USER'S MANUAL

FOR THE

CALIFORNIA WILDLIFE HABITAT RELATIONSHIPS SYSTEM

AND BIOVIEW

VERSION 9.0

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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 712 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 9.0 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 or from the website: https://www.wildlife.ca.gov/Data/CWHR.

The CWHR software application (Version 9.0) has been reprogrammed to make it compatible with 64 bit operating systems such as Windows 7. The interface has also been altered to be more user-friendly and intuitive, while preserving the structure and functionality. All queries and reports from previous versions are still present in 9.0, with the exception of the Species by Element report. The information that goes into this report is still available through the Element Information window.

CWHR now links dynamically with online content from the Department of Fish and Wildlife, such as range maps, life history accounts, and habitat descriptions from California's Guide to Wildlife Habitats (Mayer and Laudenslayer, eds., 1988). If no internet connection is present, CWHR will still run and will perform queries, but online content will not be accessible. The new application will also check the online source for any updates, and automatically prompt the user to download the latest version. This will allow us to continuously release updates to the model, rather than compiling updates to release all at once every few years.

Users can now save the query results as a PDF for reports, or as a spreadsheet (.csv format) for further analysis. Reports now include all the query parameters that were used, making verification, replication, and comparison of outputs easier. There is no longer a limit to the number of habitat types and stages that can be included in a single query.

INSTALLATION

CWHR Version 9.0 with Bioview (hereinafter collectively referred to as CWHR) can be downloaded from the CWHR website (https://www.wildlife.ca.gov/Conservation/CWHR/Registration). The user is required to register prior to downloading the application. Unzip CWHR 9.0.zip. Open the resulting folder 'CWHR 9.0' and run 'setup.exe'. This will install CWHR to a new directory under the 'All Programs' menu called 'California Department of Fish and Wildlife'[1]. Once the installation has completed, CWHR will automatically launch.

Uninstalling the program

To uninstall CWHR, click on the Start Menu and select 'Control Panel' then 'Programs and Features' and 'California Wildlife Habitat Relationships'. Choose 'Uninstall'. For Windows 7, click on the Start Menu and select 'Control Panel' then under 'Programs' chose 'Uninstall a program'. For Windows 8, hover the cursor in the bottom-left corner of the screen until a small image of the Start Screen appears, then right-click on the icon to open the Start Context Menu, select Programs and Features, select the CWHR program and press 'Uninstall/Change' button to uninstall.

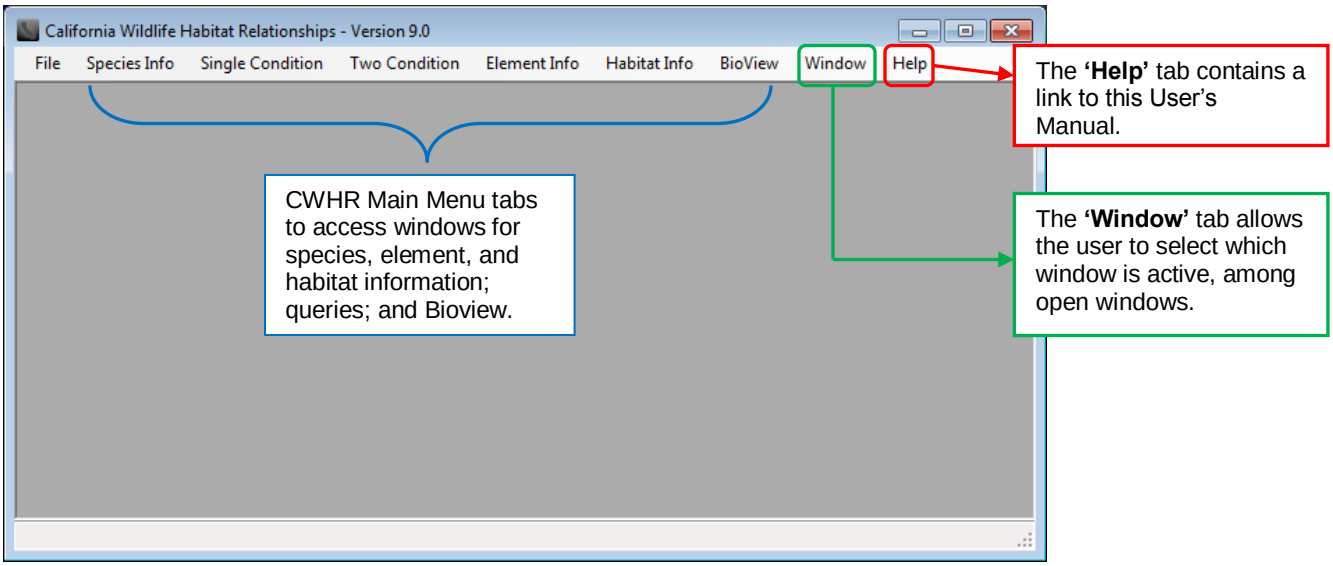
[1] In order to install properly, you may be required to remove older versions of CWHR from your computer. Follow the instructions for uninstalling the program at the end of this section, and then install the new version.

STARTING THE PROGRAM

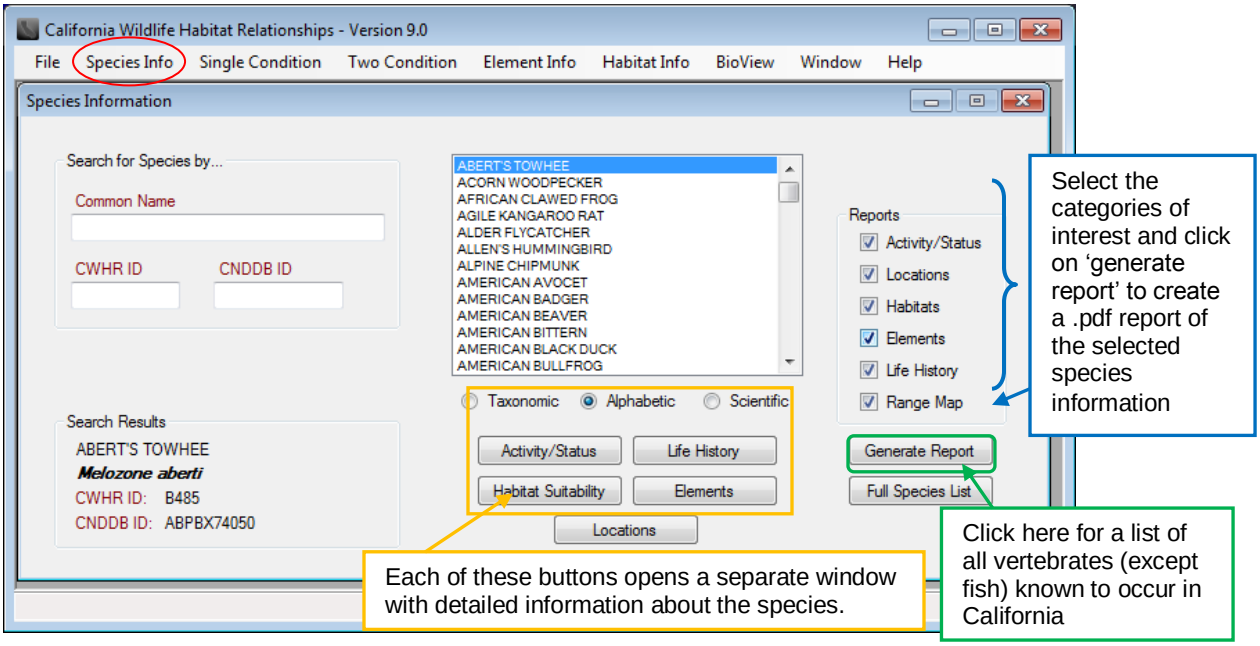
Click on the Start Menu → All Programs → California Department of Fish and Wildlife → California Wildlife Habitat Relationships. Clicking on this will launch CWHR 9.0.

Main Menu

The main menu window of CWHR contains tabs to open windows containing species, element, and habitat information; queries; and Bioview. Each of these tabs will open a new window, and multiple windows can be open at once. Detailed descriptions of how to use each window are contained in this User's Manual.



SPECIES INFORMATION WINDOW (Species Info tab)

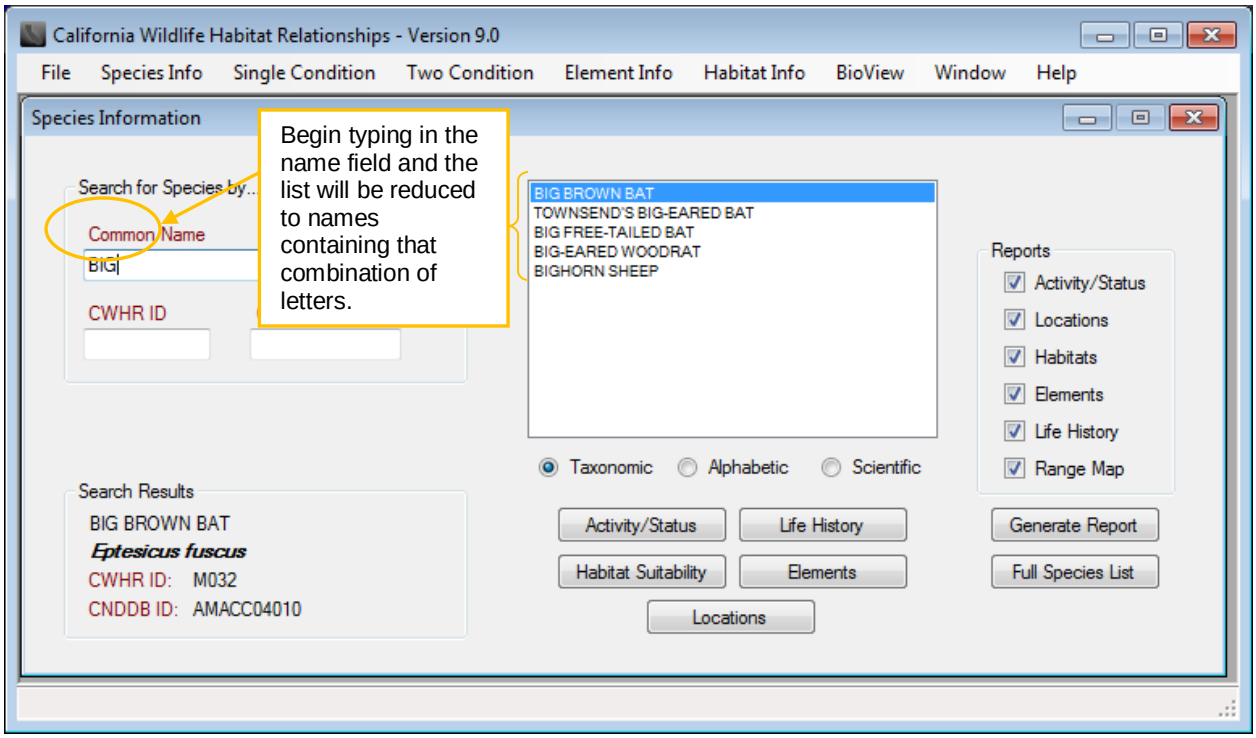


The species information window can retrieve all available information about a species in the CWHR database. This includes taxonomy, life history attributes, legal status[2], geographic distribution, seasonality, ratings for special habitat elements, and habitat suitability values for all size and cover classes of CWHR habitat types. Six reports are available for each modeled species: Activity/Status, Locations (in list form by region), Habitat Suitability, Elements, Life History, and Range Map. These can be viewed within the program or exported to .pdf using the 'generate report' button. A species list for the entire state, which includes all species that occur in the state whether or not they are modeled in CWHR, can also be accessed from this window using the 'Full Species List' button.

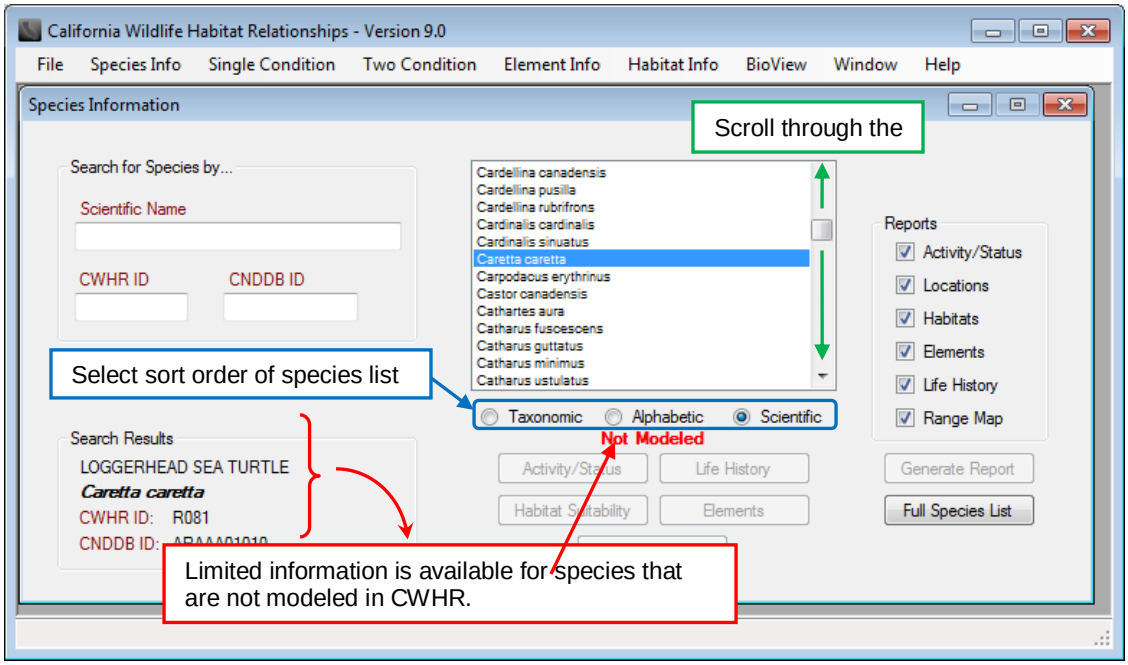
[2] Note that the legal status listed in CWHR may not reflect recent changes in status. Please refer to the CDFW list of STATE & FEDERALLY LISTED ENDANGERED & THREATENED ANIMALS OF CALIFORNIA or the CDFW SPECIAL ANIMALS list for the current status of a species.

Selecting a Species

You may select a species by entering its CWHR ID code, common name, scientific name, or CNDDB ID (same as the Natureserve code for most species) in the appropriate box. Common names are those from lists of accepted taxonomy such as that from the American Ornithologist's Union (AOU) for birds. Choose the "Scientific" option below the names list to select by scientific name. Begin typing in the name field and the list will be reduced to names containing that combination of letters.

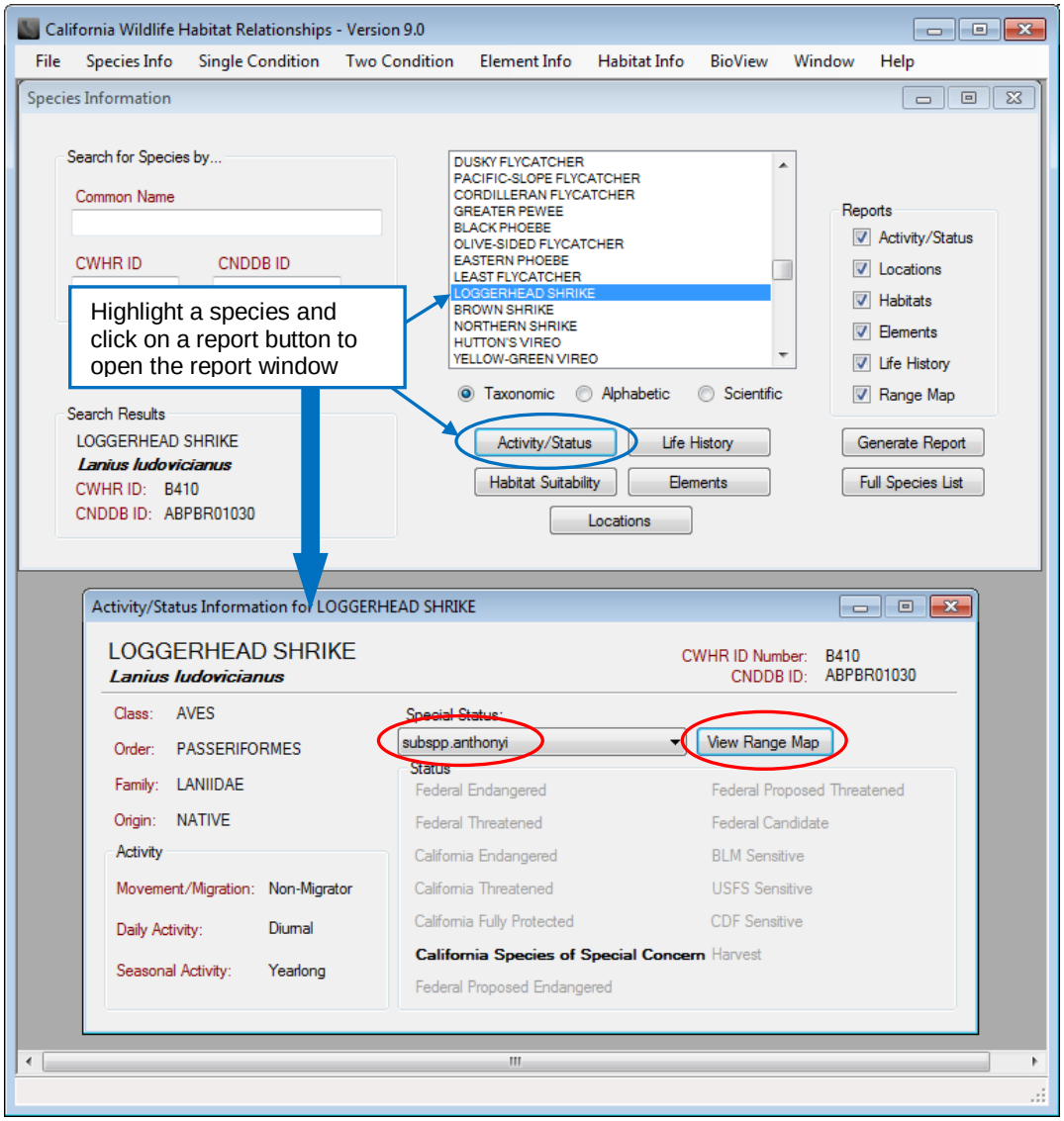


You can also scroll through the complete CWHR species list to select a species. The list can be ordered (1) taxonomically (grouped by family), (2) alphabetically by common name, or (3) alphabetically by scientific name.



Use the left mouse button to select the name of the desired species and view the report 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 CNDDB ID will be displayed in the **Search Results** box on the lower left.

Activity/Status Information



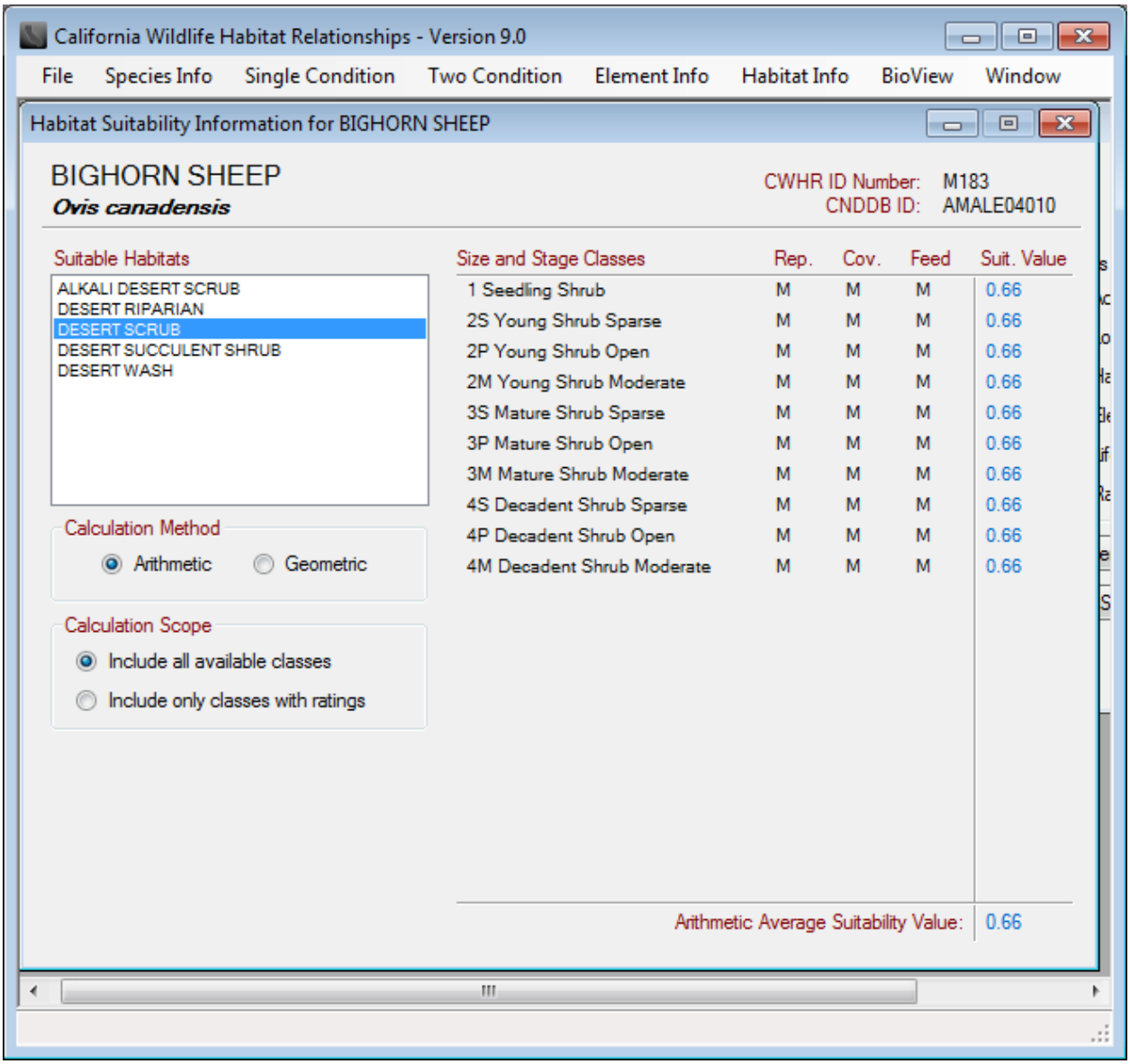
After selecting a species, click the 'Activity/Status' button. A new window will open displaying the accepted common and scientific names, class, order, family, CWHR ID number and CNDDB ID of the selected species. Legal status is also displayed at the specific and subspecific level. The status of the species or of a selected subspecies is displayed in bold when its name is highlighted by the mouse in the **Special Status** list (statuses that do not apply to the species are grayed out). 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 left mouse button when the mouse arrow is over the status or code of interest. Note that the legal status listed in CWHR may not reflect recent changes in status. Please refer to the CDFW list of STATE & FEDERALLY LISTED ENDANGERED & THREATENED ANIMALS OF CALIFORNIA or the CDFW SPECIAL ANIMALS list for the current status of a species. Amphibians and reptiles designated as Harvest species in CWHR are those species that are non-native and can be collected with no limit under a fishing license. See the California Code of Regulations, Title 14, Sections 5.05 and 5.60 for a full list of Harvest amphibians and reptiles.

Subspecies Range Maps

Subspecies range maps are currently available for some subspecies, and the CWHR is working to continue the development of subspecies range maps. If a subspecies range map is available, the 'View Range Map' button will become active within the Activity/Status Information window when the subspecies is selected. Click on the 'View Range Map' button to open a .pdf map of the subspecies range. If no subspecies range is available, the 'View Range Map' button will be grayed out.

