USER'S MANUAL

FOR

VERSION 8.2 OF THE CALIFORNIA WILDLIFE HABITAT RELATIONSHIPS SYSTEM AND BIOVIEW

Recommended Citation for CWHR Version 8.2:

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INTRODUCTION

The California Wildlife Habitat Relationships System (CWHR) is a comprehensive information system on California's wildlife. The CWHR System contains life history, habitat relationships and management information for 694 species of amphibians, reptiles, birds and mammals that are considered to be regularly occurring in California. Bioview was originally developed by the US Forest Service Pacific Southwest Research Station (PSW) as a stand-alone computer application utilizing the databases of CWHR to translate habitat suitability ratings for wildlife species into data that can be used in a Geographic Information System (GIS) for spatial and temporal analysis. The two applications have now been integrated so that the user can take maximum advantage of both.

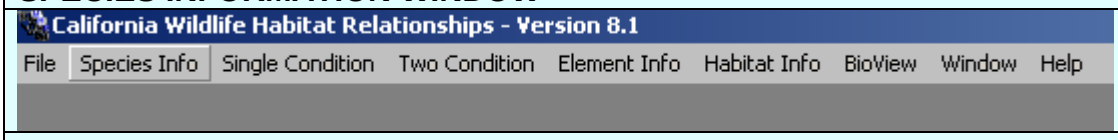
This manual supports Version 8.2 of the CWHR database and Bioview. It is relatively brief and deals specifically with these software applications. Additional information on all aspects of the CWHR System can be gathered from a CWHR training course.

INSTALLATION

CWHR Version 8.2 with Bioview (hereinafter collectively referred to as CWHR) can be installed from a CD-ROM or a network server from the setup.exe file. Setup will then lead you through a series of windows. You may choose a minimal install, which takes up about 110 MB and does not include species drawings or images of distribution maps, or a full install, which includes all images and takes just over 1,000 MB. Note that even though there is no longer a fee for this application, you must still agree to the terms of the License Agreement in order to install and use CWHR.

When installation is complete, an icon will be installed to your desktop. You may start the CWHR System from here or choose to start it from the "Programs" menu in Windows. The nine types of queries and reports from CWHR Version 8.2 and the two types of output files from Bioview are all accessed from the main menu.

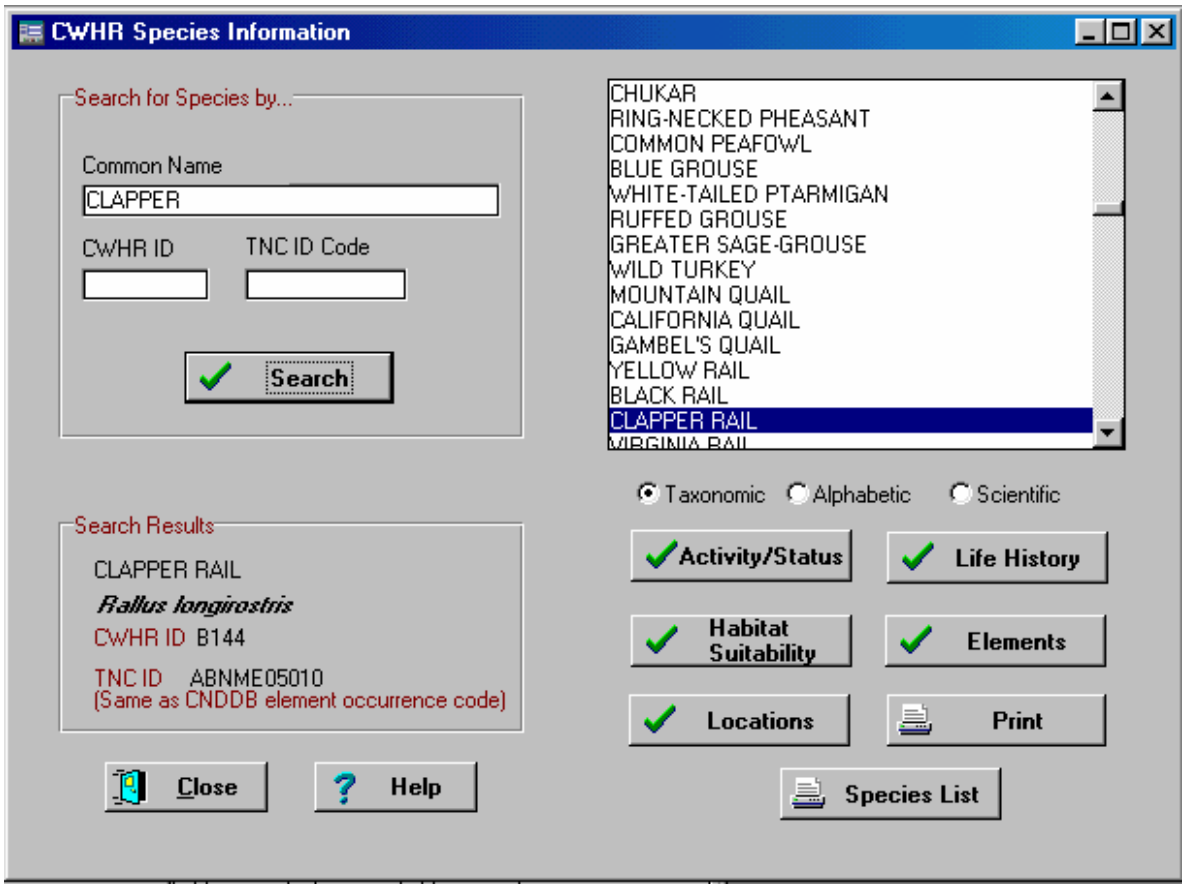
SPECIES INFORMATION WINDOW



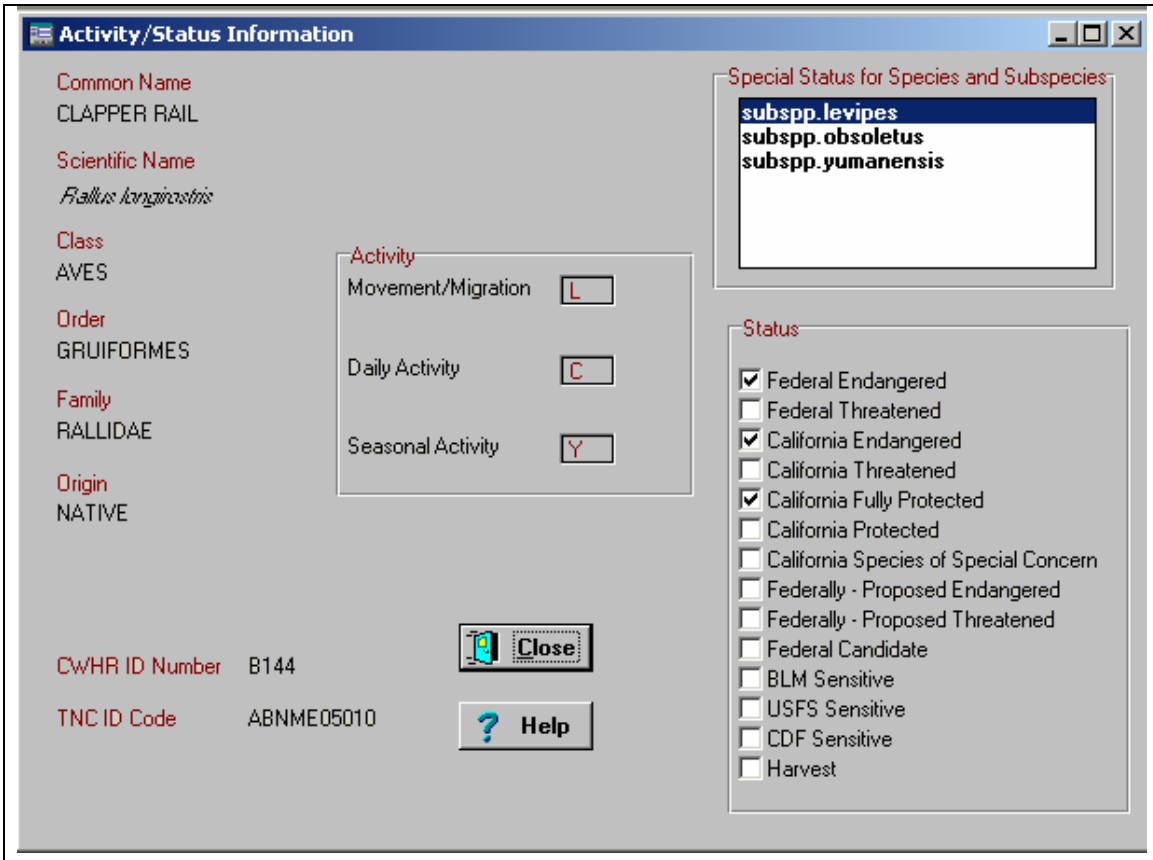
The species information window can retrieve all available information about a species in the CWHR database for viewing or printing. This includes taxonomy, life history attributes, legal status, geographic distribution, seasonality, habitat suitability values and ratings for special habitat elements. Three reports are available from this window – a Species List for the entire state, which includes all species that occur in the state whether or not they are modeled in CWHR, a List of All Information About One Species and Life History Notes and Distribution Map for a Single Species.

CWHR Species Information

You may select a species by entering its CWHR ID code, common name or code from The Nature Conservancy (TNC) in the appropriate box and pressing the **Search** button. Common names are those from lists of accepted taxonomy such as that from the American Ornithologist's Union (AOU) for birds. You can also scroll through the complete CWHR species list to select a species. The list can be ordered (1) taxonomically; (2) alphabetically by common name; or (3) alphabetically by scientific name. Use the left mouse button to select the name of the desired species and view the detail windows described below. For species that are not currently modeled in CWHR, detailed information is not available; only the common and scientific names, CWHR ID code, and TNC code will be displayed in the **Search Results** box.



To print all of the information available about a selected species, click the **Print** button. To print a list of all species in CWHR with common and scientific names and legal status codes, use the **Species List** button. To view detailed information about the selected species, click the left mouse button over one of five buttons located just below the species list. Use the **Close** button, generally located at the lower left corner of each form, to close the form and return to the Species Information window.

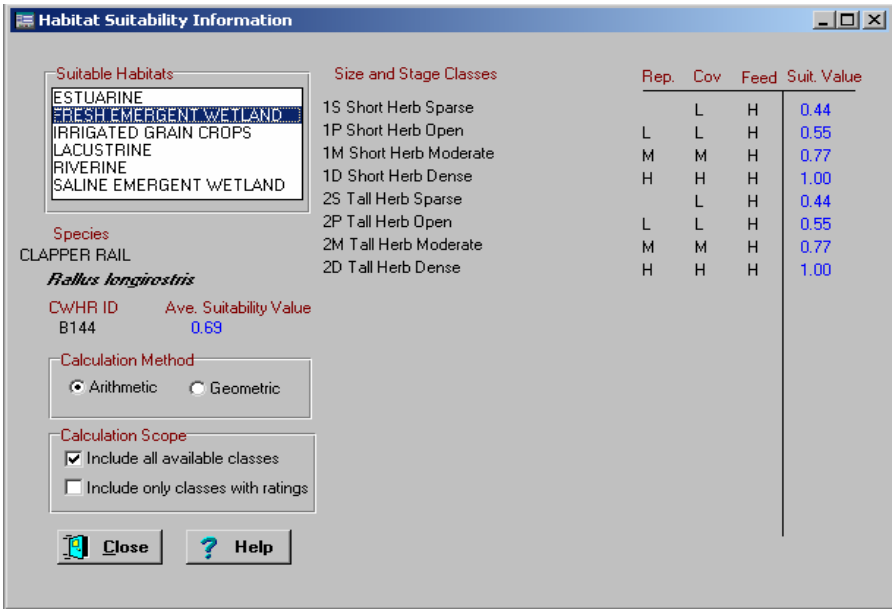


Activity/Status Information

For the selected species, this window displays the accepted common and scientific names, class, order, family, CWHR ID number and TNC code. Legal status is also displayed at the specific and subspecific level. The status of the species or of a selected subspecies is displayed when its name is highlighted by the mouse in the **Special Status for Species and Subspecies** list. The window also displays the species' patterns for migration, daily activity and seasonal activity.

Definitions for legal status and activity codes can be viewed by clicking the right mouse button when the mouse arrow is over the status or code of interest and the mouse arrow changes to vertical.

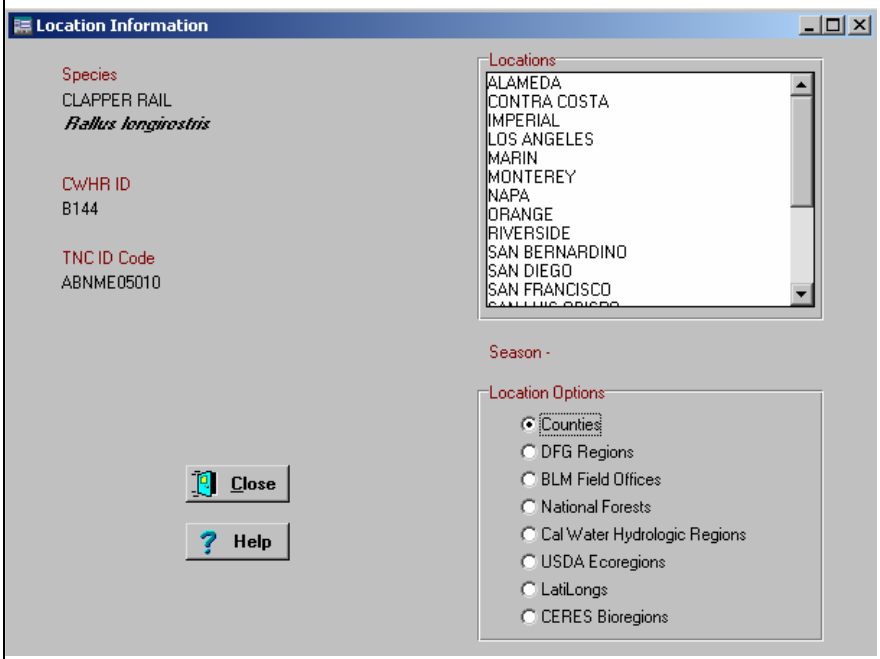
Habitat Suitability Information



Suitable habitats for the species are displayed in the **Suitable Habitats** list. When a habitat is highlighted, the suitability ratings (H=High, M=Medium, L=Low, blank=Unsuitable) for reproduction, cover and feeding are listed for each stage. An average habitat suitability value is also calculated for each stage using arithmetic or geometric mean based on numeric scores for the suitability ratings (H=1.00, M=0.66, L=0.33, blank=0.00). Average habitat suitability for the type is calculated using (1) only occupied stages or (2) occupied and unoccupied stages.

