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Freshwater Biological Traits Database

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Give credit where credit is due…

Liejun Wu

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Why we are making the traits data available online:

- We believe traits-based approaches will play an important role in future climate change analyses
- We expended a lot of effort gathering/deriving this traits data and believe it may be of value to other researchers

Data gathering

- Focused on lotic systems and North American taxa

- Traits data fit the following criteria:
  - published or otherwise well-documented by trustworthy sources
  - accessible
  - appropriate for the regions being studied
  - in a standardized format that could be analyzed or easily converted to a format that could be analyzed
  - ecologically relevant to the gradients being considered, environmentally sensitive, non-redundant, and statistically tractable (modeled after Vieira et al. 2006)

The Vision

- The database shall be a web –based application that people can use without needing to install or maintain any software
- The database shall be a ‘one-stop shop’/repository where people can go to find the most up-to-date compilation of (US) traits data for macroinvertebrates, fish and algae
- All information shall reside in a central database, which will be easy to view, edit, and upload new data into
- User shall be able to query one or more taxonomic names and retrieve the trait data associated with the taxa

The Vision
continued…

- User shall be able to download results from their queries into a spreadsheet
- There will be a mechanism for users to contribute new data to the database
- All data must have proper documentation (methodology, source, etc.), and this documentation must be easily accessible
- The database will be implemented in phases
- Tetra Tech will host web site during development/review/enhancement phase, but it will eventually need to be ‘adopted’

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USGS Traits Database
http://pubs.usgs.gov/ds/ds187/

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science for a changing world

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U.S. Geological Survey Data Series

A Database of Lotic Invertebrate Traits for North America

By Nicole K. M. Vieira, N. LeRoy Poff, Daren M. Carlisle, Stephen R. Moulton II, Marci L. Koski, and Boris C. Kondratieff

U.S. Geological Survey Data Series 187

In cooperation with Colorado State University

We wanted to build on this…

And we knew we wouldn't have the funds to achieve this…

Taxa and Autecology Database for Freshwater Organisms

http://www.freshwaterecology.info/

- **A**ssessment System for the Ecological **Q**uality of Streams and Rivers throughout **E**urope using Benthic **M**acroinvertebrates (AQEM) project (www.aqem.de)

- Europeans have compiled comprehensive species trait information for >12,000 European freshwater organisms, including macroinvertebrates, fish, macrophytes, diatoms, and phytoplankton

- Schmidt-Kloiber et al. 2006

EPA United States Environmental Protection Agency

Here is what we came up with…

FRESHWATER BIOLOGICAL TRAITS DATABASE

- traits data for 3857 North American macroinvertebrate taxa
- includes habitat, life history, mobility, morphology and ecological trait data
- traits data were integrated from 14 data sources, which are documented and available for download on the web page

EPA United States Environmental Protection Agency

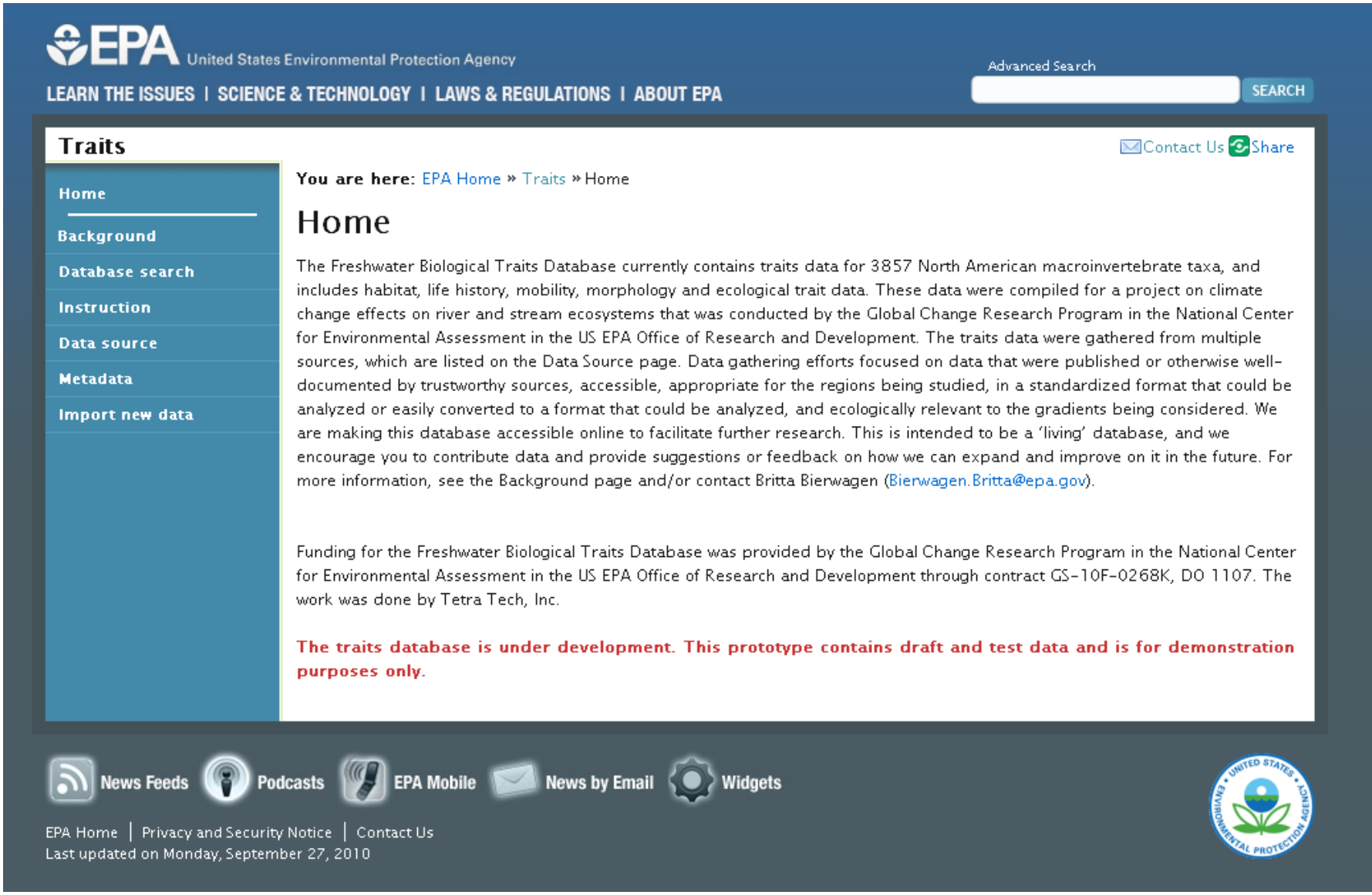
URL

http://traits.tetratech-ffx.com/index.cfm

Username: Traits

Password: Alogon2010

The traits database is under development. This prototype contains draft and test data and is for demonstration purposes only.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SEARCH
Traits
Contact Us
Share
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Database search
Instruction
Data source
Metadata
Import new data
You are here: EPA Home » Traits » Home
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The Freshwater Biological Traits Database currently contains traits data for 3857 North American macroinvertebrate taxa, and includes habitat, life history, mobility, morphology and ecological trait data. These data were compiled for a project on climate change effects on river and stream ecosystems that was conducted by the Global Change Research Program in the National Center for Environmental Assessment in the US EPA Office of Research and Development. The traits data were gathered from multiple sources, which are listed on the Data Source page. Data gathering efforts focused on data that were published or otherwise well-documented by trustworthy sources, accessible, appropriate for the regions being studied, in a standardized format that could be analyzed or easily converted to a format that could be analyzed, and ecologically relevant to the gradients being considered. We are making this database accessible online to facilitate further research. This is intended to be a 'living' database, and we encourage you to contribute data and provide suggestions or feedback on how we can expand and improve on it in the future. For more information, see the Background page and/or contact Britta Bierwagen (Bierwagen.Britta@epa.gov).
Funding for the Freshwater Biological Traits Database was provided by the Global Change Research Program in the National Center for Environmental Assessment in the US EPA Office of Research and Development through contract GS-10F-0268K, DO 1107. The work was done by Tetra Tech, Inc.
The traits database is under development. This prototype contains draft and test data and is for demonstration purposes only.
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Last updated on Monday, September 27, 2010

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Background

The Freshwater Biological Traits Database was compiled for a project on climate change effects on river and stream ecosystems that was conducted by the Global Change Research Program in the National Center for Environmental Assessment in the US EPA Office of Research and Development. For this project, long-term trend analyses were performed on biomonitoring data from Maine, North Carolina, Ohio and Utah to examine whether biological responses to changes in temperature and hydrology could be detected. One component of these analyses involved compiling and analyzing traits data for North American macroinvertebrate taxa found in lotic systems. Advantages of using traits data for these types of analyses are that they are less susceptible to taxonomic ambiguities or inconsistencies in long-term datasets; they can detect changes in functional community characteristics; and they vary less across geographical areas, which allows for larger-scale trend analyses across regional species pools.

