

Making Checklists with the SEINet Database/Symbiota Portals

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ABSTRACT: The Southwest Environmental Information Network (SEINet) is a consortium of herbaria from the United States, Canada, and Mexico that collectively provide a database of digitized specimens worldwide in scope but principally from North America. The SEINet Portal Network is one of many natural history collection databases that uses Symbiota software. Symbiota provides useful tools to generate searches based on geographic region, family, collector, year of collection, and more. These tools are readily available to the public, and our aim is to provide the knowledge to maximize their use, most specifically using the SEINet database. We mainly consider geographic checklists, lists of taxa found within a specific region. We also provide an example of a checklist based on a collector. Checklists serve many purposes including but not limited to, aiding in identification, indicating an area's documentation rate, illustrating the relative biodiversity of a region, or exploring the activities of a collector. We discuss multiple methods for creating checklists, including both temporary and saved checklists, and provide detailed examples from searches generated in the SEINet Portal Network to give a thorough overview of the checklist features available on portals that use Symbiota software.

INTRODUCTION

The SEINet Portal Network, or the Southwest Environmental Information Network, was established in 1999 through a National Science Foundation grant (BDI 9983132) to the Global Institute of Sustainability at Arizona State University (ASU). One aspect of the original funded project was a database of herbarium specimens and that has become the main lasting contribution. Two later grants to ASU and collaborating institutions in Arizona (University of Arizona [ARIZ], Northern Arizona University [NAU], and the Desert Botanical Garden [DES]) provided funds for databasing and photographing specimens. Many other institutions joined the SEINet Portal Network with funding from Advancing Digitization of Biological Collections (ADBC, https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503559) or even with no funding. We were optimistic that the SEINet Portal Network would contain about 1.4 million records by 2013. It was nearly restricted to Arizona and adjacent states until then, but because the software used by the SEINet database, Symbiota (Gries et al. 2014), was so attractive and user-friendly, and because specimens from other parts of the United States could conveniently be added to SEINet, the database grew rapidly. As of 2021, SEINet includes nearly 15.4 million specimen records and over 260,000 observations from about 360 contributing institutions in North America. There are several Symbiota-based web portals, e.g., SERNEC, Consortium of Midwestern Herbaria, Intermountain Regional Herbaria

CHECKLISTS WITH SEINet DATABASE/SYMBIOTA PORTALS

Network, that provide front-end access to these data (<http://symbiota.org/docs/seinet/>), and the database continues to grow!

The purpose of this paper is to show how one can use Symbiota-based portals to make checklists. We first discuss making temporary checklists that might be used briefly, perhaps just as a quick specimen search. Later, we discuss saved checklists that are stored on Symbiota-based portals, available to modify and use for years. Our examples use the SEINet database and portals to that database, but all Symbiota portals work in a similar way, regardless of the database used. Thus, this paper may be useful to those using other Symbiota portals and databases. The availability of certain features, such as interactive keys, may vary depending on the portal being used.

A checklist is generally a list of taxa found within a specific geographic area. Checklists can provide information about how well-documented an area is by collections, the relative biodiversity of a region, and can aid in identifying new specimens. These geographically based checklists are discussed first. Similar lists of taxa may be made, unrelated to or only partially related to geography, for instance based on a particular collector, corresponding to a time-period, or as a study aid for a class. An example of this kind of checklist, based on a collector, is discussed last.

Many aspects of this paper are explained through videos on [Symbiota YouTube Channel](https://www.youtube.com/channel/UC7glMVLrNtA6ES3VTsci7iQ) (<https://www.youtube.com/channel/UC7glMVLrNtA6ES3VTsci7iQ>); we encourage readers to also consult these. Individual videos of this series are cited in Resources and Literature cited.

MAKING TEMPORARY CHECKLISTS WITH THE SEINET DATABASE

To make a checklist in a Symbiota portal, first, open one of the portals that provide access to the database. There are two kinds of homepages as of March 2021. Type A has link-choices (buttons) at the top of the page in a grey bar, for example, SEINet Arizona-New Mexico (AZ-NM) Chapter (<http://swbiodiversity.org/seinet/>). Type B has link-choices (buttons) along the left side in a list, for example the Intermountain Region Herbarium Network (<https://intermountainbiota.org/portal/>). Type A and B homepages work essentially the same and checklist data is shared across these platforms (Fig. 1).

For these examples we use the AZ-NM Chapter portal with the type A format. Locate the grey search bar at the top of the page. Hover over “Specimen Search” until a drop-down menu appears. Select “Search Collections” [for type B format, go directly to “Search Collections” in the left column]. The next page displays the list of herbaria that are available to search via this portal (Fig. 2). Typically, you want to search all the herbaria, but if you have a specific herbarium from which you would prefer to create a checklist, click “Select/Deselect All” to deselect all herbaria and then manually select the specific herbarium (or herbaria) to query. Next, proceed to the “Search” button on the top right-hand side of the screen.

There are four ways to create geographically based checklists in Symbiota websites. See Table 1, Fig. 3, and discussion below. As an example, we begin by conducting a locality search based on search terms.

Choosing the defining features of the location (e.g., state and locality) is the first step in a locality search. Generally, limiting the search to fewer terms such as state and one other feature facilitates a more inclusive search. On the other hand, it is best to be cognizant of using a place name that may be used multiple times in a state (e.g., “Sycamore Canyon” in Arizona). Sometimes an area is known by more than one name, for instance Pima Canyon and Guadalupe

Canyon are the same place, a locality in South Mountain Park of Phoenix, Arizona. In this instance, using a broad search term such as “South Mountain” in Arizona may help capture both Pima and Guadalupe Canyon. For this checklist example, we defined our search with “State: Arizona” and “Locality: Cabeza Prieta,” which should limit the search to the Cabeza Prieta National Wildlife Refuge in southwestern Arizona.

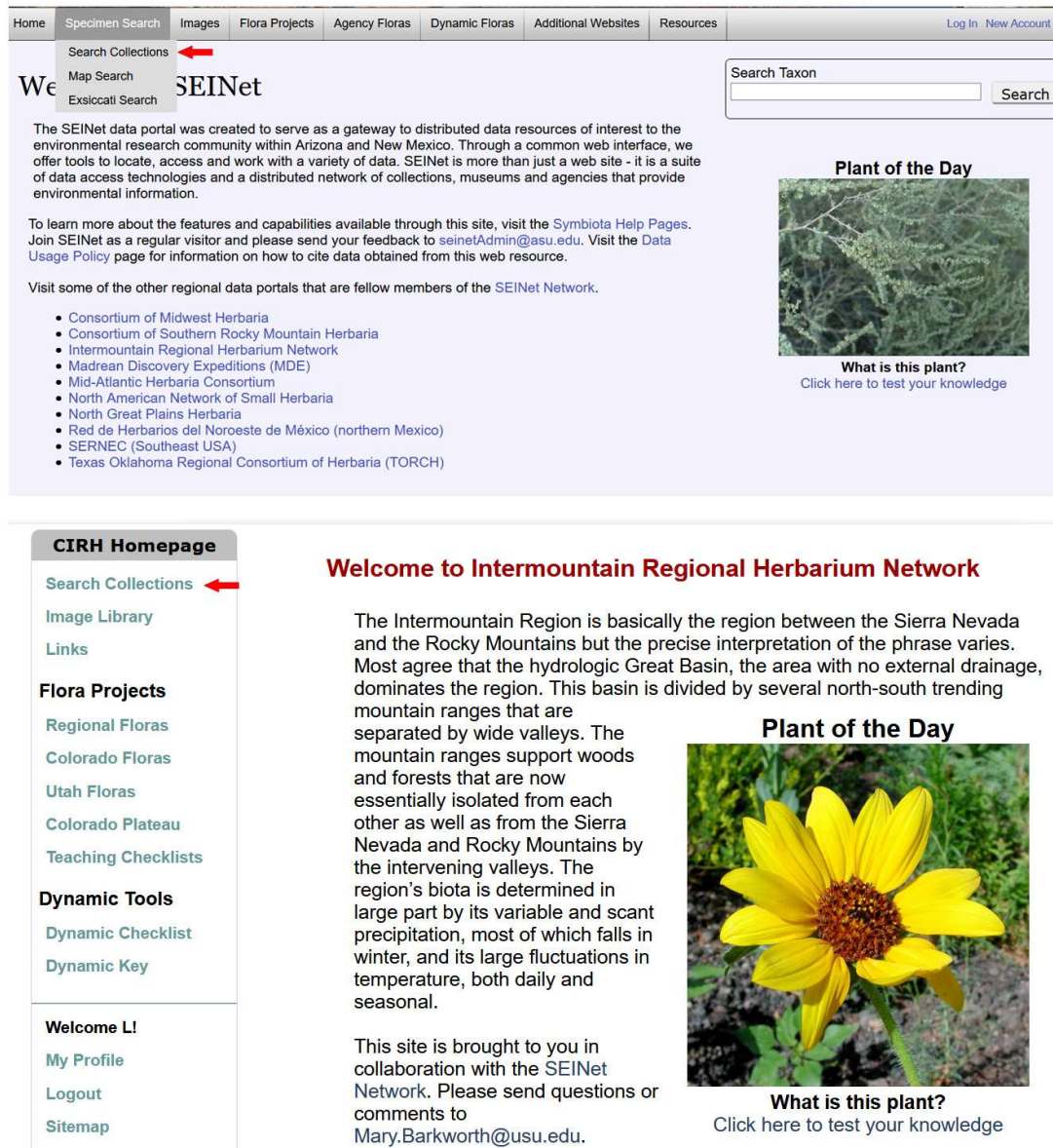


Figure 1. Examples of the two types of homepages. Type A (*Top image*) SEINet AZ-NM Chapter link-choices are located in the top grey toolbar. Type B (*Bottom image*) Intermountain Regional Herbarium Network link-choices are located in the left column. Arrows indicate button used to make a specimen search.