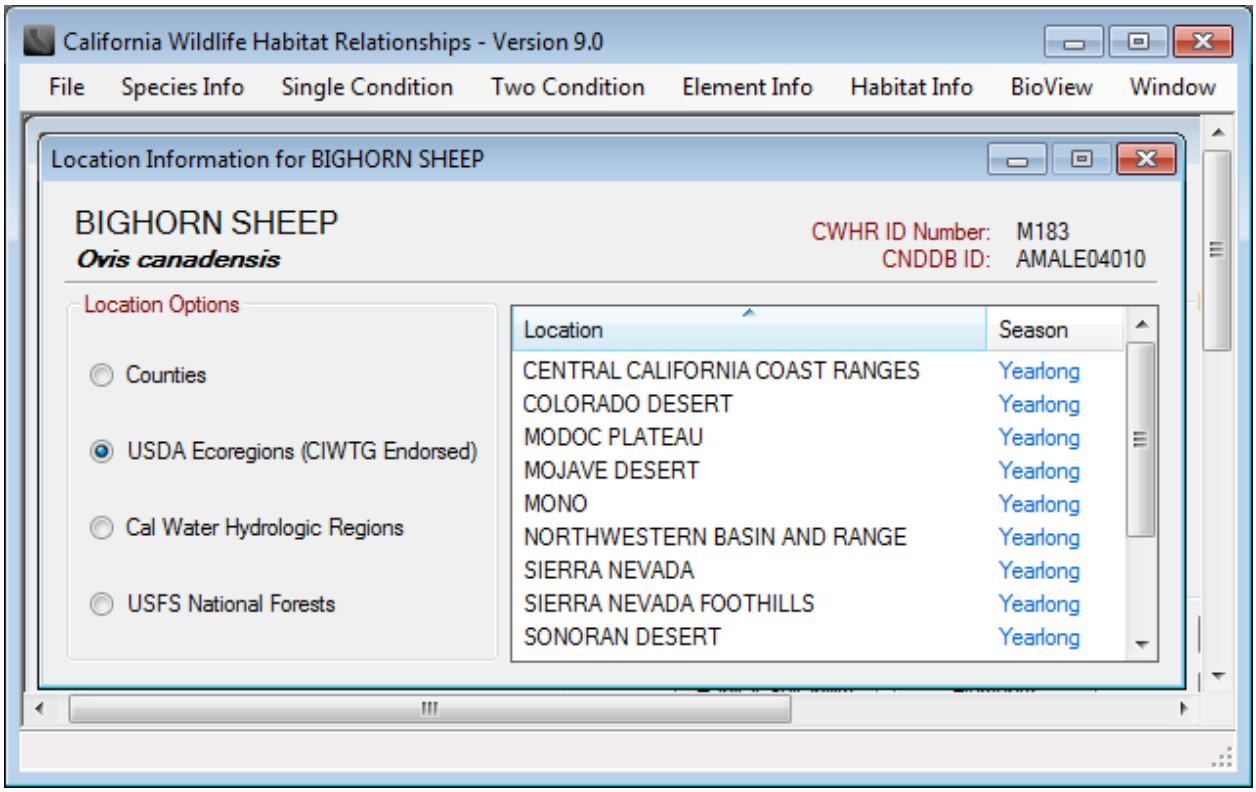
Habitat Suitability Information



Select the **'Habitat Suitability'** report button in the Species Information Window to view the habitat suitability window. 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 (Rep.), cover (Cov.), and feeding (Feed) are listed for each stage. An average habitat suitability value (Suit. Value) is also calculated for each size and stage class using arithmetic or geometric mean based on numeric scores for the suitability ratings (H=1.00, M=0.66, L=0.33, none=0.00). An overall Average Suitability Value is calculated for the type across all size and stage classes in the bottom right corner of the window. Average habitat suitability for the type can be calculated using (1) all available classes (both occupied and unoccupied stages) or (2) only classes with ratings (occupied stages only). Choose which habitats you would like included in the average habitat suitability score by selecting the appropriate button in the "Calculation Scope" box.

More information on the habitat types can be found in the Habitat Info tab on the main menu.

Location Information

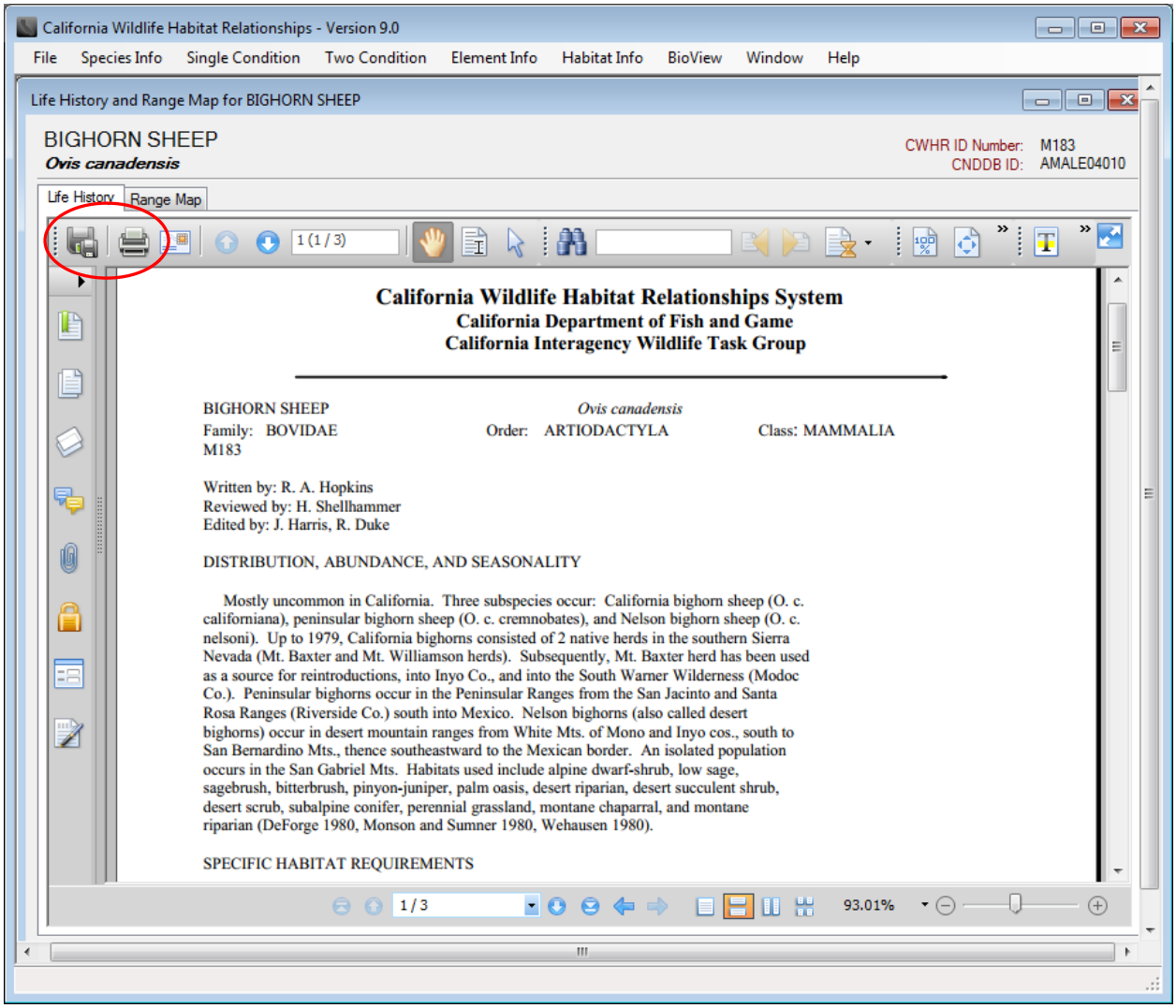


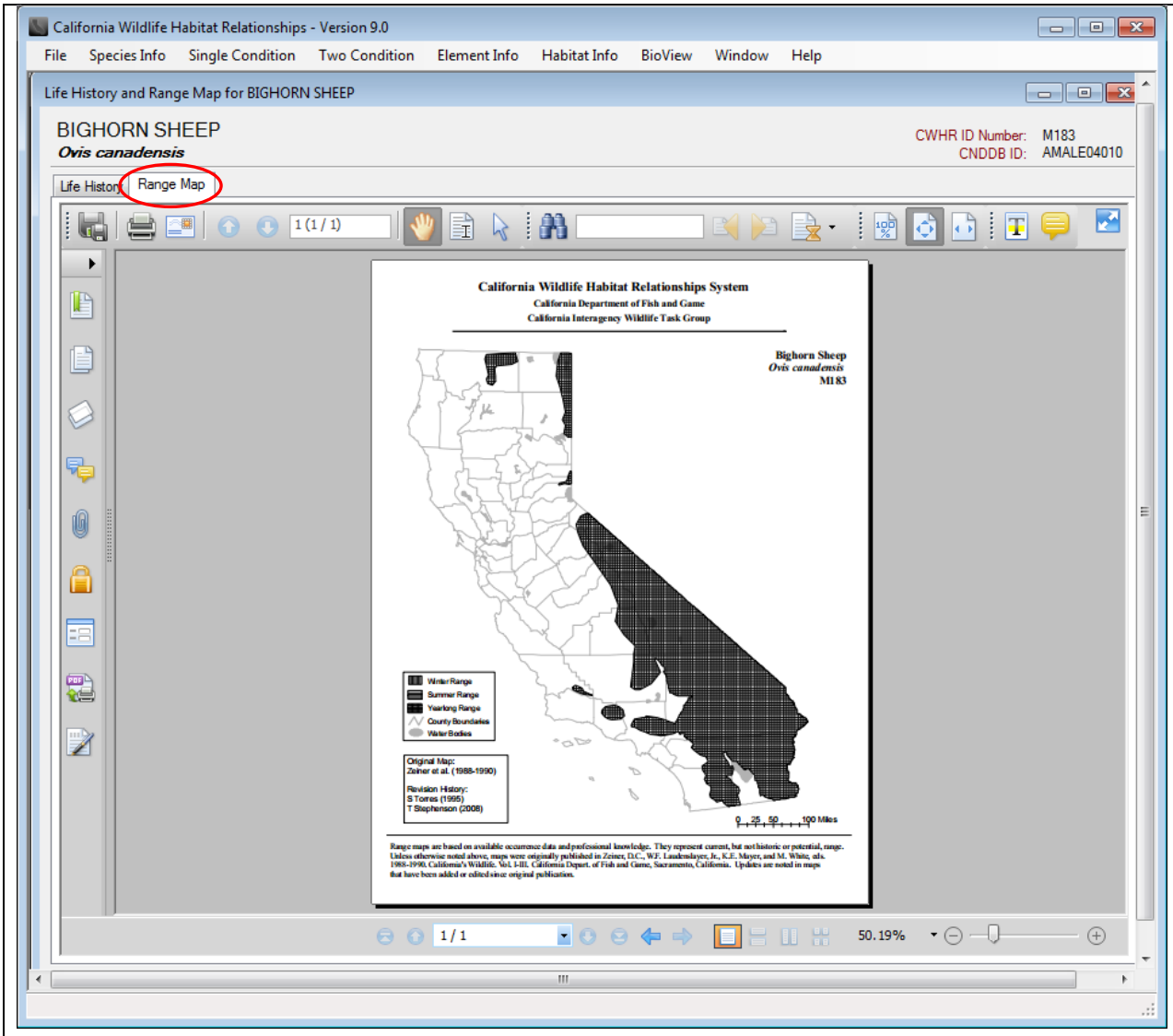
Select the **'Locations'** report button in the Species Information Window to view the Location Information Window. This window displays locations where the species is predicted to occur in California based on the species CWHR range maps. Location categories include counties, USDA Ecoregions, CALWATER Hydrologic Regions, and USFS National Forests. The seasonality pattern is given for each location. To alternate between location categories, select from the **Location Options** buttons.

Life History and Range Map

Select the **'Life History'** report button in the Species Information Window to view an online pdf with the life history description and species range map. *Note that you must be connected to the internet to access the life history accounts and range maps.*

The life history account is based on 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*". Many of these accounts have not been updated since their original publication. However, information on taxonomy and management status is updated by the CWHR staff as resources allow or as new models are developed. You can save or print the pdf from within the CWHR viewing window.





The range map tab contains the range map for the species. You can zoom, print, or save the pdf file from the CWHR viewing window. Range maps for subspecies, if available, can be accessed from within the Activity/Status Information Window.

The GIS shapefiles of species ranges can be downloaded as a bundle from the website at https://www.wildlife.ca.gov/Conservation/CWHR/Registration (the user is required to register before downloading the data). They can also be downloaded individually in the BIOS Viewer, https://map.dfg.ca.gov/bios/.

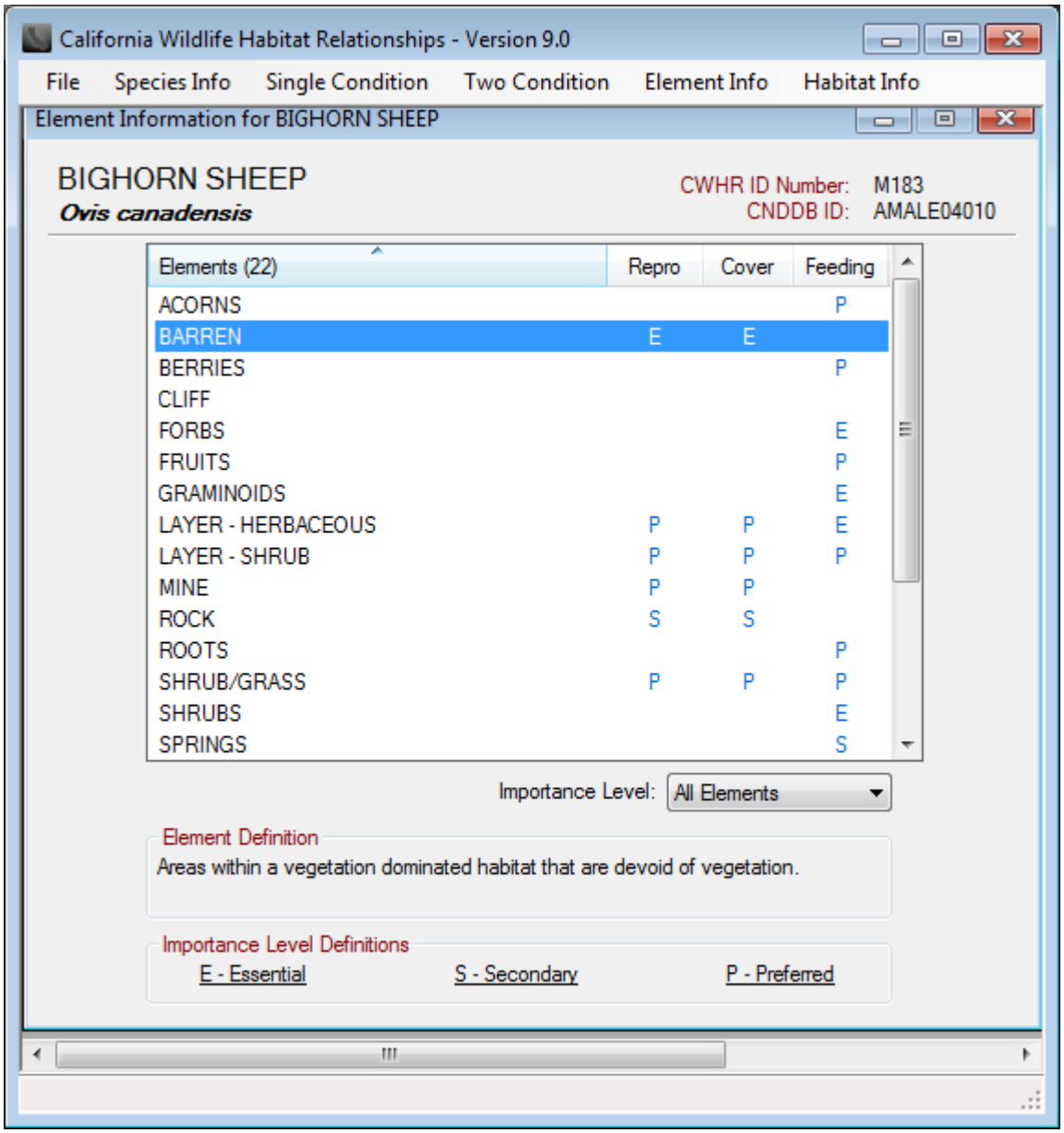
Element Information by Species

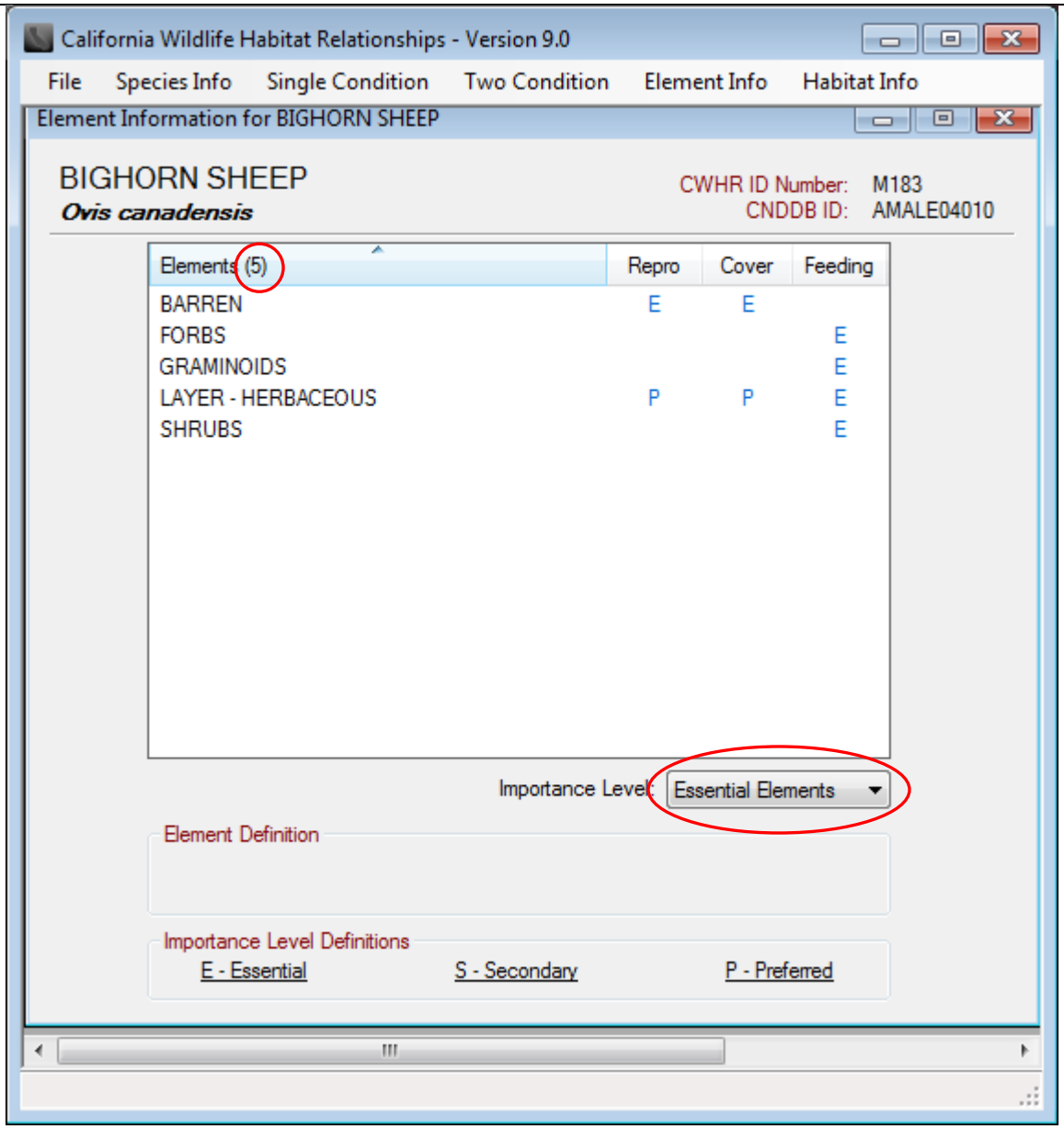
Select the **'Elements'** report button in the Species Information Window to open the **Element Information by Species** list: habitat elements predicted by CWHR to be used by the species for reproduction, cover, and feeding. Click on any element in the list to highlight it, and its definition will be displayed in the **Element Definition** box at the bottom of the window. The number in parenthesis next to the word "Elements" in the top left corner of the window shows the number of elements listed.

Elements are given one of the following ratings based on their importance to the species and their level of use:

E=Essential: The element must be present for the species to be present.
S=Secondarily Essential: The element must be present within the home range of the species for the species to be present unless it is compensated by the presence of another secondarily essential element that serves the same function to the species.
P=Preferred: The element is used by the species to a greater degree than what would be expected from its abundance; the element enhances the value of the habitat, but is not essential for the species presence.
Not listed=Not Rated

The definition of each importance level can also be found by clicking on the name of that level in the **Importance Level Definitions** box at the bottom of the window.





By default, all elements with suitability are shown in the list. To show only elements with a specific importance level, select the importance level of interest in the **Importance Level** drop-down list directly below the table. The number in parenthesis next to the word “Elements” in the top left corner of the window shows the number of elements rated at the suitability level selected.

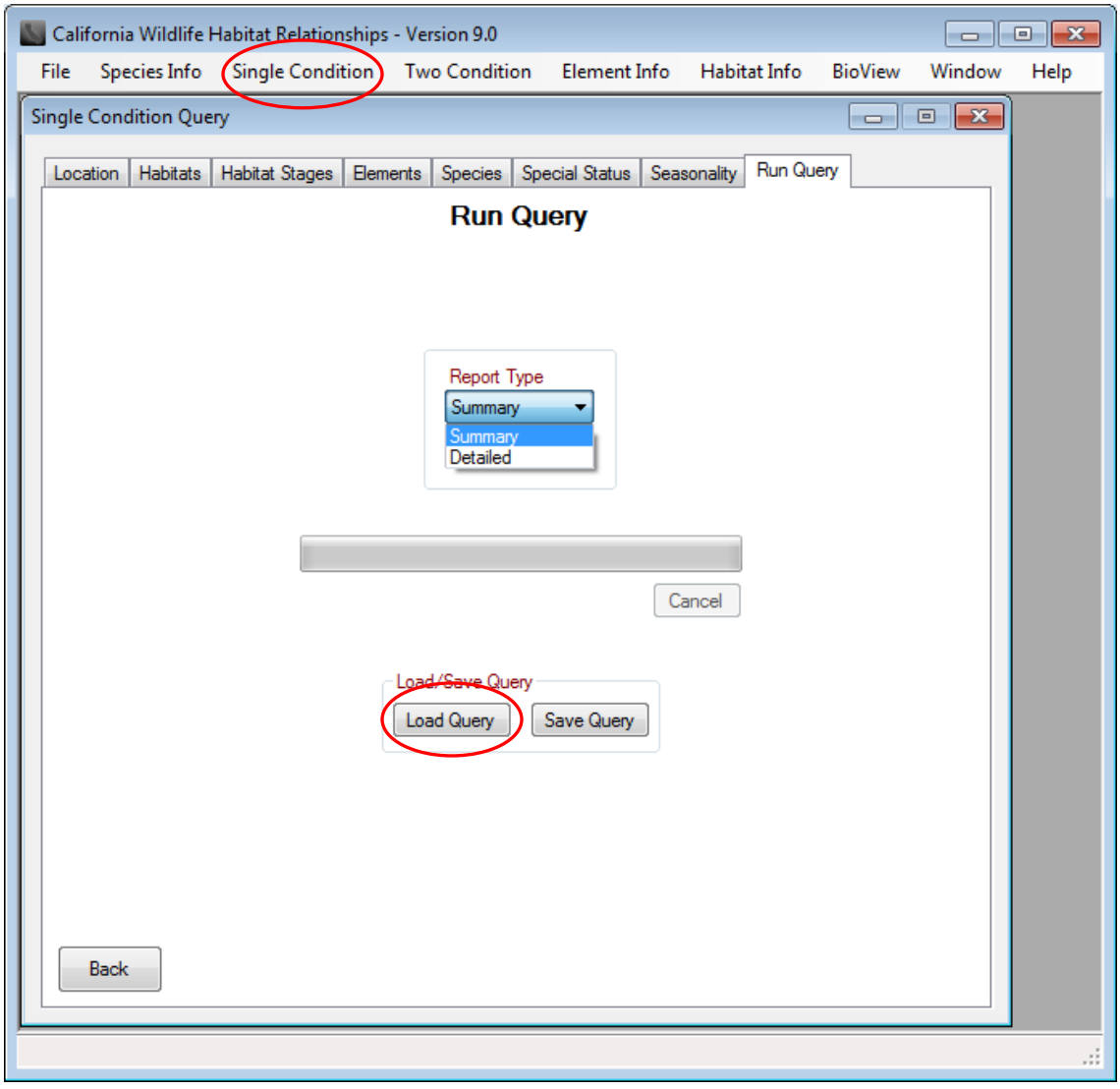
More information on Elements can be found in the Element Info tab in the main menu.

SINGLE CONDITION QUERY

Overview

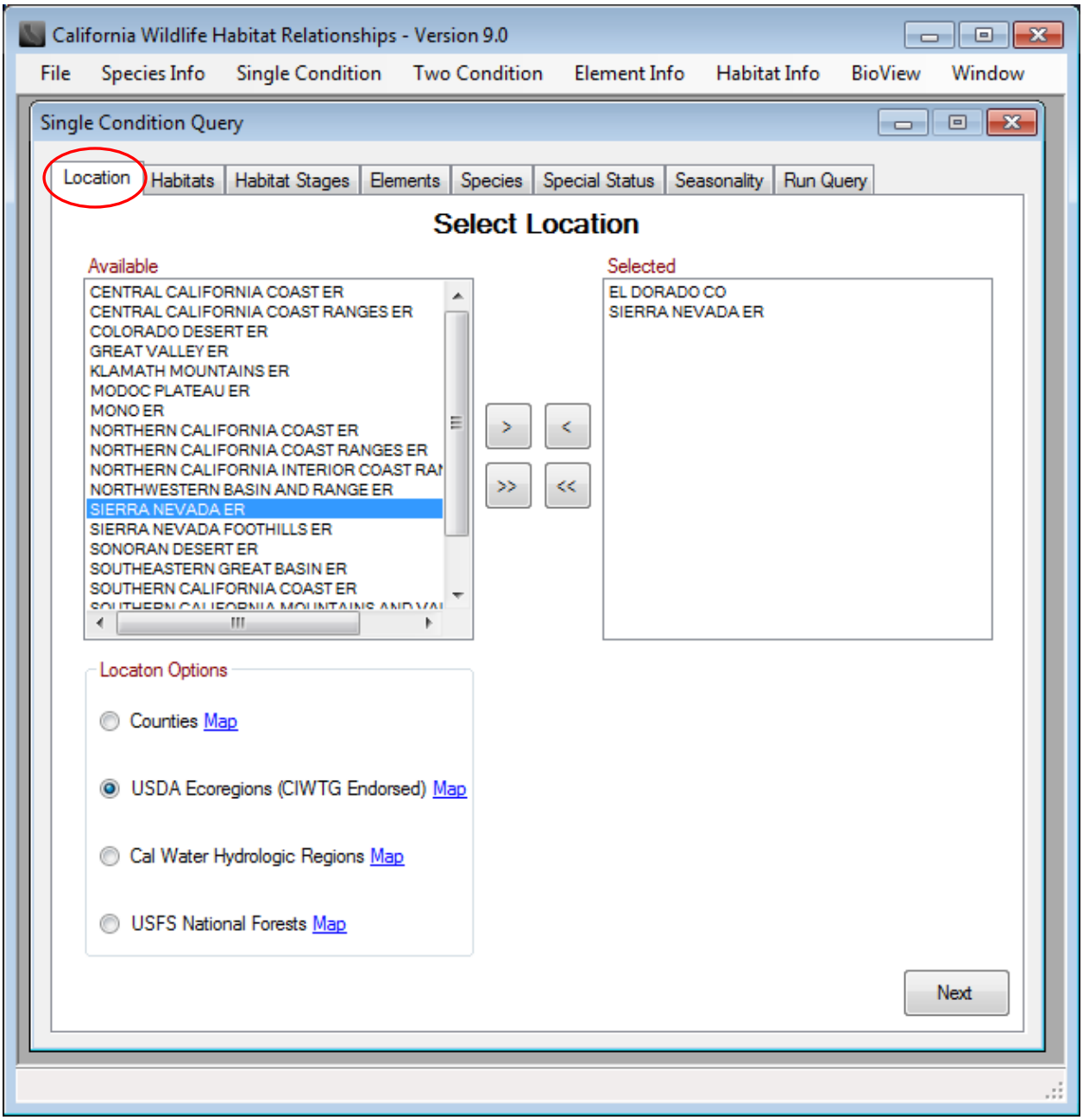
The Single Condition Query option produces a list of wildlife species predicted to occur in a single habitat situation defined by the user. Open the single condition query window by clicking on the "Single Condition" tab. A query window opens with 8 tabs allowing the user to define the query based on location, habitats, habitat stages, elements, species, special status, and seasonality. Each tab represents an opportunity to restrict the query based upon that query parameter. If the user skips a tab and nothing is selected, the query will not be constrained for that parameter type. 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 be species status. All species, including those with special status, will be considered.