For this project, data gathering efforts focused on data that were published or otherwise well-documented by trustworthy sources, accessible, appropriate for the regions being studied, in a standardized format that could be analyzed or easily converted to a format that could be analyzed, and ecologically relevant to the gradients being considered. The 14 data sources that have been integrated into the database, along with information associated with these sources, are listed (and are available for download) on the Data Source page. The main sources are the USGS traits database (Vieira et al. 2006) and the Poff et al. trait matrix (2006). Also included in the database are thermal optima and tolerance data that were generated from weighted average or generalized linear model calculations that were performed on biomonitoring data from a number of different states. Weighted average inference is a simple, robust approach for estimating the central tendencies of different taxa, or in our case, optima and tolerance values (Yuan 2006).

Because it took substantial effort to gather all of this traits data into one place, and because we would like to save other researchers from having to undergo similar efforts, we have integrated the traits data that were gathered for this project into one database and have made it accessible online. The Freshwater Biological Traits Database currently contains location, habitat, life history, mobility, morphology and ecological trait data, along with tolerance calculations for temperature and flow. Data types vary, and include binary, categorical, and text notes entries. There are currently 11,912 unique records for 3,857 different taxa. Levels of taxonomic resolution vary.

Further improvements to the database are possible and include adding fish and periphyton data and adding more functionality (i.e. new queries, automated import function, interactive map). Improvements will likely be made to the database in phases. USGS and EPA have also discussed the possibility of collaborating on this project. There also is potential for collaboration with European researchers with the online Taxa and Autecology Database for Freshwater Organisms (http://www.freshwaterecology.info/).

We would appreciate any suggestions or feedback regarding the Freshwater Biological Traits Database. If you have comments and/or questions, please contact Britta Bierwagen (Bierwagen.Britta@epa.gov).

Funding for the Freshwater Biological Traits Database was provided by the Global Change Research Program in the National Center for Environmental Assessment in the US EPA Office of Research and Development through contract GS-10F-0268K, DO 1107. The work was done by Tetra Tech, Inc.

Funding for the Freshwater Biological Traits Database was provided by the Global Change Research Program in the National Center

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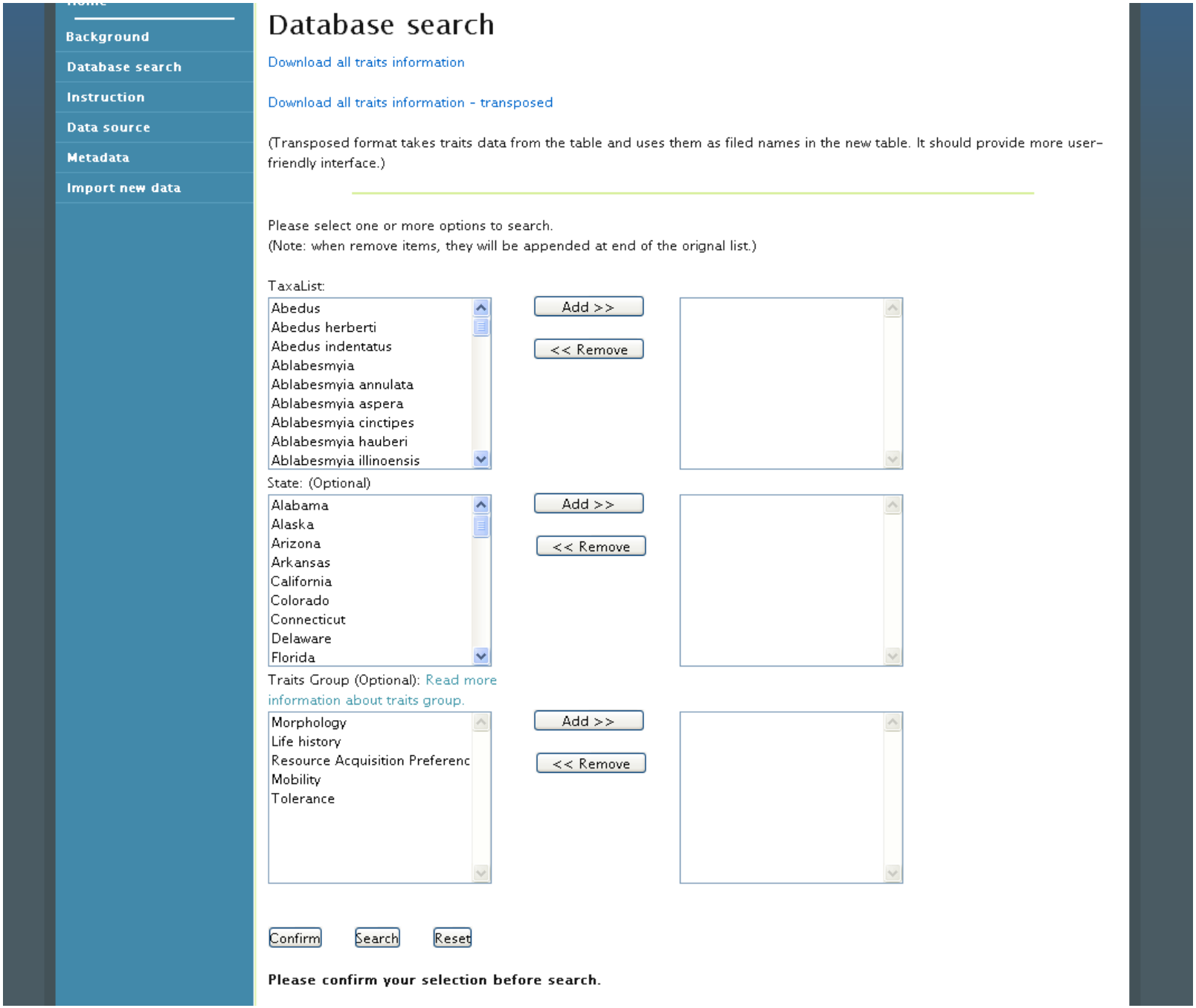
Metadata