CHECKLISTS WITH SEINet DATABASE/SYMBIOTA PORTALS

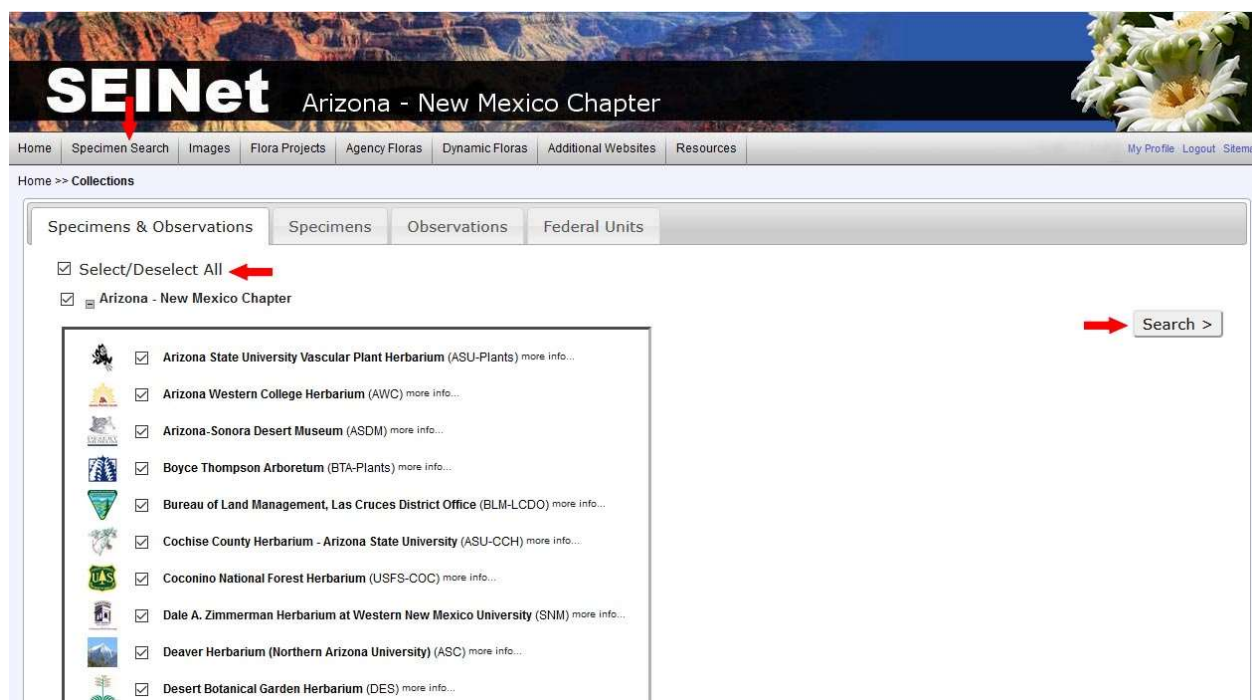


Figure 2. Web page format for initiating a checklist search. The three arrows denote how to begin the query by selecting from the Specimen Search dropdown menu on the top toolbar, Select/Deselect All for the list of herbaria, and the Search button to proceed.

Table 1. The four ways of searching for specimens to create geographically based checklists with Symbiota.

Locality criteria	Search by using words for specific areas, i.e., country, state/province, county, locality, or elevation. This type of search is helpful for specimens that are not georeferenced, or if you are trying to make a checklist for a defined area such as the state of Arizona or Maricopa County.
Bounding box	Create a square/rectangle over a certain area. This type of search is useful for a broad search of a region, but it will exclude specimens that are not georeferenced.
Polygon	Create a custom irregular polygon shape. This type of search is useful for tracing boundaries of parks, preserves, forests, or other natural features that are not easily captured through a box or circle, but it will exclude specimens that are not georeferenced.
Point-radius	Create a circle in a certain area. This type of search is useful for searching from a certain point and expanding a uniform radius (e.g., 10 km) around the point, but it will exclude specimens that are not georeferenced.

The next step is to display the results from your search and filter them appropriately. You will see two options on the top right-hand corner of the screen: “List Display” and “Table Display” (Fig. 3). For a comparison of these two displays see Table 2.

The List Display is generally better for making checklists and this discussion will proceed with that option. By selecting List Display a new page will open with three tabs, defaulting to the “Occurrence Records” tab. The Occurrence Records tab provides label information about every specimen. There are three buttons within this tab that allow you to 1) change output to table display, 2) download data of all specimens as a CSV file, or 3) copy the URL address for the search results (Fig. 4). The Maps tab allows one to make Distribution maps for all the georeferenced specimens and can often be informative, especially as a way to find poorly georeferenced specimens or problems with the search terms used. For instance, if

you had searched for “Sycamore Canyon” in Arizona it would be evident on the map that you had specimens from various localities. The Species List tab is the best for constructing checklists. Thus, we suggest that you switch to that tab (Fig. 4).

Taxonomic Criteria

☒ Include Synonyms

Scientific Name:

[List Display](#) [Table Display](#) [Reset Form](#)

Locality Criteria

Country:

State/Province:

County:

Locality:

Elevation (in meters): to

Latitude and Longitude

Bounding box

Northern Latitude: N

Southern Latitude: N

Western Longitude: W

Eastern Longitude: W

Polygon (WKT footprint)

Point-Radius

Latitude: N

Longitude: W

Radius: Kilometers

Collector Criteria

Collector's Last Name:

Collector's Number:

Collection Date: -

Specimen Criteria

Catalog Number: ☒ Include other catalog numbers and GUIDs

☐ Limit to Type Specimens

☐ Limit to Specimens with Images

☐ Limit to Specimens with Genetic Data

☐ Include cultivated/captive occurrences

[List Display](#) [Table Display](#)

Figure 3. Search Criteria page for a specimen search. The five arrows point to the most common ways of searching for specimens to make a checklist. Locality Criteria (geography word search). Latitude and Longitude options (geography search using coordinates; all allow using a map by clicking on icon in upper right corner): Bounding Box (rectangle), Polygon (irregular shape), and Point-Radius (circle). Collector Criteria (searches based on collector, number, and/or date). Criteria can be combined from different sections, e.g., elevation from Locality Criteria with Point Radius map option. Searches can also be restricted by Taxonomic Criteria or Specimen Criteria.

Table 2. Comparison of List Display versus Table Display.

List Display	Defaults to the “Occurrence Records” tab, which displays all observations and specimens alphabetically by herbarium. For example, Arizona State University herbarium might be the first herbarium listed. Switch to the “Species Tab” on the left for all the Taxa recorded in an area both through observations and specimens. The “Species List” tab list is alphabetized by family and scientific name within families. Each specimen is hyperlinked to a page in the Symbiota website that provides more information about, and images of, most organisms. List display, specifically the “Species List” tab, is the recommended option for viewing a checklist as it appears in a more user-friendly format.
Table Display	Lists all the specimens of all Taxa recorded in an area as a spreadsheet that can be sorted by up to two fields (e.g., collection, family, scientific name, etc.). This is not the recommended option for viewing a checklist unless you intend to download the data as a CSV file. One advantage of the Table display is that it allows one to see the relative abundance of taxa.

CHECKLISTS WITH SEINet DATABASE/SYMBIOTA PORTALS

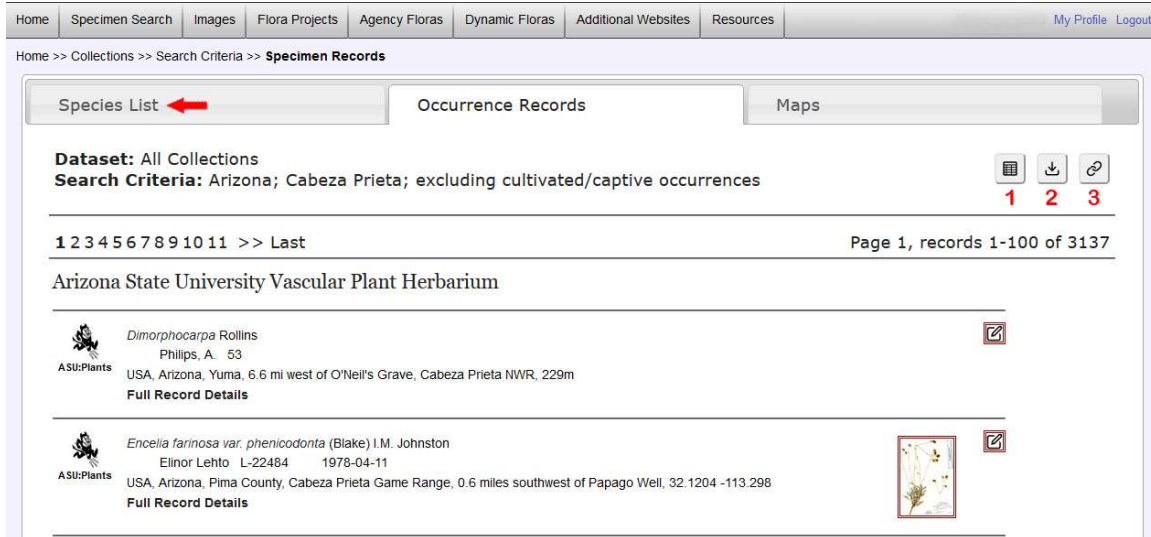


Figure 4. List display of Occurrence Records. Arrow indicates the “Species List” tab which converts “Occurrence Records” to a list of species. Button 1 changes output to Table Display (Table 2), button 2 allows you to download the data of all the specimens as a CSV file, and button 3 copies the checklist address to the computer memory and can be saved or sent to someone else.

Example of a Locality search. Cabeza Prieta National Wildlife Refuge, Arizona

The Species List tab presents a total Taxa Count denoted in bold above the list (Fig. 5). However, if you look at the Taxonomic Filter you will see that this count is generated from the raw data (taxonomy is unresolved) and may not account for species synonyms or typos, thus creating an inaccurate count of taxa. To adjust this, click the Taxonomic Filter and select a Thesaurus applicable to your region from the dropdown menu. For areas within Arizona, such as the locality used in this example of Cabeza Prieta, it is suitable to use the ASU Taxonomic Thesaurus. For areas outside of Arizona you may want to select between the Central Taxonomic Thesaurus and Integrated Taxonomic Information System (ITIS) Thesaurus. In the example in Fig. 5, the number of taxa was reduced from 712 to 673 after application of the ASU Taxonomic Thesaurus. This is because the filter identifies and consolidates species by their synonyms and removes specimens identified to family or genus only.

