs are used in this article since there are only four main categories to consider; Natural Heritage Conservation Ranks include more rarity categories that make them more descriptive, but also more complicated for analyses.

Data were used from CNDDDB shapefiles and comparisons made between the number of CRPR 1 and 2 desert plant taxa known from the area delineated by the DRECP in January 2008 with the number of CRPR 1 and 2 desert plant taxa known from the same geographic area in January 2013. Those CNDDDB plant taxa that had spatial features that intersected the DRECP boundary area were then exported from ArcMap into a Microsoft Access database. A summary query was subsequently run to determine the number of plant taxa within each CRPR category.

*Entering plant occurrence records and spatial data.*—The CNDDDB gathers data from a wide variety of sources and synthesizes the information into distinct occurrence records, with accompanying spatial features. CNDDDB occurrence records contain descriptive text information (e.g., site location, habitat, threats, population size, site quality, and the date that the taxon was last seen at the site) for each occurrence. Every time a plant is updated, CNDDDB staff search for and incorporate data from herbarium specimens, field survey forms, shapefiles, reports, and personal communications into these occurrence records and spatial features. Updating CNDDDB occurrence records for a single species can take anywhere from one day to over a month, depending on the complexity and volume of the data.

Between January 2008 and January 2013, all CRPR 1 and 2 plant taxa known from within the DRECP area were updated  $\geq 1$  time, but could have been updated more than once. All available information was incorporated into distinct occurrence records with accompanying spatial features, and comparisons made between the number of plant occurrences added to the CNDDDB in 2008 and 2013. Plant spatial features were selected from the CNDDDB shapefile that intersected with a shapefile of the DRECP area for each taxon. Those taxa that had spatial features that intersected the DRECP boundary area were then exported, and a spatial selection was performed for each county of interest. The number of selected plant features was counted for each county within the DRECP area.

## RESULTS

Within the DRECP area, a total of 27 CRPR 1 and 2 plant taxa were added to the list of CNPS- and CNDDDB-tracked taxa between January 2008 and January 2013, reflecting the increased emphasis on reviewing the status of desert taxa. Ten of those taxa were assigned to CRPR 1 and 17 of those taxa were assigned to CRPR 2 (Table 1). In January 2008, before the CNDDDB began a concerted effort to update plant taxa in the desert, there were 1,706 CNDDDB plant occurrence records present in the DRECP area (Table 2). The CNDDDB began utilizing GIS to map plant occurrences around 1990, so these 1,706 CNDDDB plant occurrence records reflect the number of occurrence records entered between 1990 and January 2008, an average of approximately 95 per year. Between January 2008 and January 2013, there were 1,728 additional CNDDDB plant occurrences added to the DRECP area, an average of approximately 346 per year.

**TABLE 2.**—Number of California Natural Diversity Database rare plant occurrences known from within the Desert Renewable Energy Conservation Plan area in California, January 2008 and January 2013.

County	January 2008	January 2013	Percent increase
Imperial	159	239	33
Inyo	271	514	47
Kern	240	303	21
Los Angeles	83	103	19
Riverside	133	318	58
San Bernardino	751	1,838	59
San Diego	69	119	42
Total	1,706	3,434	50

Between 2008 and 2013, there was an approximate 50% increase in the overall number of CNDDDB plant occurrences within the DRECP area (Table 2). The largest increases occurred in San Bernardino (+59%) and Riverside (+58%) counties. While these large increases may be partly because these counties make up a large portion of the DRECP area, they also reflect the plant survey data submitted as a result of pre-project surveys for solar energy projects proposed within those counties. All of the of the solar energy project data received for CRPR 1 and 2 taxa were entered by CNDDDB staff between 2008 and 2013.

## DISCUSSION

One of the main goals of the DRECP is to provide for the long-term conservation and management of covered species within the plan area (Dudek and ICF International 2011). However, in order for the DRECP to address this goal, high quality and current information on which taxa should be considered rare, and therefore potentially covered by the DRECP, is essential. Such data were largely lacking before 2008 due to low development pressures and resultant low survey efforts in desert areas. With the DRECP covering an area of about