CATEGORY NAME	TRAITS NAME	TRAITS DESCRIPTION
Life history	Adult	Identifies if traits were compiled for aquatic adults, otherwise entries pertain to immature life stage (entries: ADULT or blank)
Life history	No. of Aquatic stages	Number of aquatic life stages (4 potential entries)
Life history – development	Ability to survive abbreviated	Abbreviated ability to survive desiccation entries: present = able to survive desiccation; absent = not able to survive desiccation
Life history – development	Ability to survive comments	Description of abbreviated adult ability to survive desiccation entries: present = able to survive desiccation; absent = not able to survive desiccation
Life history – development	Adult ability to temporarily exit water	Indicates ability to temporarily exit water. Entries = no, yes, unknown, blank
Life history – development	Adult ability to temporarily exit water abbreviated	Abbreviated adult ability to exit entries: present = has ability to exit; absent = does NOT have ability to exit
Life history – development	Adult ability to temporarily exit water comments	Description of abbreviated adult ability to exit entries: present = has ability to exit; absent = does NOT have ability to exit. This does NOT include emergence.
Life history – development	Development pattern comments	Development pattern text notes
Life history – development	Development speed	Development speed. Entries: fast seasonal, slow seasonal, Non-seasonal
Life history – development	Development speed abbreviated	Abbreviated development entries: fast, slow, non
Life history – development	Diapause	Indicates whether diapause occurs. Entries: no, yes, unknown, blank
Life history – development	Hatch time	Time required for eggs to hatch. Entries: hours, minutes, days, months, weeks
Life history – development	Hatch time comments	Time required for eggs to hatch text notes
Life history – development	Life span	Adult lifespan. Entries: days, hours, weeks, months
Life history – development	Life span abbreviated	Abbreviated adult life span: very_short, short, long
Life history – development	Life span comments	Description of abbreviated adult life span entries: very short = less than 1 week; short = less than 1 month; long = greater than 1 month
Life history – emergence	Duration of oviposition period	Duration of oviposition period. Entries = days, months, weeks
Life history – emergence	Egg – mass	Egg type – one mass
Life history – emergence	Egg – mutiple batches	Egg type – multiple batches
Life history – emergence	Egg – single	Egg type – Single
Life history – emergence	Egg cemented	Indicates whether eggs are cemented. Entries = no, yes
Life history – emergence	Emergence begins	Season that emergence begins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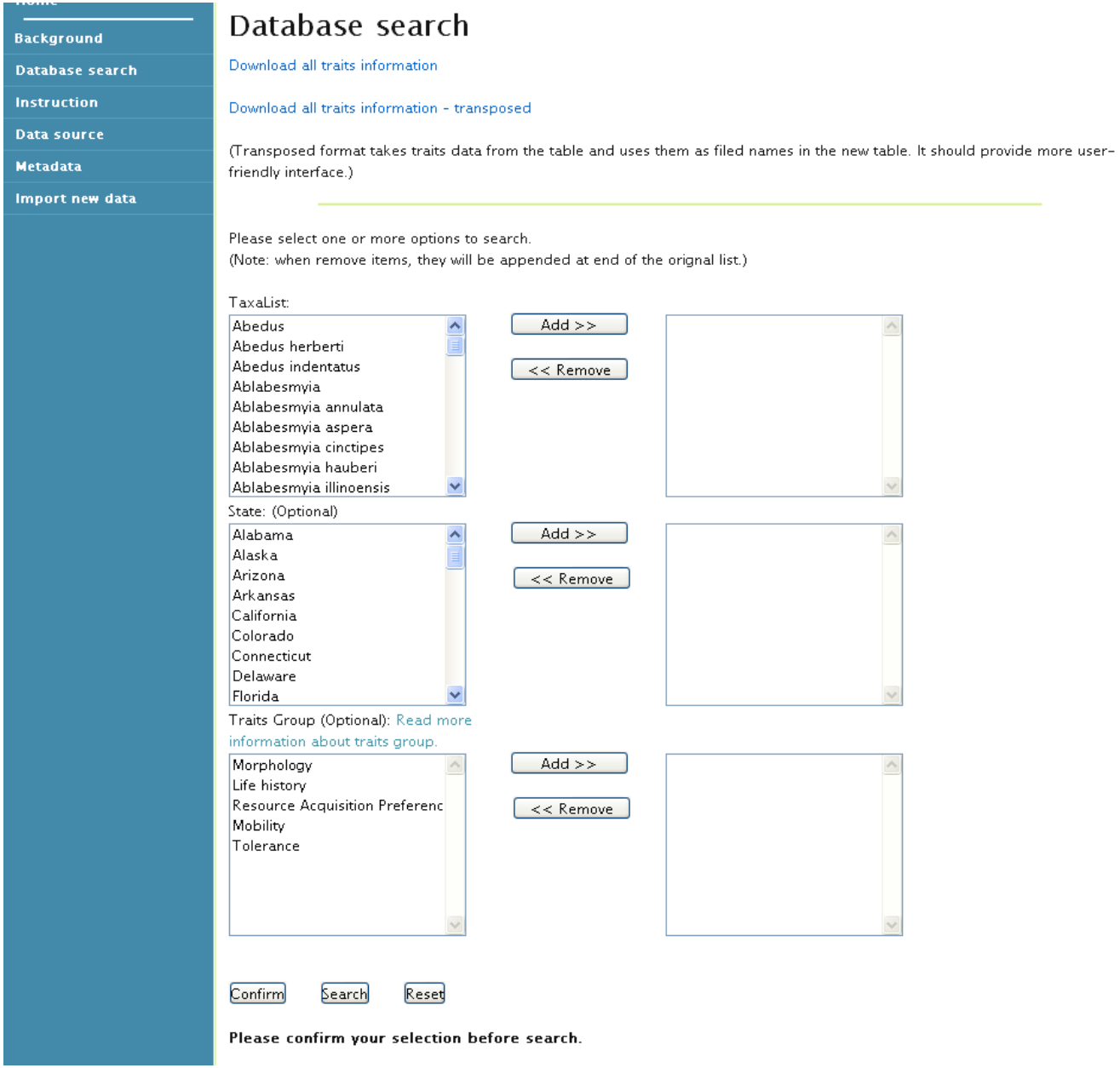
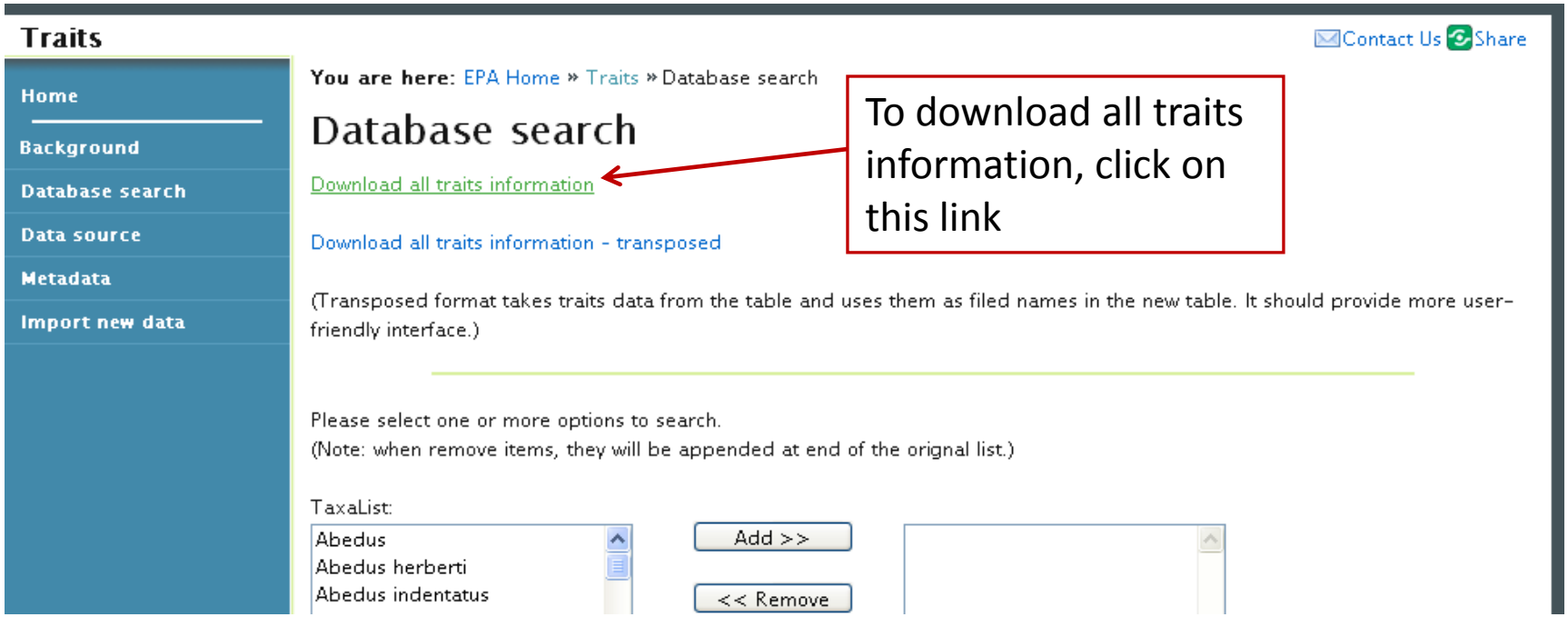
Download all traits information
Download all traits information - transposed
(Transposed format takes traits data from the table and uses them as filed names in the new table. It should provide more user-friendly interface.)
Please select one or more options to search.
(Note: when remove items, they will be appended at end of the orignal list.)
TaxaList:
Abedus
Abedus herberti
Abedus indentatus
Ablabesmyia
Ablabesmyia annulata
Ablabesmyia aspera
Ablabesmyia cinctipes
Ablabesmyia hauberi
Ablabesmyia illinoensis
Add >>
<< Remove
State: (Optional)
Alabama
Alaska
Arizona
Arkansas
California
Colorado
Connecticut
Delaware
Florida
Add >>
<< Remove
Traits Group (Optional): Read more information about traits group.
Morphology
Life history
Resource Acquisition Preferenc
Mobility
Tolerance
Add >>
<< Remove
Confirm
Search
Reset
Please confirm your selection before search.