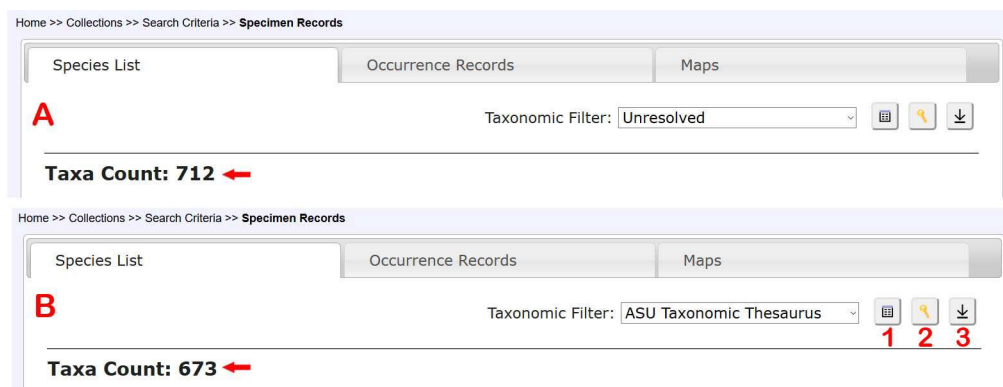


Figure 5. Species list display showing numbers of taxa using “Unresolved,” i.e., raw data (A) and using the ASU Taxonomic Thesaurus (B). Button 1 leads to Checklist Explorer, button 2 leads to an interactive key, and button 3 downloads the checklist data as a table of taxa.

Checklists can also be made with the Latitude and Longitude options (Fig. 3) that involve establishing a bounding box, polygon, or circle of choice. A word search using “Locality Criteria” and a search based on “Latitude and Longitude” may give somewhat different lists of specimens and taxa depending on how many specimens are georeferenced within that area. To search by Latitude and Longitude, click the Map icon in the top right-hand corner of the box for Bounding Box, Polygon, or Point-Radius, corresponding to your desired search option.

Once you have clicked the map icon, a new window will pop-up with a map and four buttons located on the top (Fig. 6). The first button, symbolized by a hand, allows you to move through the map to select a location without drawing a polygon or circle. The second button, symbolized by a V-shaped polygon, allows you to draw an irregular polygon. The third button, symbolized by a box, allows you to draw a bounding box. The last button, symbolized by a circle, allows you to place a point and establish a radius around the point to include. Begin by using the hand symbol and the plus or minus symbols to adjust the map and zoom into the area you are interested in. To draw a box or a circle, click near the general area of interest and drag the pointer to expand the shape to desired coverage. Edit your circle or box by hovering over one of the points on the shape perimeter then clicking and dragging to expand or contract the shape. To draw an irregular polygon, use single clicks to create points (vertices) of your polygon. Complete the polygon by linking back to the original point or double clicking. You may move any outlined shape by using the hand symbol. Once you have outlined your area of choice, click the “Save and Close” button at the top right-hand corner of the window and the defining coordinates will be saved.

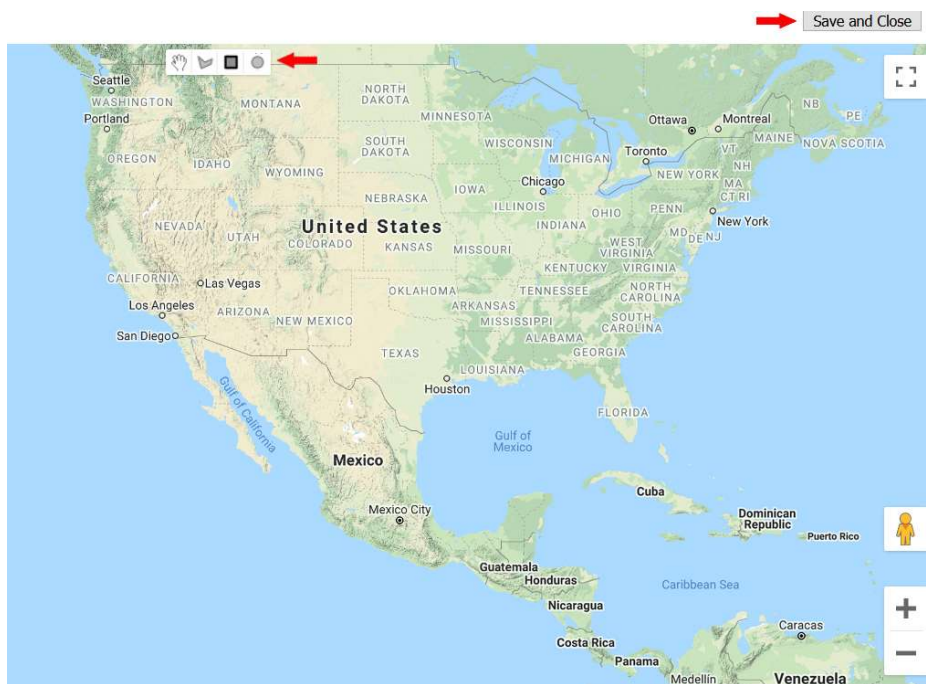


Figure 6. Map search view. Arrow on left points to tools for creating box, polygons and circles. Click the hand symbol for panning round the map, V-shaped polygon for creating irregular polygons, box for creating a bounding box, and circle for creating a point-radius circle. Arrow on right points to button to save coordinates.

CHECKLISTS WITH SEINet DATABASE/SYMBIOTA PORTALS

For this example, we used the irregular polygon tool to outline Cabeza Prieta National Wildlife Refuge and generate a checklist for specimens georeferenced within those boundaries (Fig. 7).

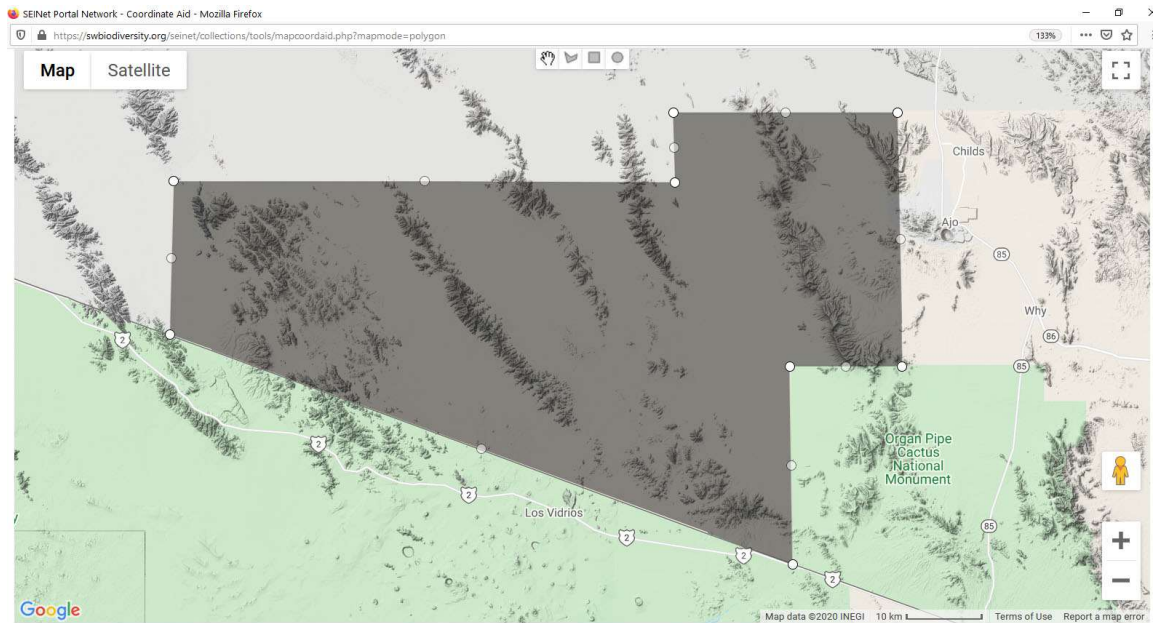


Figure 7. Irregular polygon map search outlining the boundaries of Cabeza Prieta National Wildlife Refuge.

Once you have generated your results in List Display there are additional options available to manipulate the display or search within your checklist. The three tools available via the three buttons to the right of the taxonomic filter (Fig. 5) are described below.

Checklist explorer interface: This option (button 1, Fig. 5) generates an interactive checklist that offers a number of different ways to view the list (Fig. 8). Clicking this button will open a new page with an “Options” box in the right-hand side of the screen. To modify the display, check the box next to your preferred display options in this box and then click “Build List”. For example, you may want to include common names or images if you plan to use the list as a quick field guide. You may limit the checklist taxonomically by inserting, for example, a genus or family name in the box under “Search”. The checklist interface defaults to organizing by family and alphabetizing genus within family but clicking “Show Taxa Alphabetically” will alphabetize all taxa. Once you have selected your preferred display options, you can click button 1 to export to a Word document, button 2 to Print from Browser, or button 3 to download the list as a CSV file that may be opened in Excel, Numbers, Access and other spreadsheet compatible applications (Fig. 8).