The user can define the query using any or all of these tabs, or load a previously saved query by using the "Load Query" button in the "Run Query" tab. Loading a previously saved query will modify the selections in each tab according to the query parameters of the saved query. The user then has the option to further modify the query parameters in the tabs before running the query.



Two types of reports can be produced with the single condition query: a ***Species Summary Report*** or ***Species Detail Report.*** The *Species Summary Report* lists only the names and special status categories of the species that meet the query parameters. The *Species Detail Report* lists, by species, all habitat suitability values for all habitats and stages selected. The report can be very long if many habitats and stages are selected.

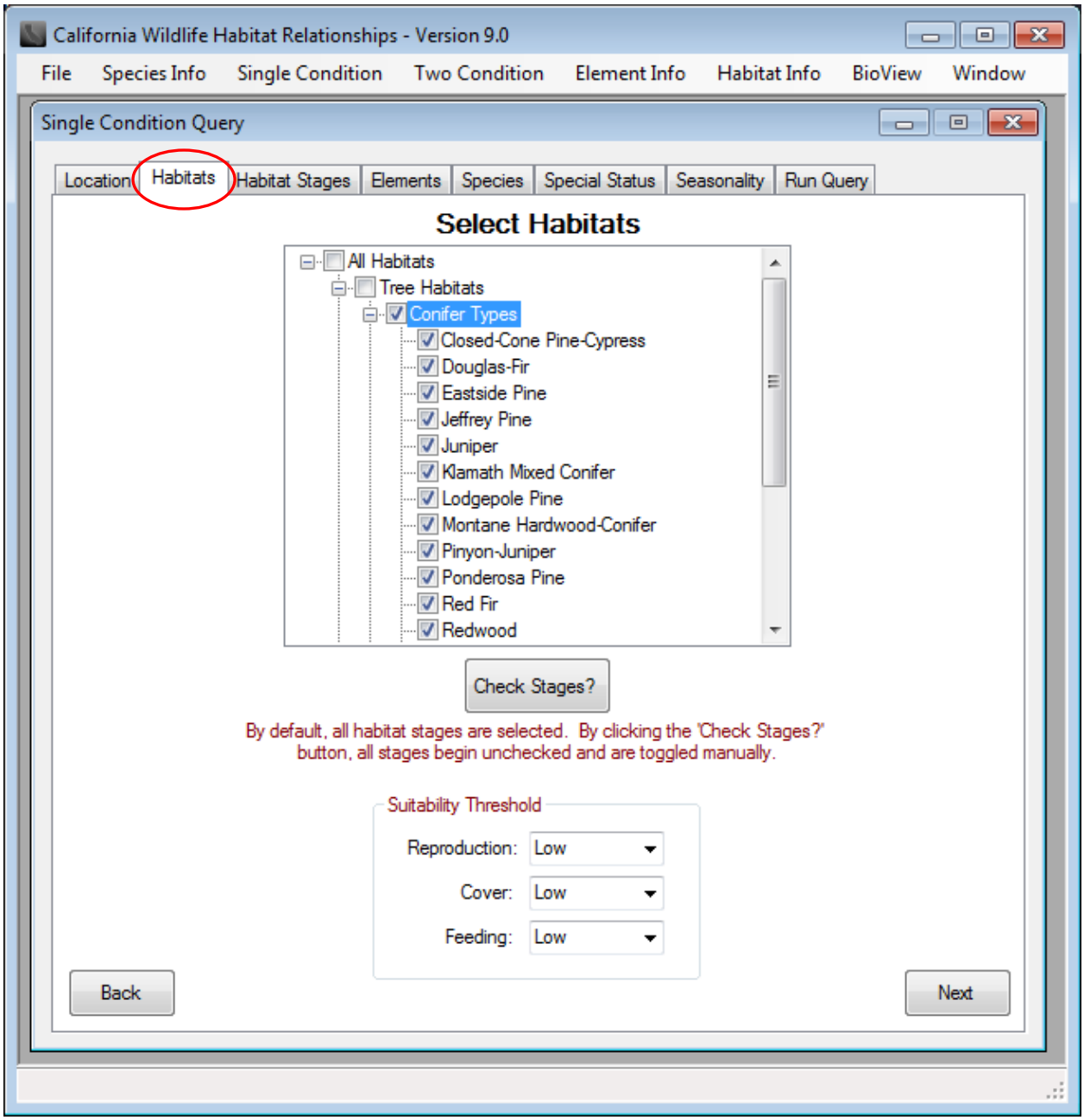
Location



Click on the **Location** tab within the Single Condition Query Window to select the geographic locations to be included in the query. Available location categories are Counties, USDA Ecoregions, Cal Water Hydrologic Regions, and USFS National Forests. 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**. Note that if locations from two categories are chosen, the full extent of both categories will be included in the query (e.g., in the example above, all of El Dorado County AND all of the Sierra Nevada Ecoregion will be included, NOT just the area where the two intersect). Double click on a location or use the arrows to add a highlighted location to the list of selected locations for the query.

Reference maps for the location categories are available by clicking on the word “Map” next to the category name in the Location Options box.

Habitats



Click on the **Habitats** tab within the Single Condition Query Window to select the CWHR habitats to be included in the query. If no specific selections are made using the Habitats tab, the query will include all habitats. To specify the habitats to be used in the query, click the checkbox next to the habitat name. All habitats with a check next to their name will be included in the query. To select all habitats within a habitat group, click the checkbox next to the group name (e.g., clicking the “Conifer types” box will add all conifer types). Reference range maps of the CWHR habitat types can be accessed in the “Habitat Info” main menu tab.

Habitats must be selected first, and then the stages for each habitat are selected in the next tab. By default, all habitat stages are included in the query. To select only specific habitat stages, click the “Check Stages?” button in the middle of the Habitats Tab, and then proceed to the Habitat Stages tab to make your selections.

A threshold suitability level for the habitats of High, Medium, or Low may also be selected to constrain the query. The query defaults to Low if no suitability level is selected. Generally, the higher the suitability level, the fewer the number of species predicted, because species with suitability levels less than the specified level will be excluded from the query.

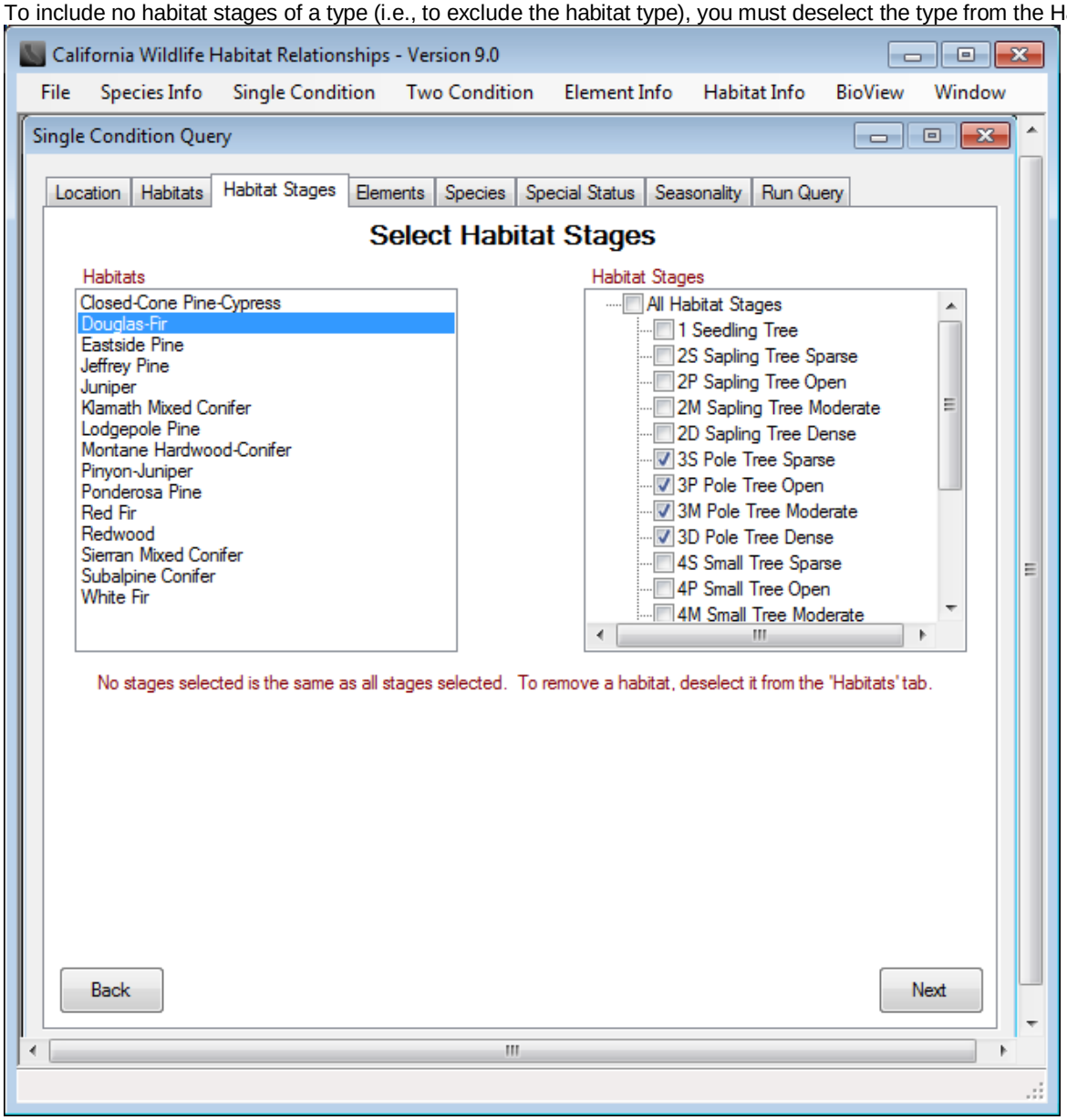
Habitat Stages

Habitat stages allow further refinement of the query parameters by density and size class of the habitat types. For each habitat selected, habitat stages can be defined if desired. If no habitat stages are selected for a given habitat type, all habitat stages for that habitat type will be included. To activate the Habitat Stages tab, the user must click the "Check Stages?" button in the middle of the Habitats tab before proceeding to the Habitat Stages tab. If the "Check Stages?" button has not been activated, the list of habitats in the Habitat Stages tab will be grayed out and no habitat stage selections will be possible.

After clicking the "Check Stages?" button in the middle of the Habitats tab, click on the Habitat Stages tab within the Single Condition Query Window to select the habitat stages to be included in the query. The list of habitats included in the query are listed on the left hand side of the window. Highlight a habitat type to generate a selectable list of habitat stages on the right side of the window.

By default, if no specific habitat stages are selected for a given habitat type, all habitat stages will be included for that habitat type. If specific habitat stages have been selected, those habitat stages with a check mark next to their name will be included in the query for that habitat type. A different set of habitat stages can be selected for each habitat type included in the query. Hover your mouse over the habitat stage name in the Habitat Stages list to see the habitat stage definition, or see the definition tables in Appendix A.

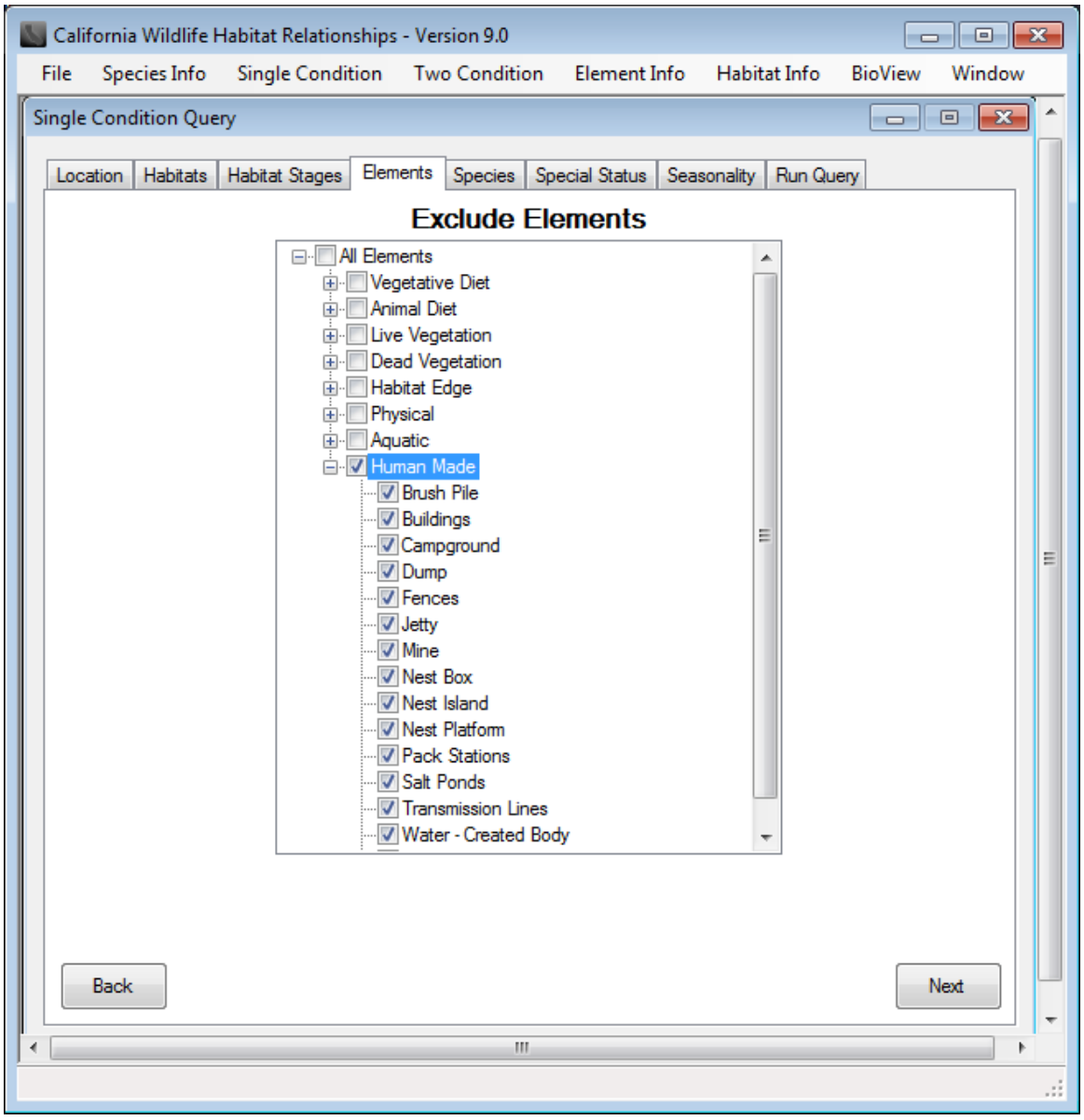
To include no habitat stages of a type (i.e., to exclude the habitat type), you must deselect the type from the Habitats tab.



Elements

Click on the **Elements** tab within the Single Condition Query Window to select the elements to be **excluded** from the query. By default, CWHR assumes all elements are present if the user does not select any elements to exclude. If elements are excluded, the resulting species list will exclude those species requiring the missing elements based on the species-specific element requirement. For example, if an Essential element is excluded, any species it is essential to will be excluded. If a Secondarily Essential element is excluded and is not compensated by another Secondarily Essential element (i.e., both the secondarily essential element and its complement have been excluded), the species dependent on the Secondarily Essential element will be excluded. For more information on Elements and their definitions, see the Element Info tab in the main menu.

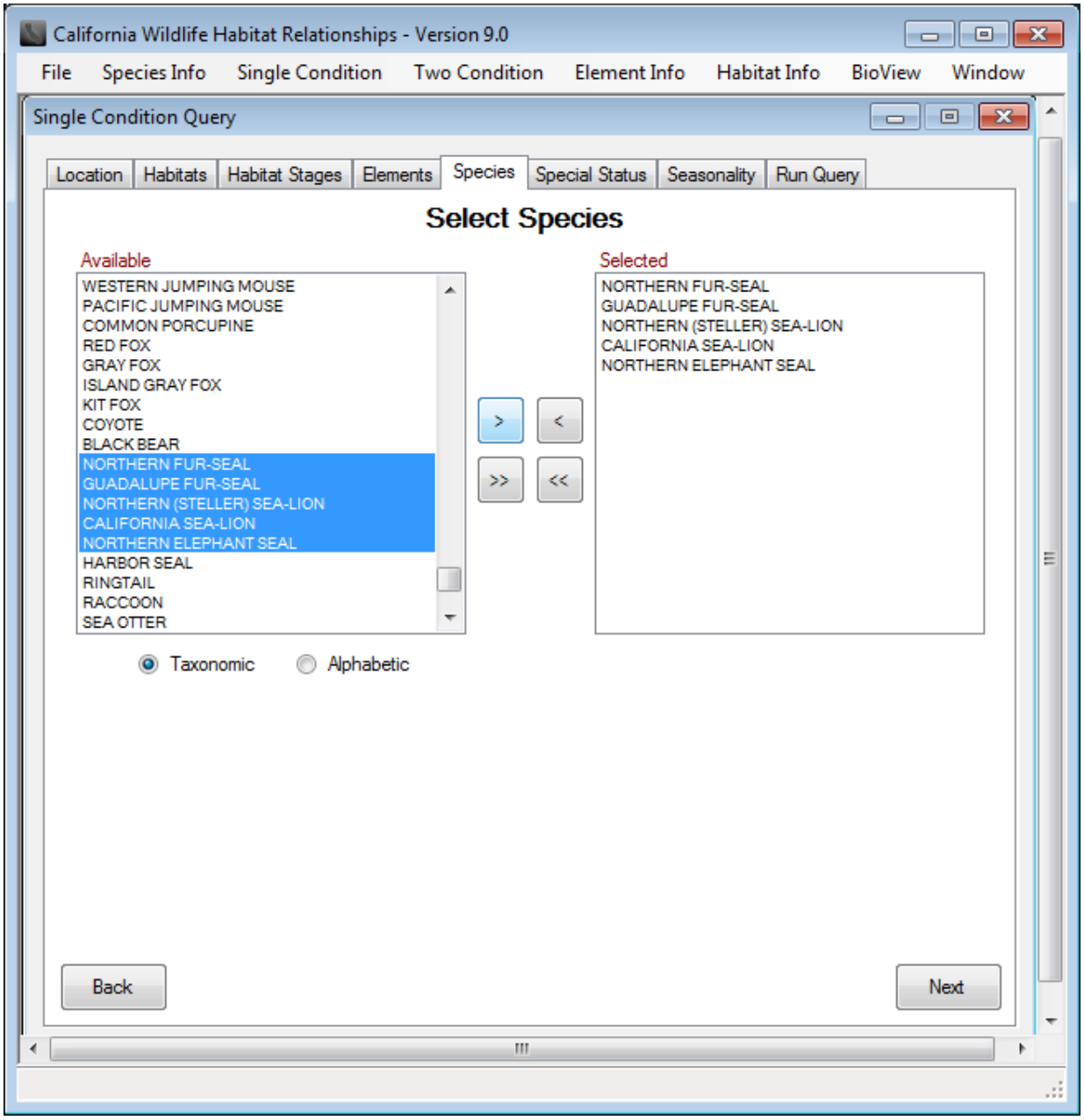
Elements may be selected for exclusion individually by clicking the box next to their name in the Exclude Elements list, or all Elements within a group can be selected by checking the box next to the Element group (e.g., Human Made Elements).



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.

Species

Click on the **Species** tab within the Single Condition Query Window to select the species to be included in the query. If no species are selected, all modeled species in the CWHR database will be included in the query. Species can be added to the query by double-clicking the species name or highlighting the selected species and clicking the arrow button to add them to the selected species list. The available species list can be sorted alphabetically or taxonomically.

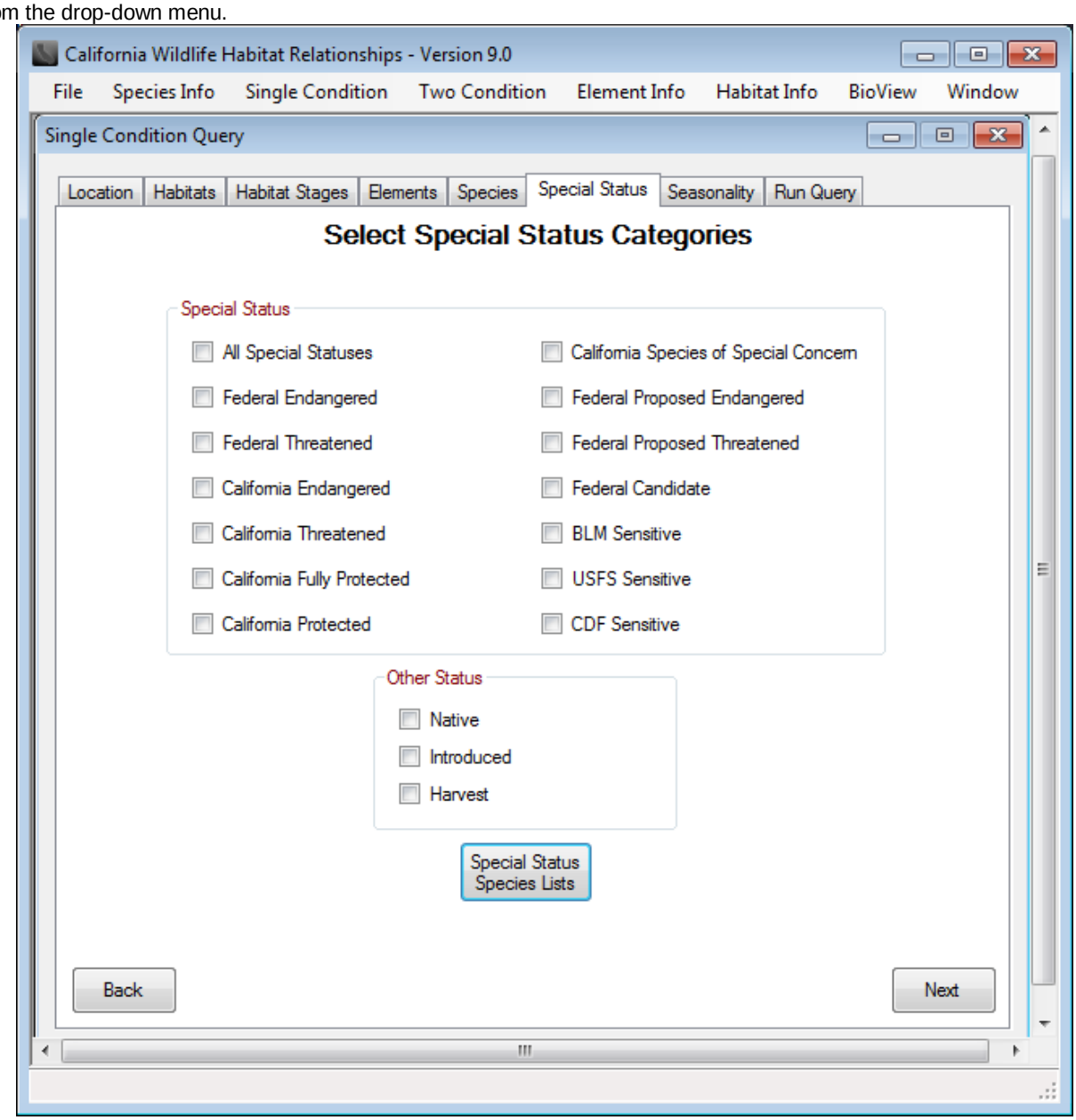


Special Status

Click on the **Special Status** tab within the Single Condition Query Window to select the special status categories to be included in the query. This tab can be used to restrict the query to species with special legal status, or to native, introduced, or harvest species. By default, species with any status are included in the query. Selecting a status category in this tab 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, USDA Forest Service (USFS) Sensitive, CA Department of Forestry & Fire Protection (CDF) Sensitive, or select "All Special Statuses" to include all of these categories. Other status categories include Native, Introduced, and Harvest.