Data Search Instructions

There are several different options for downloading data.



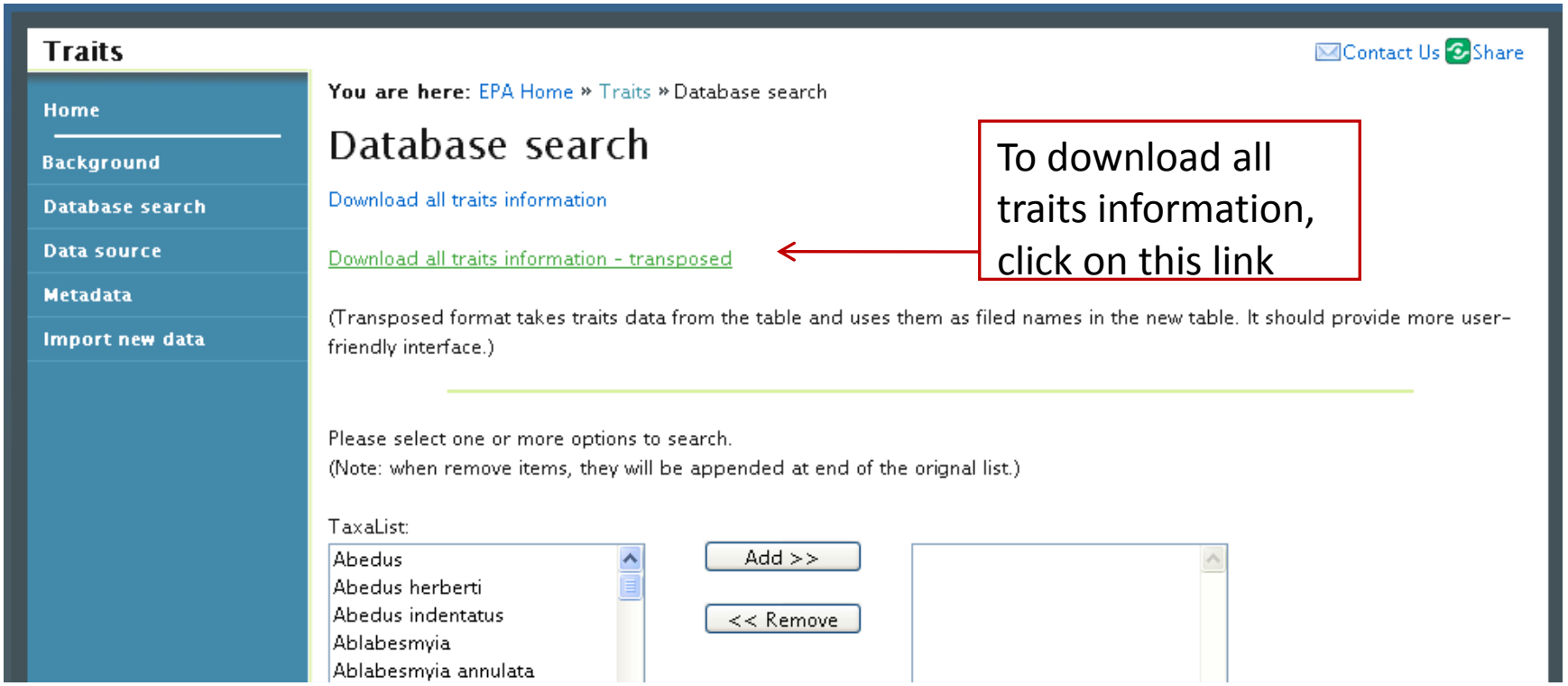
OPTION 1: DOWNLOAD ALL DATA



To download all the data (i.e. you do not want to select for taxa, state or trait group), click on the 'Download all traits information' link.

A zipped Excel file titled 'FreshwaterBioTraits_20100927.zip' will automatically download onto your computer.

OPTION 2: DOWNLOAD ALL DATA – TRANSPOSED FORMAT



To download all the data in a transposed format, click on the 'Download all traits information - transposed' link.

A zipped Excel file titled 'FreshwaterBioTraits_Transposed_20100927.zip' will automatically download onto your computer.

Why the two formats?

Data is stored in the database in the format shown below because it is more efficient than the transposed format (it eliminates all the blanks, of which there are many in this database).

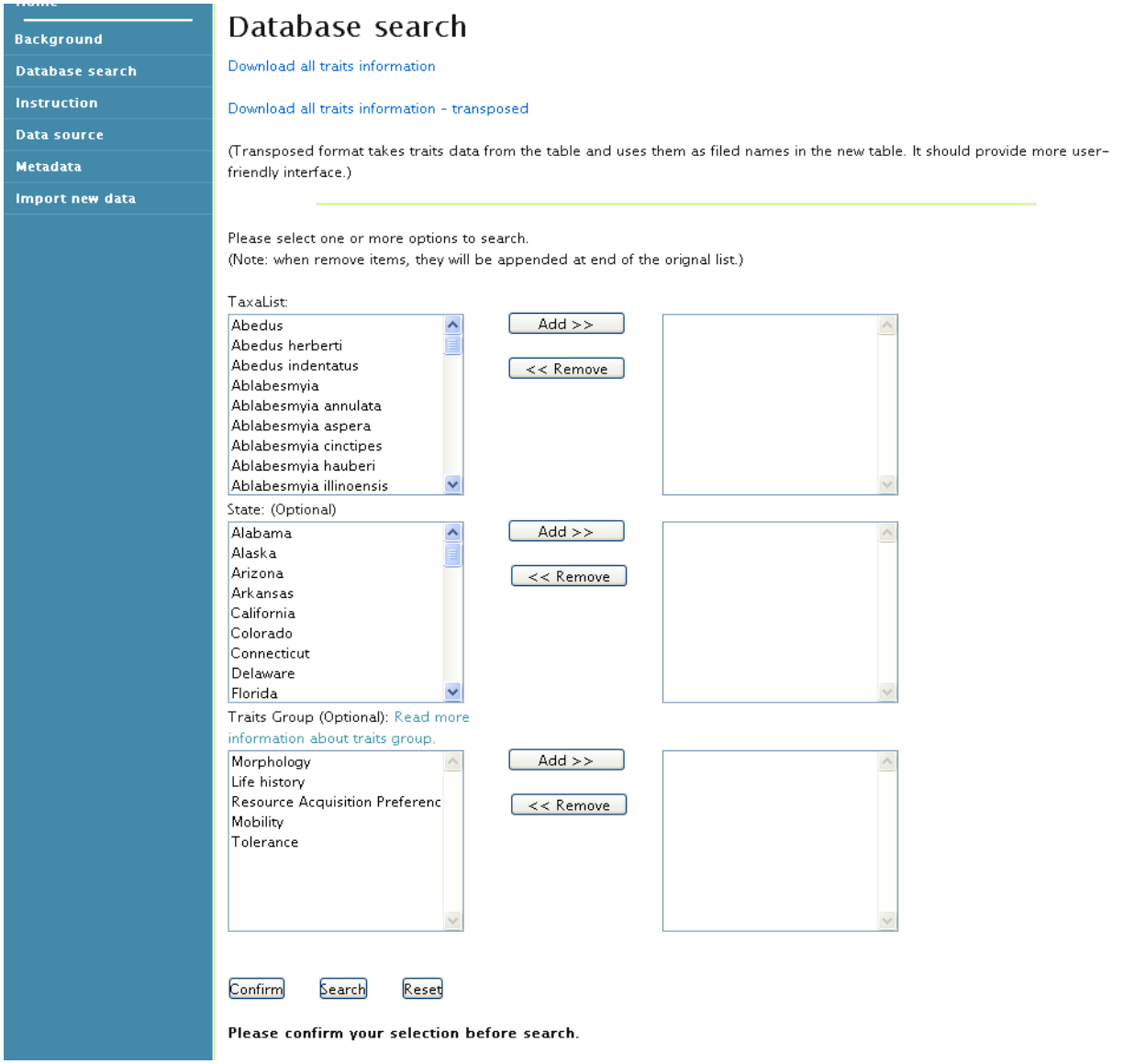
A	B	C	D	E	F
TAXON	CATEGORY_NAME	TRAITS_NAME	VALUE_YN	VALUE_NUMBER	VALUE_TEXT
Acentrella	Waterbody Type	Second-fourth order streams	Y		
Acentrella	Morphology - Adaptation	Suckers	Y		
Acentrella	Mobility	Swimming ability			strong
Acentrella	Tolerance	Thermal Indicator			cold
Acentrella	Tolerance	Thermal optima rank		3	
Acentrella	Tolerance	Thermal optima value		16.92	
Acentrella	Tolerance	Thermal tolerance rank		4	
Acentrella	Resource Acquisition Preference	Vertical habitat position benthic	Y		

Although it may be more efficient at storing data, it is likely to be less user-friendly for many of you, so we wanted to provide you with the option of downloading the data in a transposed format, as shown below (trait names are column headings, etc.).