Home >> Specimen Checklist #1603204676

Specimen Checklist #1603204676  Games

More Details

Families: 59
Genera: 274
Species: 466
Total Taxa (details): 499

ACANTHACEAE
[Carlownrightia arizonica](#)
[Justicia californica](#)

AMARANTHACEAE
[Amaranthus crassipes](#)
[Amaranthus crassipes var. crassipes](#)
[Amaranthus fimbriatus](#)
[Amaranthus fimbriatus var. denticulatus](#)
[Amaranthus palmeri](#)
[Atriplex canescens](#)
[Atriplex elegans](#)
[Atriplex elegans var. fasciculata](#)
[Atriplex pacifica](#)
[Atriplex polycarpa](#)
[Atriplex semibaccata](#)
[Blitum nuttallianum](#)

Options

Search:

☐ Common Names
☒ Synonyms

Taxonomic Filter:
Original Checklist
☐ Display Synonyms
☐ Common Names
☐ Display as Images
☐ Taxon Authors
☐ Show Taxa Alphabetically

Build List   
1 2 3

Figure 8. Checklist explorer interface. Arrow to the right of the Specimen Checklist title indicates the interactive key accessible through this interface. The options box on the right-hand side of the page allows searching within the checklist, filtering, and adjusting the checklist display. The arrow within the Options box indicates three options: 1) Export the checklist as a Microsoft Word document, 2) Print the checklist in browser, or 3) Export the checklist from browser to your computer as a CSV file that may be opened in Excel, Numbers, Access and other spreadsheet compatible applications.

Interactive key interface: This option (button 2, Fig. 5) allows you to key out taxa on your checklist based on observed morphological features (Fig. 9). This example includes a checklist generated from a locality search of Great Smoky Mountains National Park, North Carolina. By checking boxes of known features such as leaf arrangement, flower color, plant habit, etc. the checklist is reduced to indicate possible matches from within a subset of your list. Note that the accuracy of these keys is limited by the character state data that are available in the Symbiota portal.

Home Specimen Search Images Flora Projects Agency Floras Dynamic Floras Additional Websites Resources



Home >> Occurrence Checklist >> Key: Specimen Checklist #1604950274


Taxon:
All Species
Display/Reset Species List

Display as: Scientific Name

Plant habit
☐ shrubs
☒ vines / lianas

longevity
☒ perennial

Leaves
arrangement/phyllotaxy 
☒ opposite
blade division 
☐ all simple
☐ some or all fully compound

Flower
principal flower color 
☐ white or cream
☒ yellow
☐ orange
☐ red
☐ pink

Specimen Checklist #1604950274

Species Count: 3

Bignoniaceae
[Bignonia capreolata](#)

Caprifoliaceae
[Lonicera japonica](#)
[Lonicera sempervirens](#)

CHECKLISTS WITH SEINet DATABASE/SYMBIOTA PORTALS

Figure 9. Interactive Key Interface assists in identifying taxa based on observed morphological characteristics. In this case the characters of perennial, vine, leaves opposite, and flowers yellow produced a list of three taxa.

Download checklist data: This option (button 3, Fig. 5) allows you to download a Comma Delimited (CSV) file and compare it with other checklists via Excel or other programs such as Access. When you click this, a new window will pop up with the default options: Comma Delimited (CSV), ISO-8859-1 (western), and Compressed ZIP file selected (Fig. 10). We will use these options. Once you unzip and open the CSV file you can export it to your software of choice (File > Export To > Excel, Numbers, Access, etc.) for an easier platform in which to work with the data (Fig. 11). To keep track of data, consider naming the file after the locality you downloaded.

Data Usage Guidelines

By downloading data, the user confirms that he/she has read and agrees with the general [data usage terms](#). Note that additional terms of use specific to the individual collections may be distributed with the data download. When present, the terms supplied by the owning institution should take precedence over the general terms posted on the website.

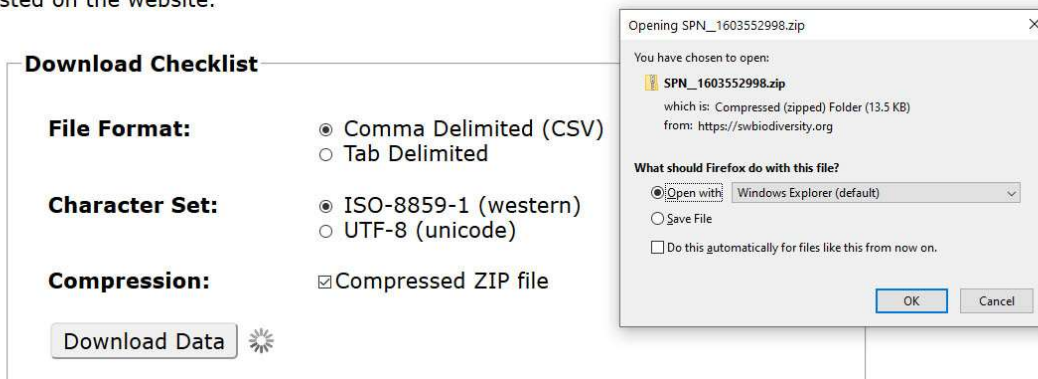


Figure 10. Pop-up window for downloading checklist data. Data will download as a CSV zip file; click OK to save to computer.

	A	B	C	D	E	F	G	H	I	J
1	family	scientificName	genus	specificEpithet	taxonRanI	infraSpecificEpithet	scientificNameAuthorship			
2	Acanthaceae	Carlowrightia arizonica	Carlowrightia	arizonica			A. Gray			
3	Acanthaceae	Justicia californica	Justicia	californica			(Benth.) D. Gibson			
4	Amaranthaceae	Amaranthus crassipes	Amaranthus	crassipes			Schlecht.			
5	Amaranthaceae	Amaranthus crassipes var. crassipes	Amaranthus	crassipes	var.	crassipes	Schltidl.			
6	Amaranthaceae	Amaranthus fimbriatus	Amaranthus	fimbriatus			(Torr.) Benth. ex S. Wats.			
7	Amaranthaceae	Amaranthus fimbriatus var. denticulatus	Amaranthus	fimbriatus	var.	denticulatus	(Torr.) Uline & Bray			
8	Amaranthaceae	Amaranthus palmeri	Amaranthus	palmeri			S. Watson			
9	Amaranthaceae	Atriplex	Atriplex				L.			
10	Amaranthaceae	Atriplex canescens	Atriplex	canescens			(Pursh) Nutt.			
11	Amaranthaceae	Atriplex elegans var. fasciculata	Atriplex	elegans	var.	fasciculata	(S. Wats.) M.E. Jones			
12	Amaranthaceae	Atriplex pacifica	Atriplex	pacifica			A. Nels.			
13	Amaranthaceae	Atriplex polycarpa	Atriplex	polycarpa			(Torr.) S. Wats.			
14	Amaranthaceae	Atriplex semibaccata	Atriplex	semibaccata			R. Br.			
15	Amaranthaceae	Chenopodium murale	Chenopodium	murale			(L.) S. Fuentes-B, Uotila & Borsch			
16	Amaranthaceae	Chenopodium desiccatum	Chenopodium	desiccatum			A. Nels.			
17	Amaranthaceae	Monolepis nuttalliana	Monolepis	nuttalliana			(Schult.) Greene			
18	Amaranthaceae	Salsola tragus	Salsola	tragus			L.			
19	Amaranthaceae	Suaeda nigra	Suaeda	nigra			(Raf.) J.F. Macbr.			
20	Amaranthaceae	Tidestromia lanuginosa	Tidestromia	lanuginosa			(Nutt.) Standl.			
21	Amaryllidaceae	Allium macropetalum	Allium	macropetalum			Rydb.			
22	Anacardiaceae	Rhus kearneyi	Rhus	kearneyi			Barkl.			
23	Anacardiaceae	Schinus terebinthifolius	Schinus	terebinthifolius			Raddi			

Figure 11. Example CSV file opened as an Excel sheet from downloaded checklist data. Columns are broken into family, scientific name, genus, specific epithet, and authorship.

DYNAMIC FLORAS TAB

An additional way to create a checklist is to use the Dynamic Floras Tab located on the grey toolbar on the top of any Symbiota-based portal (Type A homepage) or left side (Type B homepage). This tool is essentially a checklist or key generated from a point-radius search. However, this method skips a number of checklist-creating steps.

When you click either Dynamic Checklist or Dynamic Key in the dropdown menu from the Dynamic Floras tab, you will be prompted to a map view. From here, use the zoom tool and hand to pan across the screen and drop a pin in the desired location. You can modify what is included in your search such as limiting to a specific family or genus using the “Taxon Filter” box, though this box is not a required field. Once you have your location selected and optional filter applied, click the box titled “Build Checklist” (Fig. 12). This technique is advantageous as a quick field guide reference. For example, use this method if you recognize an unknown organism to genus or family but would like to compare photos or use a key filtered to that taxon.

If a radius is defined, taxon lists are generated using observations and specimen data collected within the defined area (Gilbert, pers. comm.). If a radius is not supplied, the area is sampled by progressively increasing the radius by up to 9 steps of 10 miles each. Once a sample of 2500 taxa is reached, a good example of local diversity, the search is stopped. In other words, poorly collected areas will have a larger radius sampled. The maximum radius is 90 miles or 145 km.

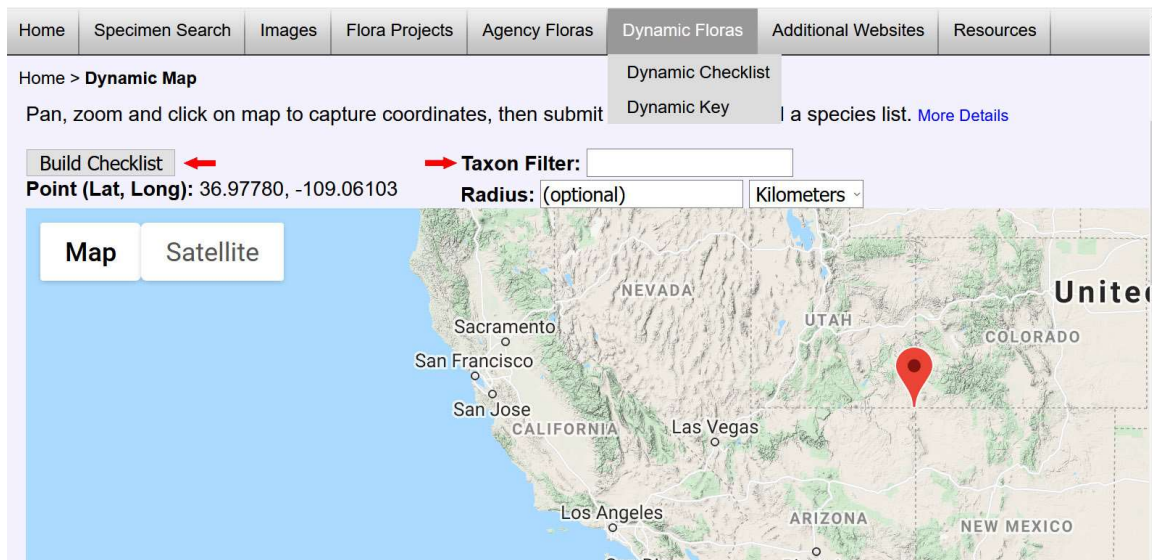


Figure 12. Creating a checklist or key with the Dynamic Flora tool. Dynamic Floras tab located is on the top toolbar of Type A Homepages, click “Dynamic Checklist” to create checklist. Pan, zoom, and click on the map to capture coordinates. Click the “Build Checklist” button to proceed. The Taxon Filter allows filtering the checklist to a specific family or genus prior to generating the search.