Please note that the legal status listed in CWHR may not reflect recent changes in status. Please refer to the CDFW list of STATE & FEDERALLY LISTED ENDANGERED & THREATENED ANIMALS OF CALIFORNIA or the CDFW SPECIAL ANIMALS list for the current status of a species.

To view a list of species in a designated status category, click on the "Special Status Species Lists" button and choose the status of interest from the drop-down menu.

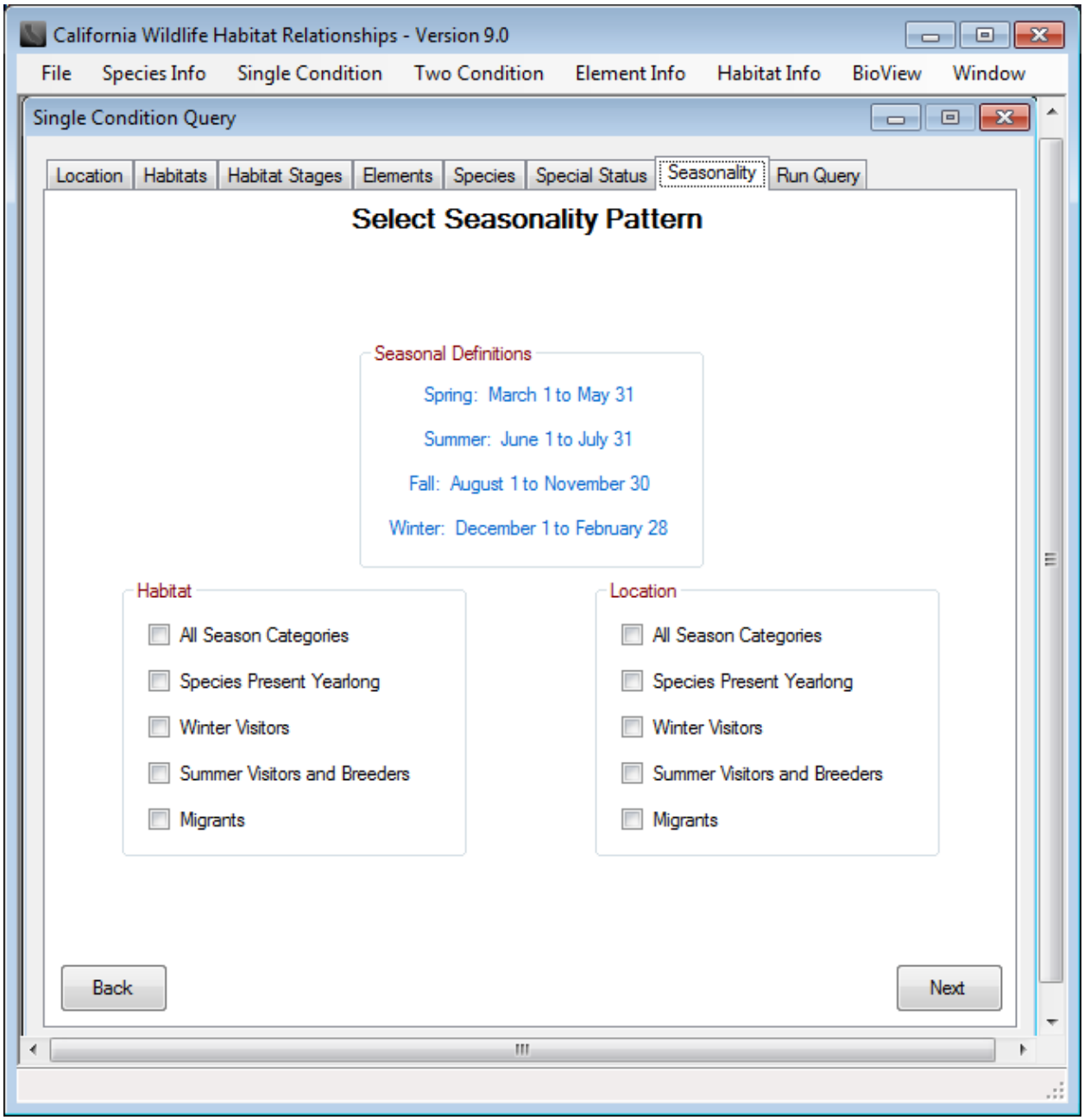


Seasonality

Click on the **Seasonality** tab within the Single Condition Query Window to select the seasonality patterns to be included in the query. The predicted species list will include only those species that meet the selected seasonality patterns for habitat and location. By default, species from all possible seasonality patterns are included in the query.

There are four season categories: species present yearlong, winter visitors, summer visitors and breeders, and migrants. The categories include all seasonality patterns that overlap the season for which they are named, except yearlong. For example, 'Summer Visitors' includes species that occur in summer only, from spring to summer, from summer to fall, and from spring to fall.

Seasonality patterns may be different for habitats and locations because habitat seasonality patterns are statewide ratings while location seasonality patterns are geographically restricted but not habitat restricted.



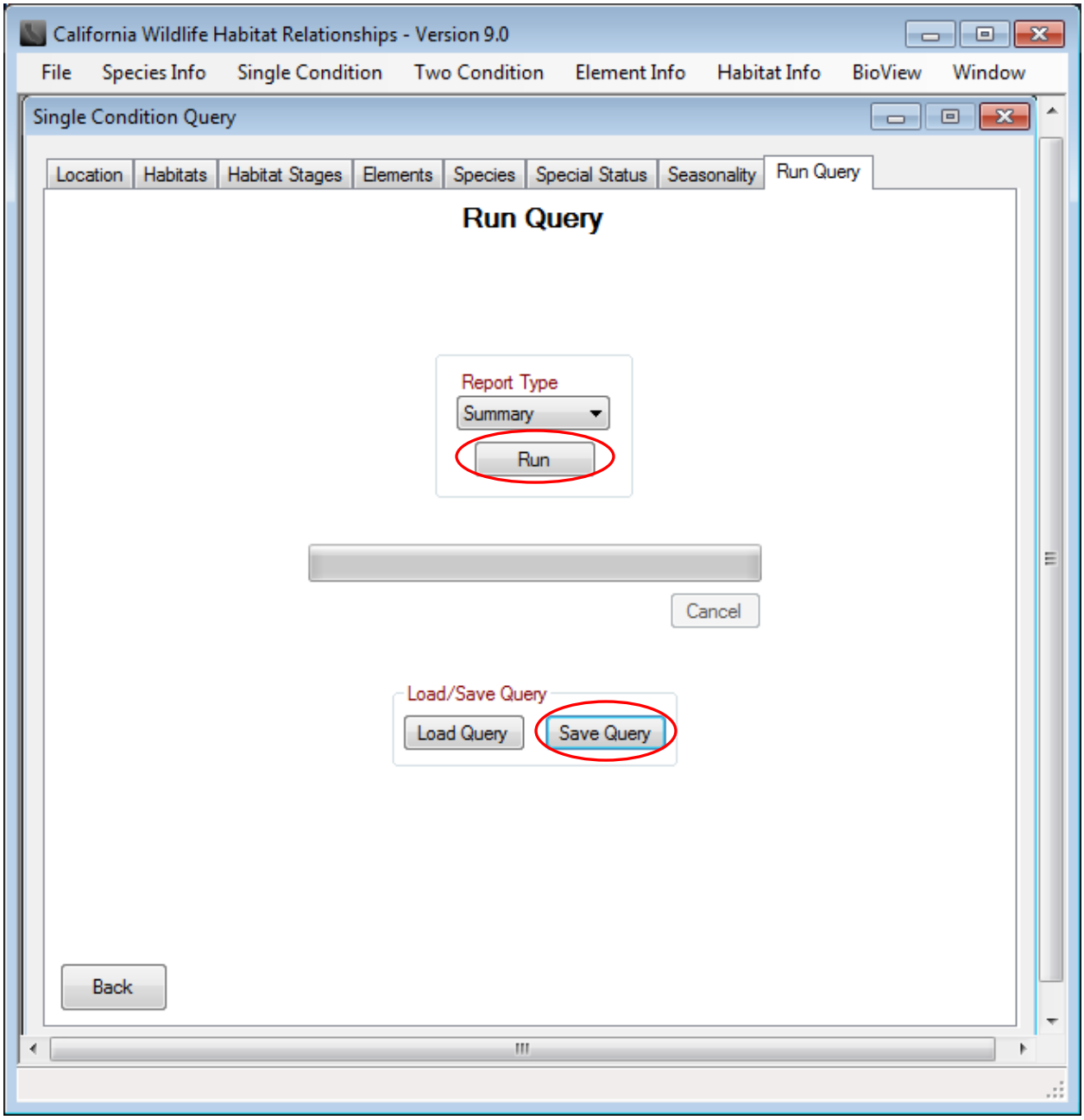
TIP: Note that season in CWHR refers to the seasonality use pattern of each species. If you are interested in knowing all the species that might be seen in a given location during the summer, for example, you must remember to select both "Species Present Yearlong" and "Summer Visitors and Breeders".

Run Query

Click on the **Run Query** tab at any time to save a query or generate a summary or detailed report. The default settings will be used for any query parameters that have not been customized using the query tabs.

Save query

To save a query, click the “Save Query” button and designate a query name and file location. The query will be saved as an *.scq file, which can be loaded into CWHR in a future session. Loading a previously saved query will modify the selections in each tab according to the query parameters of the saved query. The user then has the option to further modify the query parameters in the tabs before running or re-saving the query.

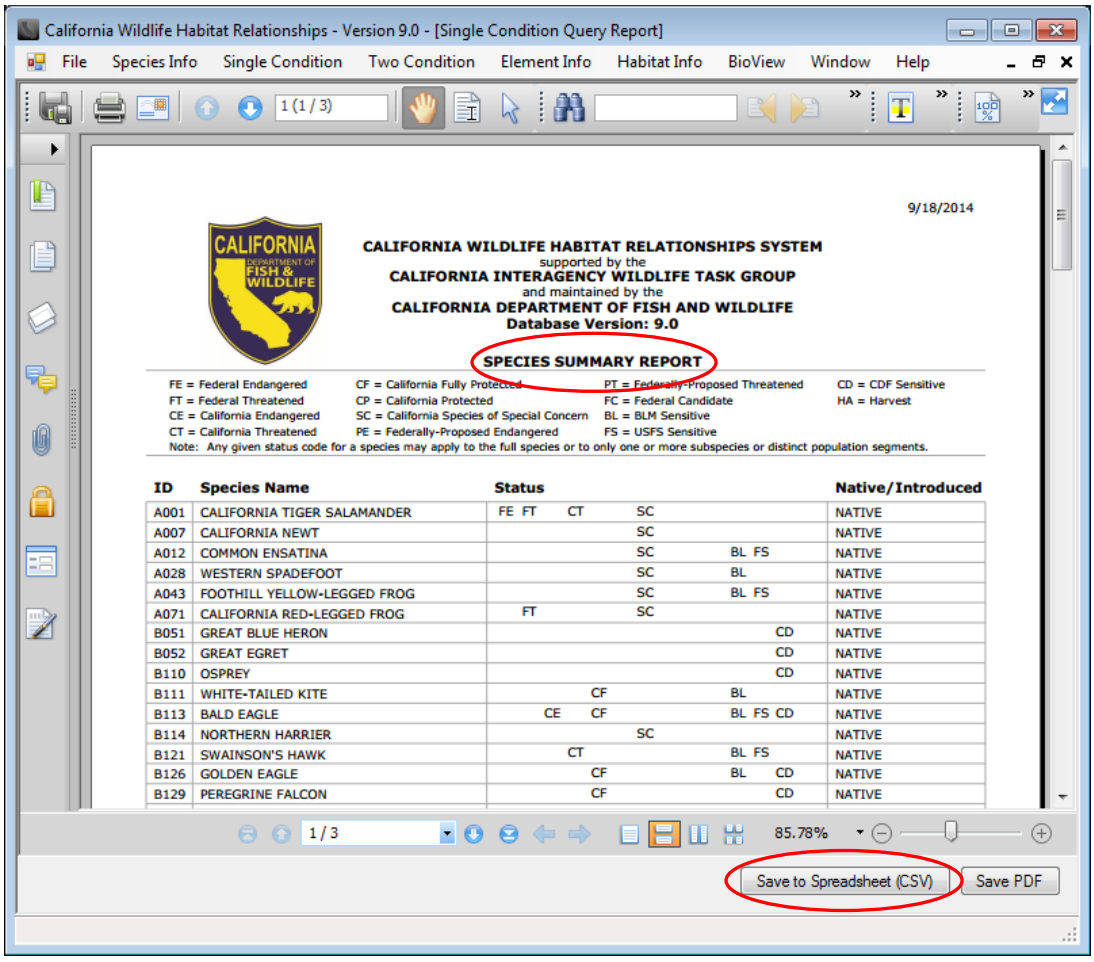


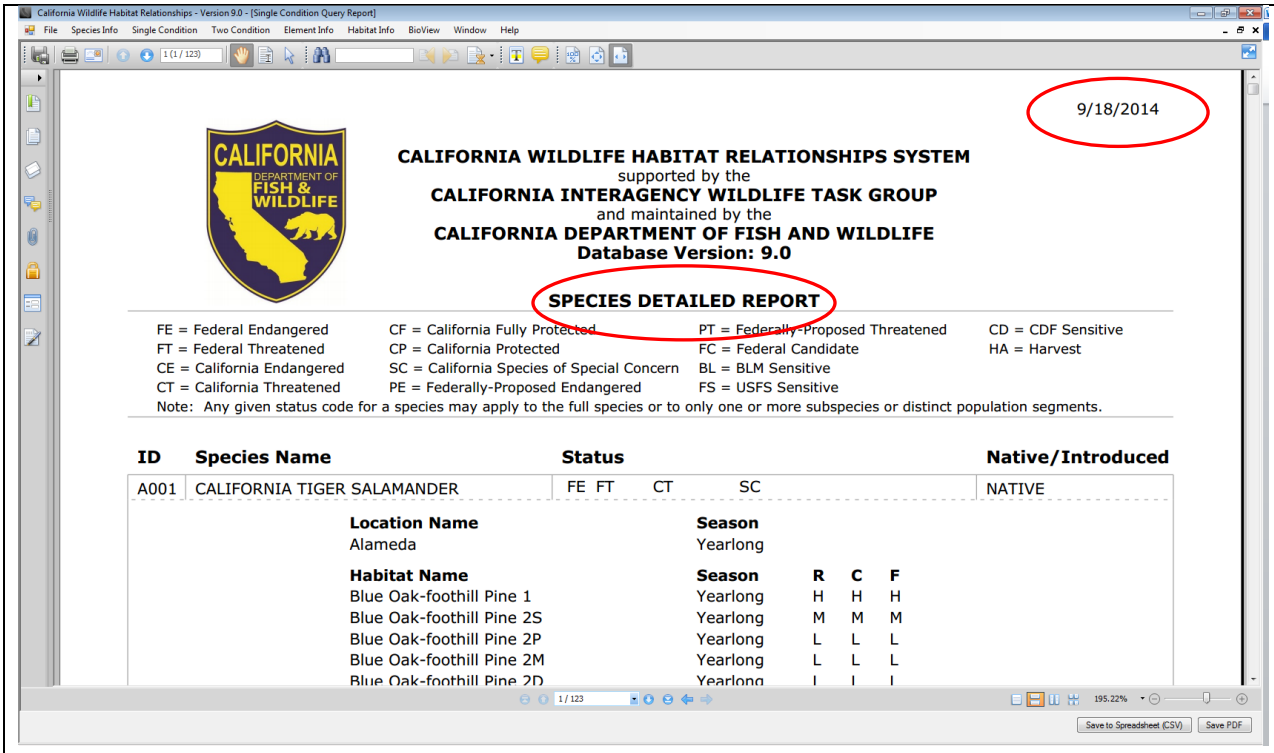
Reports

A **summary report** will generate a list of species meeting the query parameters, while a **detailed report** will provide all information from the summary report plus location, seasonality, and habitat suitability information for each species. Reports can be saved in .pdf or .csv (spreadsheet) format.

The pdf report includes the date, the list of species and their status, the total number of species, and a list of the query parameters.

To save the report output as a spreadsheet (*.csv) file, click on “Save to Spreadsheet (CSV)” in the lower right hand corner. The **summary report** .csv file includes the list of species and their status. The **detailed report** .csv file includes the list of species and their habitat suitability ratings for each habitat type.





9/18/2014

CALIFORNIA WILDLIFE HABITAT RELATIONSHIPS SYSTEM
supported by the
CALIFORNIA INTERAGENCY WILDLIFE TASK GROUP
and maintained by the
CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE
Database Version: 9.0

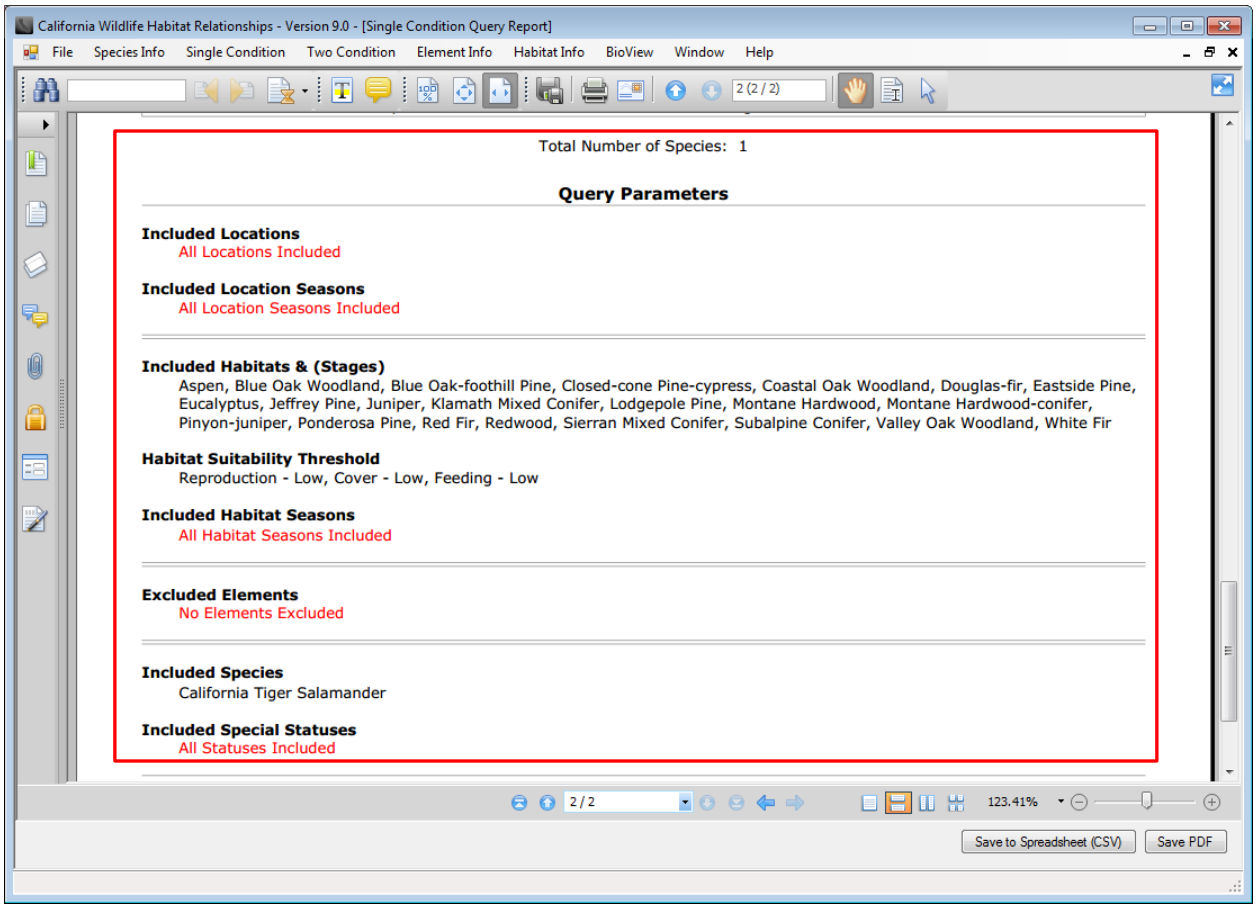
SPECIES DETAILED REPORT

FE = Federal Endangered
FT = Federal Threatened
CE = California Endangered
CT = California Threatened
CF = California Fully Protected
CP = California Protected
SC = California Species of Special Concern
PE = Federally-Proposed Endangered
PT = Federally-Proposed Threatened
FC = Federal Candidate
BL = BLM Sensitive
FS = USFS Sensitive
CD = CDF Sensitive
HA = Harvest
Note: Any given status code for a species may apply to the full species or to only one or more subspecies or distinct population segments.

ID	Species Name	Status	Native/Introduced
A001	CALIFORNIA TIGER SALAMANDER	FE FT CT SC	NATIVE

Location Name	Season
Alameda	Yearlong

Habitat Name	Season	R	C	F
Blue Oak-foothill Pine 1	Yearlong	H	H	H
Blue Oak-foothill Pine 2S	Yearlong	M	M	M
Blue Oak-foothill Pine 2P	Yearlong	L	L	L
Blue Oak-foothill Pine 2M	Yearlong	L	L	L
Blue Oak-foothill Pine 2D	Yearlong	L	L	L



Total Number of Species: 1

Query Parameters

Included Locations
All Locations Included

Included Location Seasons
All Location Seasons Included

Included Habitats & (Stages)
Aspen, Blue Oak Woodland, Blue Oak-foothill Pine, Closed-cone Pine-cypress, Coastal Oak Woodland, Douglas-fir, Eastside Pine, Eucalyptus, Jeffrey Pine, Juniper, Klamath Mixed Conifer, Lodgepole Pine, Montane Hardwood, Montane Hardwood-conifer, Pinyon-juniper, Ponderosa Pine, Red Fir, Redwood, Sierran Mixed Conifer, Subalpine Conifer, Valley Oak Woodland, White Fir

Habitat Suitability Threshold
Reproduction - Low, Cover - Low, Feeding - Low

Included Habitat Seasons
All Habitat Seasons Included

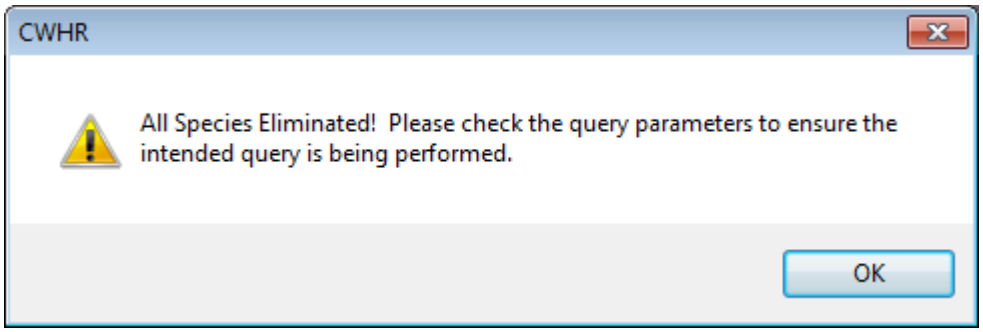
Excluded Elements
No Elements Excluded

Included Species
California Tiger Salamander

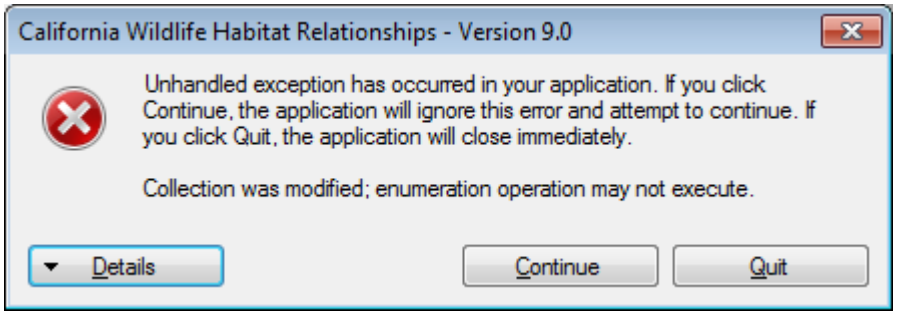
Included Special Statuses
All Statuses Included

*********TIP: When CWHR is used for any official or regulatory processes, the pdf format showing the query parameters and date should be used.**********

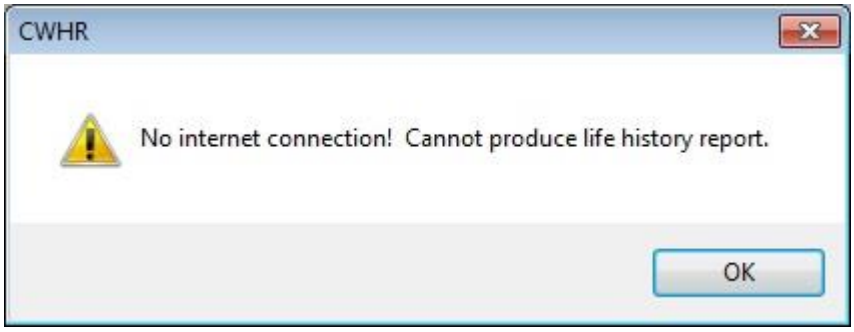
ERRORS



This message is generated when no species meet the specified query parameters. This may happen if the selected species (or species with the selected special status designations) do not occur in the selected locations or habitats. It can also happen if the selected habitats do not occur in the selected locations (e.g., a query using location Mendocino County and Habitat type Desert shrub).