TSN	Taxon	Study_Citation_abbrev	WB_type_headwater	WB_type_2-4_order	Max_body_size	Body_shape_abbrev	ThermalOptima
100801	Acentrella	EPA GCRP North Carolina (2010)		1		streamlined	16.93
100801	Acentrella	EPA GCRP Maine (2010)		1		streamlined	20.61
100801	Acentrella	Rankin and Yoder (2009)		1			23.90
100801	Acentrella	Yuan (2006)		1			17.00
100801	Acentrella	USGS (2006)		1			
100801	Acentrella	Poff et al. (2006)		1	Small (length < 9 mm)	streamlined	
609528	Acentrella alachua	USGS (2006)		1	Small (length < 9 mm)		
568571	Acentrella ampla	USGS (2006)		1			
568571	Acentrella ampla	USGS (2006)		1			
568571	Acentrella ampla	USGS (2006)		1	Small (length < 9 mm)		
609529	Acentrella feropagus	USGS (2006)			Small (length < 9 mm)	streamlined	
568572	Acentrella	Oregon DEQ (2008)		1			22.20

OPTION 3: DOWNLOAD SELECTED DATA

You can select for taxa, state (optional) and/or trait group (optional)



SELECTING FOR A TAXON OR MULTIPLE TAXA – Step 1: Highlight the taxa of interest

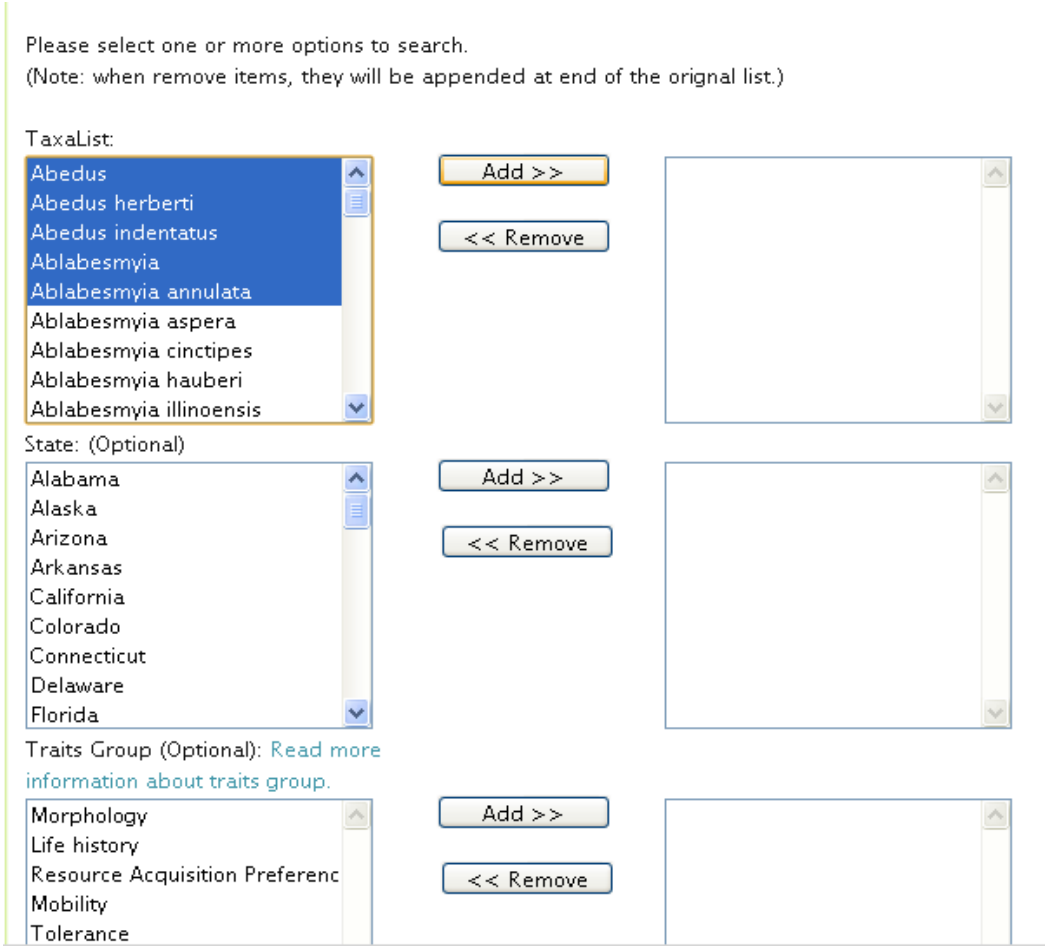
The taxa list is sorted alphabetically.

You can select a single taxon or multiple taxa.

To select a single taxon, click on the name of the taxon. The name will then be highlighted.

To select multiple taxa, if sequential, you can hold the shift key down while left clicking on the taxa of interest. If not sequential, use Ctl+Shift to make your selections, or select each taxa and click on 'Add' individually.

You will see the selected taxa highlighted in blue.

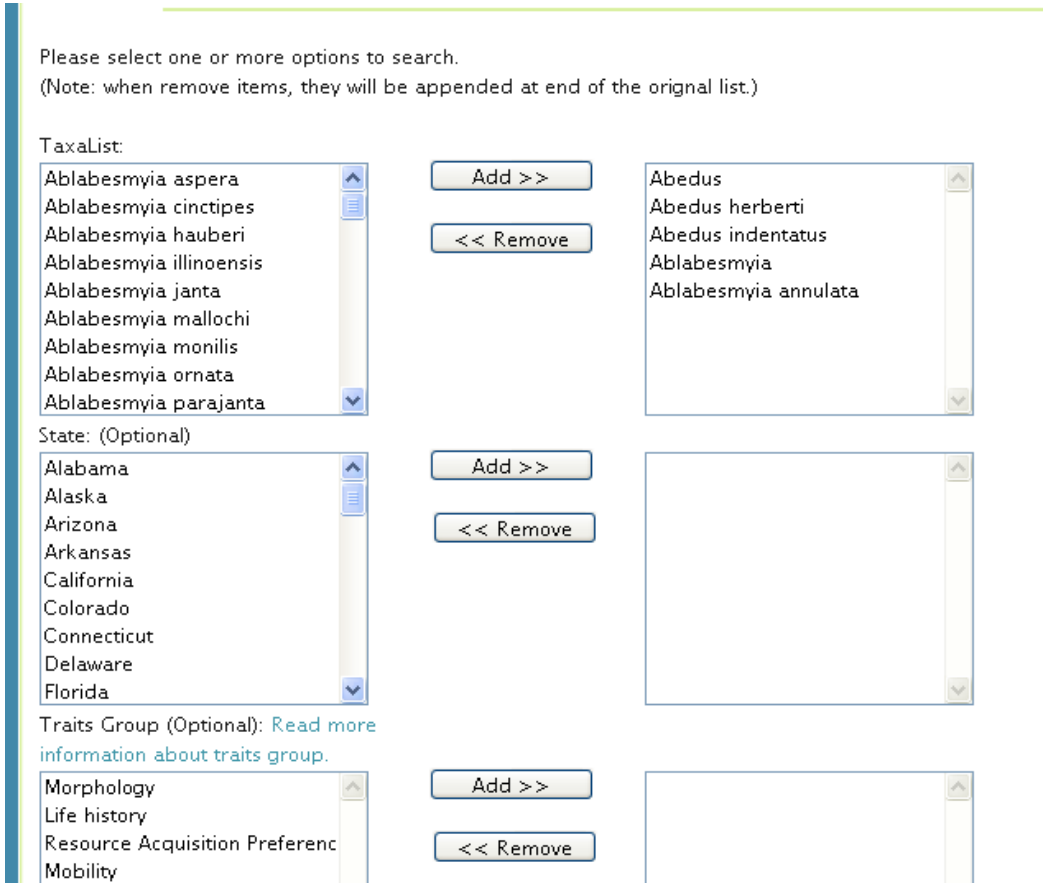


SELECTING FOR A TAXON OR MULTIPLE TAXA – Step 2: Click ‘Add’

After you click ‘Add,’ the names of the highlighted taxa will appear in the box to the right, as shown.