SAVED CHECKLISTS, PERSONAL AND PUBLIC

Until now, the options discussed for creating checklists have been temporary or downloaded checklists that are not saved to a portal. However, it is possible to create checklists that are saved and can be revisited via the Symbiota portal you are using. Saved checklists can

CHECKLISTS WITH SEINet DATABASE/SYMBIOTA PORTALS

be continually updated over time, can be linked to specimen records, and can be shared with the public.

A personal checklist generally begins as a private checklist created on a Symbiota portal such as SEINet AZ-NM Chapter and saved to “My Profile” for future access via that portal. A private checklist may be made public on a Symbiota site for the use of different agencies, education groups, and/or the general public.

A user account is required for creating saved checklists within any Symbiota portal. If you do not have an account, you can obtain one by clicking on “New Account” in the upper right corner of the opening page of SEINet Arizona-New Mexico Chapter (Type A format). Other Symbiota portals (Type B format) such as Intermountain Regional Herbarium Network or North American Network of Small Herbaria have this information on a left-hand sidebar. Once you click this, a form appears, and you need to provide name and email and create a login and password. Once your login information is established you will automatically be signed in. This login is accepted across all sites within the SEINet Portal Network. For a list of these portals, visit the SEINet Arizona-New Mexico Chapter homepage and locate the bulleted list at the bottom of the page.

There are many reasons for creating personal or public checklists including

- Inventories for government agencies such as the National Park Service or Forest Service
- Field contractors working on vegetation projects
- Graduate student floras
- Teaching classes
- Personal knowledge prior to visiting a new area

Public checklists can be added to any of the Biotic Inventory Projects listed within the Sitemap or the menu toolbar upon request. There is some overlap in the checklists that appear on the menus of SEINet portals. Simply hover your mouse over the Flora Projects tab or Agency Floras and select an option from the dropdown menu. On the SEINet Arizona–New Mexico Chapter homepage options include Arizona, New Mexico, Colorado Plateau, Plant Atlas of Arizona (PAPAZ), Sonoran Desert, or Teaching Checklists (Fig. 13).

After you select a category of projects from the dropdown menu, the next page displays all the public checklists created under that category. Select a project that interests you; in this example we selected “Antelope Island State Park” from the Teaching Checklists category (Fig. 14). If you look to the right of the title of the checklist selected, each project has an interactive key (denoted by the key symbol) and an automatically generated name game and flash card quiz (Fig. 15). These are useful educational tools to help with the identification process of specific taxa within an area.



Figure 13. Public checklists are organized within the Inventory Projects typically available in the dropdowns listed within top menu (e.g., Flora Projects and Agency Flora tabs). Red arrow indicates the tab to hover over to see the drop-down menu options.

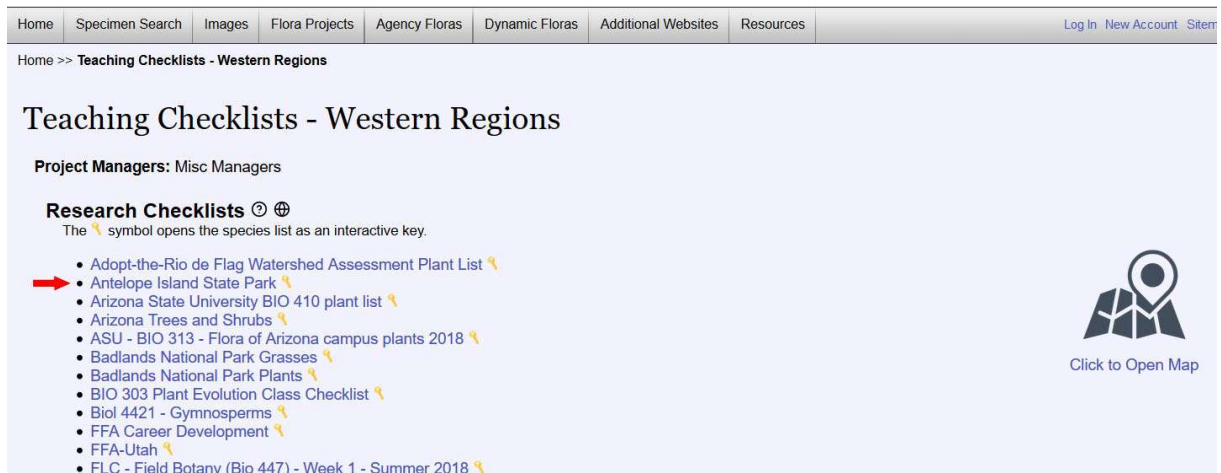


Figure 14. Teaching Checklists category of public checklists. Red arrow indicates link-choice for “Antelope Island State Park”, the example checklist.

CHECKLISTS WITH SEINet DATABASE/SYMBIOTA PORTALS

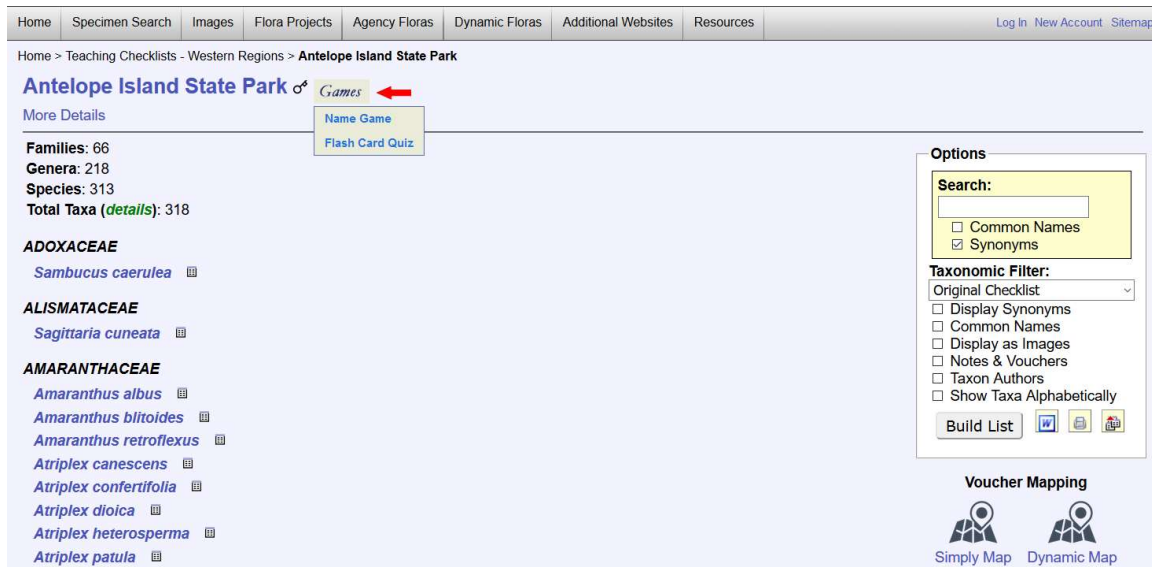


Figure 15. Example public checklist “Antelope Island State Park”. Red arrow indicates the Key symbol (leads to an Interactive Key available for the checklist) and the Games located to the right of the checklist title. There are two options for games: Name Game and Flash Card Quiz.

HOW TO CREATE SAVED CHECKLISTS ON SEINET/SYMBIOTA WEBSITES

Click on “My Profile” located on the right of the grey toolbar at the top of the page (Type A sites) or left column (Type B sites) for other Symbiota sites. The page will default to the “Species Checklists” tab. From this tab, follow the hyperlink “Click here to create a new checklist”, or click the green plus (+) symbol to begin creating a checklist (Fig. 16).



Figure 16. Introduction to creating a saved checklist on a Symbiota website, browser view after clicking “My Profile” on a Type A site. Vertical red arrow points to the Type A location for “My Profile” link-choice. Horizontal red arrows indicate two options for creating a new checklist.

The resulting page is a form where you can record important metadata about your checklist (e.g., authors, abstract). The only required field is the checklist name, but providing authorship and locality is recommended. This form may be edited later. It is also possible to define a latitude, longitude, and uncertainty radius or a polygon footprint for your checklist. You may also toggle the accessibility of your checklist between private (default; open only to you or anyone you share the direct link with) or public (available to be added to an Inventory Project). Once you have entered the Checklist name and any other information you wish to add, click on “Create Checklist” at the bottom of the page (Fig. 17). If you make your checklist public you may want it assigned to some specific project (e.g., teaching checklists, regional flora projects). Note, assignments to specific projects require help from portal administrator

or managers of the inventory projects and checklists must be adequately developed in order to be accepted as a public checklist.