This error window may appear upon minimizing a CWHR information window. This is a known bug in the program but does not affect query results or other uses of the program. Click “Continue” to continue on using the program. Clicking “Quit” will close CWHR.



This error window may appear when generating a report from the Species Information window. This is a result of intermittent or a lack of internet connection. Many of CWHR’s documents are pulled from the CDFW document library which require an internet connection. Click “OK” to continue using the program, the report will still generate, but it will not have the species range map. Often attempting to generate the report once more resolves the issue. Otherwise, the CWHR application may have to be restarted or the user will have to verify the computer has a working internet connection.

This error may appear when running a query with a detailed report type. This is a result of not having enough restricting conditions to generate a detailed report. Clicking “Yes” generates a species summary report; while clicking “No” returns the user to Run Query tab of the Single Condition Query window. To resolve this issue, be more specific with the query (i.e. selet more paramaters).

This error can occur when installing CWHR. This a known error which causes the program to crash upon opening it. To resolve this issue a Microsoft SQL Server Compact Service Pack must be installed; the file can be found here https://www.microsoft.com/en-us/download/details.aspx?id=5783. Alternatively, if more assistance is needed contact CWHR staff to get the appropriate file and install instructions.

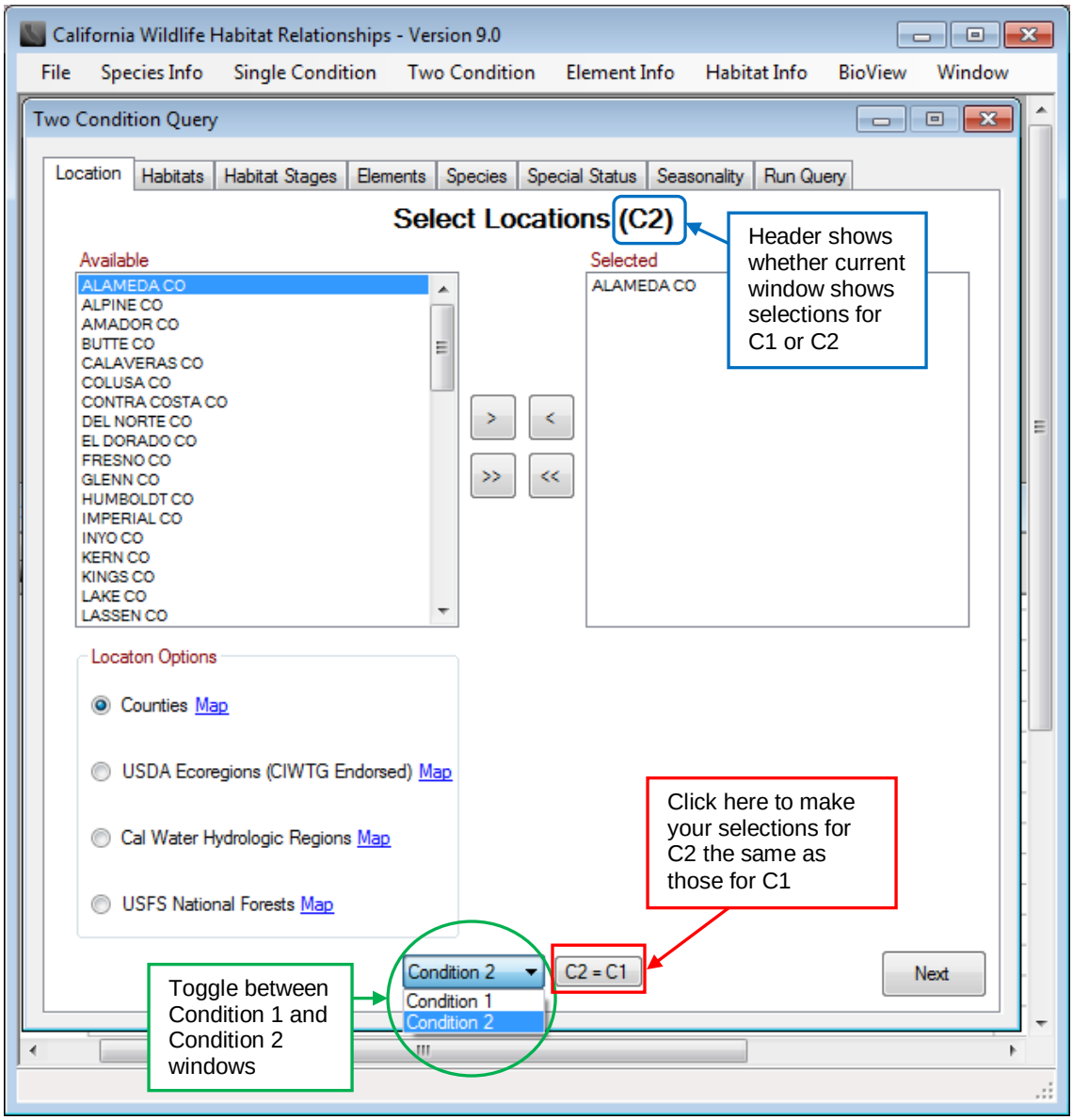
Please check our CWHR FAQ and Software Troubleshooting webpage for more information about software troubleshooting.

TWO CONDITION QUERY

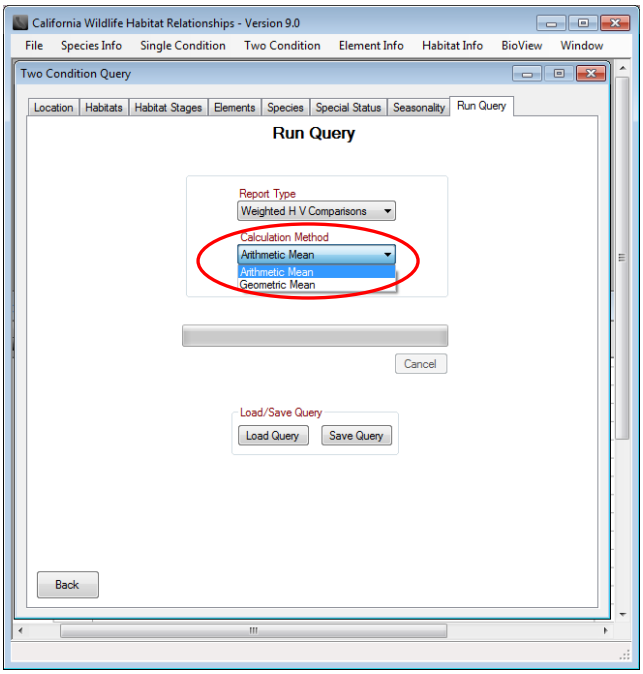
The Two Condition Query is similar to the Single Condition Query except that two habitat conditions are defined so that predicted species lists or habitat values can be compared. Three types of reports are available in this query. The ***Species Comparison Report*** lists all the wildlife species predicted to occur in the two conditions. For example, the list of species expected to occur in the same habitat type in two different locations can be compared, or the list of species in two different habitat conditions in the same location can be compared. The ***Habitat Value Comparison Report*** (or ***Weighted Habitat Value Comparison Report*** if weights are defined) lists, for each species, the mean suitability value for all habitats and stages for each of the two conditions specified in the query, and the difference in suitability values between the two conditions. For example, the query shows the change in average habitat suitability value for a species as the size class or cover class changes in a given habitat type.

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.)

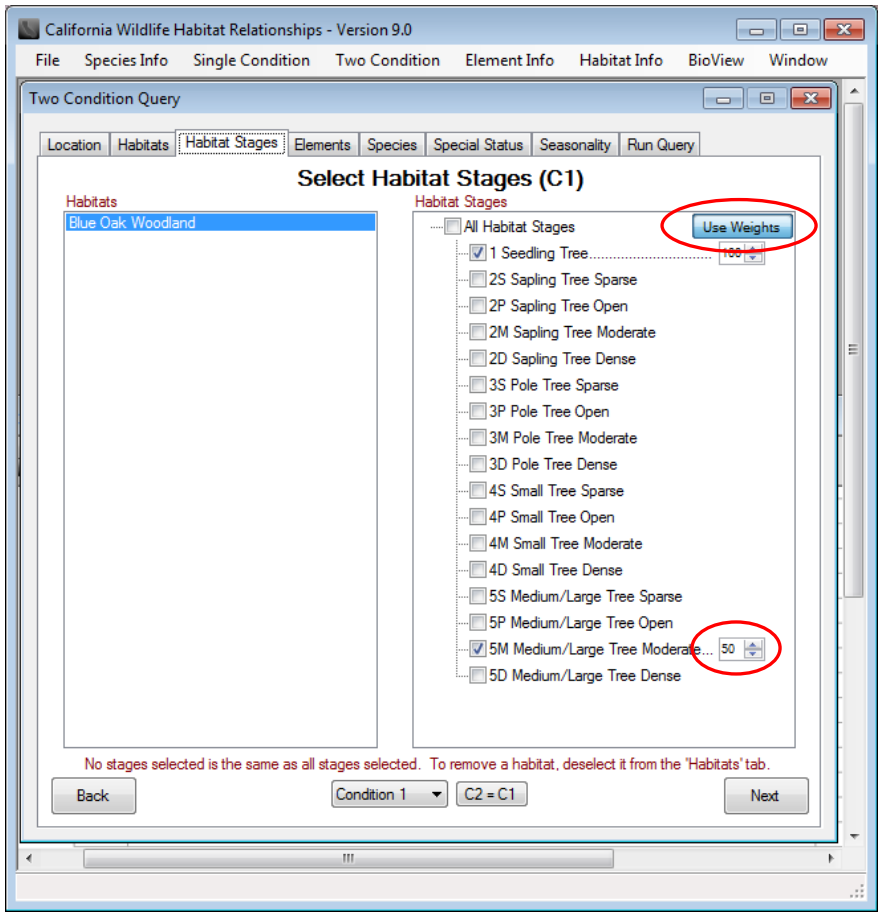
First, the user must specify query parameters for both conditions displayed as *Condition 1* (C1) and *Condition 2* (C2). For each selection window, the user must toggle between both conditions when entering the query parameters. If a query parameter is set for Condition 1 but not for Condition 2, the query will not be constrained for Condition 2. Click the **C2=C1** button to set the query parameters for *Condition* 2 the same as those selected for *Condition 1*: Clicking **C2=C1** will copy the parameters from *Condition 1* to *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.

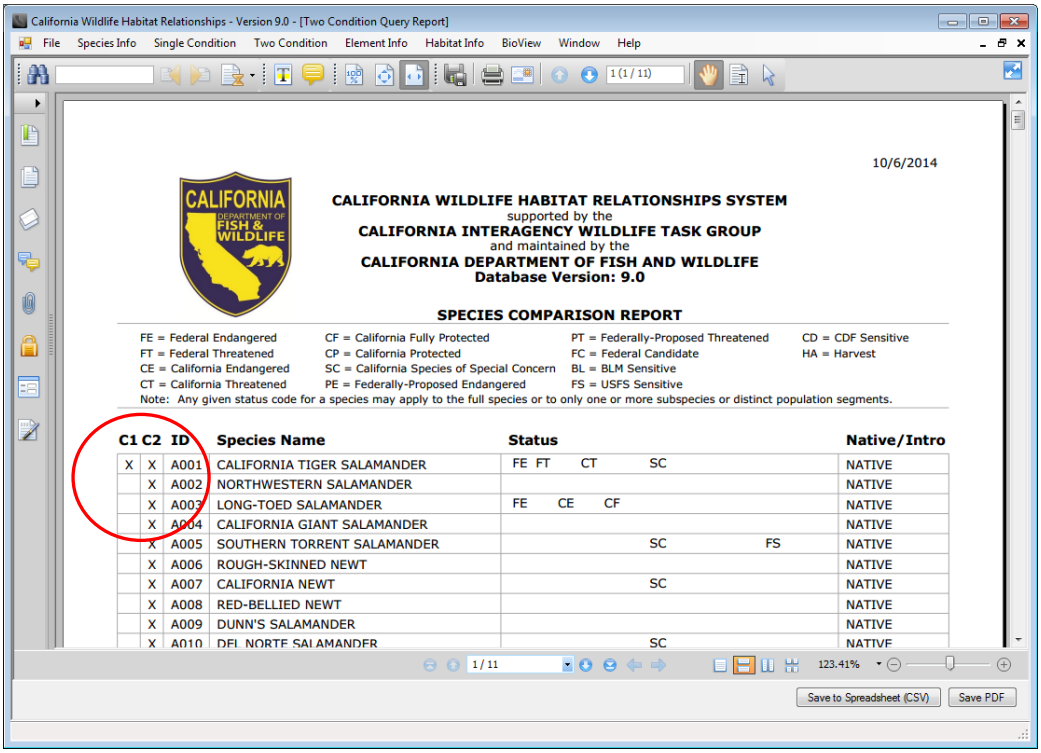


Finally, for the ***Weighted Habitat Value Comparison***, you will need to apply weights to each habitat stage selected. Weights are generally based on acreage of the habitat types (or percentage of acreage) within the study region. When you click the "Use Weights" button, boxes will appear next to each selected habitat stage in which the weight must be entered. You can either use the arrows to select a number or type in an integer value from 0 to 100.

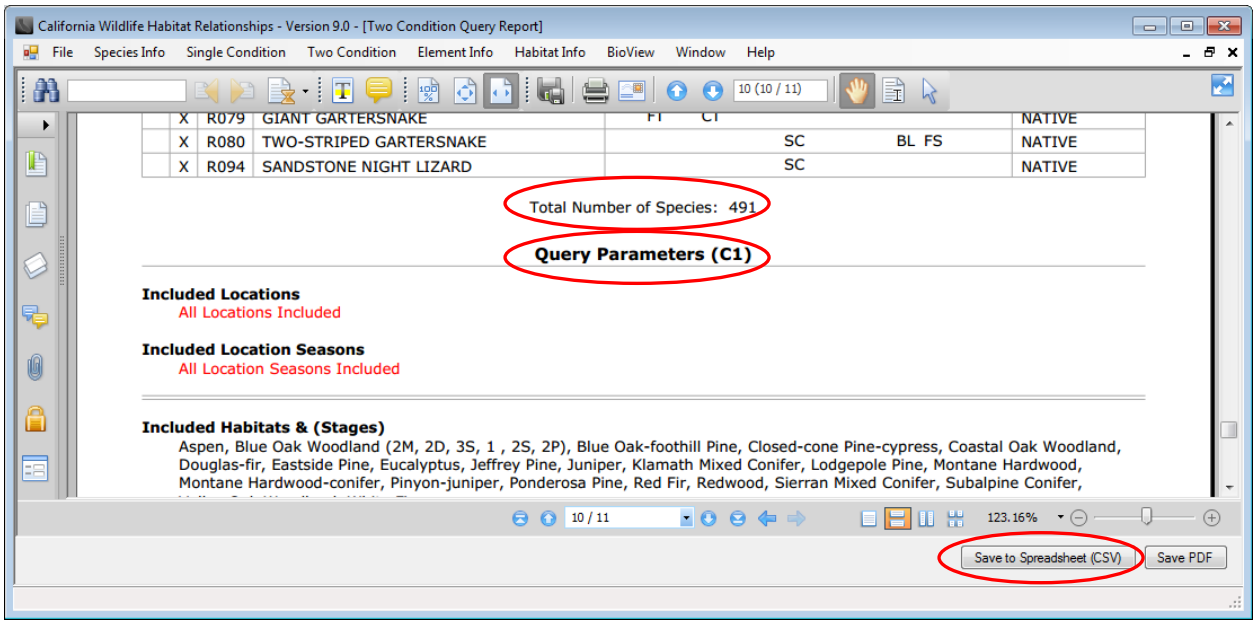


Species Comparison Report

In the ***Species Comparison Report***, 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.



The total number of species predicted for either condition is summarized at the bottom of the report. The query parameters for both habitat conditions are also listed at the bottom of the report.

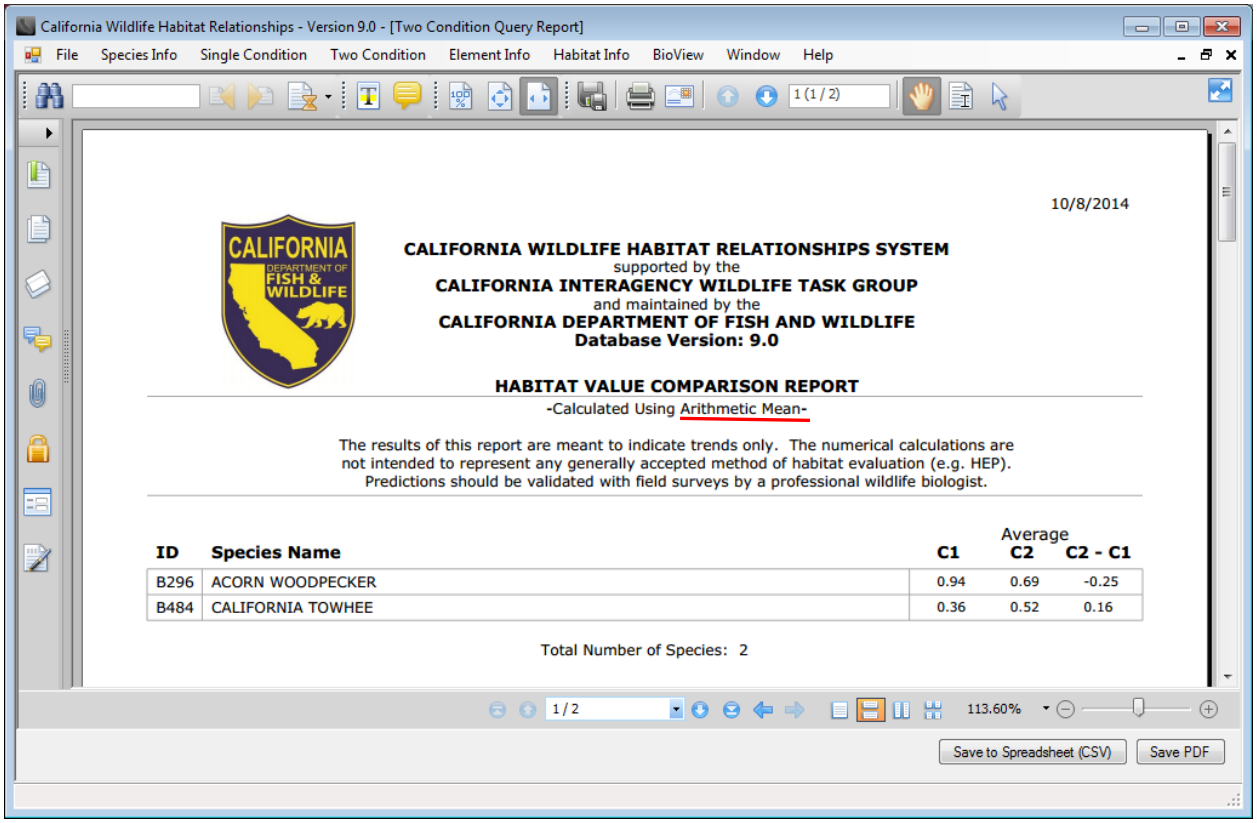


To save the report output as a spreadsheet (*.csv) file, click on "Save to Spreadsheet (CSV)" in the lower right hand corner.

**********TIP: When CWHR is used for any official or regulatory processes, the pdf format showing the query parameters and date should be used.*********

Habitat Value Comparison Report

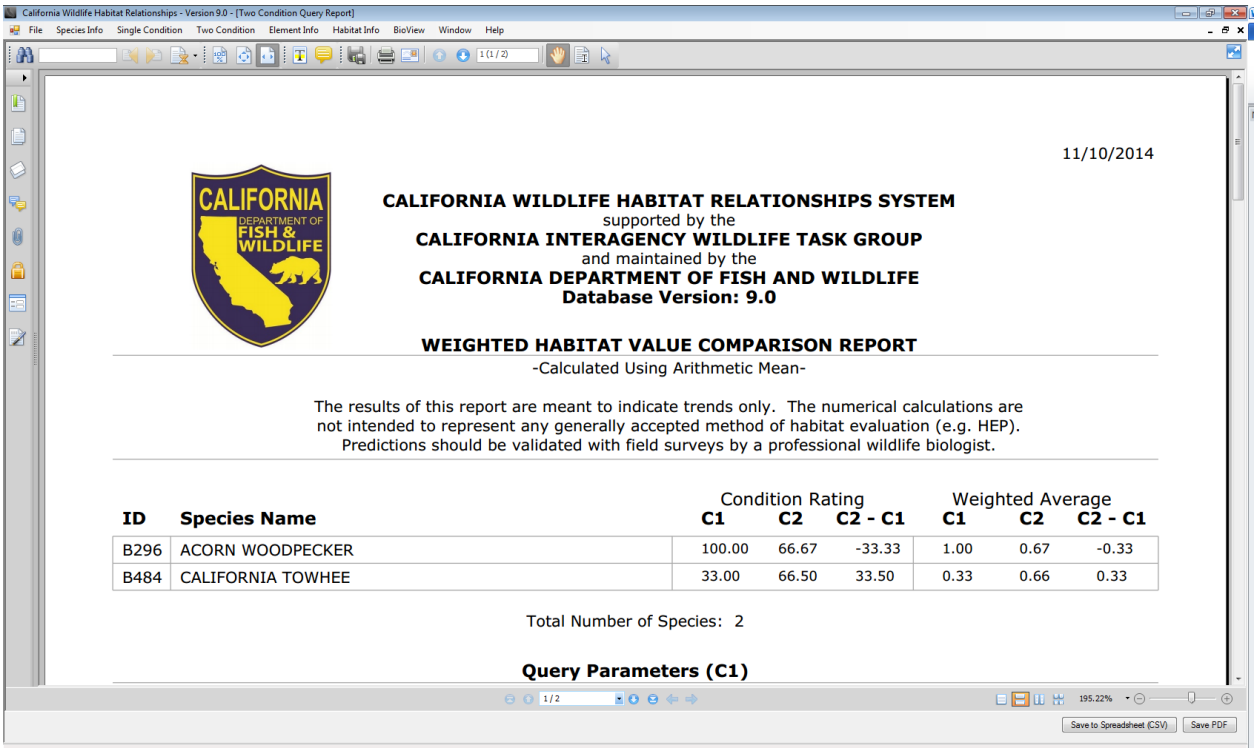
The ***Habitat Value Comparison Report*** lists the mean habitat suitability value of all habitats and stages selected for every species in the query. The suitability values for reproduction, feeding and cover are averaged using the method selected during the query process (arithmetic or geometric mean). The difference between average habitat suitability values for *Condition I* and *Condition II* (C2-C1) is also reported. For example, the report below shows the average habitat suitability for two bird species in Blue Oak Woodland with trees of size class 5 (C1) and trees of size class 3 (C2).



Weighted Habitat Value Comparison Report

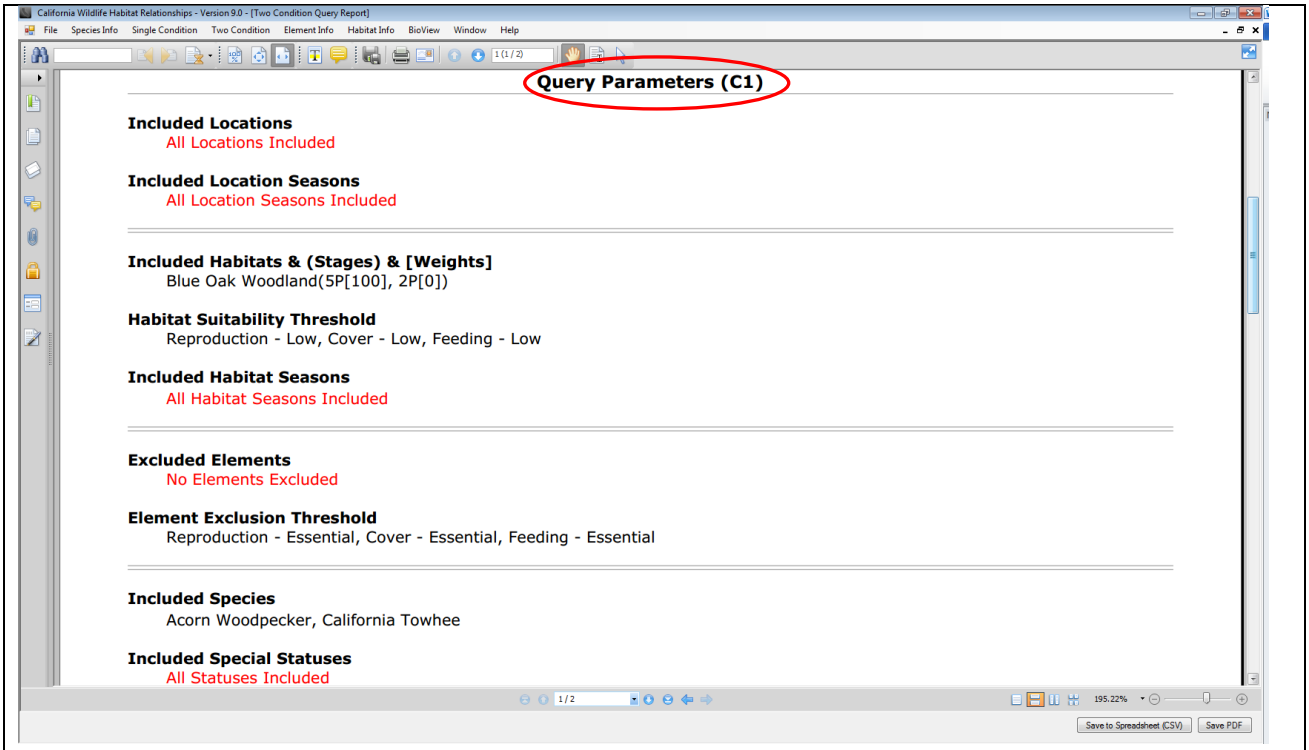
The ***Weighted Habitat Value Comparison Report*** lists the *weighted average suitability* value and *condition rating* for each species. These values are based on user-defined weights of habitats and stages that range from 0-100. The **weighted average suitability value** is the weighted mean (geometric or arithmetic, as defined by the user) habitat suitability of all habitats and stages included in the query for each species. The habitat suitability values for each habitat and stage are weighted by the user from 0-100 and then the arithmetic or geometric mean of these values is taken. The **condition rating** is produced by multiplying the habitat weights provided by the user for each habitat stage by the average habitat suitability value to yield "habitat units". The "habitat units" are then summed to produce the condition rating. More information on the calculation of weighted habitat values can be found in the Definitions section.