If you would like to remove any of these taxa from this list, click ‘Remove.’

The names of the removed taxa will be appended to the bottom of the taxa list. If you want to resort the taxa list, click the ‘Reset’ button at the bottom of the page.



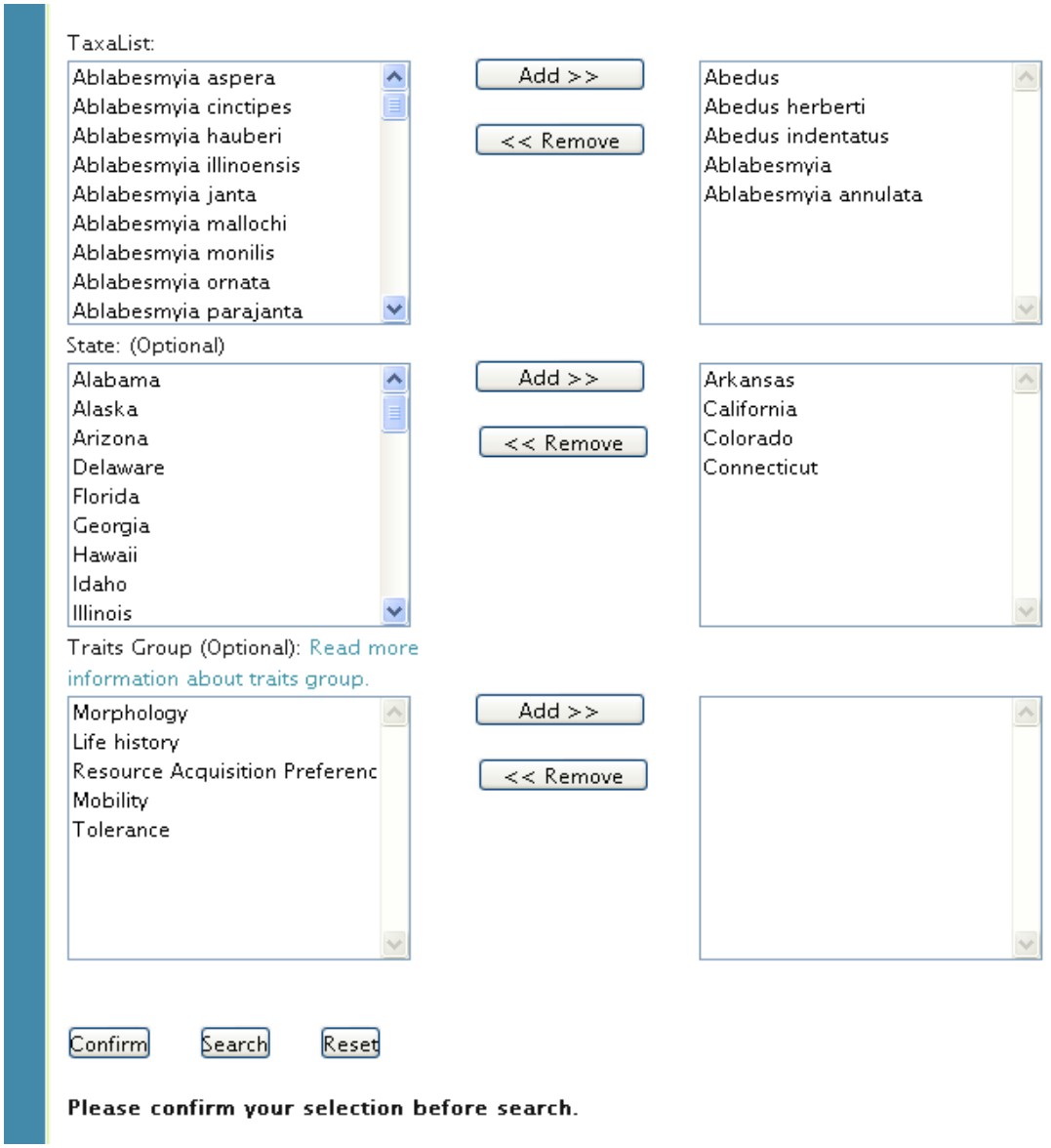
SELECTING FOR A STATE (OPTIONAL) –

You have the option of selecting a state or multiple states.

You can do so by following the same instructions as above.

If you do not select a state, all records will be shown.

IMPORTANT NOTE: search on this field with caution; this type of geographical information has not been entered for all of the records.



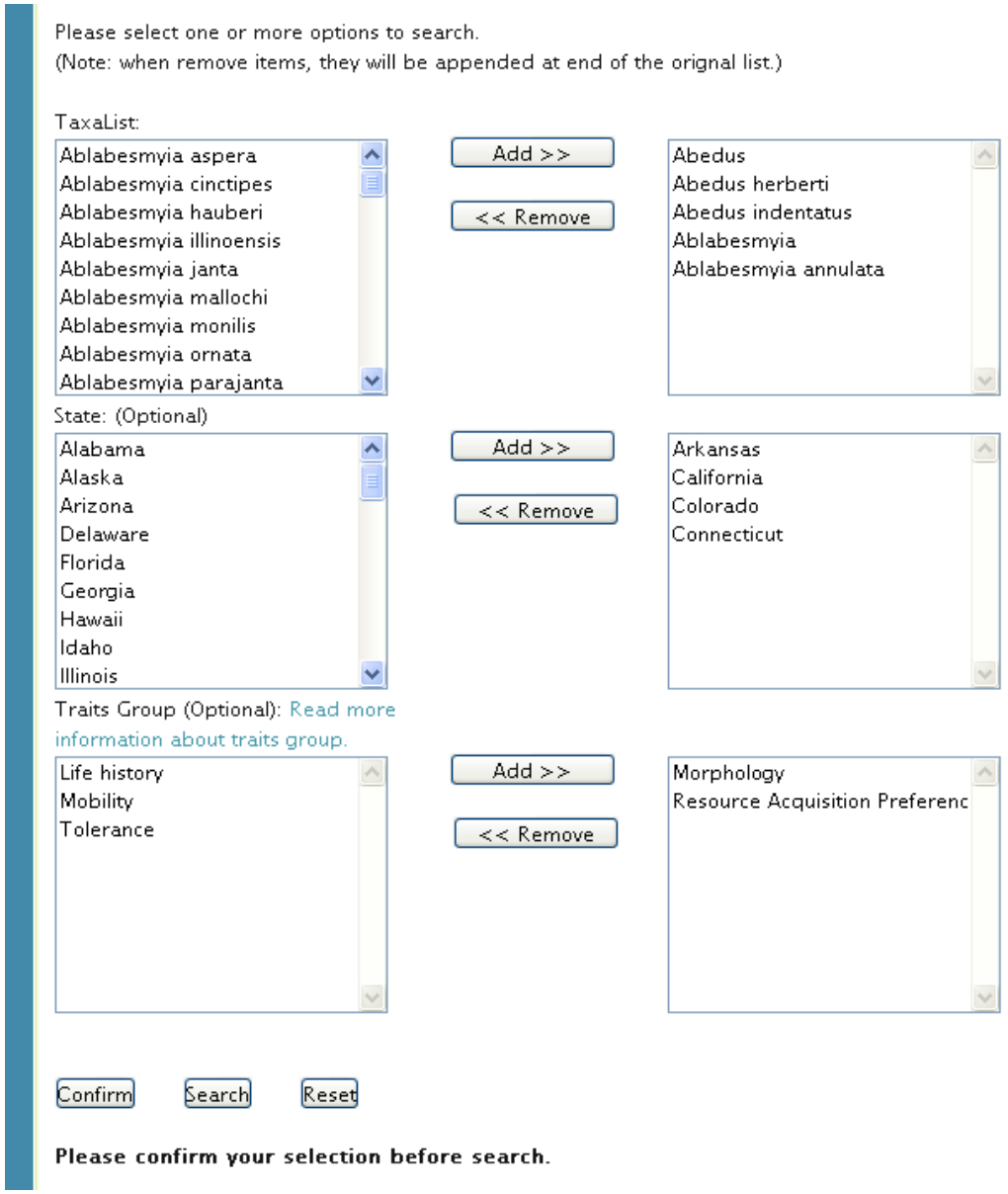
SELECTING FOR A TRAIT GROUP (OPTIONAL) –

You have the option of selecting one or multiple trait groups.