The screenshot shows the 'Create New Checklist' form with the following elements:

- Checklist Name:** A required text field indicated by a red arrow.
- Authors:** A text field indicated by a red arrow.
- Checklist Type:** A dropdown menu currently set to 'General Checklist'.
- Locality:** A text field.
- Citation:** A text field.
- Abstract:** A text area.
- Notes:** A text area.
- More Inclusive Reference Checklist:** A dropdown menu currently set to 'None Selected'.
- Latitude, Longitude, Point Radius (meters):** Input fields for location data.
- Polygon Footprint:** A section with a message 'Polygon footprint not defined. Click globe to create polygon' and a globe icon.
- Default Display Settings:** A box containing checkboxes for:
 - Display Synonyms
 - Display Common Names
 - Display as Images
 - Show Details
 - Show Notes & Vouchers
 - Display Taxon Authors
 - Display Taxa Alphabetically
 - ☒ Activate Identification Key
- Default Sorting Sequence:** A dropdown menu set to '50'.
- Access:** A dropdown menu set to 'Private', indicated by a red arrow.
- Create Checklist:** A button at the bottom.

Figure 17. Create new checklist form. Red arrows indicate the fields that are recommended to fill out: Checklist name (required), Authors, and Access (private or public).

If you already have a list of taxa you wish to include in your checklist, there are two main methods for adding taxa to a checklist after you have filled out the Create New Checklist form. You can either ***manually add taxa individually*** or ***batch upload a spreadsheet*** of several taxa all at once. Both of these options can be accessed via the “Add Species to List” box below the Options box (Fig. 18). If this box is not visible, click the drawing symbol (pen and paper) icon with “spp” in the top right corner of the page. The batch upload option is recommended for most saved checklists because it is efficient at capturing a large number of taxa in well-documented locations. The two options can be used in combination if the batch upload fails to capture all the taxa that you want on your list. It is important to note if a taxonomic name does not already exist in the Symbiota portal’s taxonomic thesaurus or is misspelled, an error will result from attempting to add that name. You will need to contact your portal administrator about adding the name to the thesaurus or ensure you are spelling it correctly before it can be added to your checklist.

Manual upload—Single Species: If this is a new checklist, without any taxa, you see a screen as shown in Fig. 18. “Taxon” will appear just below “Add Species to List” (red arrow). Enter the scientific name of the taxon you wish to add. As you type, a drop-down menu for taxa with similar names is automatically generated. Select the desired name from the drop-down menu. The “Taxon:” text window is the only required field for adding taxa, but there are additional fields into which you may add information about the taxon’s habitat, abundance, etc. as they pertain to your checklist. Proceed by clicking “Add Species to List”. Repeat this process for

CHECKLISTS WITH SEINet DATABASE/SYMBIOTA PORTALS

each individual taxon. Once you have one or more checklists in your Profile, you may click on the name of a checklist to edit data or add more taxa using buttons 1, 2, and 3. These options will be discussed below.

The screenshot shows the Symbiota SEINet database interface. At the top, there is a navigation bar with 'Home >> A' and a user profile section for 'A o' with 'Authors: Testman'. On the right, there are three red buttons labeled 1, 2, and 3, corresponding to 'A', 'V', and 'spp' respectively. The main content area displays 'No Taxa Found' and a list of taxonomic counts: Families: 0, Genera: 0, Species: 0, and Total Taxa (details): 0. On the right side, there is an 'Options' panel with a search bar, checkboxes for 'Common Names' and 'Synonyms', a 'Taxonomic Filter' dropdown set to 'Original Checklist', and several checkboxes for display options: 'Display Synonyms', 'Common Names', 'Display as Images', 'Notes & Vouchers', 'Taxon Authors', and 'Show Taxa Alphabetically'. Below these are 'Build List' and three small icons. A red arrow points to the 'Add Species to List' button, which is highlighted in yellow. Below this button is a form with fields for 'Taxon:', 'Family Override:', 'Habitat:', 'Abundance:', 'Notes:', 'Internal Notes:', and 'Source:'. A blue arrow points to the 'Add Species to List' button at the bottom of this form. A green arrow points to the 'Batch Upload Spreadsheet' button at the bottom of the page.

Figure 18. How to add taxa to a saved checklist and options for editing a checklist. This image shows an empty Checklist (“No Taxa Found”). Red arrow indicates the box for either manually adding taxa or batch uploading a spreadsheet. Blue arrow indicates the button to proceed with adding a single taxon using the text boxes above. Green arrow indicates the option for adding multiple taxa at a time from a taxon list saved as a spreadsheet. Red numbers 1-3 are options for editing a checklist: 1) Checklist Administration, 2) Manage Linked Vouchers, and 3) Edit Species List.

Batch upload a spreadsheet—Multiple species: One way to obtain a spreadsheet compatible for upload is to download a checklist CSV file from a search generated on a Symbiota site as described on page 9 and illustrated in Fig. 11. Instructions for this procedure are described in the section “How to make Checklists with the SEINet database” on pages 3 to 9 above. The essential field for a batch upload is “scientificName” (Fig. 11, column B). Any CSV spreadsheet that has that field will work for a batch upload. Note that the file must be in CSV format, but an Excel spreadsheet for instance with an xlsx extension can be converted to a CSV file using the “Save as...” function. Switch back to the original tab under “My profile” for adding taxa to your checklist. If the Checklist has some taxa entered already you will have to click on “spp” button (Fig 18, red 3). Click “Batch Upload Spreadsheet” (Fig. 18, green arrow) at the bottom of the cream-colored box. Click “Choose File” [“Browse...”] and select the CSV file you have prepared; Taxonomic Resolution can remain as “Leave Taxonomy as Is”. Proceed by clicking “Upload Checklist” (Fig. 19). The next page (not illustrated here) displays a bulleted list describing the upload status of the list. Some errors may occur that you may want to read through. These are typically duplicate entries that can be ignored. As previously mentioned, if some names fail to upload, you can use the single species method to manually add them to your list. To view and/or edit your saved checklist, click “Proceed to Checklist” in the last bullet.

Authors:

Checklist Upload Form

Checklist File: No file selected.

Taxonomic Resolution:

Must be a CSV text file with the first row containing the following columns. Note that Excel spreadsheets can be saved as a CSV file.

- sciname (required)
- family (optional)
- habitat (optional)
- abundance (optional)
- notes (optional)
- internalnotes (optional) - displayed only to editors
- source (optional)

Figure 19. Checklist Upload form to Batch Upload a Spreadsheet. Red arrows indicate how to attach a file and upload.

To edit a saved checklist, locate the three icons in the top right corner of the generated checklist (Fig. 18, red 1-3): 1) Checklist Administration, 2) Manage Linked Vouchers, and 3) Edit Species List. The second choice, Manage Linked Vouchers, is the most complex so we discuss it last.

Checklist Administration: Drawing Symbol (pen and paper) + A (Fig. 18, red 1)

Selecting this option leads to a new page with three tabs located underneath the checklist title. The first tab, **Admin**, allows you to add an editor or to delete the checklist. The **Description** tab allows you to modify the checklist description notes. The **Related Checklists** tab allows you to establish hierarchal relationships between checklists so information in one may be transferred to another.

Edit Species List: Drawing symbol + spp (Fig. 18, red 3)

This option allows you to add and delete taxa manually or upload spreadsheets for multiple taxa (See previous section).

Manage Linked Vouchers: Drawing Symbol + V (Fig. 18, red 2)

You may want to link vouchers of specimens for taxa on your checklist. This is helpful if you are preparing and collecting for a specific flora project. Vouchers, which serve as the documentation of floras, should be specimens collected and identified by yourself or specimens known to you to be correctly identified by experts.

BUILDING A CHECKLIST FROM SPECIMEN RECORDS

You can populate (or build) a checklist using the Manage Linked Vouchers tool that pulls existing specimen records for your taxon list. Go to My Profile and click on the name of an existing checklist or create a new checklist as described above. On the next page, as shown in Fig. 18 (an empty checklist or one populated with some names), click Manage Linked Vouchers (Fig. 18, red 2). If the checklist is new or has no criteria in the Search Statement,


CHECKLISTS WITH SEINet DATABASE/SYMBIOTA PORTALS

the resulting page displays a search term box titled “Edit Search Statement” to enter criteria (Fig. 20). If the “Search Statement” contains criteria already, you are directed to the New Vouchers tab (Fig. 21). Clicking on the pencil icon toggles the display of the Edit Search Statement page editing panel.

B

Edit Search Statement

To use the voucher administration functions, it is first necessary to define a search terms that will be used to limit occurrence records to those collected within the vicinity of the research area.

Country: Lat North: 

State: Lat South:

County: Long East:



Locality: Long West:

Taxon:

Collection:

Collector:

☐ Only include occurrences with coordinates

☐ Search based on polygon defining checklist research boundaries  



☐ Exclude cultivated/captive occurrences

Figure 20. Search term box for creating a checklist from Manage link vouchers tool. Red arrow indicates the bullet point to check and pencil to click in order to draw a polygon.


Home Specimen Search Images Flora Projects Agency Floras Dynamic Floras Additional Websites Resources Welcome LI My Profile Logout

Home >> Return to Checklist >> **Checklist Administration**

AZ Berberis


Arizona; Berberis  


New Vouchers Missing Taxa Voucher Conflicts Reports


Taxa without Vouchers: 5  **Display Mode:**


Listed below are species from the checklist that do not have linked specimen vouchers. Click on name to use the search statement above to dynamically query the occurrence dataset for possible voucher specimens. Use the pulldown to the right to display the specimens in a table format.

BERBERIDACEAE

Berberis fremontii 

Berberis haematocarpa 

Berberis repens 

Berberis trifoliata 


Berberis wilcoxii 

Figure 21. The page generated from clicking on the “Managed Linked Vouchers” button if the checklist already contains some information in the boxes of the Search Statement. The arrow indicates the pencil icon that when clicked, directs you to the page in Fig. 20. In this case the search criteria are taxon equal to *Berberis* and state equal to Arizona. There are 5 taxa without vouchers. Clicking on the icon to the right of each name leads you to potential voucher specimens.