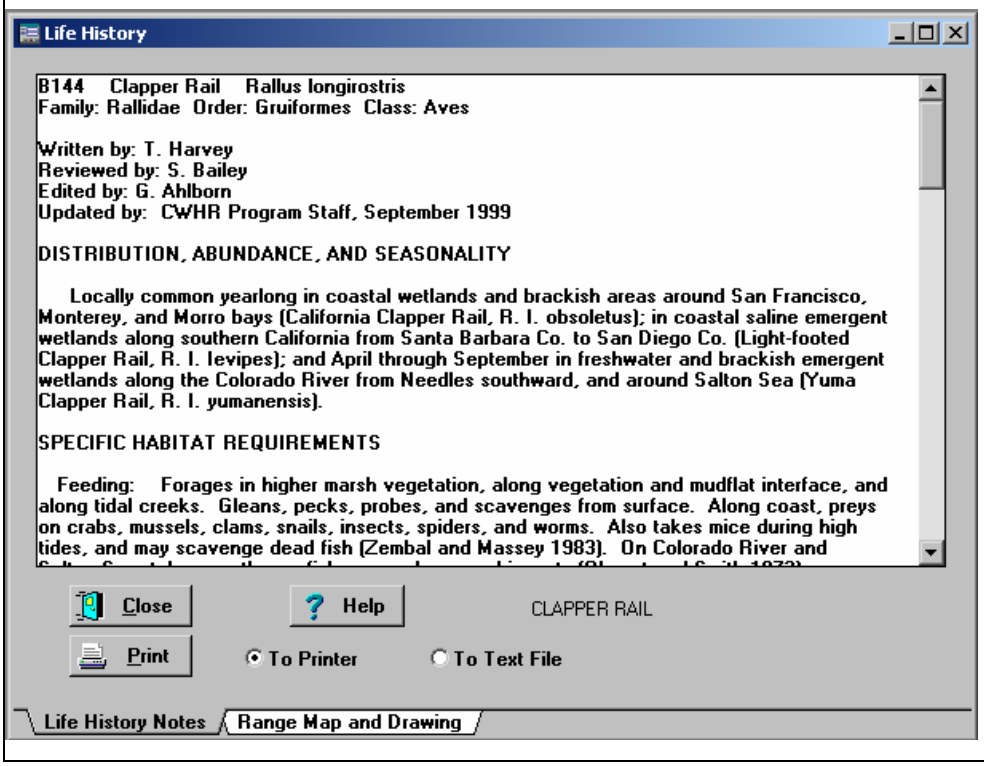
Summary information on the habitat can be displayed by clicking the right mouse button when the arrow is over the highlighted type in the **Suitable Habitats** list. The pop-up window contains information on primary plant species associated with the type, corresponding vegetation communities from the classification system of Sawyer and Keeler-Wolf (1995) and a distribution map of the habitat in California from "*A guide to wildlife habitats of California*" (Mayer and Laudenslayer 1988).

Location Information

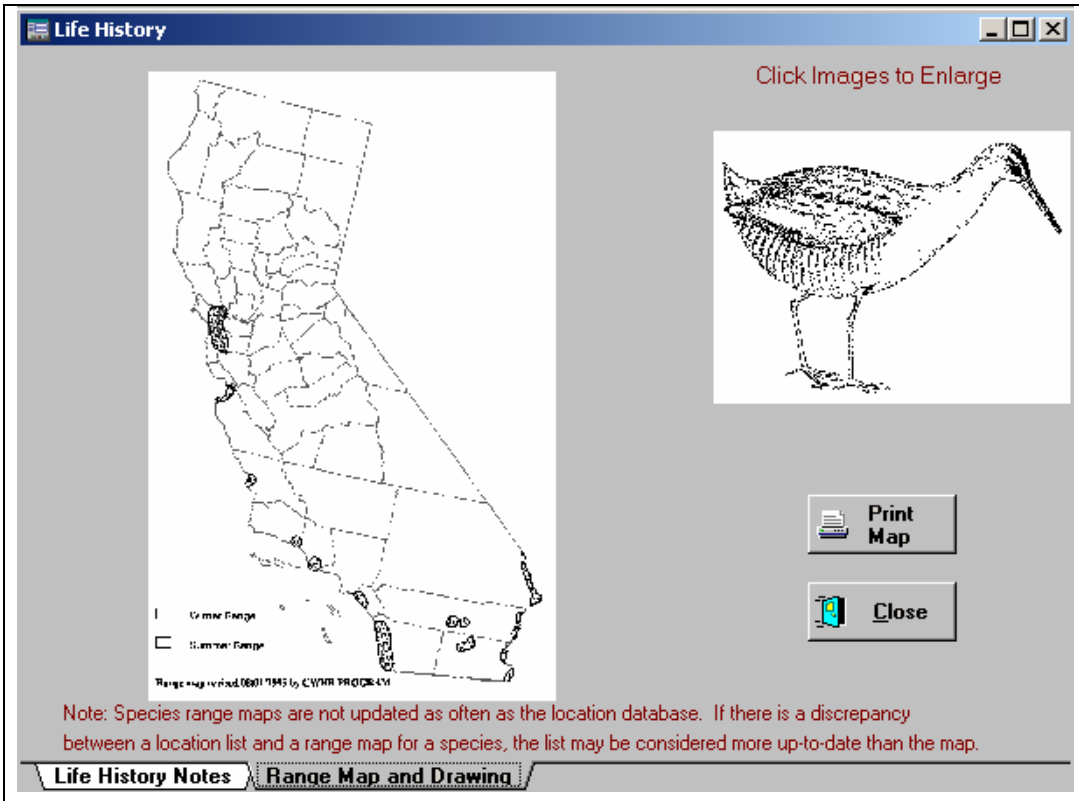


This window displays various locations where the species is predicted by CWHR to occur in California. Location categories include counties, California Department of Fish and Game Regions, US Bureau of Land Management Field Offices, USFS National Forests, CALWATER Hydrologic Regions, 1 degree by 1 degree blocks of latitude and longitude, USDA Ecoregions and CERES Bioregions. The seasonality pattern for a given location can be displayed by highlighting the location of interest in the **Locations** list. Click the right mouse button when the mouse arrow is over a displayed seasonality pattern to view the definition. To alternate between location categories, select from the **Location Options** buttons.

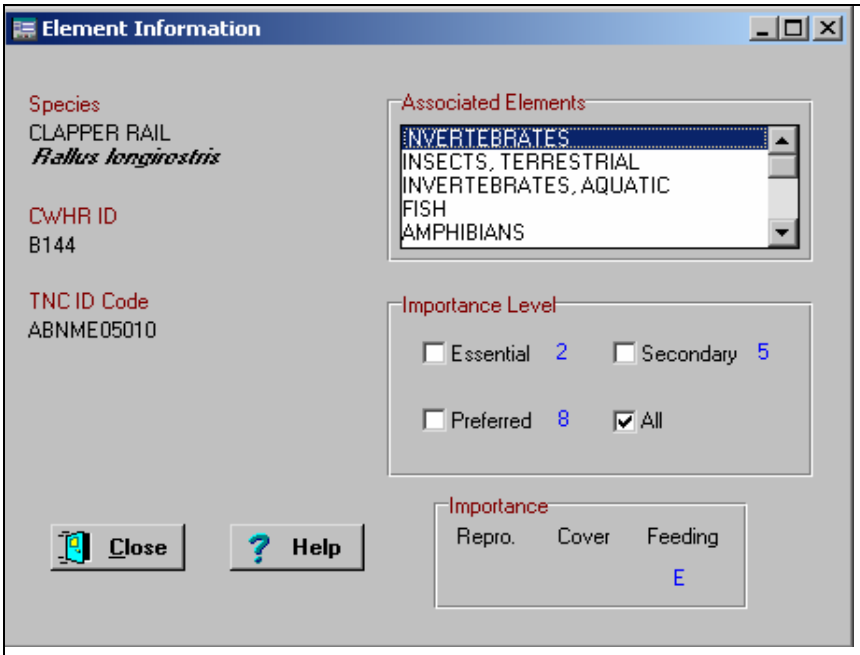
Life History



The first page of this window displays the life history notes taken from Volumes I (Amphibians and Reptiles) (Zeiner et al. 1988), II (Birds) (Zeiner et al. 1990a), or III (Mammals) (Zeiner et al. 1990b) of "*California's wildlife*". The life history notes can be saved to a text file or printed by selecting the appropriate option and pressing the **Print** button. Most of these accounts have not been updated since their original publication. However, information on taxonomy and management status is frequently updated for the database by the CWHR staff. Updates are made as resources allow or as new models are developed.



The second page of this window contains the range map and drawing for the species. The page is accessed by clicking on the **Range Map and Drawing** tab at the bottom of the window. To view an enlarged range map or drawing, click the left mouse button while the mouse arrow is inside the image and vertical. Currently, only the range map will be printed when the **Print** button is pressed.

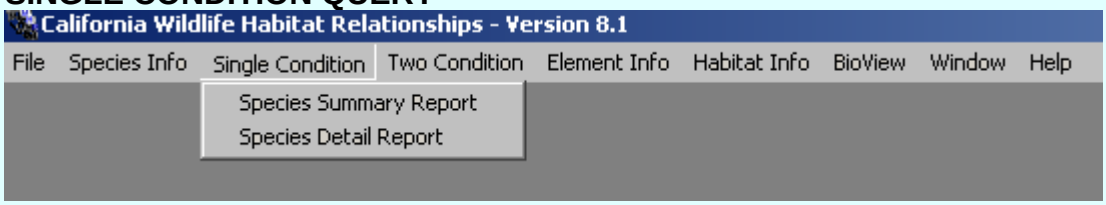


Element Information

Habitat elements predicted by CWHR to be used by the species for reproduction, cover and feeding are listed in the **Associated Elements** list. The definition of an element can be displayed by clicking the right mouse button when the mouse arrow is over a highlighted element. Elements are given one of the following ratings based on their importance to the species and their level of use: E=Essential; S=Secondarily Essential; P=Preferred; and Not listed=Not Rated. Please refer to the definitions for a full description.

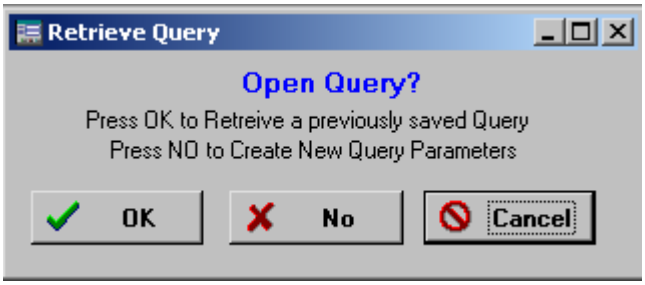
When highlighted, the importance levels of the element for the species' reproduction, cover and feeding are displayed in the window's **Importance** box. The blue number next to the importance level is the number of elements rated at that suitability level. Checking the box to the left of the importance level displays only the elements with that level in the **Associated Elements** list.

SINGLE CONDITION QUERY



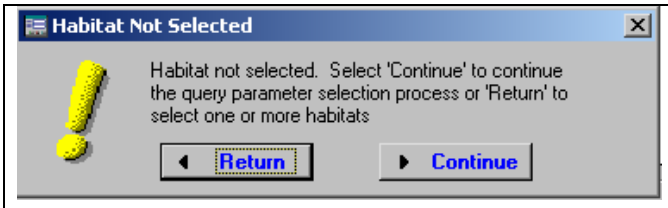
The Single Condition Query option produces a list of wildlife species predicted to occur in a single habitat situation defined by the user. Two types of reports can be produced with the single condition query. You may choose either a ***Species Summary Report*** or ***Species Detail Report.*** Both queries take the user through the same set of windows. The *Species Summary Report* lists only the names and special status categories of the species that meet the criteria you define. The *Species Detail Report* lists, by species, all habitat suitability values for all habitats selected. The report can be very long if many habitats and stages are selected.

Before the criteria selection windows are opened, you will be given the option of retrieving a previously saved query. Retrieving a saved query allows you to bypass the selection windows. However, you still have the option of changing any saved parameters before the query is processed. Selecting to create a new query loads the first criteria selection window.