You can do so by following the same instructions as above.

If you do not select a trait group, all records will be shown.

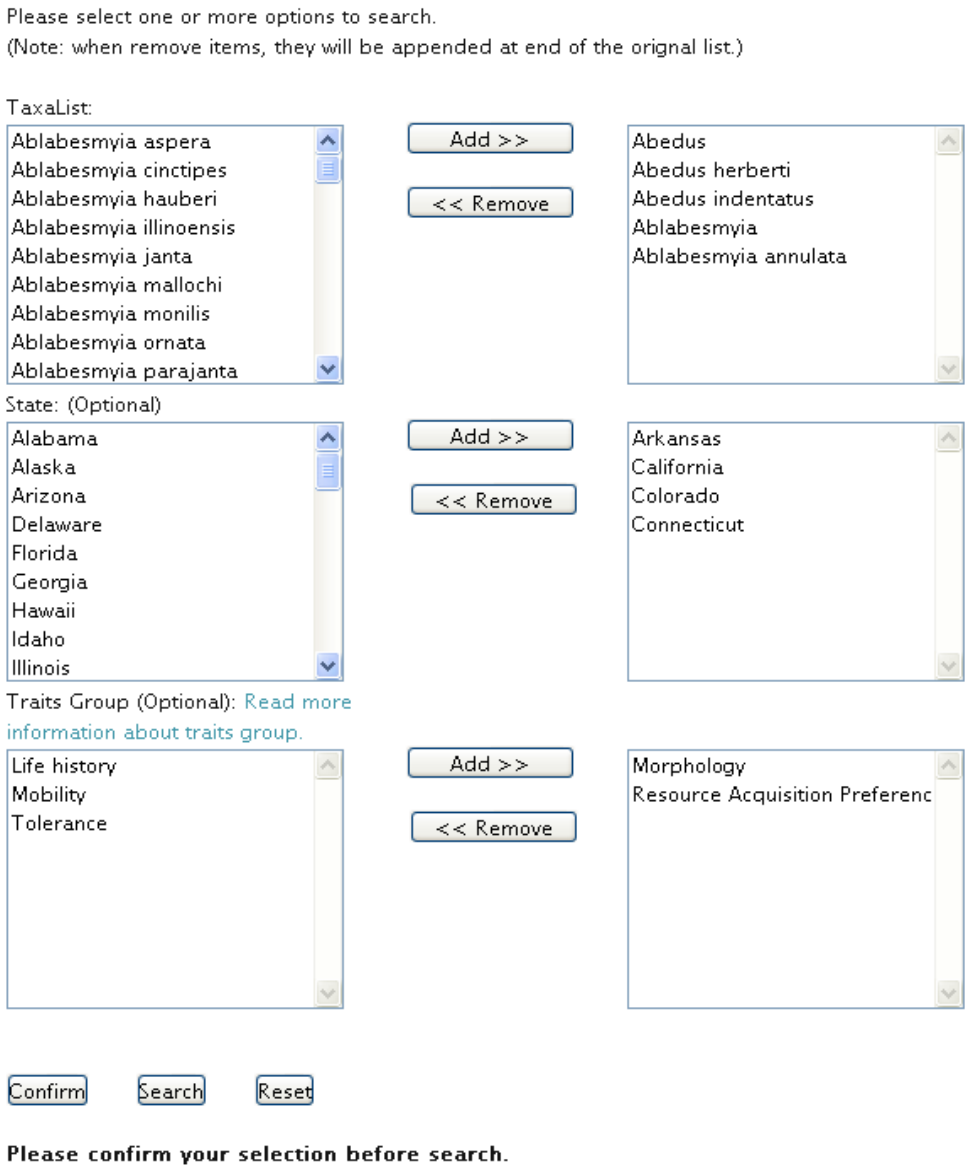
To see which traits are included in each trait group, click on the 'read more information about traits group' link.



4. CLICK ‘CONFIRM’

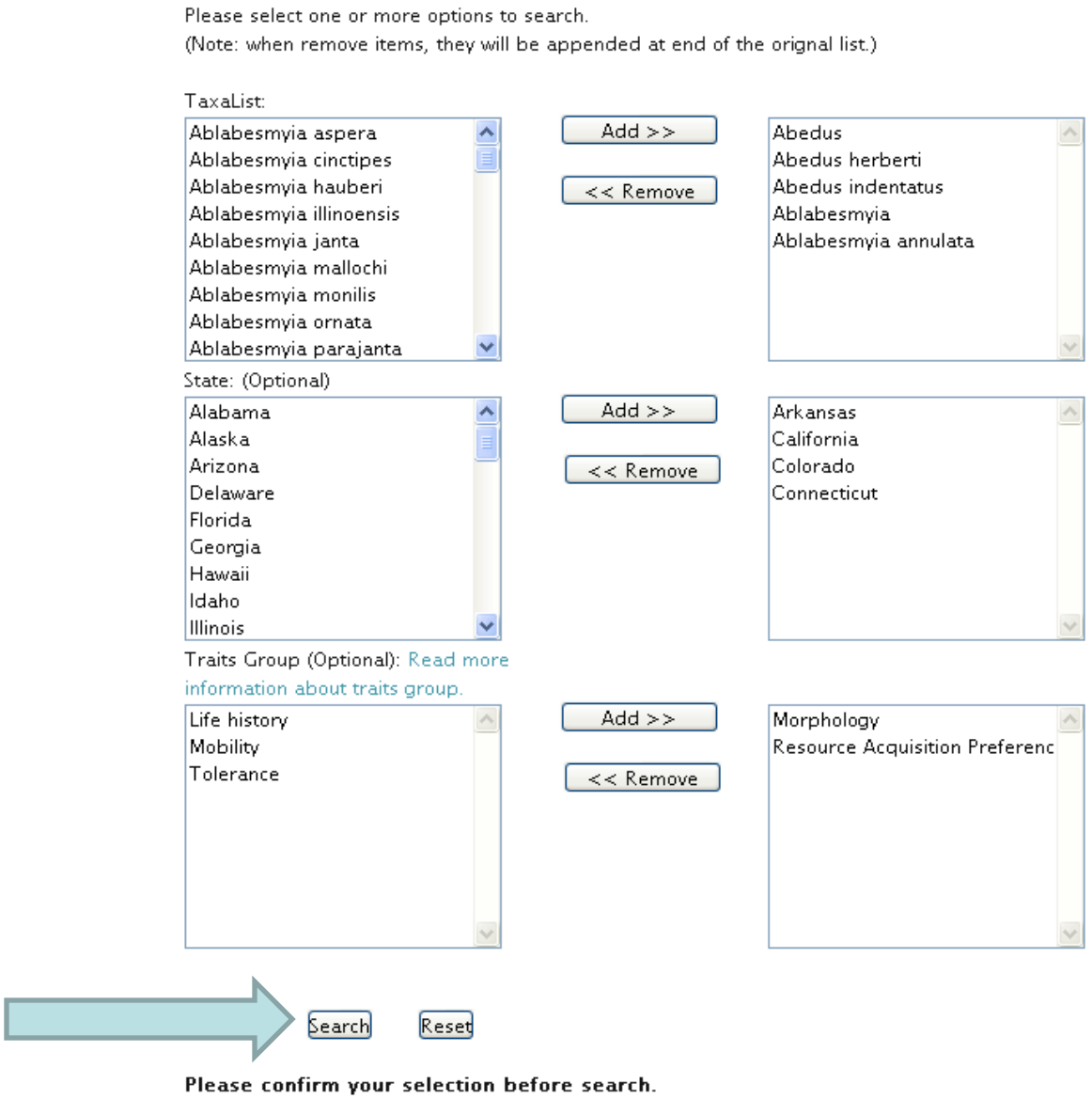
Important!
Do not forget to do this, otherwise you will get an error message when you try to do the data download.

After you click ‘confirm,’the selections you have made will be highlighted in gray.



Click on this!