There are three options for the Search Statement in which you may: 1) use the text boxes for a locality search, 2) enter coordinate data using the mapping tool (a globe or similar icon) to create a bounding box, or 3) search using a polygon (select the box “Search based on polygon defining checklist” and click the pencil symbol to the right to enter map view with the polygon tools). If searching using text terms, typically try to limit the search to state and one other defining feature (e.g., collector)—fewer terms facilitate a more inclusive search. If drawing a polygon, make sure the browser is expanded to full page and click the button “Save Polygon” at the bottom of the page when finished (Fig. 22). Using a bounding box or polygon search will automatically exclude specimens that have not been georeferenced. Note that the

point-radius circle option and searching by date or elevation are not available within this Search Statement tool. To add these options, refer to the “Batch Upload” technique discussed earlier on page 16. Note also that it is possible to return and alter the Search Statement repeatedly to compile a checklist consisting of multiple variables. For instance, you might want to create checklists based on a few different collectors or spelling variants of a locality.

Once the search is properly defined, click “Save Search Terms” button to proceed. At the top of the next page (Fig. 21) there are four tabs. We will only discuss the first two tabs. The first tab on the left, “New Vouchers”, lists taxa records that do not yet have linked voucher specimens (Fig. 21). The second tab labeled “Missing Taxa” (Fig. 23), lists taxa that are vouchered within your search area, but are missing from your checklist. In order to populate your checklist, you must move the specimens from the “Missing Taxa” to the “New Vouchers” tab. The quickest way to add large quantities of taxa to a list requires changing the display mode to “Batch Linking”, which displays a table view of the specimens. The user can select the vouchers one by one or click the box in the top left corner of the list to Select all (Fig. 23). At the bottom of the page, there are two boxes that offer options for adding these taxa to the list (Fig. 23). The first option “Add name using current taxonomy” is recommended to ensure the taxonomy is consistent with the taxonomic thesaurus. The second option “Add names without linking vouchers” allows you to choose to upload just names or both names and vouchered specimens (Fig. 23). Note that this method only batch uploads ~200 taxa at a time so repeat these steps as necessary to complete your checklist. Click “Submit Vouchers” to link the voucher specimens to your checklist.

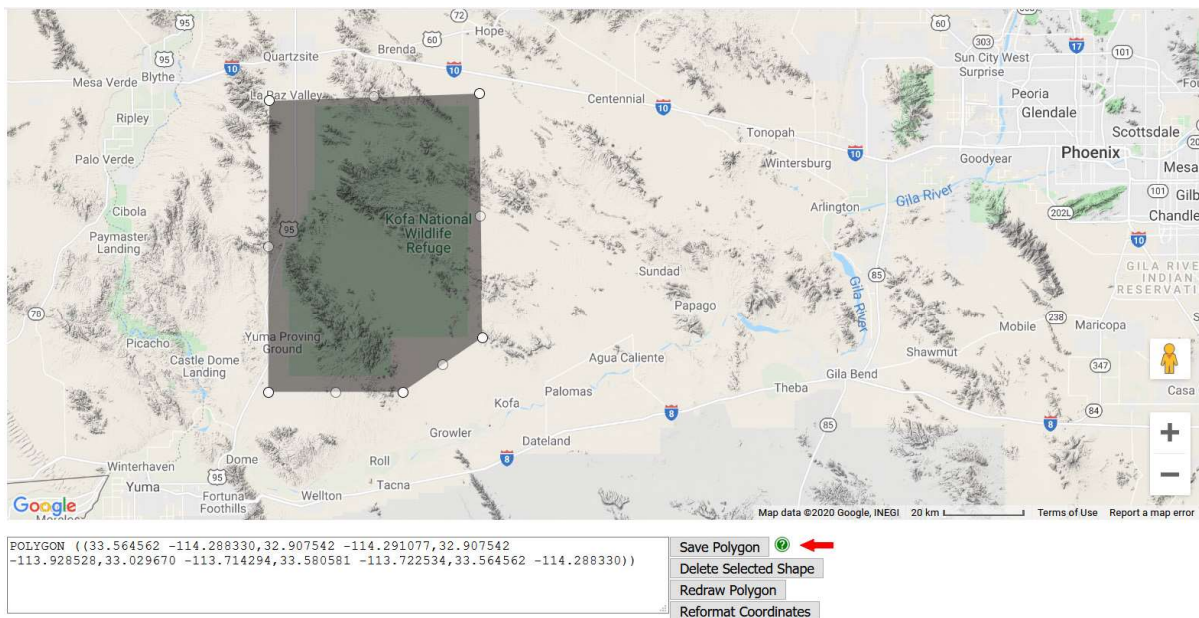





Figure 22. Map view page for creating a polygon using the Manage Vouchers Tool. Red arrow indicates the “Save Polygon” button to proceed to save your coordinates for the checklist.

CHECKLISTS WITH SEINet DATABASE/SYMBIOTA PORTALS

Search based on polygon 

Missing Taxa (indicated by red arrow)

Possible Missing Taxa: 599  Display Mode: Batch Linking  (indicated by red arrow)

Listed below are specimens identified to a species not found in the checklist. Use the form to add the names and link the vouchers as a batch action.

<input checked="" type="checkbox"/> Specimen ID	Collector	Locality
<input checked="" type="checkbox"/> Abutilon abutiloides	Mary J. Russo 226 1985-12-06 ASU0098272	USA, Arizona, Yuma, Kofa National Wildlife Refuge, Castle Dome Mountains, just above edge of lowest Horse Tank
<input checked="" type="checkbox"/> Abutilon californicum	E. Linwood Smith 1980-03-00 Sonoran Atlas-[catalog number null]	United States, Arizona, La Paz, Within 19 km of BRENDA
<input checked="" type="checkbox"/> Abutilon californicum	E. Linwood Smith 1980-04-00 Sonoran Atlas-[catalog number null]	United States, Arizona, La Paz, Within 19 km of BRENDA
<input checked="" type="checkbox"/> Abutilon incanum	T.R. Van Devender 1972-12-01 GreaterGood-mde-19084	United States, Arizona, Yuma, Brass Cap Point, 44.8 km (by air) SE of Quartzsite, Kofa Mountains.
<input checked="" type="checkbox"/> Cryptantha barbiger	Mary J. Russo 769 1986-03-29 ASU-Plants-[catalog number null]	USA, Arizona, Yuma, Kofa National Wildlife Refuge, Castle Dome Mountains, blow Gray Tanks and north of trail
<input checked="" type="checkbox"/> Cryptantha barbiger	Mary J. Russo 773 1986-03-29 ASU-Plants-[catalog number null]	USA, Arizona, Yuma, Kofa National Wildlife Refuge, Castle Dome Mountains, below Gray Tanks and north of trail
<input checked="" type="checkbox"/> Cryptantha barbiger	Mary J. Russo 309 1986-01-19 ASU-Plants-[catalog number null]	USA, Arizona, Yuma, Kofa National Wildlife Refuge, Castle Dome Mountains, just before first Gray Tank in west branch
<input checked="" type="checkbox"/> Cryptantha barbiger	Mary J. Russo 402 1986-02-02 ASU-Plants-[catalog number null]	USA, Arizona, Yuma, Kofa National Wildlife Refuge, Castle Dome Mountains, above Horse Tanks

☒ Add name using current taxonomy
☐ Add names without linking vouchers

Submit Vouchers (indicated by red arrow)

Specimen count: 1000

Figure 23. Table view of potential vouchers for Missing Taxa. **Above:** Four specimens at top of the list potential vouchers. First red arrow indicates the “Missing Taxa” tab. Second red arrow indicates how to switch the display mode to “Batch Linking” so you can select a large quantity of vouchers all at once to save to your list. The display (above and below) lists taxon names and potential voucher specimens for those names. **Below:** Four specimens at bottom of the list with “Add name using current taxonomy” selected. “Submit vouchers” marked with Red arrow. Individual specimens may be selected by checking the box on the left or as in this case all specimens have been selected by checking the box at the top of the column to the left of “Specimen ID”.

CREATING A CHECKLIST BASED ON A COLLECTOR

So far, the checklists we have created have all been based on geography. It is also possible to use “Collector” as your principal criterion. To demonstrate this feature, we made a saved checklist, “W. H. Emory”, of species collected by William H. Emory. Emory was a military officer and topographical engineer of the 19th century. In 1846, during the war between Mexico and the United States, he was assigned to a military expedition to what is now New Mexico, Arizona, and California (Emory 1848; Norris et al. 1998). He later supervised the survey of the boundary between these countries. Considering the many responsibilities Emory had (e.g., establishing coordinates by astronomical observations, mapping, planning and supervising the construction of a fort, participating in military activities), it seems likely that he was aided in his plant collecting by his collaborators. In any case, the specimens generally appear with his name. His plant specimens were often “new to science” and many were later used as type specimens by botanists such as John Torrey and Asa Gray.

We began adding a single name to the “W. H. Emory” checklist, *Quercus emoryi* Torr. We searched the SEINet database for a specimen of *Q. emoryi* collected by Emory, which turned out to be the type specimen at the New York Botanical Garden herbarium (NY) displayed in the Occurrence Records tab. We clicked on “Full Record Details” and came to a new window with label information and a photo of the specimen (Fig. 24). Locating the three

tabs at the top of the page, we switched to the “Linked Resources” tab, which prompted a new page, “Species Checklist Relationships” with a green + on the right. Clicking the + displayed “New Voucher Assignment” (Fig. 25) with a dropdown menu of potential checklists. We chose the “W. H. Emory” checklist and clicked on the “Add Voucher” tab. The next screen allows for general editing and voucher administration and can be ignored for now.