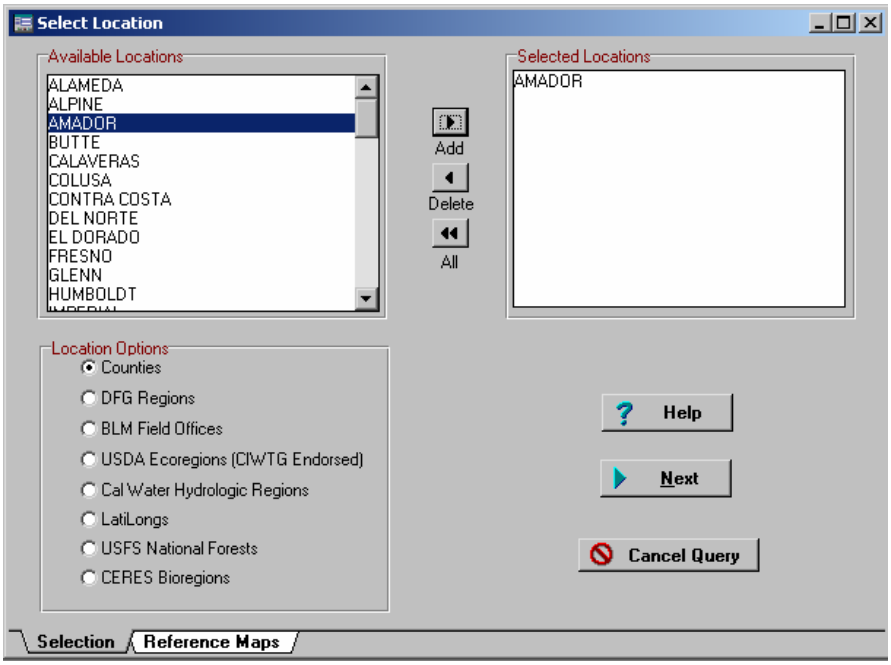
A series of sequential windows leads you through this query option. Each window represents an opportunity to restrict the query based upon that query parameter. If nothing is selected, the query will not be constrained. For example, if no locations are selected, the query will not be constrained by location. All locations throughout the state will be considered. If no special status categories are selected, the query will not be restricted to only those species with special status. All species, including those with special status, will be considered.

TIP: Wherever the mouse pointer appears as a vertical arrow over text in any window, right-click for a definition or additional information. Source data and citations also appear throughout the CWHR software program as yellow boxes that pop up when the cursor passes over text.



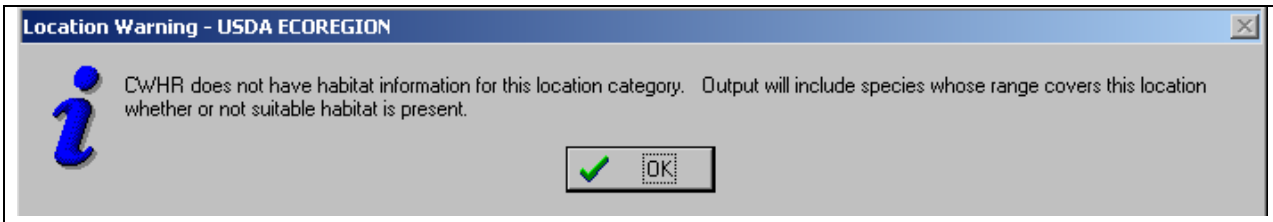
If you do not select anything in a given window, a message box will appear to remind you of this and ask you whether or not you want to continue. You may return to the previous window at any time by using the **Return** button or continue to the next screen by using the **Continue** button.

Select Location



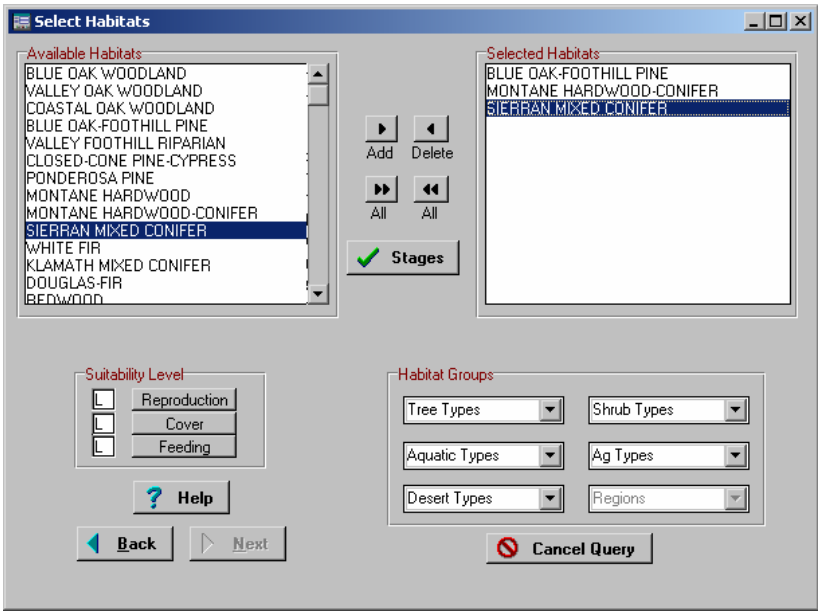
This window is where the geographic locations are selected. Available location categories include counties, California Department of Fish and Game Regions, US Bureau of Land Management Field Offices, USFS National Forests, CALWATER Hydrologic Regions, 1 degree blocks of latitude and longitude, USDA Ecoregions and CERES Bioregions. Locations from more than one category can be used in a query. To toggle between categories, click the button next to the desired category under **Location Options**. Use the **Add** button to add a highlighted location to the list of locations selected for the query.

Reference maps for the location categories are available on the **Reference Maps** page of this window. To view a reference map, click the **Reference Maps** tab at the bottom of the window, then click the button next to the category of interest. To return to the location selection page, click the **Selection** tab at the bottom of the window.



TIP: Counties is the default category for location selection. There is an advantage to selecting location by county. CWHR will check the habitats you select against the counties you select to determine whether or not habitat and location could occur together and will let you know if they do not. Otherwise, it is possible to see species on your report that would never occur together in reality. If you select another location category, CWHR cannot perform this function and a warning will let you know that CWHR does not have habitat information for that location category. It is therefore up to you, the user, to select habitats biologically realistic for that location.

Select Habitats

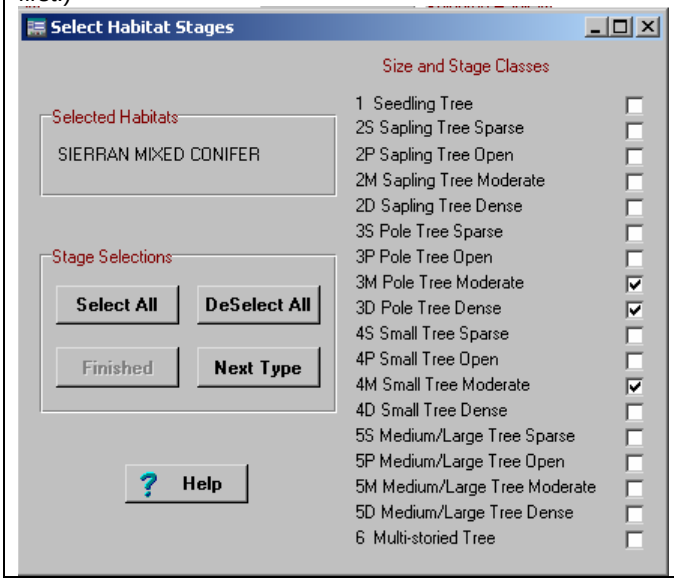


This window is where the CWHR habitats are selected. Habitats must be selected first, and then the stages for each habitat. A maximum of 100 habitat stages may be selected for a query. To add a habitat, highlight it in the **Available Habitats** list and click the **Add** button. The selected habitat will appear in the **Selected Habitats** list. Habitats are also grouped together into broad categories (e.g., "Riparian" includes Valley-Foothill Riparian, Montane Riparian, and Desert Riparian) that can be selected by accessing the **Habitat Groups** drop boxes. Reference range maps can be accessed from habitats in the **Selected Habitats** list. To view a map, highlight the habitat of interest and click the right mouse button when the mouse arrow changes to vertical.

Threshold suitability levels for the habitats may also be selected to constrain the query. Habitat suitability levels include H=High, M=Medium, and L=Low. The query defaults to "L" if no suitability levels are selected. Generally, the higher the suitability level, the fewer the number of species predicted, as species with suitability levels less than the specified level will be excluded from the query.

Select Habitat Stages

For each habitat selected, the user must define habitat stages. Open the stage selection window by clicking on the **Stages** button. The selected habitat appears in the upper left-hand corner of the window and the available size and stage classes along the right edge. Definitions of the habitat stages can be displayed by clicking the right mouse button when the mouse arrow on the screen changes to a vertical position over the desired stage. Use the **Finished** button to return to the habitat selection window after stages have been selected for each habitat. (Note: If the **Finished** button is "grayed-out" or not available after you are through selecting stages, click on the **Next Type** button first.)



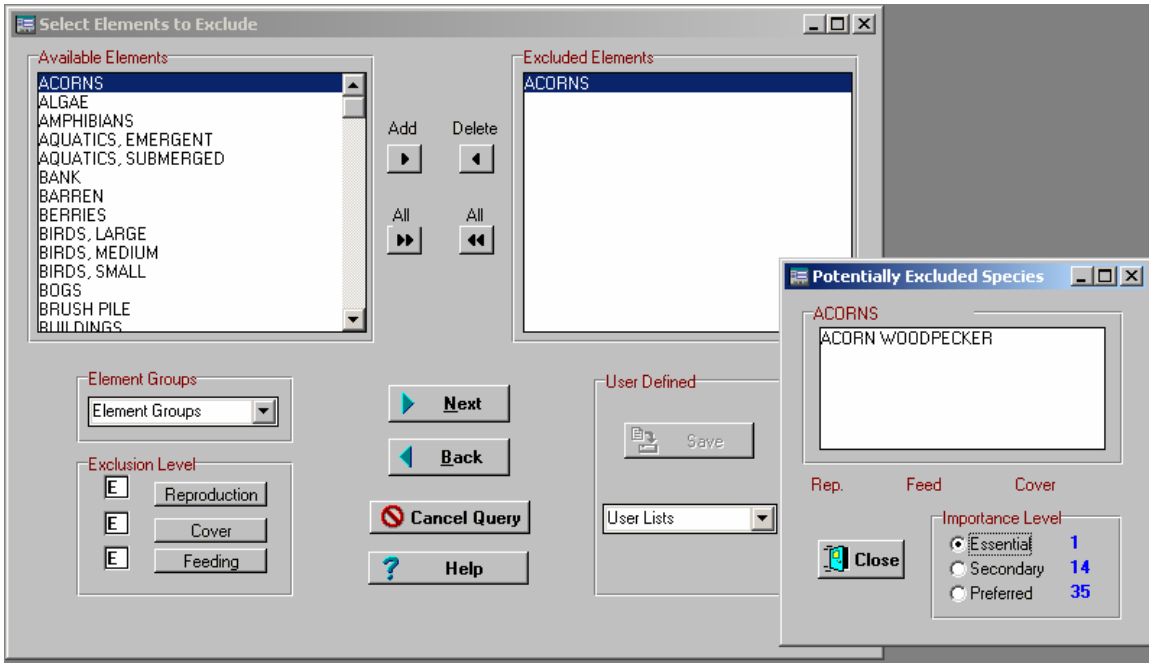
Select Elements to Exclude

This window is where the habitat elements are selected for exclusion. The resulting species list will exclude those species requiring the missing elements at the specified suitability level. CWHR assumes all elements are present if the user does not select any elements to exclude.

Elements may be selected for exclusion individually from the **Available Elements** list by highlighting the element and clicking the **Add** button. They can also be selected in broad categories (e.g., animal diet elements) using the **Element Groups** drop box. Selecting a group from the drop box list will add all the elements in the selected group to the exclusion list. Users can also save and retrieve up to six element lists for use in later queries. To do this, press the **Save** button and enter a name for your list of selected elements.

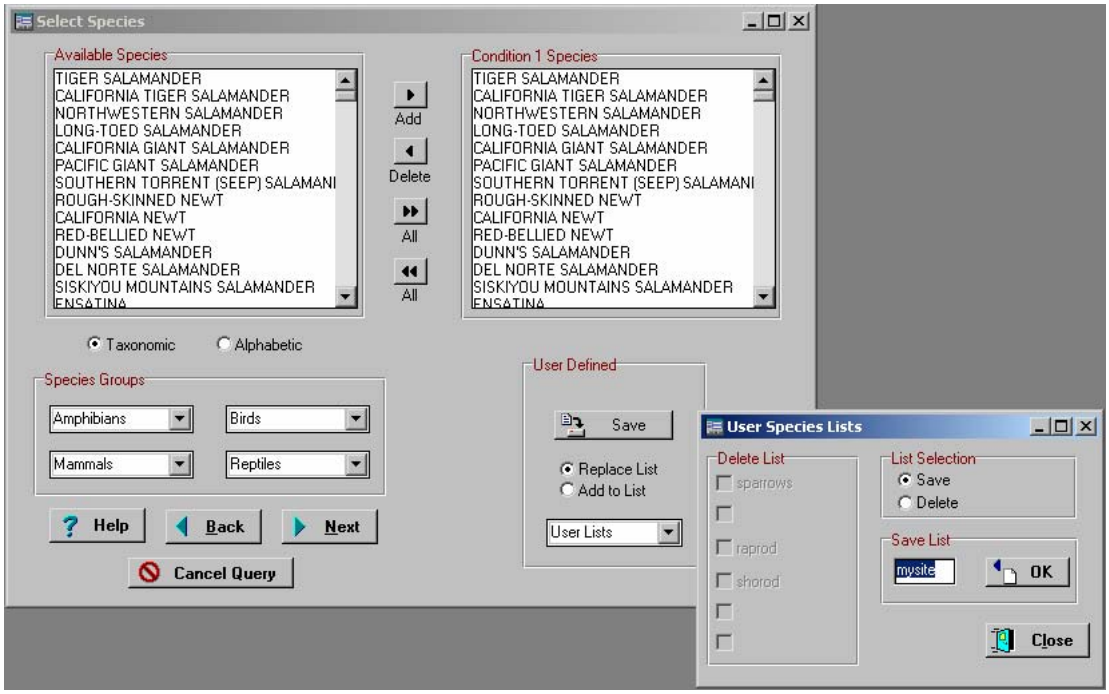
Importance levels for the elements include E=Essential, S=Secondarily Essential and P=Preferred. The query default is "E" so that only those species that find the absent elements to be absolutely essential for one of their life requisites will be dropped from the predicted species list. The user can also elect to exclude species at the "S" or "P" level of importance. The user is cautioned that this will exclude far more species from the list than the default of "E". Excluding species at the "S" level will also drop those at the "E" level. Excluding species at the "P" level will also drop those at the "S" and "E" levels.