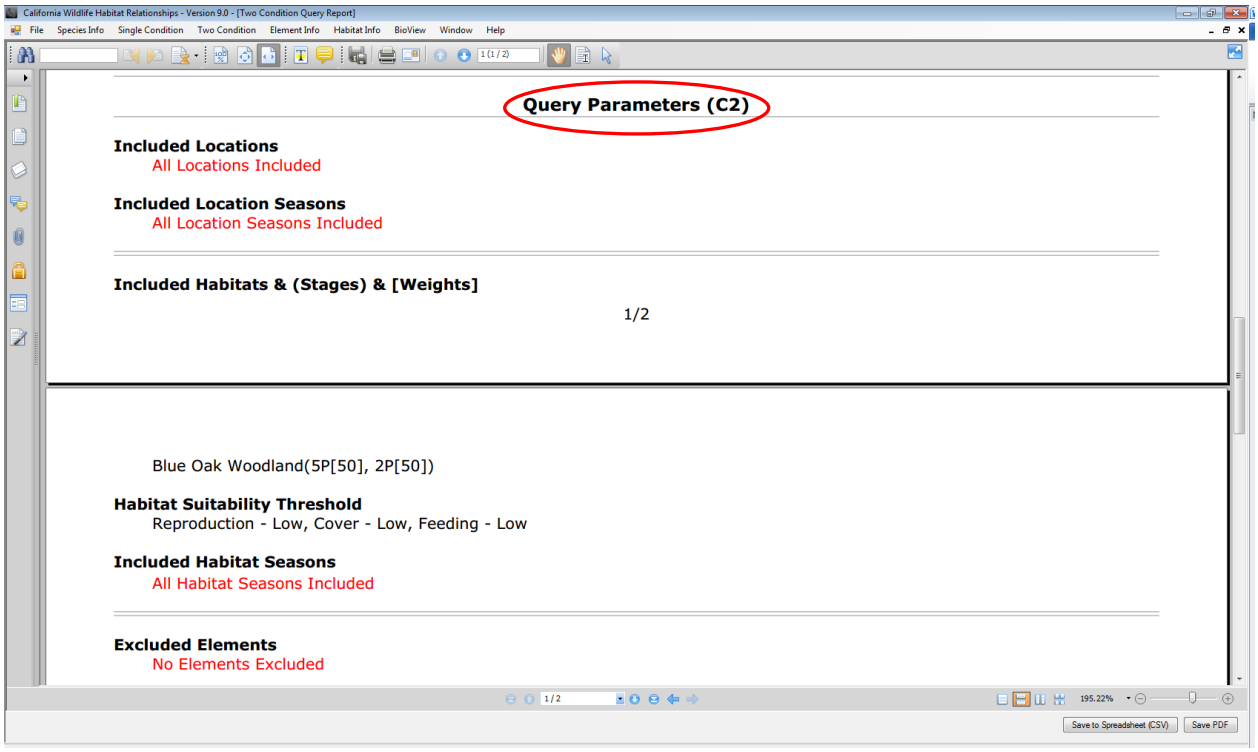
For example, the report below shows the condition rating and weighted average habitat suitability for two bird species in Blue Oak Woodland with the following conditions:
C1: 100% large/open trees of size class 5P
C2: 50% large/open trees (size class 5P) and 50% sapling/open trees (size class 2P)



The query parameters selected for Condition 1 and Condition 2 are shown at the bottom of the report. To save the report output as a spreadsheet (*.csv) file, click on "Save to Spreadsheet (CSV)" in the lower right hand corner.

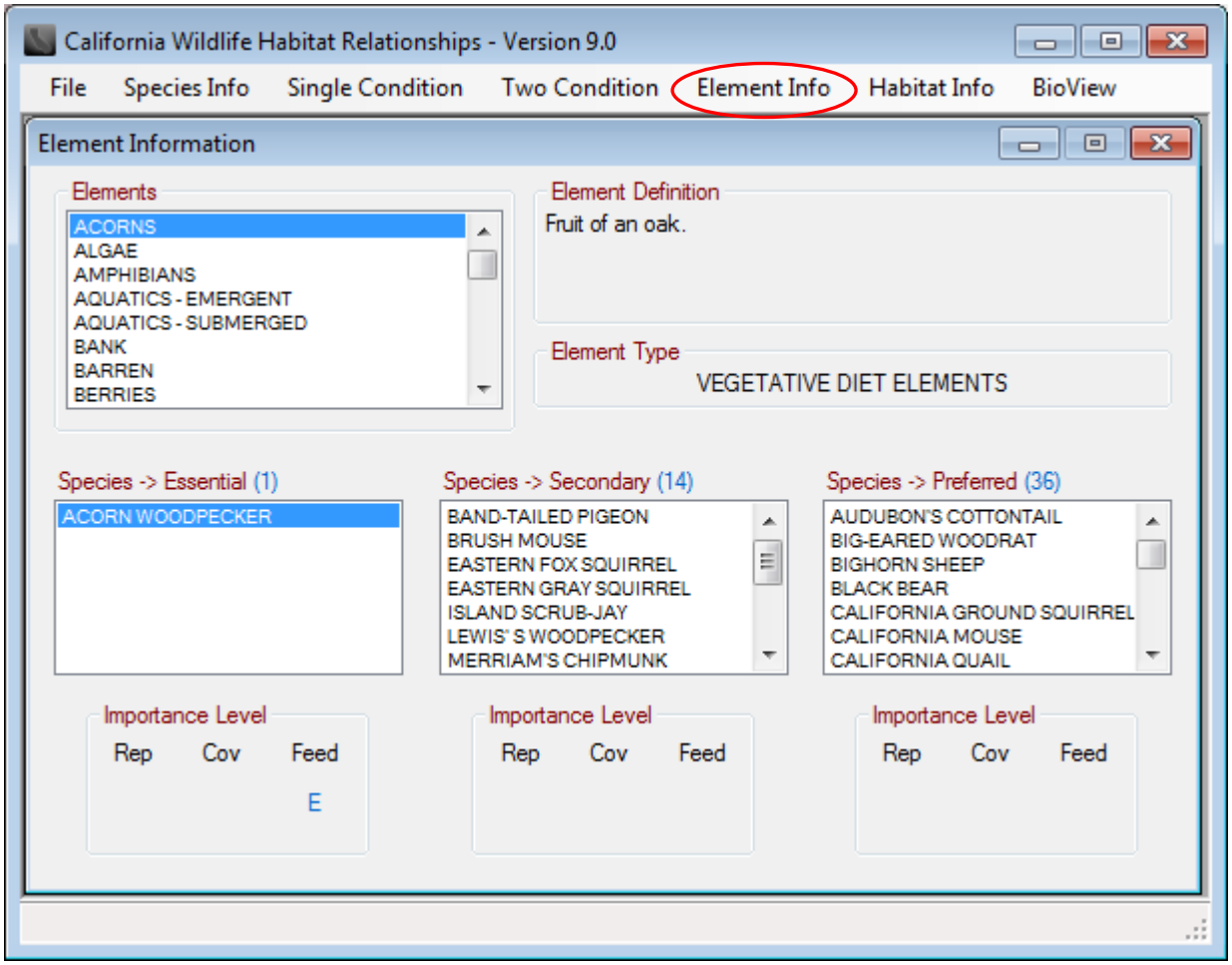
*********TIP: When CWHR is used for any official or regulatory processes, the pdf format showing the query parameters and date should be used.**********


California Wildlife Habitat Relationships - Version 9.0 - [Two Condition Query Report]
File Species Info Single Condition Two Condition Element Info Habitat Info BioView Window Help
Query Parameters (C1)
Included Locations
All Locations Included
Included Location Seasons
All Location Seasons Included
Included Habitats & (Stages) & [Weights]
Blue Oak Woodland(5P[100], 2P[0])
Habitat Suitability Threshold
Reproduction - Low, Cover - Low, Feeding - Low
Included Habitat Seasons
All Habitat Seasons Included
Excluded Elements
No Elements Excluded
Element Exclusion Threshold
Reproduction - Essential, Cover - Essential, Feeding - Essential
Included Species
Acorn Woodpecker, California Towhee
Included Special Statuses
All Statuses Included
Save to Spreadsheet (CSV)
Save PDF


California Wildlife Habitat Relationships - Version 9.0 - [Two Condition Query Report]
File Species Info Single Condition Two Condition Element Info Habitat Info BioView Window Help
Query Parameters (C2)
Included Locations
All Locations Included
Included Location Seasons
All Location Seasons Included
Included Habitats & (Stages) & [Weights]
1/2
Blue Oak Woodland(5P[50], 2P[50])
Habitat Suitability Threshold
Reproduction - Low, Cover - Low, Feeding - Low
Included Habitat Seasons
All Habitat Seasons Included
Excluded Elements
No Elements Excluded
Save to Spreadsheet (CSV)
Save PDF

ELEMENT INFORMATION WINDOW

Click on Element Info in the main menu to access the 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 for a list of species that use a particular element, and can also access an Element Information report by species.



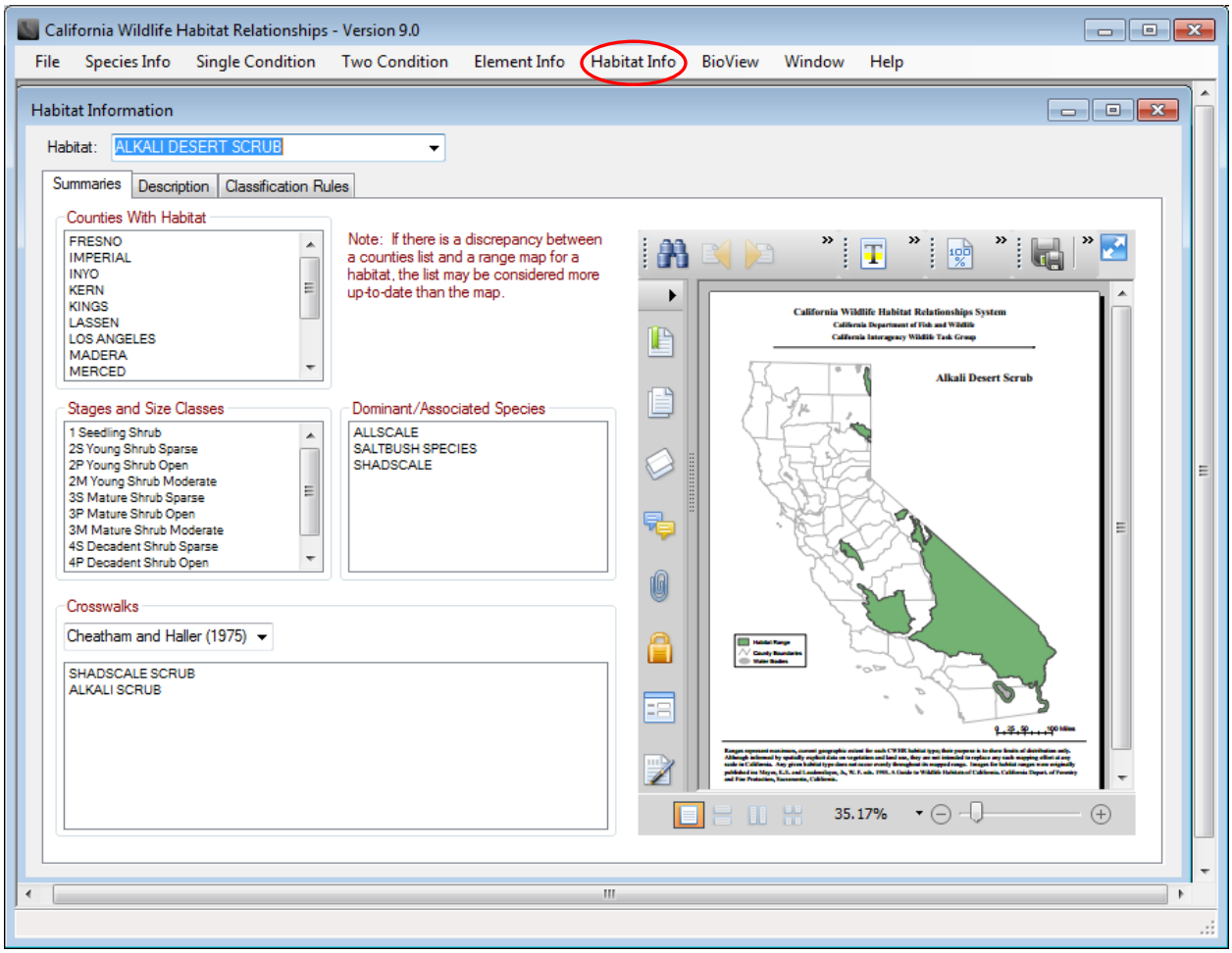
Select an element by highlighting it in the **Elements** list. The definition of the element is shown in the **Element Definition** box and the category (i.e., vegetative diet element) is shown in the **Element Type** box.

All wildlife species predicted by CWHR to find the element Essential (E), Secondarily Essential (S), or Preferred (P) are displayed in the **Species->Essential**, **Species-> Secondary** and **Species->Preferred** association lists. The number of species on each list is given in parenthesis next to the list title. Highlighting a species name in one of these lists with a single mouse click will display the importance of the element for reproduction, cover and feeding in the **Importance Level** box below the list. Species may appear in multiple association lists if the element has different importance ratings for different life requisites.

Double-click on a species name in one of the lists to open an **Element Information by species** window, which gives a list of all elements associated with that species.

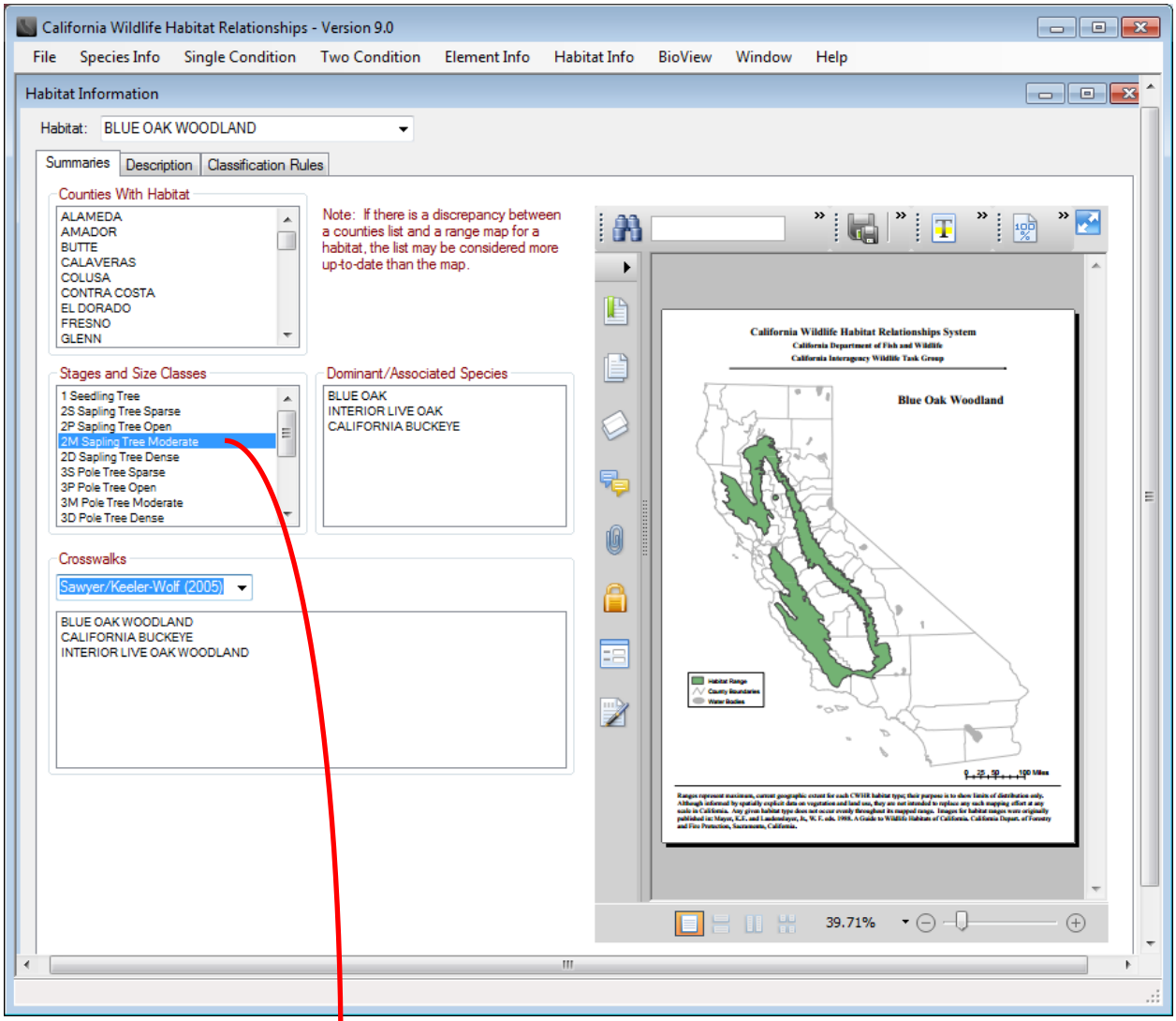
HABITAT INFORMATION WINDOW

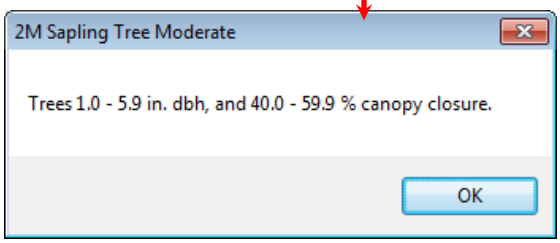
Click on Habitat Info in the main menu to access the Habitat Information Window. This window allows the user to select CWHR habitats and view information about them, including the habitat range map, written description, and classification rules.



Habitat Summary

When a habitat is selected in the drop-down **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 on the stage name.



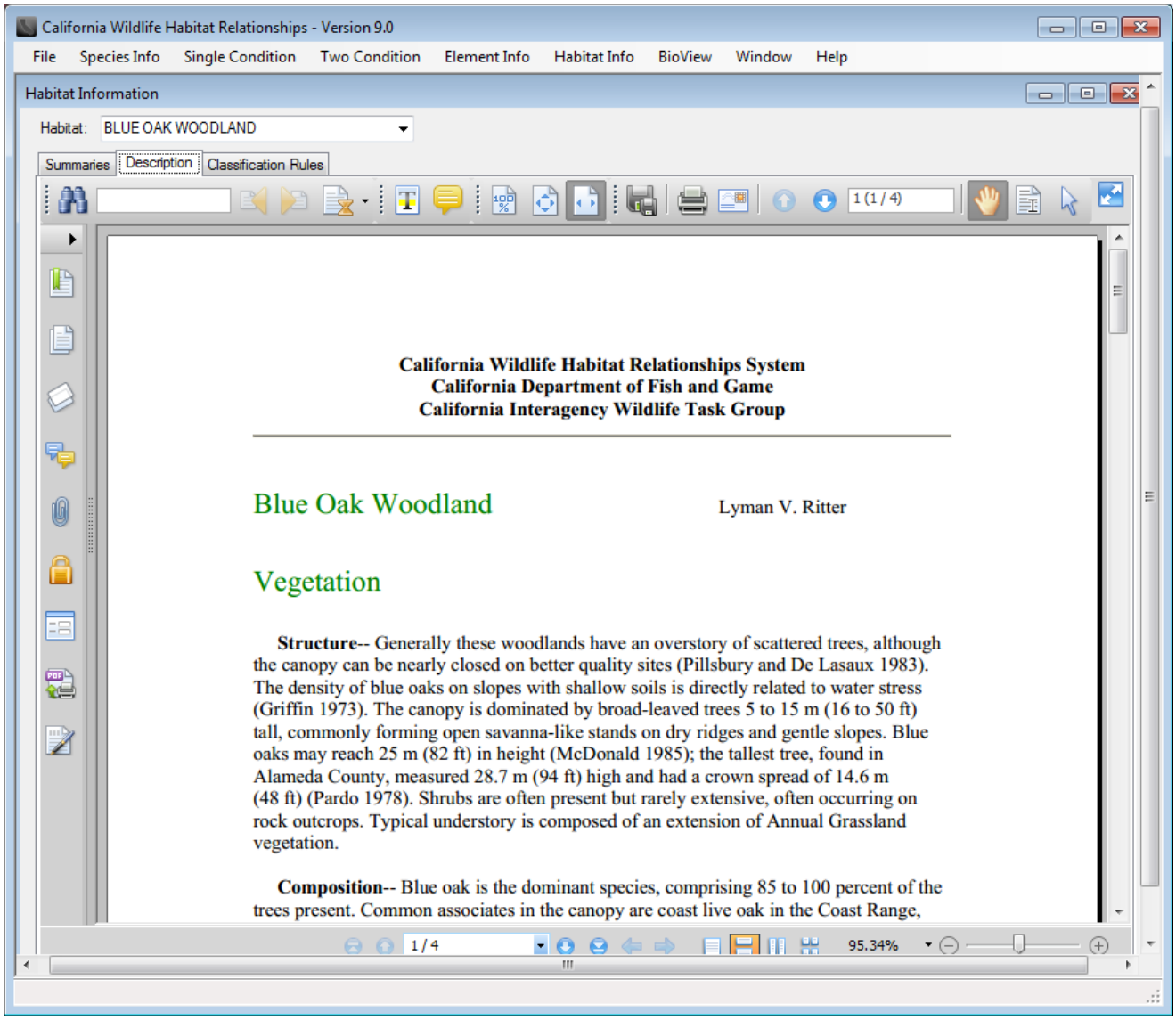


Crosswalks

In the crosswalks box you can view the corresponding vegetation type(s) from five different classification schemes: Cheatham and Haller (1975), Holland (1986), Sawyer/Keeler-Wolf (2005), UNESCO (1996), and USFS CalVeg (2005). Use the drop-down arrow to select the classification scheme of interest.

Habitat Descriptions

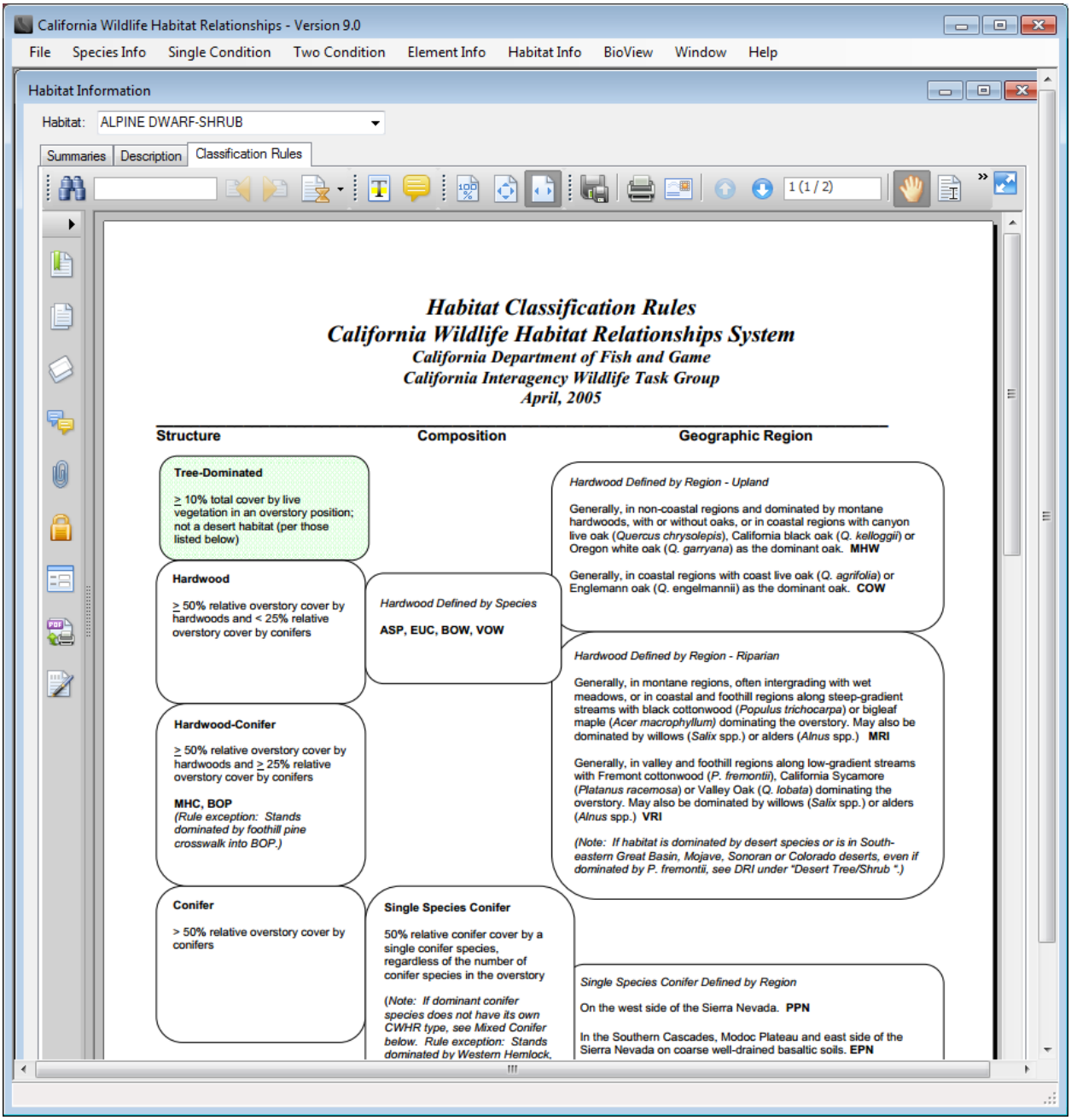
To view a habitat description, click on the “Description” tab and select the desired habitat from the **Habitat** list. The written habitat descriptions include information on vegetation structure and composition, inclusion of the type in other classifications, information on the development and duration of habitat stages; the biological setting including wildlife use, physical setting, distribution of the habitat type, and literature cited.