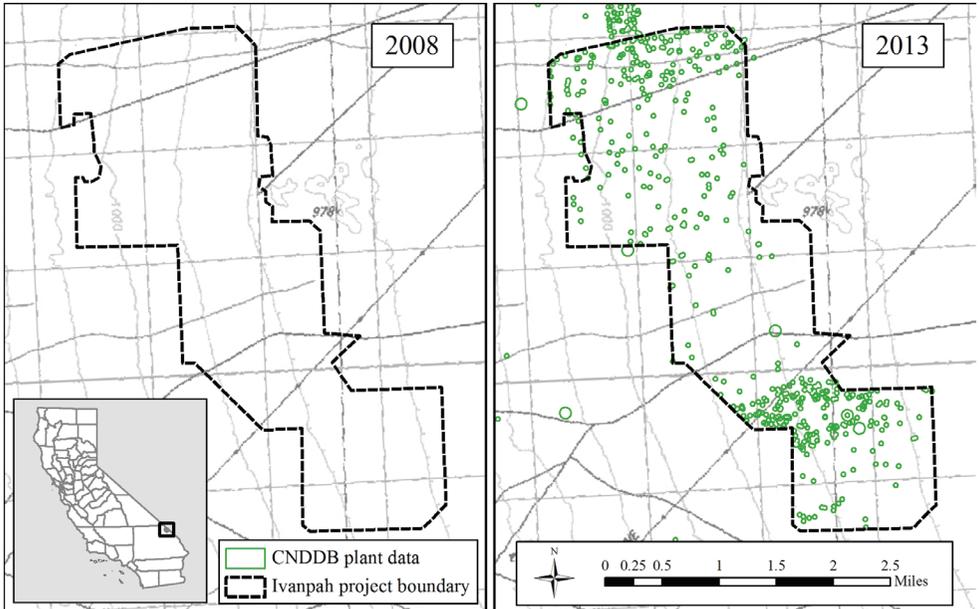
9 million ha, it can be problematic to determine which areas and taxa are of the highest conservation concern. CNDDDB and CNPS staff have made a concerted effort since 2008 to ensure that the most up-to-date information on rare plant taxa in the desert regions is available for use by those involved with the DRECP. Reviewing rarity status of plant taxa and updating CNDDDB rare plant occurrence information for the DRECP area are two key components of providing a more complete picture of the sensitive resources that could be impacted by renewable energy projects.

The majority of the 27 taxa added to CRPR 1 or 2 between January 2008 and January 2013 were assigned to CRPR 2. Although CRPR 1 taxa are high priority for conservation due to their limited global distribution, many desert taxa just cross into California from adjacent states where they may be more common. By assigning these taxa a rarity status of CRPR 2, we can be more confident that a full assemblage of desert plant taxa of conservation concern will be accounted for within the DRECP process. The increase in number of CRPR 2 plant taxa was a big step forward in preparing for the DRECP by making sure that not only is biodiversity within California conserved, but also by ensuring that those peripheral populations are conserved for the long-term benefit of the species, as discussed by Leppig and White (2006).

The large increase in number of CNDDDB rare plant occurrences entered within the DRECP area is a reflection of the priority that CNDDDB staff have placed on data entry in this area, and also reflects the type of data the CNDDDB has received. Pre-project surveys for proposed solar energy projects have had a large impact on the number of CNDDDB occurrences for rare plant taxa. For example, the Ivanpah Solar Electric Generating System (ISEGS) consists of three large solar thermal power plants that cover a total of about 1,330 ha in northeastern San Bernardino County (Figure 2; CH2M Hill 2009). There were no CNDDDB plant data in January 2008 from the vicinity of the ISEGS. However, almost entirely as a result of pre-project surveys for the ISEGS, January 2013 CNDDDB data included seven CRPR 1 and 2 plant taxa in that area, with some of those taxa having extensive occurrences within the project boundary. Of these seven plant taxa, six were CRPR 2 taxa and one was a CRPR 1 taxon.

While the CRPR 2 taxa documented within the project area were not new CRPR 2 taxa (i.e., they were not assigned to CRPR 2 between January 2008 and January 2013), the high number of CRPR 2 taxa within the project area highlights the importance of determining which taxa merit ranking of CRPR 2 so that a full assemblage of rare taxa are properly accounted for within the DRECP. If CRPR 2 plants were ignored, the ISEGS project would only have identified a single plant taxon of conservation concern, and the remaining six taxa would not have received attention.

In conclusion, joint efforts by CNPS and CNDDDB staff since 2008 to evaluate the status of desert plant taxa, and efforts made by CNDDDB staff to update rare plant occurrence information, have resulted in many additional taxa being tracked by CNPS and the CNDDDB, and in a large increase in the number of CNDDDB rare plant occurrences. The CNDDDB is an essential tool for assessing the rarity of California taxa and determining which are in the greatest need of conservation, and is used by a wide range of organizations for planning, research, and conservation purposes. While the CNDDDB can not be used as proof that a taxon is absent from a particular area, as more surveys are performed in the desert and those data are incorporated, the database will provide a more complete picture of the distribution and status of sensitive desert taxa. By doing so, the CNDDDB data can be used to help the DRECP move toward its stated goal of contributing to the conservation of covered species, as well as other unique and valuable desert resources.



**FIGURE 2.**—The two maps in this figure show the boundary (dashed black lines) of the Ivanpah Solar Electric Generating System (CH2M Hill 2009). The map on the left shows California Natural Diversity Database (CNDDDB) rare plant data available in January 2008 (when no CNDDDB rare plant populations were present in this area), and that on the right shows CNDDDB rare plant data available in January 2013; green polygons represent CNDDDB rare plant populations in this area of San Bernardino County, California.

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