To view a list of species potentially excluded by an element, highlight the element in the **Selected Elements** list. Click the right mouse button when the mouse arrow is over the element and the arrow changes to vertical. In the pop-up window, you can view potentially excluded species by importance level. Use the **Close** button on the pop-up window to return to the element selection window.



TIP: CWHR assumes all elements that are likely to be present in a given habitat or ordinarily adjacent habitats are present, unless the user excludes them. It does not, for example, assume tidepools to be present in valley oak woodland habitat, so there is no need for the user to exclude this element from such a query. Elements do not drive query results in CWHR. Any results constrained by the elements you select will first be constrained by the habitats you select.

Select Species

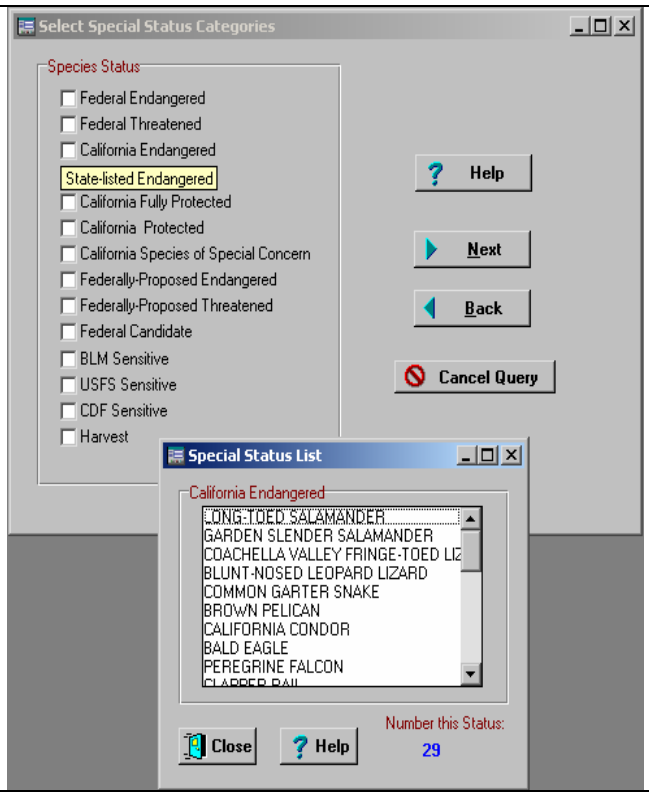


This window is where species selections are made. The default setting is to include all 694 modeled species in the CWHR database to the query. Users may refine the list in several ways. Removing all species from the **Condition 1 Species** using the **<<ALL** button allows the user to add species back in several ways. Species may be highlighted individually from the **Available Species** list and added to the selected species list with the **>Add** button. Several species groups (i.e., passerines, bats, etc.) are available under the **Species Groups** drop boxes in the lower left hand corner of the window. Selecting a group from the drop boxes will add the species in that category to the Condition 1 Species list. Users can also save and retrieve their own species lists. To do this, press the **Save** button and enter a name for your list of selected species. Currently, up to six user-defined species lists can be saved.

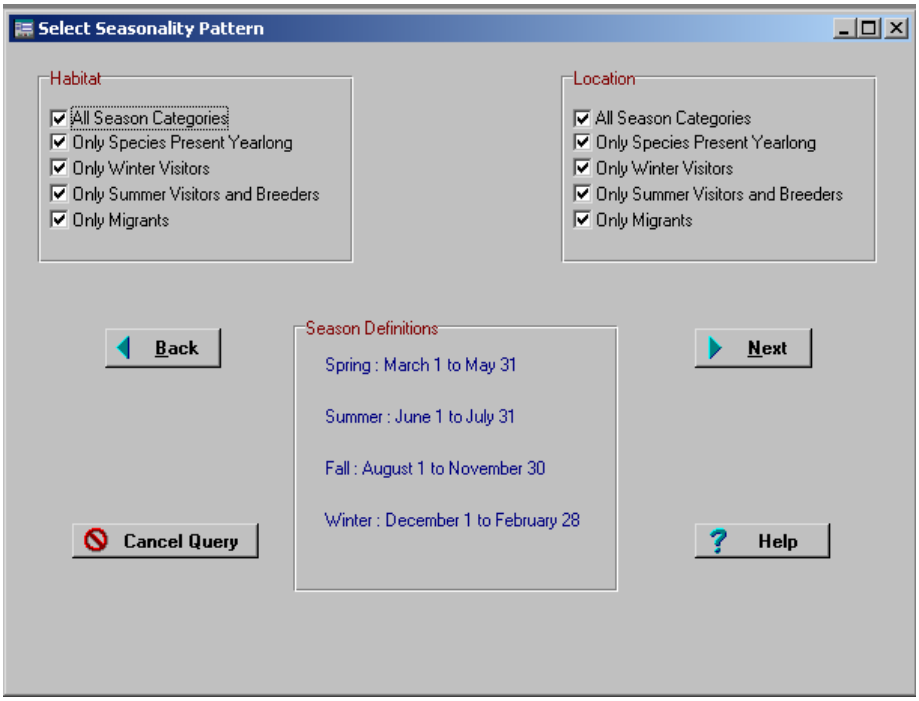
Select Special Status

This window is where queries can be restricted to species with special legal status. Requesting a special status category will eliminate all species without that status from the predicted species list. More than one status category can be selected for a single query. Categories available in CWHR include Federal Endangered, Federal Threatened, California Endangered, California Threatened, California Fully Protected, California Protected, California Species of Special Concern, Federally-Proposed Endangered, Federally-Proposed Threatened, Federal Candidate (former Category 1 species), US Bureau of Land Management (BLM) Sensitive, US Forest Service (USFS) Sensitive, CA Department of Forestry & Fire Protection (CDF) Sensitive, and Harvest.

To view a list of species in a designated status category, place the mouse arrow over the status of interest and click the right mouse button when the mouse arrow changes to vertical. Use the **Close** button on the pop-up window to return to the Status Selection window.



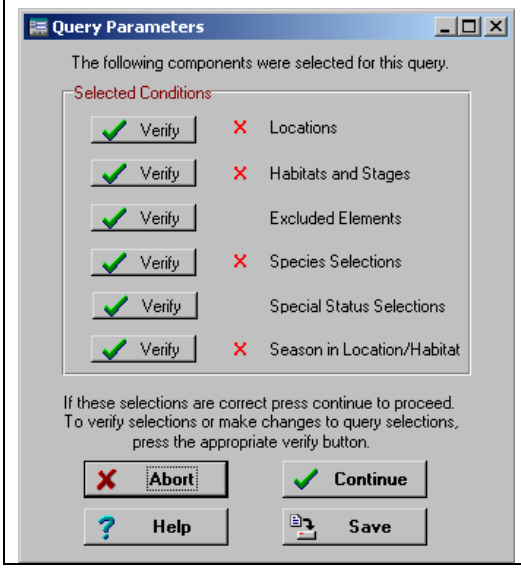
Select Seasonality Pattern



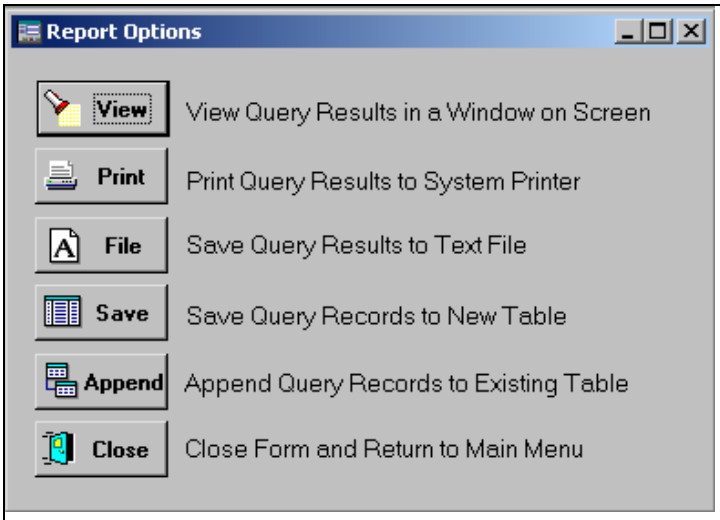
The seasonality patterns for habitats and locations in the query are selected in this window. The predicted species list will include only those species that meet the selected seasonality patterns for habitat and location. The seasonality patterns in CWHR were changed starting with Version 7.0 in 1999. There are now only four season categories. The categories include all seasonality patterns that overlap the season for which they are named. For example, 'Summer Visitors' includes species that occur in summer only, from spring to summer, from summer to fall, and from spring to fall. Not selecting a seasonality pattern results in the inclusion of all species from all possible seasonality patterns. Seasonality patterns may be different for habitats and locations because habitat seasonality patterns are statewide ratings while location seasonality patterns are geographically restricted while not being habitat restricted. If the user does not select a habitat or location during the query process, the corresponding seasonality selection options will not be available.

TIP: Note that season in CWHR refers to the seasonality use pattern of each species. If you are interested in knowing all the species that might be seen in a given location during the summer, for example, you must remember to select both "Only Species Present Yearlong" and "Only Summer Visitors and Breeders".

QUERY PARAMETERS AND RESULTS WINDOWS



When all selections have been made, the program will prompt you to save the query parameters. These parameters are saved in the \QUERIES subdirectory as a default but you may select another subdirectory if you wish. The program then provides an opportunity to verify or change the query parameters. To do this, click the **Verify** button to the left of the appropriate criteria. Criteria without checks are those where no choices were made and default settings prevail. Click the **Continue** button after verifying the selections to begin the query.



Once the query is run, CWHR provides you with several options for viewing, printing and saving the results.

Click the **View** button to see an abbreviated display of the query results in Visual Dbase's Crystal Reports format. Using the various display options in the window header bar allows you to see the information at various scales as well as print the results. Note that the page with the query parameters that is printed with the print option (see below) is not available if you print from the view option.

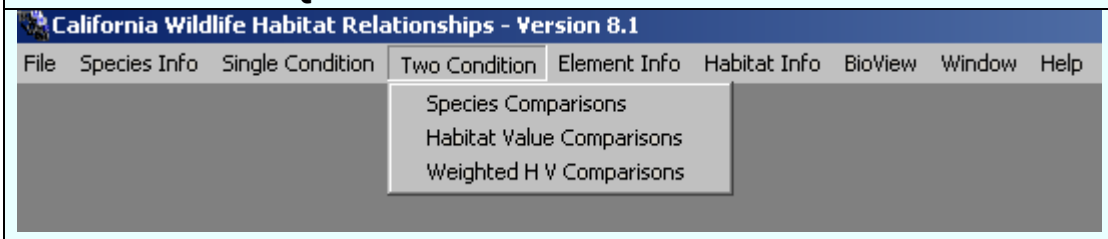
Click the **Print** button to print the full results of the query including query parameters and full query results. Clicking this button automatically routes the results to the printer.

Click the **File** button to save most of the query results as an ASCII text (*.txt) file. The results are saved in the \EXPORTS subdirectory as a default but you may specify another subdirectory if you wish. The file will have the species common name, CWHR id number, habitats and stages and habitat suitability ratings. Depending on the type of query, other information such as geographic location, elements, seasonality and legal status may not be saved. You can import the text file into a wide variety of software programs including database, spreadsheet, and word processing programs.

Click the **Save** button to save most of the query results as a Dbase or PARADOX database table. The file will have the species common name, CWHR id number, habitats and stages and habitat suitability ratings. You can import database files into a wide variety of software programs including database, spreadsheet, and statistical analysis programs. **This is also the option to select when saving a species list for later use with Bioview.**

Click the **Append** button to append the query results as a Dbase or PARADOX file to an existing Dbase or PARADOX file from another query. This is an especially useful feature if you want to combine the results from two or more large CWHR queries into a single database file. The appended file will be added below the selected existing file. You must sort the resulting file in a database program.

TWO CONDITION QUERY



The Two Condition Query is similar to the Single Condition Query except that two habitat conditions can be defined so that predicted species lists and habitat values can be compared.

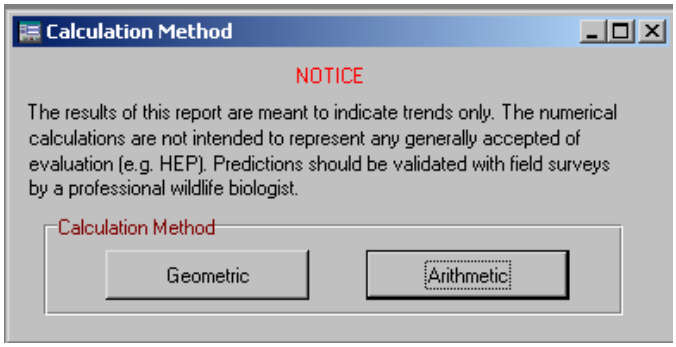
Three types of reports are available in this query. The ***Species Comparison Report*** lists all the wildlife species predicted to occur in the two conditions. An "X" in the column under the appropriate condition indicates that CWHR predicted the species to occur in that condition. Blank columns indicate that CWHR did not predict the species to occur in that condition. Total number of species predicted for both conditions are summarized at the bottom of the report.

The ***Habitat Value Comparison Report***, for every species in the query, lists the average habitat suitability value for each habitat stage selected. The preference values for reproduction, feeding and cover are averaged using the method selected during the query process (arithmetic or geometric mean). For display purposes the resulting mean is multiplied by 10 to produce a value between 1 and 10 as the overall rating for the habitat and stage combination. When a stage is not rated for a species, it is not displayed on this report. As a result, the number of stage ratings may not equal the number of stages selected in the query process. An asterisk denotes a reproductive value is included in the habitat and stage rating. The difference between average habitat suitability values for *Condition I* and *Condition II* is also reported. Three matrices at the end of the printed report present the number of species whose habitat values increased, decreased or were equal with the two conditions.