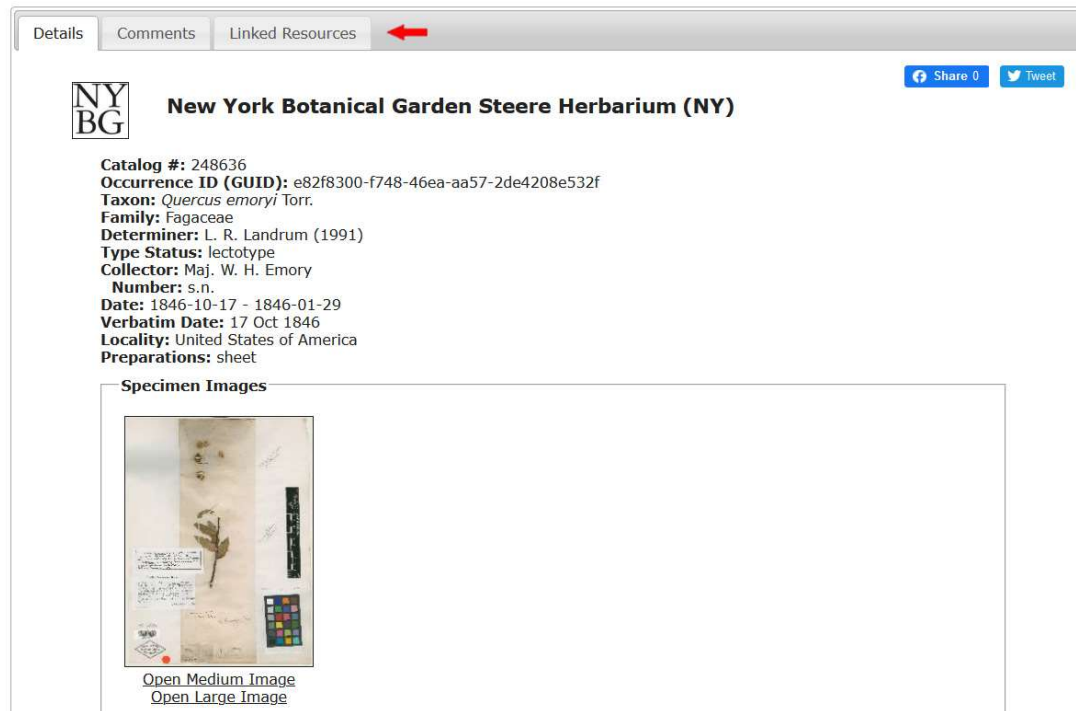


Figure 24. Occurrence record of Emory’s collection of *Quercus emoryi*, the type specimen at NY. The arrow indicates the Linked Resources Tab.

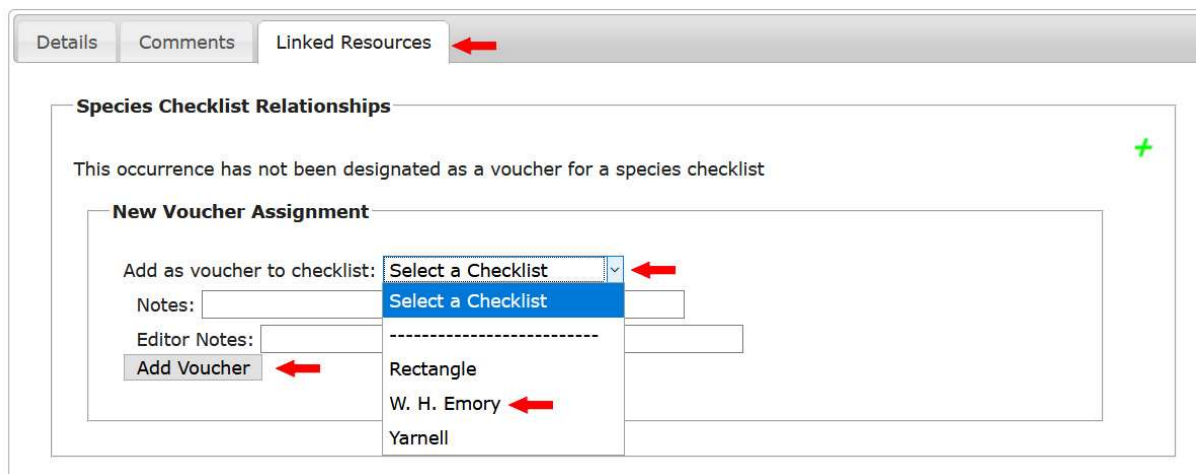


Figure 25. Linked Resources Page. This is the third tab accessible from the original Occurrence record (see Fig. 24). Click the green + symbol to access the “New Voucher Assignment” box. Click “Select Checklist” to extend dropdown menu options and select your checklist of choice (“W. H. Emory” in this case). Click “Add Voucher” button to proceed.

CHECKLISTS WITH SEINet DATABASE/SYMBIOTA PORTALS

You can also add taxa as a group to a checklist as we have done with the geographic checklists. In this case we used the “Manage Linked Voucher” option (Fig. 18, red 2) as described above. In the “Edit Search Statement” we filled in the “collector” box with “W. H. Emory” (Fig. 26). Next, we used the “Missing Taxa” tab and Batch Linking option in Display Mode (Fig. 22). We found that collections of several people named Emory appeared. It is possible to scan the list and select only specimens with W. H. Emory as collector. However, to expedite the process we modified the search statement by returning to the “Manage Linked Vouchers” option and including the name of a state (e.g., New Mexico) in the Search Statement. Modifying the search statement excluded most specimens made by collectors other than W. H. Emory. We repeated this process with other states that W. H. Emory was known to visit and quickly found numerous collections of interest. A portion of the list with voucher specimens listed is shown in Fig. 27.

Home >> Return to Checklist >> Checklist Administration

W. H. Emory

Edit Search Statement

To use the voucher administration functions, it is first necessary to define a search terms that will be used to limit occurrence records to those collected within the vicinity of the research area.

Country: Lat North:

State: Lat South:

County: Long East:

Locality: Long West:

Taxon:

Collection:

Collector: →

☐ Only include occurrences with coordinates

☐ Search based on polygon defining checklist research boundaries

☐ Exclude cultivated/captive occurrences

Figure 26. Search Statement with “W. H. Emory” as the only criterion in the Collector box. By adding another criterion, for example New Mexico in the State box it is possible to narrow the search.

Home >> W. H. Emory

W. H. Emory

Families: 22
Genera: 46
Species: 62
Total Taxa (details): 62

AMARANTHACEAE

Allenrolfea occidentalis ☐
Maj. W. H. Emory s.n. [NY]

Amaranthus cruentus ☐
W. H. Emory, Jr. 1846-10-06 [Harvard]

Obione lentiformis ☐
Maj. W. H. Emory s.n. [NY]

Obione polycarpa ☐
Maj. W. H. Emory s.n. [NY]

ARECACEAE

Washingtonia filifera ☐
Maj. W. H. Emory s.n. [NY]

Options

Search:

☐ Common Names
☒ Synonyms

Taxonomic Filter:

☐ Display Synonyms
☐ Common Names
☐ Display as Images
☒ Notes & Vouchers
☐ Taxon Authors
☐ Show Taxa Alphabetically

Figure 27. A portion of the H. W. Emory checklist with vouchers displayed.

Notice in Fig. 26 that the Search Statement does not include an option to indicate dates, elevation, or collector number. These can all be included by producing a checklist (Fig. 8) from a Specimen Search in Search Collections (Fig. 3). Using option 3 in Fig. 8, a CSV file

can be downloaded, which in turn can be used to Batch Upload the names to a saved checklist as discussed above (Figs. 18 & 19).

CONCLUSION

The SEINet database combined with the Symbiota portals that deliver its data provide unparalleled accessibility to a network of herbarium specimens and observations at the click of a button. You have been introduced to the utility of checklists, for example, generating a mini field-guide based on a map search, using an interactive key for identifying taxa, researching historical collections, or producing a list of taxa as a study aid for you or your students. Now, you have the knowledge of how to make, save, and edit your own private checklist, or share it as a public checklist across Symbiota platforms. Our examples included geographically based and collector-based checklists. Another kind of checklist is introduced by Lafferty and Landrum (2021, in this volume). They developed a new program, NEARBY, that makes use of three Symbiota databases – SEINet, NEOTROPICAL, and CNALH (lichens). It constructs checklists of taxa that grow near a primary species (e.g., [the 100 most commonly collected plants near *Pinus ponderosa* in Arizona](#)) and provides tools for analyzing the acquired data.

The value of the collaborative effort in building databases and the power of shared data is enormous. What surprising discoveries will be uncovered using Symbiota databases and portals? As the amount of digitized specimen data from herbaria around the world continues to grow, the opportunities for scientific discovery and educating ourselves and others abound.

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RESOURCES AND LITERATURE CITED

- Emory, W. H. 1848. *Notes of a Military Reconnaissance from Fort Leavenworth, in Missouri, to San Diego, in California, Including Parts of the Arkansas, Del Norte, and Gila Rivers*. PDF version available online at books.google.com.
- Gilbert, E. E. & K. D. Pearson. Symbiota. 2021 February 16. Symbiota Checklists 1: Overview of Checklists (Species Inventories). <https://youtu.be/YwBC-52j6Ps>
- Gilbert, E. E. & K. D. Pearson. Symbiota. 2021 February 16. Symbiota Checklists 2: Creating a Checklist. https://youtu.be/jm2_mn2nClo
- Gilbert, E. E. & K. D. Pearson. Symbiota. 2021 February 17. Symbiota Checklists 3: Batch Uploading Taxon Names. <https://youtu.be/Hnk09MYIMVg>
- Gilbert, E. E. & K. D. Pearson. Symbiota. 2021 February 22. Symbiota Checklists 4: Adding Voucher Specimens to a Checklist. <https://youtu.be/NRW2kh6xln0>
- Gilbert, E. E. & K. D. Pearson. Symbiota. 2021 February 22. Symbiota Checklists 5: Creating Quick Checklists from Specimens in a Portal. <https://youtu.be/L45s7c19kNw>

CHECKLISTS WITH SEINet DATABASE/SYMBIOTA PORTALS

- Gries, C., E. E. Gilbert, & N. Franz. 2014. Symbiota – A virtual platform for creating voucher-based biodiversity information communities. *Biodiversity Data Journal* 2: e1114. doi: 10.3897/BDJ.2.e1114
- Lafferty, D. L. & L. R. Landrum. 2021. NEARBY, a Computer Program for Phytogeographic Analysis Using Georeferenced Specimen Data. *CANOTIA* 17: 25–45.
- Norris, L. D., J. C. Milligan, O. B. Faulk. 1998. *William H. Emory: Soldier-Scientist*. University of Arizona Press.