***** If the habitat description or range maps do not open, the documents can be access through the CWHR website at https://www.wildlife.ca.gov/Data/CWHR/Wildlife-Habitats *****

Classification Rules

Select the Classification Rules tab 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.



***** If the classification map does not open, the document can be accessed through the CWHR website at https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=65851 *****

BIOVIEW

Bioview uses habitat suitability ratings from the CWHR database for 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 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 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. Both types of output reports are produced are .csv files per species, with columns showing input habitat information, suitability values for reproduction (REPRO), cover (COVER), and feeding (FEEDING), and the arithmetic mean (ARITH_MEAN) and geometric mean (GEOM_MEAN) of those values.

One output contains ***Standard Habitat Suitability Values*** for a given species. Values provided are the CWHR expert opinion suitability ranking for reproduction, cover, and feeding (0.33 for low suitability, 0.66 for medium suitability and 1.0 for high suitability) and the arithmetic and geometric means of these three numbers are given.

The second output contains ***Habitat Suitability Values Using Fuzzy Logic***. See Appendix B for more information on fuzzy logic. Note that fuzzy logic outputs are given as integers rather than decimals – 0 or 1 for no suitability*, 33 for low suitability, 66 for medium suitability and 100 for high suitability.

> *Note that in the Fuzzy Logic Bioview output, 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 high value for cover (value of 100), 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.

Opening Bioview

To open BioView, click on the BioView tab and choose "Create/Edit Habitat Data File", or if you already have a habitat/data file in csv format, choose "Run Bioview".

Configuring Your Data for Bioview

Bioview requires a single input file: a list of habitats, along with their size and cover classes/values, that it will return habitat suitability values for. Bioview can only accept data in a .csv ("comma-separated values") format. This is a common export format from database and spreadsheet software programs. Microsoft Excel works well for both importing data in a variety of formats and exporting it as a .csv file. You may create a Habitat Data file within the "Create/Edit Habitat Data File" tab in Bioview, or import an existing file, such as the attribute table of a GIS layer. Please check your Habitat Data file carefully. To ensure the Bioview output is correct, the file must be correctly formatted and the appropriate data must be entered for each column.

The Habitat Data file must contain four columns of data (see Appendix A for a list of the codes and numeric values). If you use the names shown below in green as the column headings, Bioview will automatically recognize what data the column contains when you load the Habitat Data file.

1. **HAB_CODE**: The three-character habitat code.
   (RIC is an exception. See fuzzy logic table in Appendix A.)
2. **SIZE**: The size class code (for standard output) or dbh measurement (in inches, for fuzzy logic output). *Note that Bioview needs a value in this field, even for habitats that have no size classes such as URB and BAR.* Insert a "1" where this is the case, even when using the numeric values/fuzzy logic option. If this field is left blank, no suitability output will be given for that row.

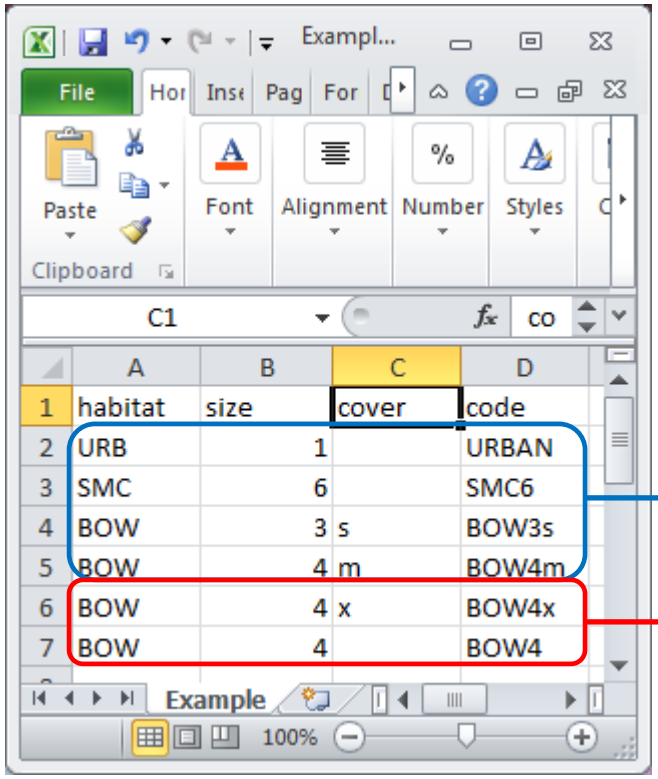
3. **COVER**: The cover class code (standard output) or percent cover value (as an integer, for fuzzy logic output). *Note that for habitats with no defined cover classes, such as URB and BAR, as well as tree habitats of size class 6, the cover class field should be left blank.*

4. **SELECTION**: The selection ID, a user-defined unique code representing the habitat, size, and cover class combination. This may be the polygon ID in a GIS coverage.

Bioview will only produce an output value for those habitat cover and size classes that are defined in CWHR for a given habitat type, and for those habitat types rated for a given species. Before running BioView, ensure that your Habitat Data file meets the following criteria:

1. **For each habitat type, a size class and cover class must be defined using the appropriate code** (see Appendix A for a list of codes). If cells in the table are blank (except for cover class in certain circumstances, see below) or contain incorrect codes, no habitat suitability value will be returned for that row. In the example below, rows 6 and 7 (codes BOW4x and BOW4), which include a blank cell and an undefined cover class code "x", will not return a habitat suitability value, even if the species of interest has high suitability in size class 4 at any cover value.

   Note that for habitats with no defined cover classes (BAR, URB, DGR, IGR, IRH, IRF, VIN, DOR, EOR), the cover class field must be left blank. In addition, size class 6, defined for many tree-dominated habitats, does not have any corresponding cover classes and the cover class must be left blank in this case. For types with no size class (BAR, URB, DGR, IGR, IRH, IRF, VIN), a "1" should be entered in the size class field.



Example 1. Input Habitat Data .csv file for a standard Biovew output

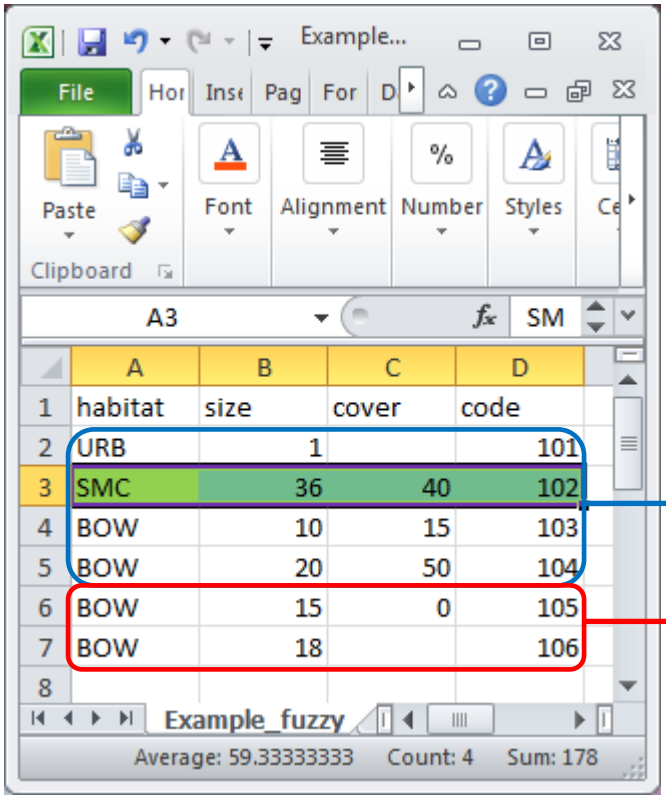
Correct

Incorrect: no habitat suitability value will be returned

Note: When importing a Habitat Data file from another source, such as an ArcGIS attribute table, check the values in all cells carefully to ensure that no missing or incorrect codes are present. The user may choose to replace missing or incorrect codes with a default code. For example, some GIS vegetation layers may contain blank "size class" or "cover class" cells for some polygons if the size or cover class could not be determined during vegetation mapping, or may contain codes not recognized by CWHR. The user may choose to assign these polygons the mean or median size or cover class value for that type, to ensure that a generalized suitability result is obtained for that polygon. If the cells are left blank, Bioview will return no suitability rating for that polygon, which, when translated back to the map, would be seen as 0 suitability.

2. Ensure that the habitat table only includes size and cover classes/values that are defined for each habitat type. For example, size class 6 (multi-storied tree) is defined for Redwood habitat but not Coastal Live Oak habitat. If a Habitat Data table contained a row with Coastal Live Oak, size class 6, no output value would be given by

Bioview and this row would not be included in the Bioview output table. A list of habitat stages and size classes defined for a habitat type can be found on the "Summaries" tab of the Habitat Info window.



Example 2: Input Habitat Data .csv file for a fuzzy logic Biovew output

Note: Compare the input for Sierra Mixed Conifer (SMC) in Examples 1 and 2. Size class 6, multi-storied tree with no defined cover class, does not have an equivalent category when using fuzzy logic. Fuzzy logic is based on tree diameter and percent cover only. In this example, SMC is coded as size class 6 with no cover class for the Bioview standard output. For the fuzzy logic output, the user must include not only tree size but also a percent cover value.

Create/Edit Habitat Data File

Click on Bioview, "Create/Edit Habitat Data File" to open a window that allows the user to create a Habitat Data file by selecting habitat types from a list and entering the size and cover class/value, or to load and modify a previously saved table.

Create Habitat Data File

Choose Habitats

Click "Full Habitat List" to generate a list of all available CWHR habitats. Double-click on a habitat type from that list, and the 3-letter code for that type will be added to the HAB_CODE field in the list below. Alternatively, the user can type the 3-letter code into the HAB_CODE field.

Define Size and Cover Classes/Values

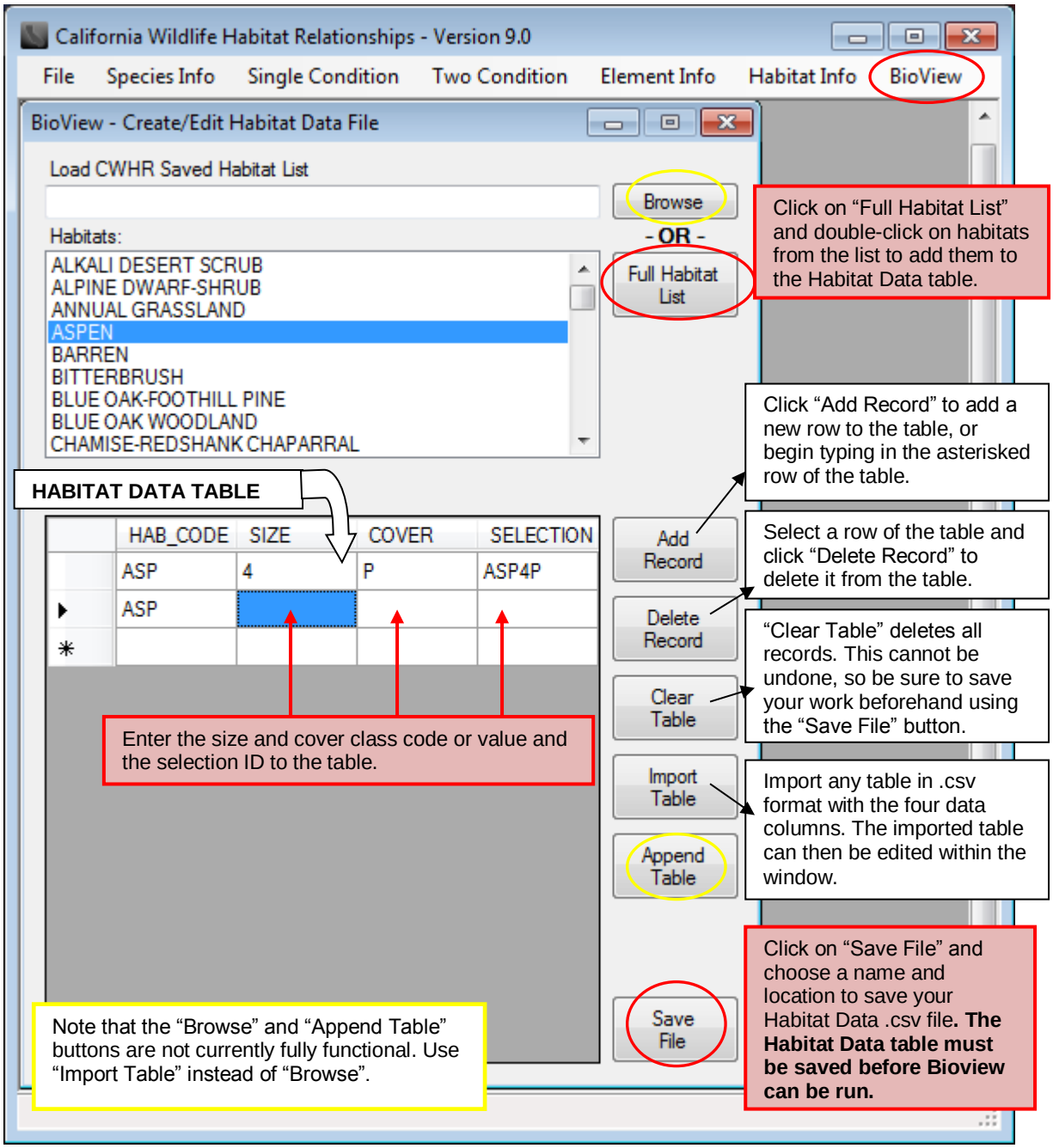
The size and cover classes/values must be manually typed into the table by the user. There is no pick list available. Bioview will only produce a result if the codes or range of values entered is recognized by the program. See Appendix A for the list of codes and numerical values to be entered in these fields.

The "Size" field contains information on tree size, shrub decadence, or herb height. This is a numerical code for the standard Bioview output, or actual value for the fuzzy logic output. The "Cover" field contains information on canopy cover or crown closure. The cover code is a letter representing the cover class, or the actual percent cover value.

Define Selection ID

The selection ID is a user-defined alphanumeric code that identifies the habitat, size and cover class combination.

Save table: click the “Save File” button to save your Habitat Data file as a .csv. You must choose a file name and location to save the file. **The Habitat Data file must be saved first before “Bioview” can be run.**



Edit Habitat Data File

Import an existing habitat data file using the “Import Table” button. Use “Import Table” instead of the “Browse” button. Once the table has been imported, it can be edited within the window. Then re-save the table using the “Save File” button.

IMPORTANT!: Check that your habitat file is correctly formatted and includes the appropriate data in each column, as described in “Configuring your Data for Bioview”.

Running Bioview

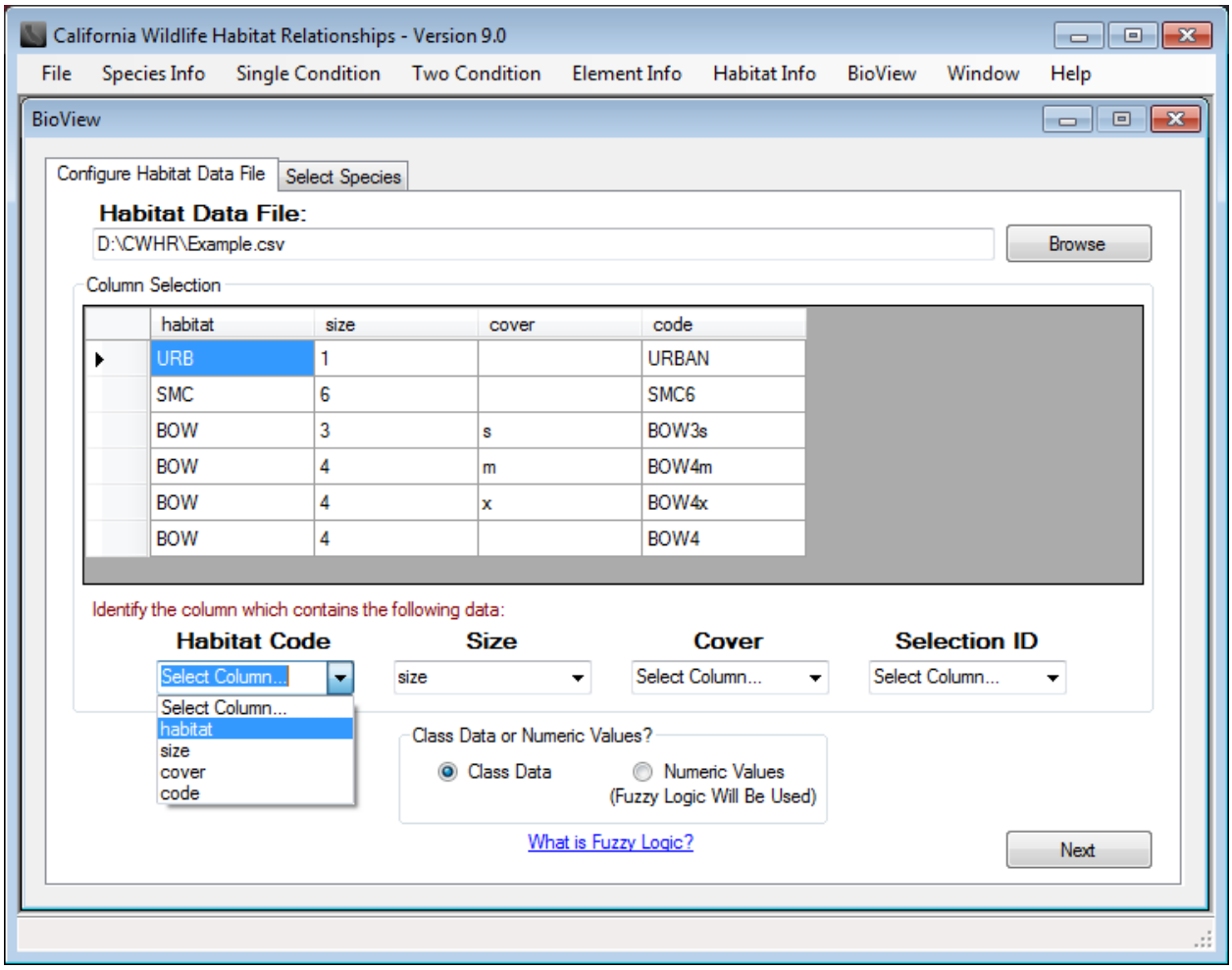
Configure Habitat Data File

This window allows you to select an existing habitat data file. The Habitat Data file must be in .csv format and contain the appropriate four columns of data. Please review "Configuring your Data for Bioview" to ensure that your data is formatted correctly before proceeding with Bioview. You can modify your Habitat Data file using "Create/Edit Habitat Data File".

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. If the file is in the proper format, the columns below will fill in with data.

If the file is formatted with the default column headings, Bioview will automatically recognize the data in each column. If not, you must use the drop-down boxes below the table to identify which column contains each piece of required data.

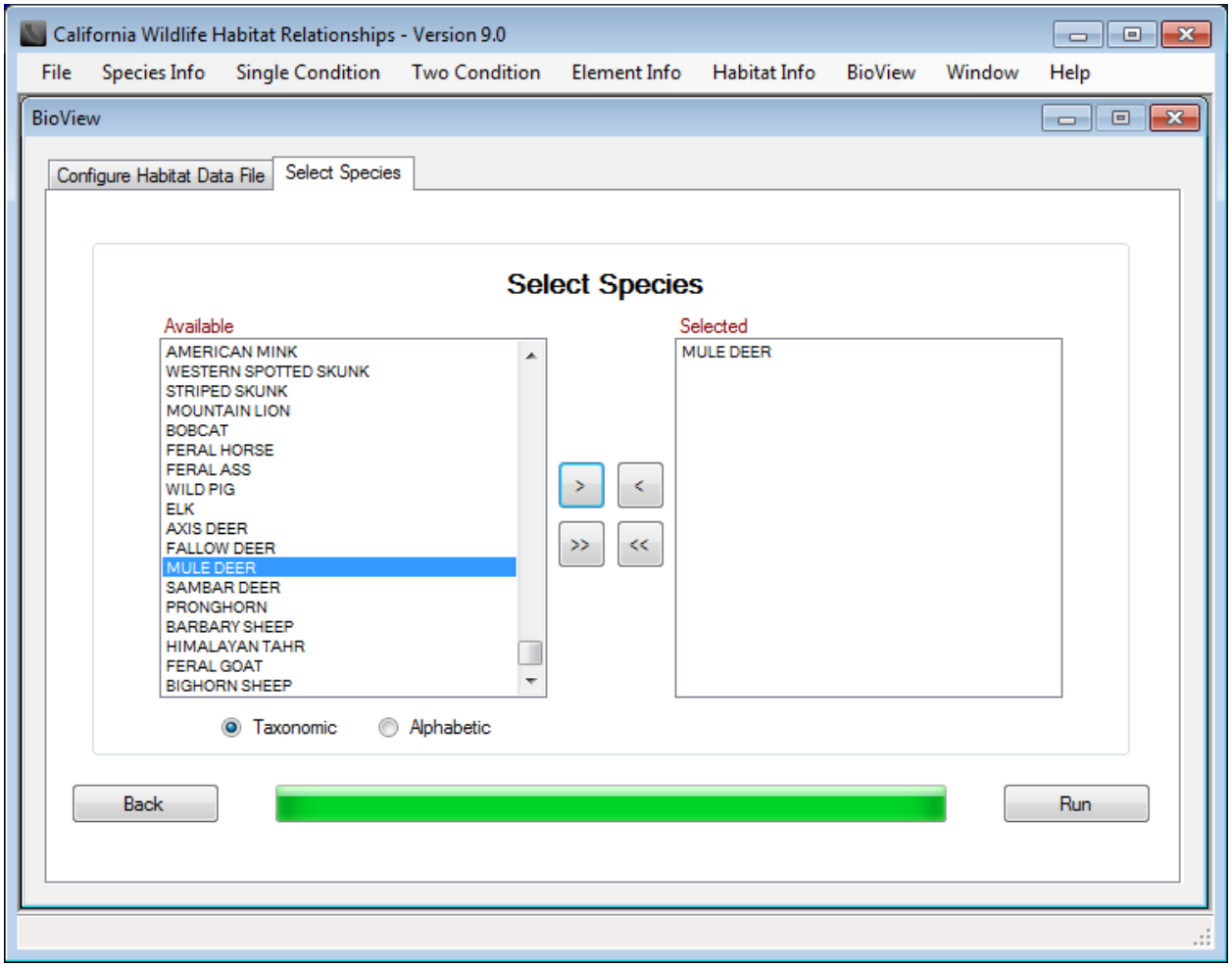
Finally, select the type of data that is contained in the file – class data or numeric values. **This is an important selection because fuzzy logic calculations can only be performed correctly on actual numeric values representing size and cover.** Running fuzzy logic on size class codes will produce an erroneous result. For a description of what fuzzy logic is and how it is applied here, click on the button "What is fuzzy logic?"



Note that Bioview will allow the import of a Habitat Data file with incorrect codes, such as those used in Habitat Data Table Example 1 (pg 36), which was imported in the example shown here. The user must ensure that all codes used in the Habitat Data table are correct before running Bioview. Any rows of the table with incorrect codes will produce no result in the Bioview output table.

Select Species

Click the “Next” button or choose the “Select Species” tab above to access the species selection window. Select a species by clicking on its name to highlight it and click the arrow to move it to the “Selected” box. To remove species from the Selected list, highlight the species and use the other arrow.