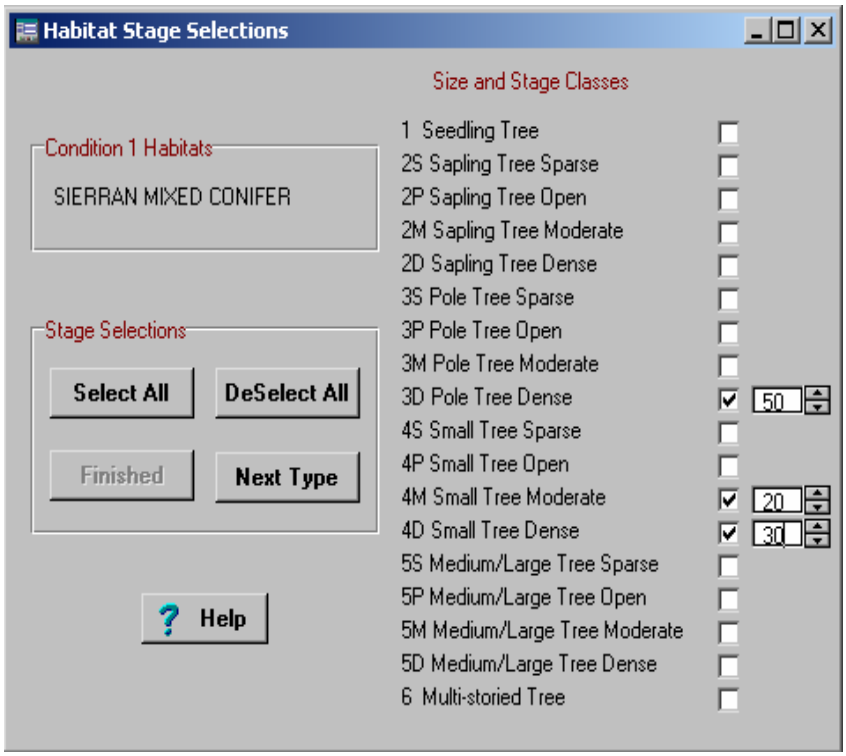
The ***Weighted Habitat Value Comparison Report*** lists average habitat values for each species and stage as described for the Habitat Value Comparison Report, but the habitat weights provided by the user for each habitat stage are multiplied by the average habitat suitability value to yield habitat units. These products are then summed to produce the condition rating. When a stage is not rated for a species, it is not displayed on this report. As a result, the number of stage ratings displayed may not equal the number of stages selected in the query process. An asterisk denotes a reproductive value is included in the habitat and stage rating. The difference in units between the two conditions is also reported. Three matrices at the end of the printed report present the number of species whose habitat values increased decreased or were equal with the two conditions.

The selection windows for the two condition query are the same as those for the single condition query with a few exceptions. (See "Single Condition Query" above for help with the query parameter selection process.)

First, the user must specify query parameters for both conditions displayed as *Condition 1* and *Condition 2*. On most selection windows, the user must toggle between both conditions when entering the query parameters, but the **C2=C1** button can be clicked in situations where query parameters are the same for *Condition 1* and *Condition 2*. Clicking **C2=C1** will copy the parameters from *Condition 1* to *Condition 2* so that the user does not have to enter them a second time. Some windows, such as "Select Special Status" and "Select Seasonality Pattern" have side-by-side check boxes for *Condition 1* and *Condition 2.*



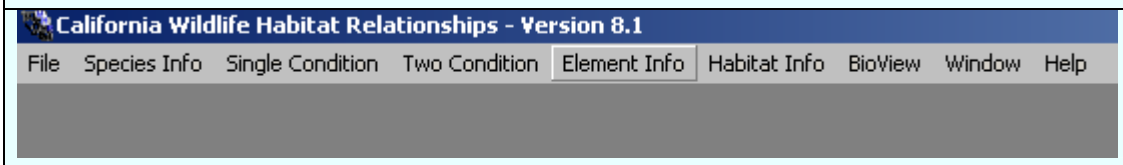
Second, for the ***Habitat Value Comparison*** and ***Weighted Habitat Value Comparison*** options you will need to select a method for calculating average habitat suitability value for reproduction, cover and feeding for a species in each selected habitat and stage. The choices are arithmetic and geometric mean.



Finally, for the ***Weighted Habitat Value Comparison*** only, you will need to apply weights to each habitat stage selected. Once a stage is selected, a spin box appears to its right. You can either use the arrows or type in directly an integer value from 0 to 100.

TIP: It is important to note that because there are three types of two condition reports, saved parameters may or may not be compatible between types. Parameters for the ***Species Comparison Report*** and the ***Habitat Value Comparison Report*** are compatible, but they are not compatible with ***Weighted Habitat Value Comparison Report*** since the latter report requires weights to be entered during parameter selection. An error message will be displayed if you attempt this.

ELEMENT INFORMATION WINDOW

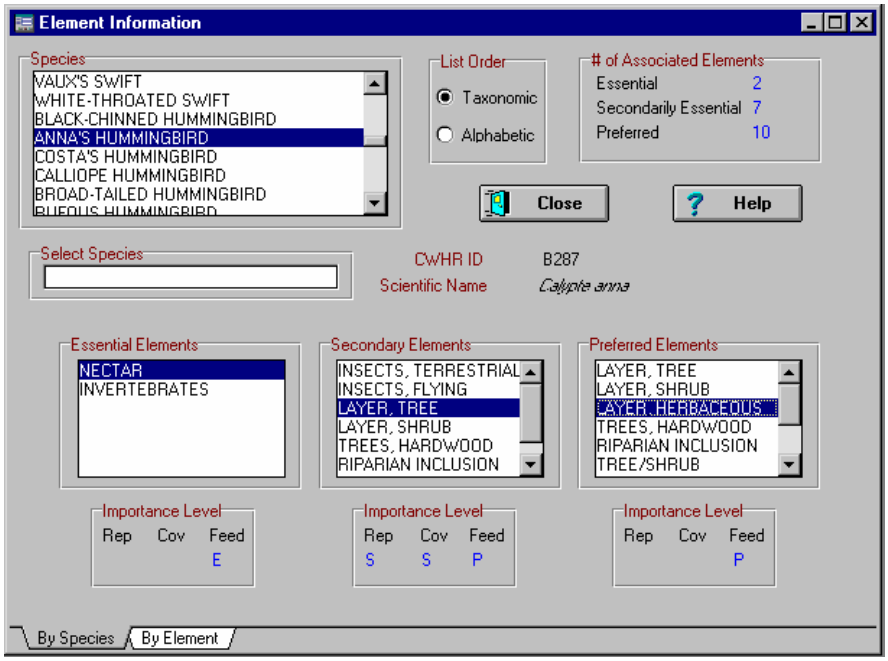


This window allows the user to query the CWHR database for information on the 124 habitat elements in the CWHR System. Users may query elements by the species that use them or the species by which elements they use. Use the page tabs at the bottom of the window to alternate between the two options.

The one report available from the element information window is ***Species By Element***. This lists each species that uses a selected habitat element (e.g. acorns, large snags, vernal pools) to meet its requirements for reproduction, cover and feeding and whether each finds that element essential, secondarily essential, or preferred.

Elements Associated with Species

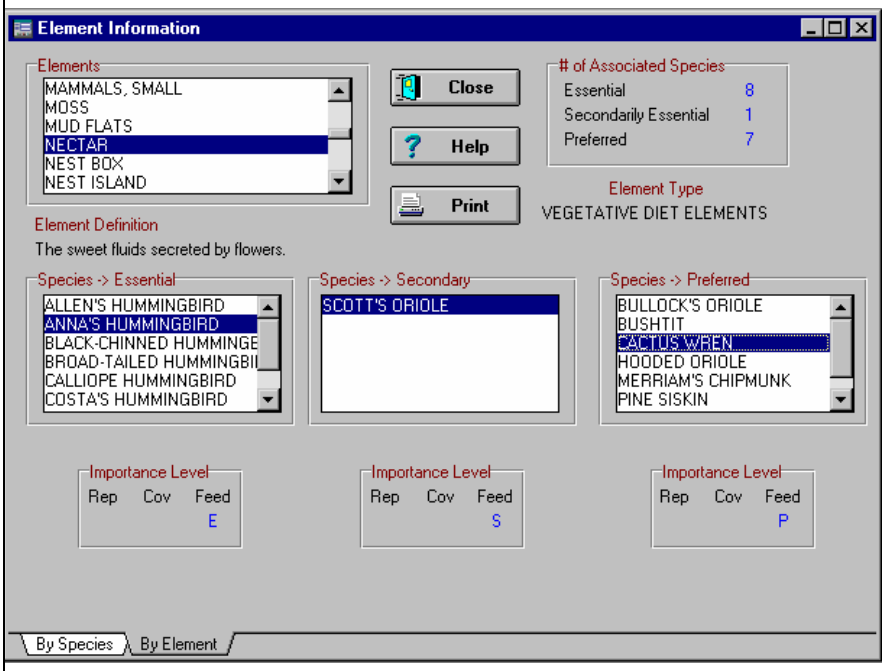
- **By Species**



Select the species by highlighting it in the **Species** list. The number of elements predicted by CWHR to be Essential, Secondarily Essential and Preferred is totaled in the **# of Associated Elements** box. The screen also displays the species scientific name and CWHR ID code. All elements used by the species are displayed in the **Essential Elements**, **Secondary Elements**, and **Preferred Elements** lists. Highlighting a particular element in one these lists will display its importance for reproduction, cover and feeding. An element may be listed multiple times if it has different importance ratings for different life requisites.

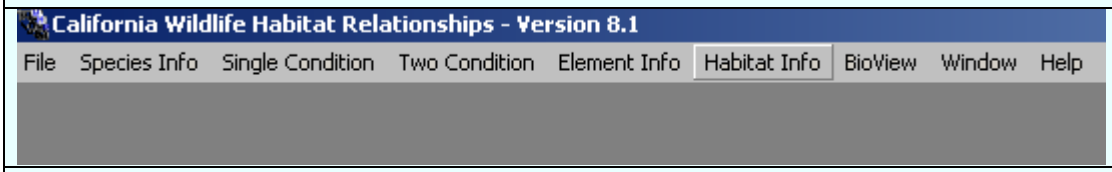
Elements Associated with Species

– **By Element**



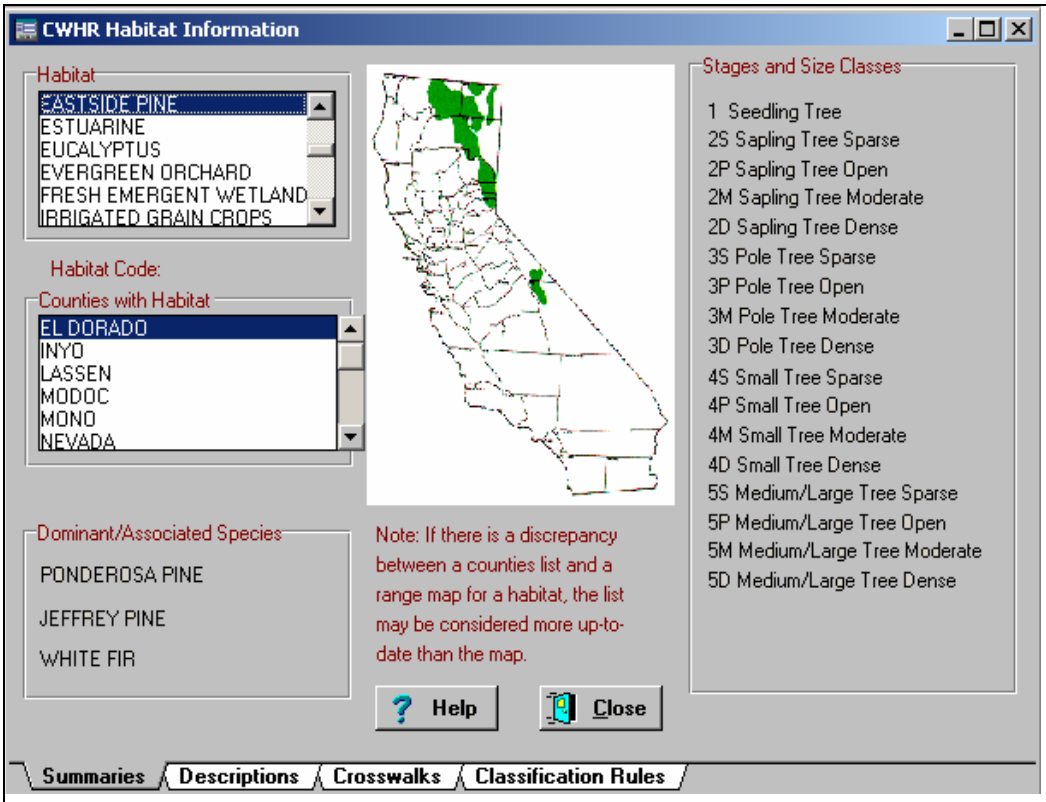
Select an element by highlighting it in the **Elements** list. The number of wildlife species finding the element to be Essential, Secondarily Essential and Preferred is totaled in the **# of Associated Species** box. The screen also displays the definition of the element and the category (i.e., vegetative diet element) in which the element is placed. All wildlife species predicted by CWHR to find the element Essential, Secondarily Essential or Preferred are displayed in the **Species->Essential**, **Species-> Secondary** and **Species->Preferred** association lists. Highlighting a particular species in one of these lists will display the importance of the element for reproduction, cover and feeding. Species may appear in multiple association lists if the element has different importance ratings for different life requisites. Clicking the **Print** button will send a list of all species associated with the selected element to the system printer.

HABITAT INFORMATION WINDOW



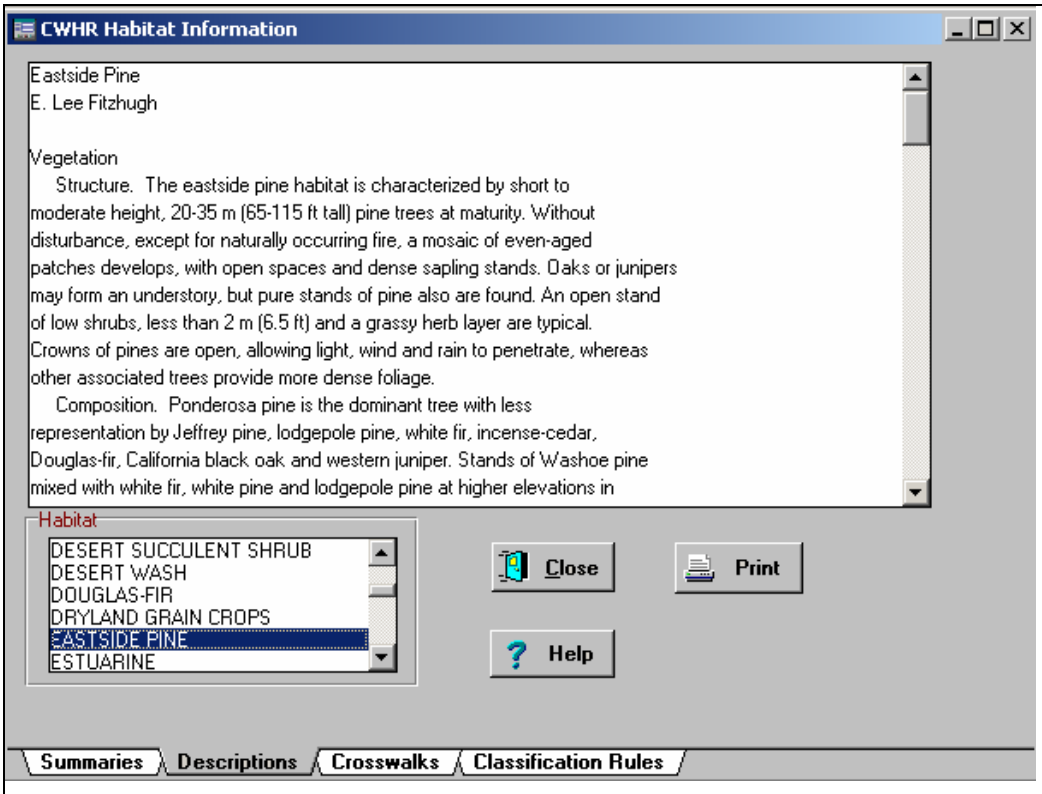
This window allows the user to select CWHR habitats and view information about them. There are four different pages containing habitat information. Each page can be accessed by clicking the left mouse button on the corresponding tab at the bottom of the window. Use the **Close** button

The one report available from the habitat information window is ***Description of a Single Habitat*****,** available on the second page of the window. This allows the user to print an individual habitat account from "A guide to wildlife habitats of California" (Mayer and Laudenslayer, 1988) plus some additional accounts added since publication of the guide.



Summaries

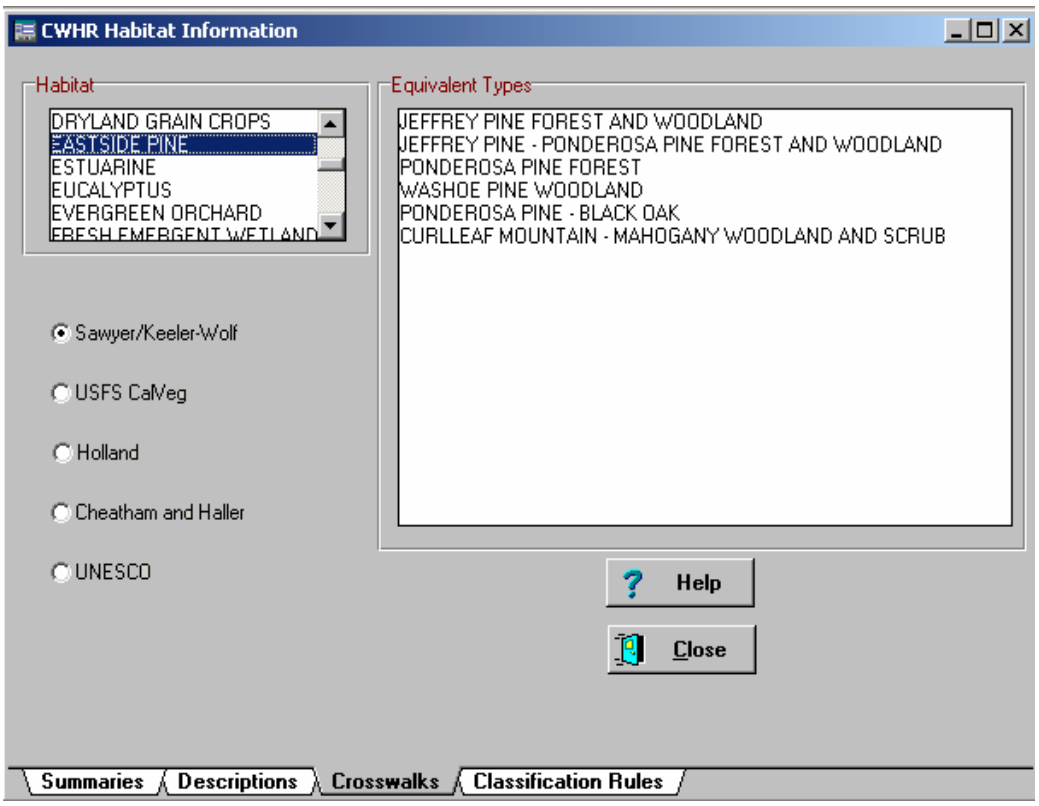
When a habitat is highlighted in the **Habitat** list, this page displays a geographic range map, available stage and size classes, a list of counties where the habitat in known to occur, and dominant plant species associated with the habitat. Definitions of habitat stages can be displayed by clicking the right mouse button when the mouse arrow is over the desired stage and the arrow becomes vertical.



Descriptions

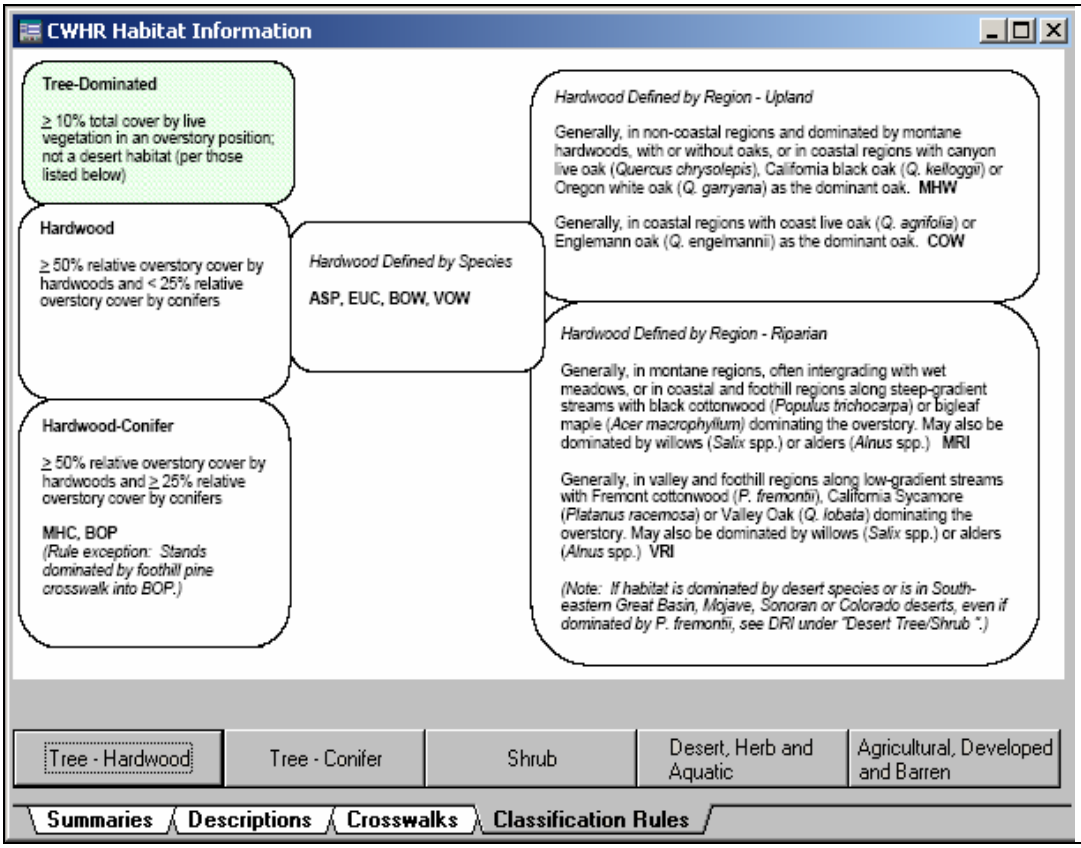
To view a habitat description, select the desired habitat from the **Habitat** list in the lower left corner of the window. Use the **Print** button to send the description to the system printer.

TIP: Unlike the pages of the species information window, the pages of the habitat information window operate independently. That is, the habitat you select on the summaries page, the first page of this window, is not automatically selected on the descriptions page.



Crosswalks

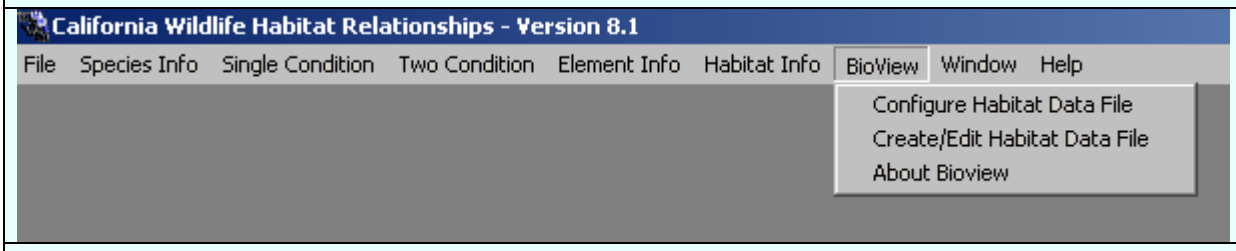
When a CWHR habitat is highlighted on this page, you can view the corresponding vegetation type(s) from five different classification schemes. The default crosswalk is with "A manual of California vegetation" (Sawyer and Keeler-Wolf 1995). Use the radial buttons to toggle between the various schemes. When the mouse arrow is placed over a source's name, a yellow box will appear with the title of the source.



Classification Rules

This page allows the user to view the revised habitat classification guidelines from "*A guide to wildlife habitats of California*" (Mayer and Laudenslayer 1988). The revised guidelines allow for the habitats added since publication of the guide. Use the buttons to view selected portions of the classification rules.

BIOVIEW



Bioview uses habitat suitability ratings from the CWHR database for user-selected species and applies them to a user-provided habitat data file. The habitat data file is generally a list of polygons in a Geographic Information System (GIS) data set representing habitats and stages for a forest or region or project area. However, the habitat data file need not necessarily represent a GIS layer. Bioview only requires a unique identifier for each habitat and stage for which a user wants a habitat suitability value for a given species. One advantage of Bioview over CWHR is that the user can provide habitat and stage selections in an input file rather than selecting them one-by-one as in a conventional CWHR query.

Bioview produces two types of output, each in two different formats. One output contains ***Standard Habitat Suitability Values*** for a given species from CWHR, except that they appear as integers rather than decimals – 0 or 1 for no suitability, 33 for low suitability, 66 for medium suitability and 100 for high suitability. Values are provided for reproduction, cover, feeding, the arithmetic mean of these three numbers and the geometric mean of these three numbers. The second output contains ***Habitat Suitability Values Using Fuzzy Logic***. Each of these output types is available as a series of five comma-delimited text files (*.val files) or a single database file (*.dbf) with five fields.

> Note that in Bioview, unlike in CWHR, the value for no suitability may be a 0 or a 1. A value of 1 is assigned when a habitat and stage has value for one or two of the life requisites, but not for all three. This convention was adopted to distinguish a habitat that provides some habitat value to a species, from one that does not have any. When a location has no value for any of the three life requisites, then a value of 0 is assigned. If you were to produce a Bioview GIS display of information for a species that has medium value for cover (value of 66), low value for forage (numeric value of 33), and no value for reproduction, the display for reproduction would show that the location had value for one or more of the other life requisites because of the presence of “1”s in the display

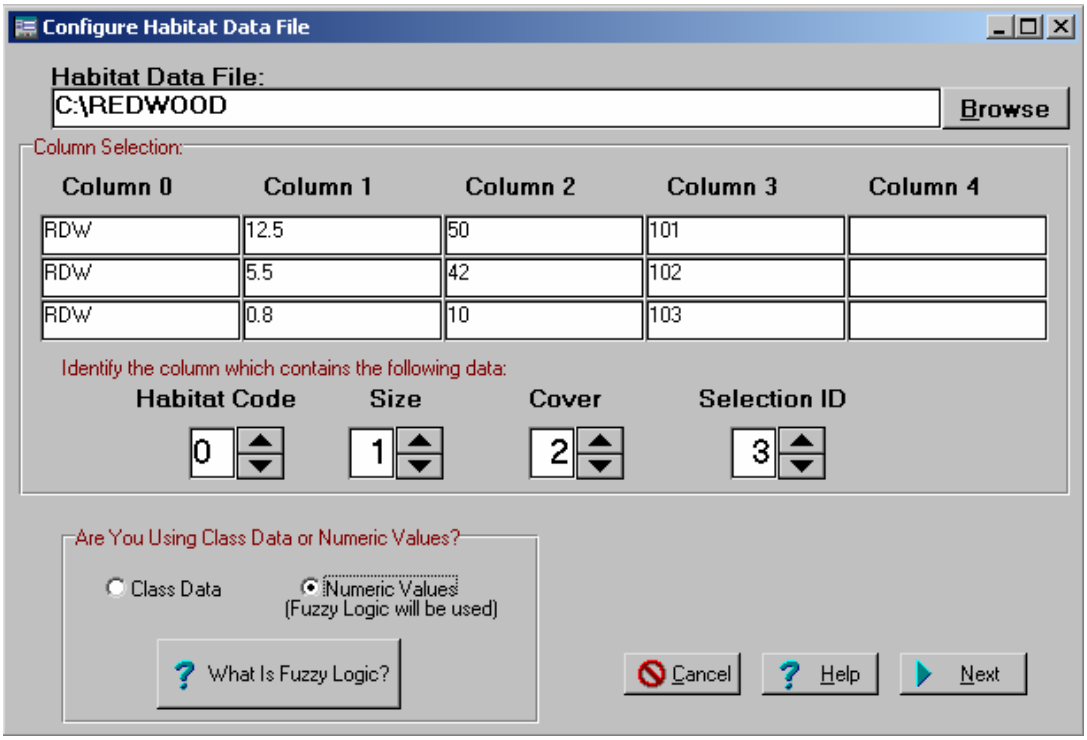
The two choices for Bioview on the main menu will both lead you through Bioview. Select “Configure Habitat Data File” if you already have a habitat data file in comma-delimited text format. Select “Create/Edit Habitat Data File” to create such a file. (For more information on preparing your data for use with Bioview and using Bioview output in a GIS, see Appendix A.)