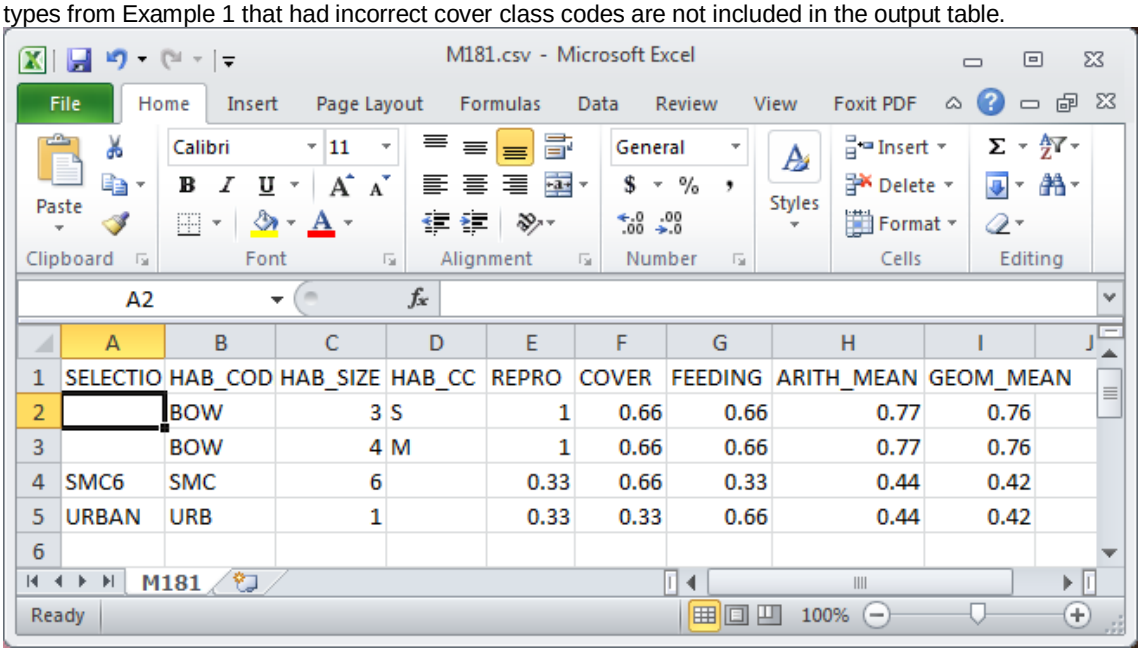
Once your species selection is complete, click the “Run” button to run Bioview. You will be prompted to browse for a location to save the output report(s). A separate report (.csv file) will be generated for each species selected, named with the 4- character alphanumeric CWHR code. Note that these files will overwrite any existing files with the same name in the folder location selected.

Bioview Reports

You will be prompted to choose a folder location for your Bioview report output file. A separate .csv output file is generated for each species, named with the species 4-character CWHR code. NOTE: Each time a new output file is generated, it will over-write any other files with the same name within the selected output folder. If running different scenarios for the same species, make sure to save the outputs into different folders.

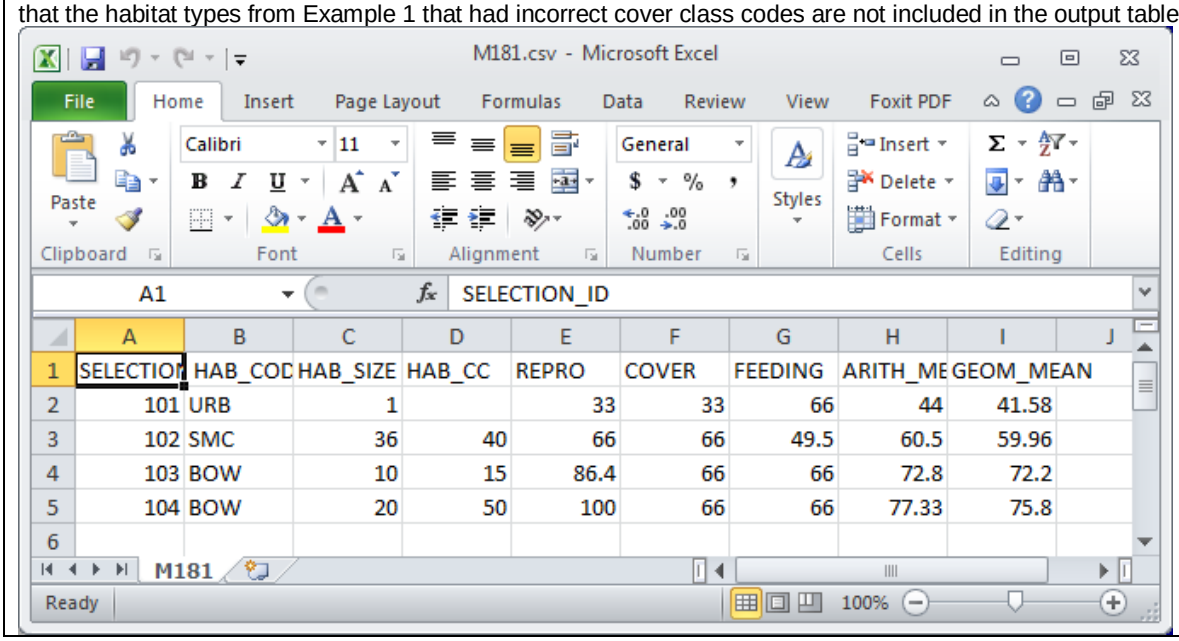
The Bioview report will only contain habitat suitability information for habitats with suitability for a given species. If habitats were included in the Habitat Data file but do not appear in the output file, this may be because 1) the excluded habitats provide no habitat suitability for the species, or 2) there was an error in the habitat, size, or cover class code in the table.

Example Bioview report for mule deer (M181) based on the Example 1 (see pg 39) Habitat Data file. Note that the habitat types from Example 1 that had incorrect cover class codes are not included in the output table.



	A	B	C	D	E	F	G	H	I
1	SELECTIO	HAB_COD	HAB_SIZE	HAB_CC	REPRO	COVER	FEEDING	ARITH_MEAN	GEOM_MEAN
2		BOW	3	S	1	0.66	0.66	0.77	0.76
3		BOW	4	M	1	0.66	0.66	0.77	0.76
4	SMC6	SMC	6		0.33	0.66	0.33	0.44	0.42
5	URBAN	URB	1		0.33	0.33	0.66	0.44	0.42
6									

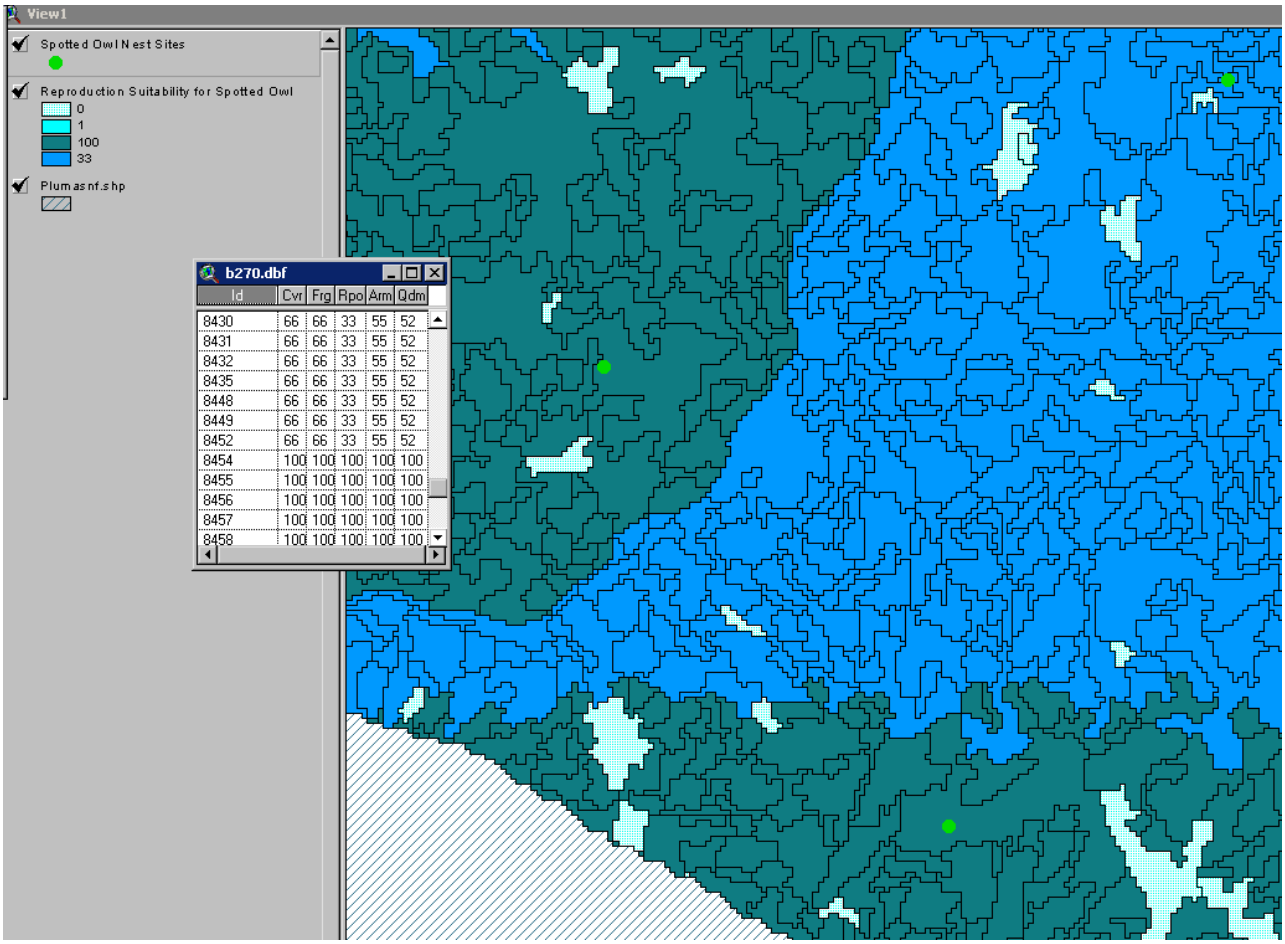
Example Bioview report for mule deer (M181) based on the Example 2 (see pg 40) Habitat Data file with fuzzy logic. Note that the habitat types from Example 1 that had incorrect cover class codes are not included in the output table.



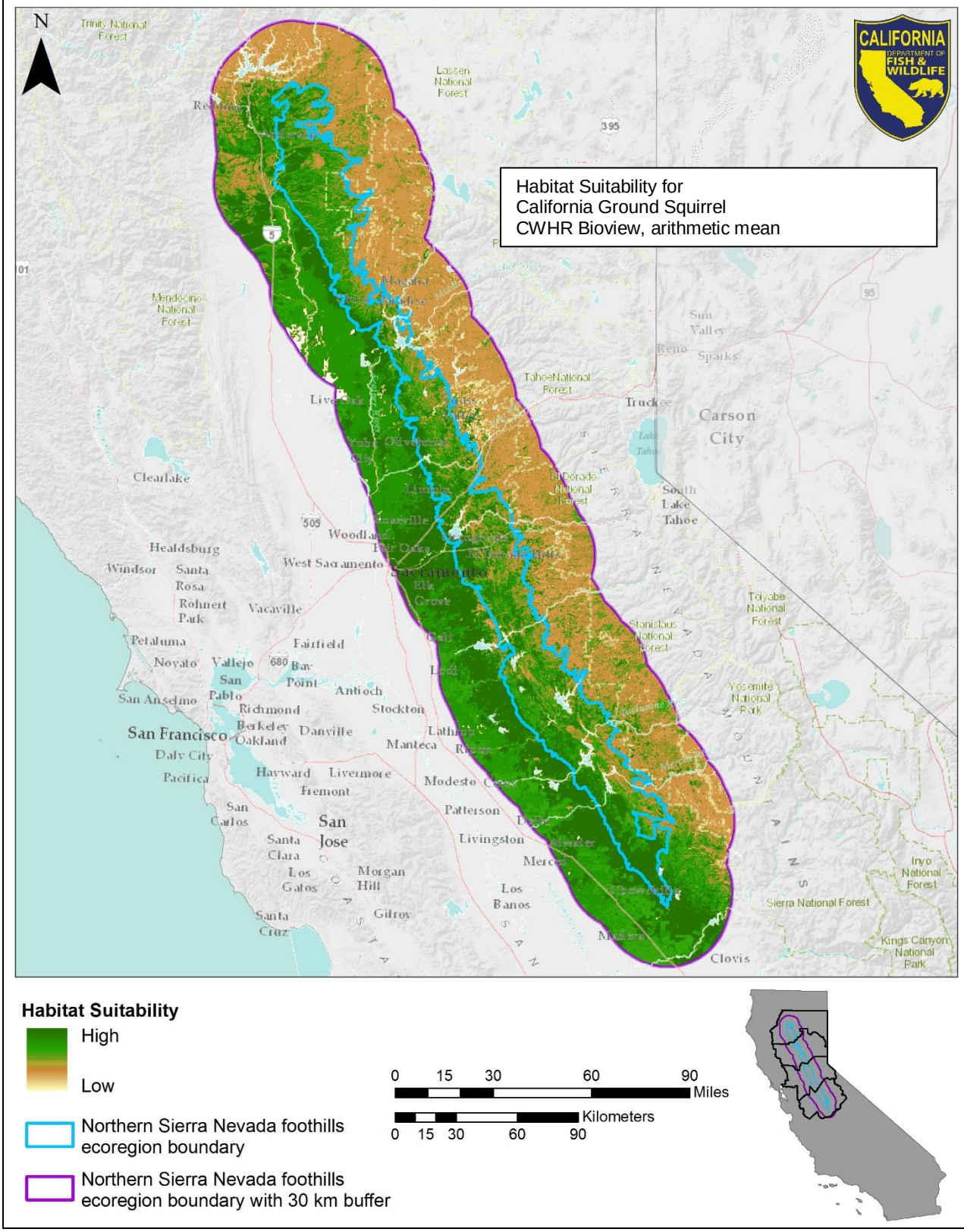
	A	B	C	D	E	F	G	H	I
1	SELECTIO	HAB_COD	HAB_SIZE	HAB_CC	REPRO	COVER	FEEDING	ARITH_ME	GEOM_MEAN
2	101	URB	1		33	33	66	44	41.58
3	102	SMC	36	40	66	66	49.5	60.5	59.96
4	103	BOW	10	15	86.4	66	66	72.8	72.2
5	104	BOW	20	50	100	66	66	77.33	75.8
6									

Displaying Output Data from Bioview using GIS

Displaying the results of your query spatially is beyond the programming language of CWHR Version 9.0 or Bioview. However, Bioview output is designed so that, for each species of interest, all habitat suitability values will appear in a single table. Because the table contains the unique identifier for each polygon or habitat code in your habitat data file, it can be joined to the attribute table in ArcGIS and used to "attribute" the spatial data. This is a simple process if you are familiar with GIS software programs. 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 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.



The map below shows the Bioview habitat suitability model results for California Ground Squirrel used in the [northern Sierra Nevada foothills fine-scale connectivity project].



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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

Where:

R = suitability value for Reproduction
C = suitability value for Cover
F = suitability value for Feeding
SI = mean habitat suitability index
N = number of habitat/stage combinations within a single study area
weight = weight (i.e., acres, percent of area, etc.) of individual habitats in query

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.

Weighted Habitat Value Comparison Report:

Weighted Arithmetic Mean: $$SI = \sum_{i=1}^{N} \left(\left(\frac{R_i + C_i + F_i}{3} \right) * (weight_i) \right)$$

Weighted Geometric Mean: $$SI = \sum_{i=1}^{N} \left(\sqrt[3]{R_i * C_i * F_i} * weight_i \right)$$

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.

Harvest Species

Harvest species are defined as Game Birds (Fish and Game Code § 3500), Game Mammals (Fish and Game Code § 3950), and Fur-bearing mammals and Nongame animals as designated in the California Code of Regulations. Amphibians and reptiles designated as harvest species in CWHR are those species that are non-native and can be collected with no limit under a fishing license. See the California Code of Regulations, Title 14, Sections 5.05 and 5.60 for a full list of Harvest amphibians and reptiles.

APPENDIX A: CWHR Habitat Codes

CWHR habitats are classified using dominant existing vegetation. The major CWHR habitat subdivisions are:

1. Tree-dominated: Tree canopy ≥ 10% cover
2. Shrub-dominated: Shrub canopy ≥ 10% cover, and tree canopy < 10% cover
3. Herbaceous- dominated: Herbaceous ≥ 2% cover, and <10% tree or shrub cover
4. Barren: Does not have canopy cover to meet Tree-, Shrub-, or Herbaceous-dominated
5. Aquatic: Open water ≥ 98.0% of surface

Habitat Stages (size and cover classes):

Habitat Size Classes

Stem diameter is the primary attribute used to determine tree size with the CWHR system. Stem diameter is the quadratic mean diameter of all woody stems in the sample plot or with measurement unit >= 5 inches in diameter at breast height (4.5 ft). Shrub size classes are defined by shrub age (i.e., decadence). Herb size classes are defined by plant height of dominant herb at maturity.

CWHR Tree Size Classes		
Size Code	**Description**	**Diameter at Breast Height**
1	Seedling	Less Than 1 inch
2	Sapling	1 to 6 inches
3	Pole	6 to 11 inches
4	Small Tree	11 to 24 inches
5	Medium/Large	Tree Greater Than 24 inches
6	Multi-Layered	Size 5 Over Size 4 Or 3; Total Tree Crown Closure Greater Than 60%

CWHR Shrub Size Classes		
Size Code	**Description**	**WHR Shrub Crown Decadence**
1	Seedling Shrub	Seedlings or sprouts < 3 years
2	Young Shrub	None
3	Mature Shrub	1 – 25%
4	Decadent Shrub	> 25%

CWHR Herbaceous Size Classes		
Size Code	**Description**	**Plant Height at Maturity**
1	Short Herb	<12 inches
2	Tall Herb	>12 inches

Habitat Cover Classes

Canopy cover or crown closure is another structural attribute used to classify CWHR habitat stages. For tree-dominated habitats, the % cover by overstory trees contributing to the canopy is measured. This can be done from the ground or from remotely sensed information. For shrub types the total shrub canopy is measured, and for herb types the total herb canopy is estimated.

CWHR Cover Classes for Trees, Shrubs, and Herbs			
Cover Code	**Description**	**% Canopy Closure***	**% Canopy Closure (for herbaceous types and desert shrub types DSS, DSC, ASC)**
S	Sparse	10 to 24%	2-9%
P	Open	25 to 39%	10-39%
M	Moderate	40 to 59%	40 to 59%
D	Dense	60 to 100%	60 to 100%
*except for herbaceous types and desert shrub types including desert succulent scrub (DSS), desert scrub (DSC), and Alkali desert scrub (ASC)			

CWHR Habitat Names

CODE	CWHR NAME	Dominant/Associated Species	Type**
ADS	Alpine-Dwarf Shrub	Oceanspray, Greene Goldenweed, Mountain Heather	S
AGS	Annual Grassland	Wild Oats, Soft Chess, Brome Species	H
ASC	Alkali Desert Scrub	Allscale, Saltbush Species, Shadscale	S
ASP	Aspen	Aspen, Willows, Alders	T
BAR	Barren	Rock, Gravel, Soil	B
BBR	Bitterbrush	Bitterbrush Species, Big Sagebrush, Rubber Rabbitbrush	S
BOP	Blue Oak-Foothill Pine	Foothill Pine, Blue Oak, Interior Live Oak	T
BOW	Blue Oak Woodland	Blue Oak, Interior Live Oak, California Buckeye	T
COW	Coastal Oak Woodland	Coast Live Oak, Engelmann Oak, Island Oak	T
CPC	Closed-Cone Pine-Cypress	Sargent Cypress, Monterey Cypress, Monterey Pine	T
CRC	Chamise-Redshank Chaparral	Chamise, Redshank, Ceanothus Species	S
CSC	Coastal Scrub	Coyotebush, California Buckwheat, Sage Species	S
DFR	Douglas Fir	Douglas Fir, Tanoak, Ponderosa Pine	T
DGR	Dryland Grain Crops	Cereal Rye, Barley, Wheat	D
DOR	Deciduous Orchard	Almonds, Walnuts, Peaches	D
DRI	Desert Riparian	Tamarisk, Mesquite, Fremont Cottonwood	T
DSC	Desert Scrub	Creosotebush, Catclaw Acacia, Desert Agave	S
DSS	Desert Succulent Shrub	Octillo, Mojave Yucca, Desert Agave	S
DSW	Desert Wash	Paloverde Species, Desert Ironwood, Mesquite	S
EOR	Evergreen Orchard	Oranges, Avocados, Lemons	D
EPN	Eastside Pine	Ponderosa Pine, Jeffrey Pine, White Fir	T
EST	Estuarine	Plankton, Algae, Eel Grass	A
EUC	Eucalyptus	Blue Gum, Red Gum	T
FEW	Freshwater Emergent Wetland	Cattail, Bulrush, Redroot Nutgrass	H
IGR	Irrigated Grain Crops	Corn, Dry Beans, Safflower	D
IRF	Irrigated Row and Field Crops	Tomatoes, Cotton, Lettuce	D
IRH	Irrigated Hayfield	Alfalfa, Hay	D
JPN	Jeffrey Pine	Jeffrey Pine, Ponderosa Pine, Sugar Pine	T
JST	Joshua Tree	Joshua Tree, Juniper Species, Mojave Yucca	T
JUN	Juniper	Juniper Species, White Fir, Jeffrey Pine	T
KMC	Klamath Mixed Conifer	White Fir, Douglas-Fir, Ponderosa Pine	T
LAC	Lacustrine	Plankton, Duckweed, Water Lilies	A
LPN	Lodgepole Pine	Lodgepole Pine, Aspen, Mountain Hemlock	T
LSG	Low Sage	Low Sagebrush, Black Sagebrush, Rabbitbrush Species	S
MAR	Marine	Plankton, Algae, Kelp	A
MCH	Mixed Chaparral	Scrub Oak, Ceanothus Species, Manzanita Species	S
MCP	Montane Chaparral	Ceanothus Species, Manzanita Species, Bitter Cherry	S
MHC	Montane Hardwood-Conifer	Ponderosa Pine, Incense Cedar, California Black Oak	T
MHW	Montane Hardwood	Canyon Live Oak, California Black Oak, Oregon White Oak	T
MRI	Montane Riparian	Black Cottonwood, Bigleaf Maple, White Alder	T
PAS	Pasture	Bermuda Grass, Ryegrass, Tall Fescue	H
PGS	Perennial Grassland	California Oatgrass, Hairgrass, Sweet Vernalgrass	H
PJN	Pinyon-Juniper	Pinyon Species, Juniper Species, Mountain Mahogany Species	T
POS	Palm Oasis	Fan Palm, Velvet Ash, California Sycamore	T
PPN	Ponderosa Pine	Ponderosa Pine, Jeffrey Pine, Douglas Fir	T
RDW	Redwood	Redwood, Grand Fir, Sitka Spruce	T
RFR	Red Fir	Red Fir, White Fir, Lodgepole Pine	T
RIC	Rice	Rice	D
RIV	Riverine	Water Moss, Algae, Duckweed	A
SCN	Subalpine Conifer	Engelmann Spruce, Subalpine Fir, Mountain Hemlock	T
SEW	Saline Emergent Wetland	Cordgrass, Pickleweed, Bulrush	H
SGB	Sagebrush	Sagebrush Species, Rabbitbrush Species, Horsebrush	S
SMC	Sierran Mixed Conifer	Douglas Fir, Ponderosa Pine, White Fir	T
URB	Urban	Grass Lawns, Ornamental Trees, Hedges	D
VIN	Vineyard	Grapes, Kiwi Fruit, Boysenberries	D
VOW	Valley Oak Woodland	Valley Oak, California Walnut, California Sycamore	T
VRI	Valley Foothill Riparian	Cottonwood, Sycamore, Valley Oak	T
WFR	White Fir	White Fir, Douglas Fir, Sugar Pine	T
WTM	Wet Meadow	Sedge Species, Rush Species, Tufted Hairgrass	H

**T = tree-dominated, S = shrub-dominated, H = herbaceous-dominated, A = aquatic, D = developed, B = barren

Discontinued Types

These habitat types were used in previous versions of CWHR, but have been replaced with new types.

Old Code	Old Type Name	Replaced by
CRP	Cropland	DGR, IGR, IRH, IRF, RIC
OVN	Orchard and Vineyard	DOR, EOR, VIN

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[1]	% cover[2]
Tree Habitats with No Cover Class (DOR,EOR)	dbh or QMD[1]	---
Shrub Habitats	% decadence[2]	% cover[2]
Herb Habitats	height[1]	% cover[2]
Aquatic Habitats	% time exposed[2]	---
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.	**Please note: habitat suitability values for rice are not currently available using the fuzzy logic option in Bioview.**	

[1] Diameter at breast height (dbh) or quadratic mean diameter (QMD) should be in inches.
[2] Percentages should be entered as an integer between 1 and 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.

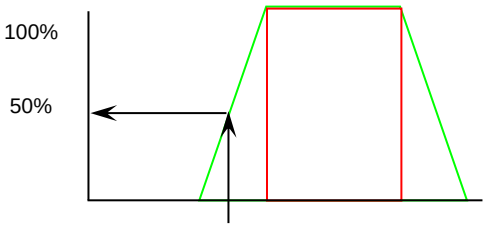
In the simplest terms, fuzzy sets represent the mathematics of uncertainty, an emerging response to the recognition that little in the real, physical, and especially in the biological world is clear-cut and unambiguous. That the real world is only defined with uncertain, ambiguous, and incomplete data 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.

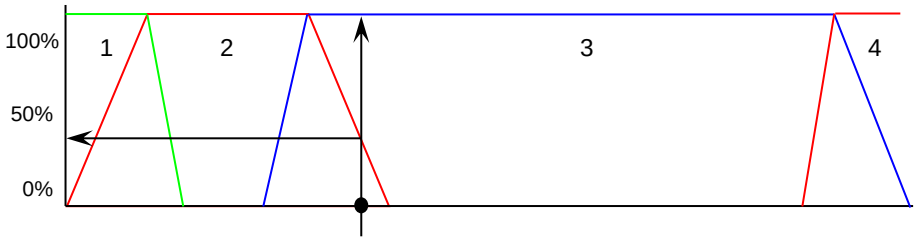
The CWHR models use environmental variables expressed as classes (crown decadence and percent ground cover for shrub habitats), with a suitability rating for each combination. These classes are fuzzy sets with unclear and ambiguous boundaries. Bioview applies fuzzy logic to these classes to provide a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