Configure Habitat Data File

This window allows you to configure an existing habitat data file. First, click the **Browse** button to search for and select the habitat data file you wish to use. When you have done so, the selected file and its pathway will appear in the window at the top of the form. If the file is in the proper format, the columns below this window will fill in with data.

Next, use the spin boxes below these columns to identify which column contains each piece of required data. In the example, habitat code is found in Column 0, size in column 1, cover in column 2 and selection ID in column 3.

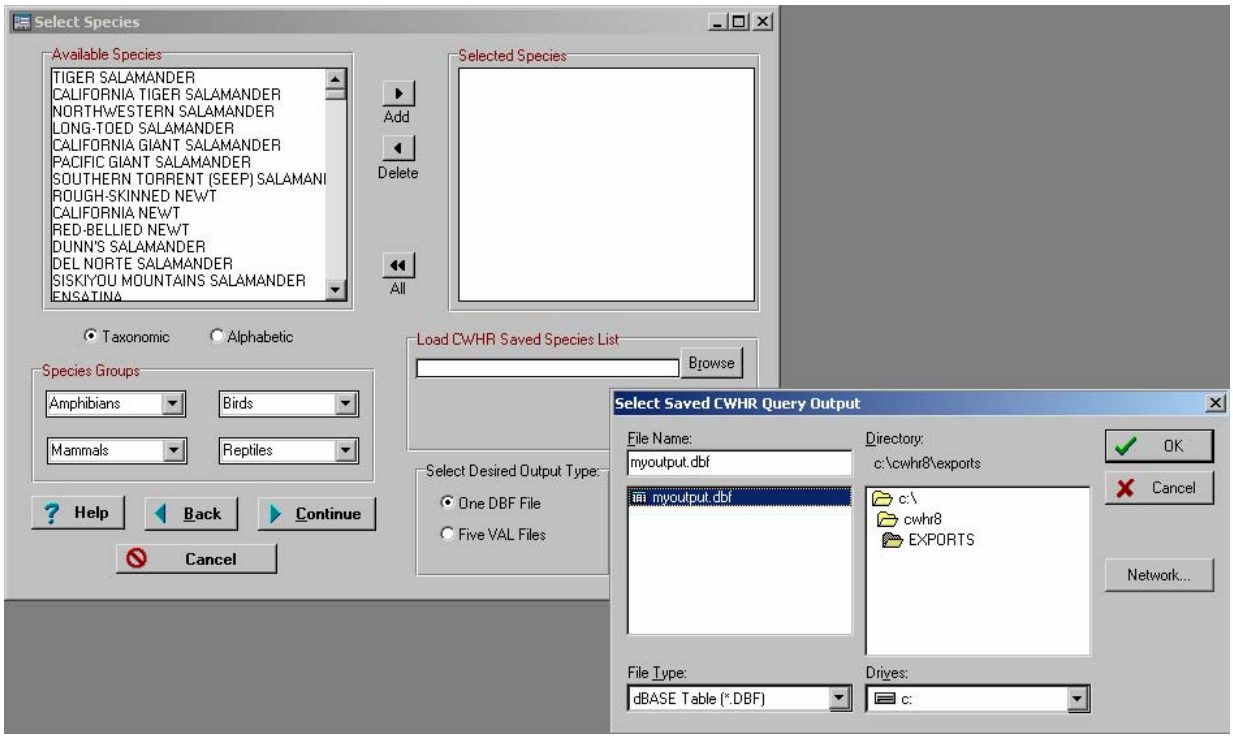
Finally, select the type of data that is contained in the file – class data or numeric values. Right-click using the mouse when a vertical arrow appears over either of these terms to see examples of class data or numeric values data. **This is an important selection because fuzzy logic calculations can only be performed correctly on actual numeric values representing size and cover.** For a description of what fuzzy logic is and how it is applied here, click on the button "What is fuzzy logic?"



The habitat data file above contains numeric values. The output files from this query will contain ***Habitat Suitability Values Using Fuzzy Logic.***

Select Species

The species selection window appears next. Species are selected in a similar way as in CWHR queries except that here, by default, no species are selected. Use the radial buttons to sort the list taxonomically or alphabetically. To select a species, double-click on its name or highlight it and click the **Add** button. To remove species from the selected list, use the **Delete** button for one species at a time or the **All** button for all species at once.



Several species groups (i.e., passerines, bats, etc.) are available under the **Species Groups** drop boxes. Picking a group from the drop boxes will add the species in that category to the selected list.

You may also load a saved species list from a CWHR query and edit it using the **Delete** and **All** buttons. Doing this takes advantage of the query parameters in CWHR. For example, if you run CWHR first and save the output list to use later in Bioview, you will have had a chance to screen out those species which would not be present in your project area by virtue of their range in the state. Use the **Browse** button to search for and load a saved species list from a CWHR query. When you have done so, the selected file and its pathway will appear in the window next to the **Browse** button and the **Okay** button will be highlighted.

Finally, select the desired output type using the radial buttons in the lower right-hand corner of the form. Bioview will create either one database (*.dbf) file or five val (comma-delimited ascii text format) files for each species selected. The five val files include one output file each for reproduction, cover and feeding habitat suitability values, an output file for the arithmetic mean of these numbers and an output file for the geometric mean of these numbers. These files will automatically be saved into the same directory from which you loaded your habitat data file. One or five files, depending on your selection, will be named for each species using the following naming convention:

A048cvr.val – Cover Values

A048cvrf.val – Cover Values Using Fuzzy Logic

A048frg.val – Foraging or Feeding Values

A048frgf.val – Foraging or Feeding Values Using Fuzzy Logic

A048rpo.val – Reproduction Values

A048rpof.val – Reproduction Values Using Fuzzy Logic

A048arm.val – Arithmetic Mean

A048armf.val – Arithmetic Mean (Fuzzy)

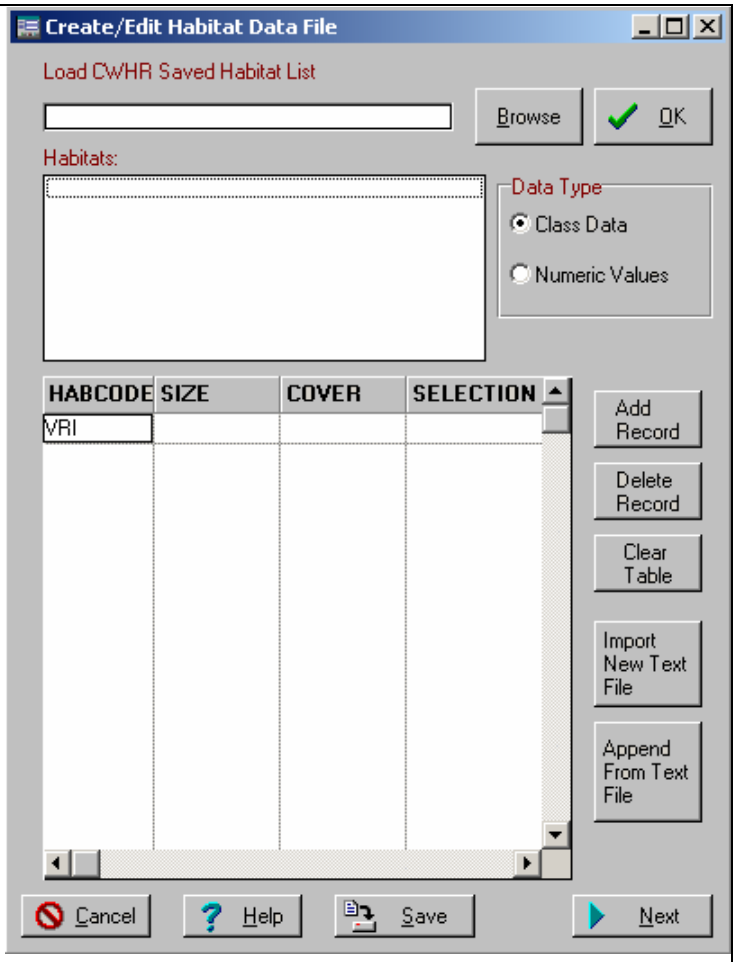
A048qdm.val – Quadratic or Geometric Mean

Create/Edit Habitat Data File

Under this option, all the information for the habitat data file can be entered into a table and saved. Use the **Browse** then the **OK** button to search for and load a CWHR saved habitat list. This is not required but is provided as a convenient way to enter habitat codes into the new data file from a saved CWHR query. (A complete list of habitats, named "allhabs.dbf", has also been loaded into the default folder for retrieving.) If you select **Add Record** next to the table and then double click on one of the habitat names in the window above, its code will be placed in the table on the selected line.

Use the buttons to the right of the table to create and edit the file. **Clear Table** removes all data from the table. **Add Record** allows you to add to the table. **Delete Record** removes the currently selected record from the table. **Import New Text File** brings up a file selection window. Note that all information in the table will be removed if an import is performed. To simply append a file of existing records without deleting removing the table, use the **Append From Text File** button.

You may save your table at any time by using the **Save** button.



Before clicking **Next** to move to the species selection window, be sure the correct **Data Type** is selected near the top of the form. Data types and species selection are described above.

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Zeiner, D.C., W.F. Laudenslayer, Jr., K.E. Mayer, and M. White, eds. 1990a. California's wildlife Volume III: mammals. State of California, The Resources Agency, Department of Fish and Game, Sacramento, California.

Zeiner, D.C., W.F. Laudenslayer, Jr., K.E. Mayer, and M. White, eds. 1990b. California's wildlife Volume II: birds. State of California, The Resources Agency, Department of Fish and Game, Sacramento, California.

DEFINITIONS

Activity Codes

Movement/Migration: Identifies random or periodic movements to different habitats.

Unpredictable Movements (U) – Individuals perform irregular, unpredictable movements.

Local Migrator (L) – Regular seasonal migrations generally limited to less than 100 miles travel distance; generally implies within-state migrations as the norm.

Distant Migrator (D) –Regular seasonal migrations generally longer than 100 miles travel distance; generally implies interstate migrations as the norm.

Non-migratory (-) – Do not engage in predictable movements away from normal home range during the year. Dispersal of juveniles is not considered a migration.

Daily Activity: Indicates the time periods when the species is active (not just most active) foraging, traveling, etc. Animals that are most active at dawn and dusk but are also active throughout the day and night (e.g. deer) are circadian, not crepuscular.

Circadian I – Active during all parts of 24-hour period.
Diurnal (D) –Active only during daylight.

Nocturnal (N) –Active only during darkness.

Crepuscular (P) – Active only at dawn and dusk.

Seasonal Activity: Identifies seasonal activity in the broadest sense (i.e., Hibernators include facultative hibernators such as raccoons and bears.)

Yearlong (Y) – Active during all months.

Hibernate (H) – Inactive during winter.

Aestivate (A) – Inactive during summer.

Calculation Methods for Average Habitat Suitability Value

Arithmetic Mean: the arithmetic average of the numeric scores given to the habitat suitability ratings for the reproduction, cover, and feeding life requisites within an individual habitat stage. The formula is:

$$SI = \frac{(R + C + F)}{3}$$

Therefore, a stage where reproduction suitability was rated as High=1.00, cover was rated as Medium=0.66, and feeding was rated as Low=0.33 would have an average suitability value = 0.66.

Geometric Mean: the geometric average of the numeric scores given to habitat suitability ratings for the reproduction, cover, and feeding life requisites within an individual habitat stage. The formula is:

$$SI = \sqrt[3]{R * C * F}$$

Therefore, a stage where reproduction suitability was rated as High=1.00, cover was rated as Medium=0.66, and feeding was rated as Low=0.33 would have an average suitability value = 0.60. Using the geometric mean results in habitat suitability values of 0.00 when at least one life requisite is unsuitable.

Element Importance Ratings

Essential: habitat element importance rating where the element is required for the species to exist; element must be present in habitat if species is to be present.

Secondarily Essential: Habitat element importance rating where the element must be present in the habitat unless its absence is compensated by presence of other secondarily essential elements in the same life requisite category.

Preferred: Habitat element importance rating where the element is marginally helpful for survival; it is preferred because use exceeds availability, and the presence of the element enhances habitat suitability, but is not essential for species to be present.

Habitat Suitability Levels

High: Habitat suitability rating where habitat is optimal for species occurrence; habitat can support relatively high population densities at high frequencies. Suitability index value = 1.00.

Medium: Habitat suitability rating where habitat is suitable for species occurrence; habitat can support relatively moderate population densities at moderate frequencies. Suitability index value = 0.66.

Low: Habitat suitability rating where habitat is marginal for species occurrence; habitat can support relatively low population densities at low frequencies. Suitability index value = 0.33

Unsuitable: Habitat stage is unsuitable for species occurrence, and the species where habitat is rated unsuitable is not expected to reliably occur in the habitat. Suitability index value = 0.00.

APPENDIX A: USING YOUR DATA WITH BIOVIEW

Configuring Your Data for Bioview

Bioview can only accept data in a comma-delimited ascii text format. This is a common export format from database and spreadsheet software programs. Be certain the program you export from does not install quotation marks (“”) around data or extra spaces between commas. Microsoft Excel works well for both importing data in a variety of formats and exporting it as comma-delimited ascii text. It will give the exported file an extension of *.csv (stands for “comma-separated values”), which Bioview will easily read.

Export only the four columns of data needed by Bioview.

Note that, although Bioview allows you to point to the columns containing the data it requires, it runs best when the data is in the default configuration suggested by the **Configure Habitat Data File** window in the program:

> The first column (Column 0) is the three-character code representing the habitat. (RIC is an exception. See table below.)
>
> The second column (Column 1) is the size class. **Note that Bioview needs a value in this field, even for habitats that have no stages such as URB and BAR**. Insert a "1" where this is the case, even when using the numeric values/fuzzy logic option.
>
> The third column (Column 2) is the cover class. **If you are using a configuration other than the default, be certain this is not the final column of data**. There are several habitats for which no cover classes are defined, such as URB and BAR. Also, size class 6, defined for many tree-dominated habitats such as SMC, does not have any corresponding cover classes. If these fields are empty for records or polygons representing such habitats, the final column of data in a comma-delimited ascii text file will be represented by a dangling comma. Bioview will search frantically for data that follows that comma and it will not find anything. The program will return an error message and you will not be able to continue. Also, for habitats that have no cover classes, be certain the cover class column does indeed have no data, rather than a "0", or the output will be incorrect. **Bioview looks for data matches for both size and cover class values for species in a habitat and it returns values of "0" suitability for size and cover class combinations that do not exist in CWHR**. For example, RDW 1D will show "0" suitability, even for a species you know finds suitability in RDW 1. You may have a numeric value in this field if you are using the numeric values/fuzzy logic option.
>
> The fourth column (Column 3) is the selection ID, often the polygon ID in a GIS coverage.

Ideally, your data should look like this:

RDW,3,M,101

RDW,1,,102

Or, if you are using fuzzy logic, like this:

RDW,12.5,50,101

RDW,0.8,10,102

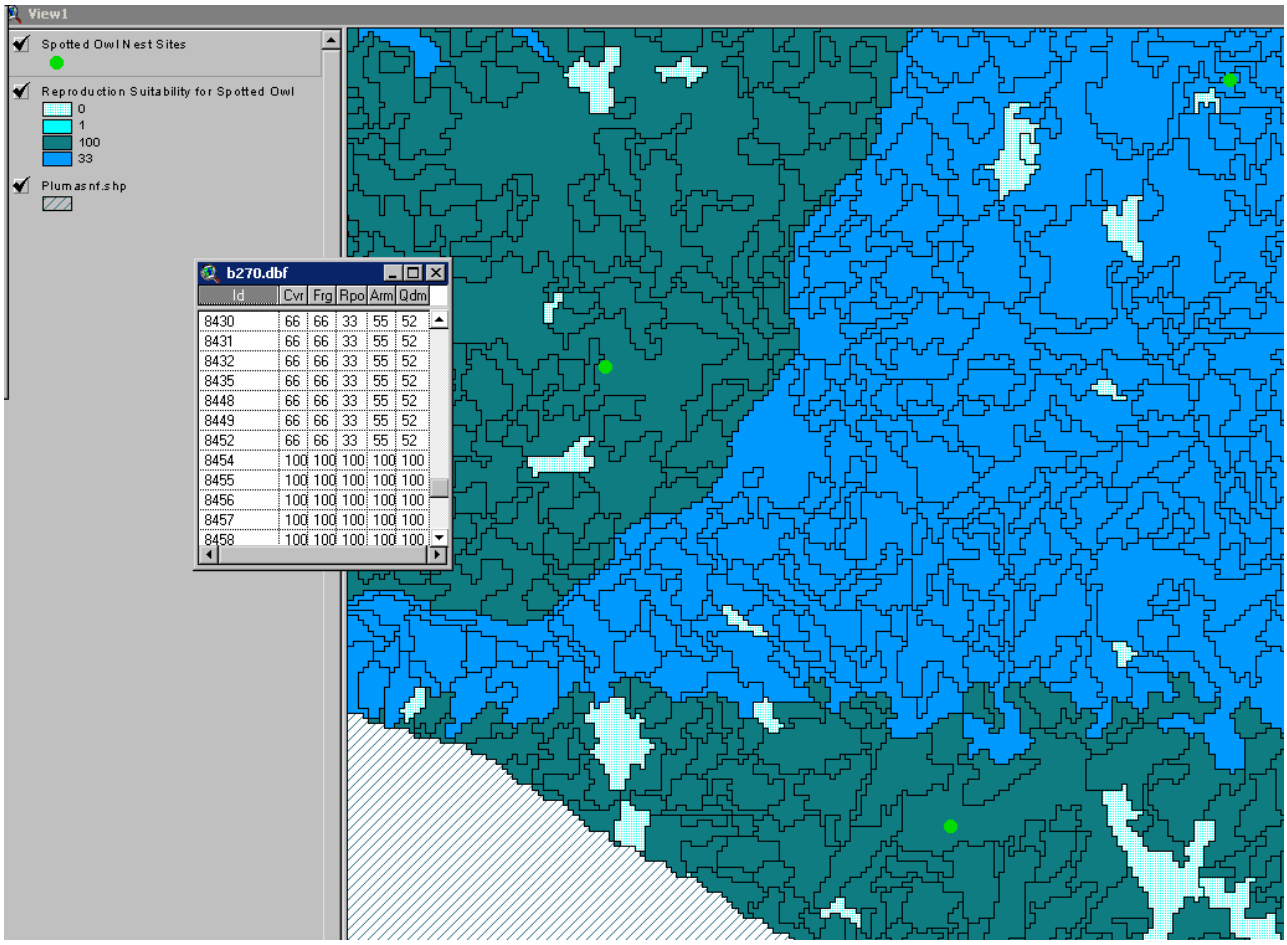
Using Numeric Values with the Fuzzy Logic Option

Below is a guide to the numeric values which should appear in the size and cover fields if you are using the fuzzy logic option.

Habitats	**Size Column**	**Cover Column**
Tree Habitats	dbh or QMD	% cover
Tree Habitats with No Cover Class (DOR,EOR)	dbh or QMD	---
Herb Habitats	height	% cover
Aquatic Habitats	% time exposed	---
Habitats with One Class (BAR, URB,DGR,IGR,IRH,IRF,VIN)	any value between 0 and 100	---
Rice (RIC) This is a special case as cover values are defined for non-flooded rice habitat and depth values for flooded rice habitat. We have adopted the following new codes for RIC for Bioview only; the codes remain the same for all other CWHR queries. Rice, Non-flooded RIC 1A, 1B = RIN 1,2 Rice, Flooded RIC 2S, 2M, 2D = RIF 1,2,3	 % cover depth	 --- ---

Displaying Output Data from Bioview in a GIS

Displaying the results of your query spatially is beyond the programming language of CWHR Version 8.2 or Bioview. However, Bioview output is designed so that, for each species of interest, all habitat suitability values will appear in a single *.dbf table. Because the table contains the unique identifier for each polygon in your habitat data file, it can then be used to "attribute" the actual spatial data in a GIS. This is a simple process if you are familiar with popular GIS software programs such as ArcInfo or ArcView. A variety of habitat suitability maps can then be created for each species showing the range of values across a forest or region or project area, be it for reproduction, cover, feeding or an average of all three. Below, the Bioview output table b270.dbf is used to attribute a polygon coverage of habitats in an ArcView session to create a reproduction suitability map for the Spotted Owl in a section of Plumas National Forest.



Id	Cvr	Frg	Rpo	Arm	Qdm
8430	66	66	33	55	52
8431	66	66	33	55	52
8432	66	66	33	55	52
8435	66	66	33	55	52
8448	66	66	33	55	52
8449	66	66	33	55	52
8452	66	66	33	55	52
8454	100	100	100	100	100
8455	100	100	100	100	100
8456	100	100	100	100	100
8457	100	100	100	100	100
8458	100	100	100	100	100

APPENDIX B: FUZZY LOGIC AND ITS APPLICATION TO CWHR

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Some Background – Fuzzy Logic or Fuzzy Thinking?

Fuzzy Logic is a semi-popular term referring to an emerging branch of mathematics that is sometimes called multi-valued set theory. This section is an attempt to describe the concepts and applications of this mathematics of uncertainty as it applies to wildlife habitat evaluations. The theoretical and mathematical underpinnings for fuzzy logic are clearly beyond the scope of this document. Although, for those with a serious interest in mathematical theory, the treatise "Fuzzy Sets and Fuzzy Logic: Theory and Applications" by George J. Klir and Bo Yuan (published by Prentice-Hall Inc. of New Jersey) is highly recommended.

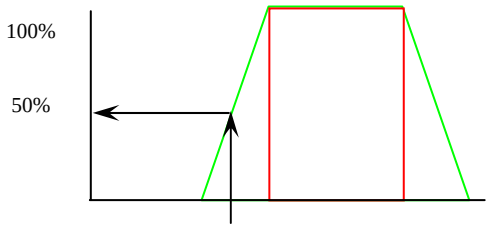
In the simplest terms, fuzzy sets represent the mathematics of uncertainty, an emerging response to the recognition that little in the real, physical, and especially in the biological world is clear-cut and unambiguous. That the real world is only defined with uncertain, ambiguous, and incomplete data should be no surprise to those who regularly attempt to understand, explain, and/or manage natural systems. However, in many ways, such a reality is a recent discovery in the field of mathematics. From this recognition, and the "first" formalizations of a mathematics of uncertainty (fuzzy mathematics) by Lotfi Zadeh in the 1960's, has grown a respectable body of theory, proofs, and practice.

Fuzzy logic is not confused thinking, but a recognition that little in the world is clearly one thing or another. Fuzziness (not error) arises from classes of objects the boundaries of which cannot be well defined. A can of paint that contains no color but green is a member of the fuzzy class "green paint". As the proportion of green is reduced by the addition of blue dyes, the paint slowly begins to turn color. When is it not green? When is it "sea foam green" or cyan or turquoise? It could be conceived that when there is only green dye, membership in the class green paint is 100% and membership in the class blue paint is 0%. As blue dyes are added, the "blueness" of the paint increases (membership in class blue increases above 0) and at some point membership in the class green decreases. Turquoise, for example, could be described as a 65% member of the class blue and a 35% member of the class green.

Why Apply Fuzzy Logic to CWHR?

Fuzzy logic is ideally suited for application to the biological world where the differences (boundaries) between "things" are, at best, unclear. When is an erect woody plant a tree rather than a bush? When is a forest great habitat, versus good habitat or poor habitat? The kind of habitat represented by a forest with an average stand diameter of 45 inches and a crown cover of 90% is very different from a dense thicket of young trees whose average diameter is 4 inches, and crown cover 90%. But, does a forest with an average stand diameter of 12 inches represent a different quality of habitat than one with a diameter of 10 inches? Probably not, at least in the real world. This question identifies the fuzzy nature of the CWHR habitat suitability models.

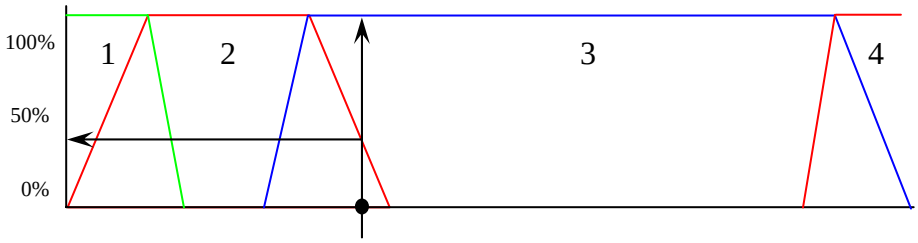
The CWHR models use environmental variables expressed as classes (crown decadence and percent ground cover for shrub habitats), with a suitability rating for each combination. These classes are fuzzy sets with unclear and ambiguous boundaries. Bioview applies fuzzy logic to these classes to provide a more realistic evaluation of habitat suitability.



The figure to the right represents a single CWHR class (of any variable) with the vertical lines the CWHR class boundaries. Maximum membership is 100% and all values of the variable on the x-axis between the vertical lines are 100% members in the class. Values that fall between the vertical and the slanting lines are partial members of the class. Their degree of membership is determined by where their vertical extension intersects the diagonal line. In this example degree of membership in this specific class is just less than 50%. Values outside the slanted lines have zero membership in the class. Any value can have partial or complete membership in one or more additional classes as explained below.

How is Fuzzy Logic Applied to CWHR in Bioview?

Bioview applies a linear boundary for the fuzziness although any shape, including logarithmic and sigmoid, is appropriate as long as it represents the change in uncertainty with closeness to the boundary. For many sets the fuzziness can be calculated or measured and the best shape derived.



By extending the previous diagram to cover the full range of a variable (e.g., size class for forests) it becomes obvious that every point is a member in at least one class. Points that fall in the fuzzy regions, defined by the slanted lines, are members in two classes. The point illustrated is a full member of Size Class 3 and about a 40% member of Size Class 2. If, in this example, the habitat value for Northern Goshawk is high in Class 3 and medium in class 2 the actual value of the habitat lies somewhere between medium and high. Size Class 3 contributes a full membership in a set of high habitat value and Size Class 2 contributes a 35% membership in a medium value. The net value (from size alone) is a balance of the two.

However, CWHR does not use just one variable for determining habitat suitability. In the case of forests there are two, size and cover. And there is a CWHR model for every combination of those two variables. Because fuzzy sets can be combined in any number, Bioview evaluates the variation in habitat suitability with size and cover independently, and then combines them in one “unfuzzied” value.