5. CLICK ‘SEARCH’



Then click on this!

6. SELECT CITATIONS

You are given a choice of citations.

To find out more about the citations, click on the arrow next to the Data Source column heading, and you will be taken to the Data Source page.

To select individual citations, click on the check boxes.

Or to select all records, click 'select all.'

If, after doing so, you decide you don't want to select them all, click the 'uncheck all' button.

Database search

Here is your search critera:

Taxa List:('Abedus','Abedus herberti','Abedus indentatus','Ablabesmyia','Ablabesmyia annulata','Ablabesmyia aspera','Ablabesmyia cinctipes','Ablabesmyia hauberi')
State
List:('Arizona','Arkansas','California','Colorado','Connecticut','Delaware','Florida','Georgia','Hawaii','Idaho','Illinois','Indiana','Iowa
Traits Groups: ('Mobility','Morphology','Resource Acquisition Preference')

Please select the items to download:

Select All | Uncheck All

	Taxon	TSN	Citation	Country	Region	State	Data Source
☐ 3654	Abedus	103721	Aquatic Insects and Oligochaetes of North and South Carolina.	United States	Gulf Coast / Delta Area (TX – FL)	Mississippi	Vieira, N.K.M., N.L. Poff, D.M. Carlisle, S.R. Moulton II, M.K. Koski, and B.C.Kondratieff. 2006. A database of lotic invertebrate traits for North America: U.S. Geological Survey Data Series 187. Available at: http://pubs.water.usgs.gov/ds187
☐ 3663	Ablabesmyia	128079	Secondary production of Chironomidae (Diptera)	United States		Indiana	Vieira, N.K.M., N.L. Poff, D.M. Carlisle, S.R. Moulton II, M.K. Koski, and B.C.Kondratieff. 2006. A database of lotic invertebrate traits for North America: U.S. Geological Survey Data Series 187. Available at: http://pubs.water.usgs.gov/ds187
☐ 3666	Ablabesmyia	128079	Freshwater Biological Traits Table for Maine	United States		Maine	EPA GCRP State Biomonitoring Data Climate Change Pilot Project 2010: Freshwater Biological Traits Table for Maine (traits data came from several different sources (main sources were Vieira et al. 2006 and the Poff et al. 2006 trait matrix).
☐ 3660	Abedus herberti	103731	An Introduction	United States		Arizona	Vieira, N.K.M., N.L. Poff, D.M. Carlisle, S.R. Moulton II, M.K. Koski, and

Whichever citations have checks in the checkboxes will be included in your data output file.

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Data source:

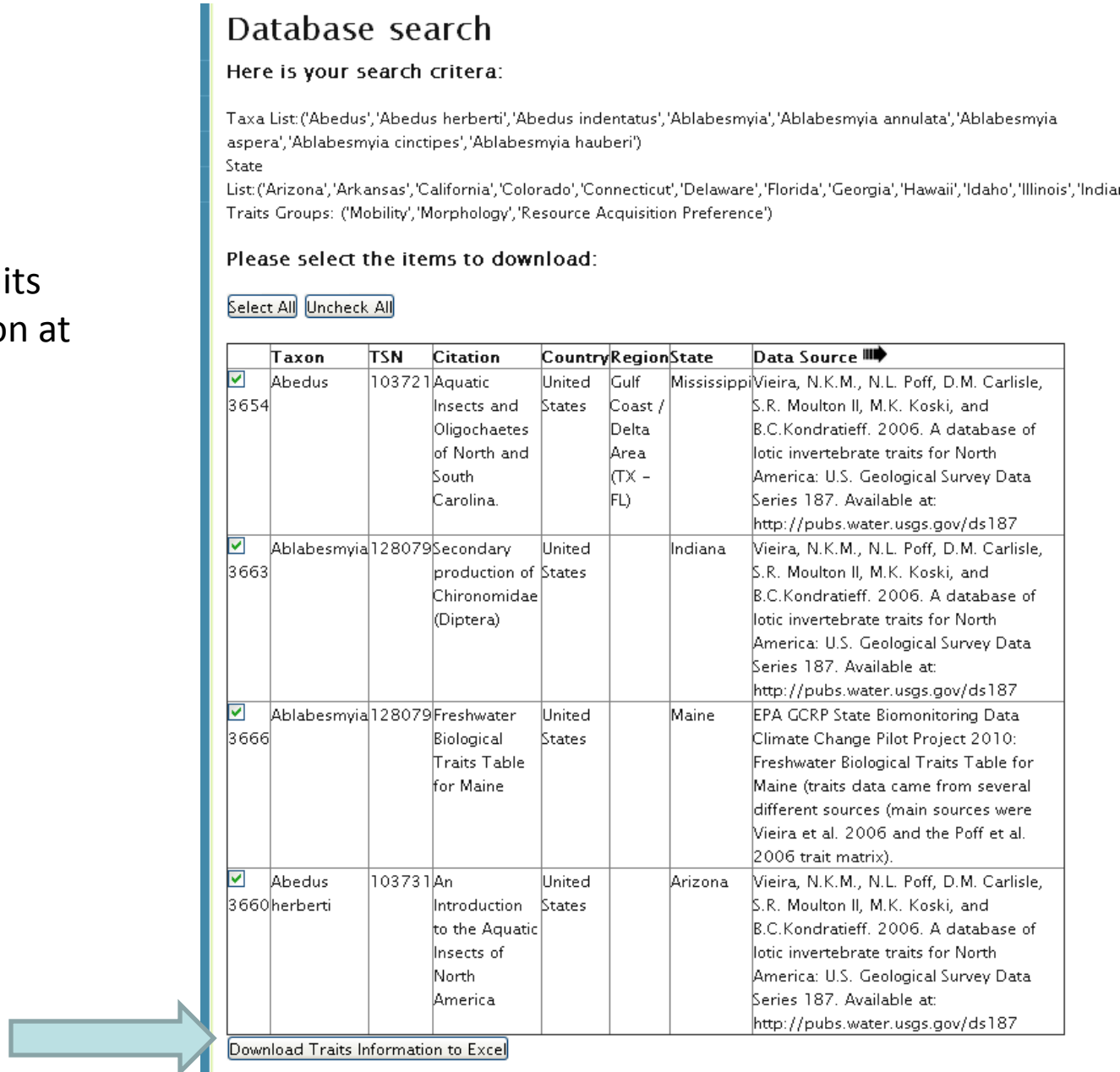
Data source	Tolerance Calculations	Download
Vieira, N.K.M., N.L. Poff, D.M. Carlisle, S.R. Moulton II, M.K. Koski, and B.C.Kondratieff. 2006. A database of lotic invertebrate traits for North America: U.S. Geological Survey Data Series 187. Available at: http://pubs.water.usgs.gov/ds187	Not applicable	Summary Full Report Traits Data Metadata Citations
Poff, N.L., J.D. Olden, N.K.M. Vieira, D.S. Finn, M.P. Simmons, and B.C. Kondratieff. 2006. Functional trait niches of North American lotic insects: traits-based ecological applications in light of phylogenetic relationships. Journal of the North American Benthological Society 25(4):730–755 (Trait Matrix, Appendix)	Not applicable	Summary Trait Matrix Metadata
EPA GCRP State Biomonitoring Data Climate Change Pilot Project 2010: Freshwater Biological Traits Table for **North Carolina** (traits data came from several different sources (main sources were Vieira et al. 2006 and the Poff et al. 2006 trait matrix)).	Temperature	NC Summary NC Trait Table and Metadata NC Cold and Warm Water Taxa NC Traits Gap Analysis NC Data Integration Rules
EPA GCRP State Biomonitoring Data Climate Change Pilot Project 2010: Freshwater Biological Traits Table for **Maine** (traits data came from several different sources (main sources were Vieira et al. 2006 and the Poff et al. 2006 trait matrix).	Temperature	ME Summary ME Trait Table and Metadata ME Cold and Warm Water Taxa ME Traits Gap Analysis ME Data Integration Rules
EPA GCRP State Biomonitoring Data Climate Change Pilot Project 2010: Freshwater Biological Traits Table for **Utah** (traits data came from several different sources (main sources were Vieira et al. 2006 and the Poff et al. 2006 trait matrix)).	Temperature	UT Summary UT Trait Table and Metadata UT Cold and Warm Water Taxa UT Traits Gap Analysis UT Data Integration Rules
Rankin, E. T. and C.O. Yoder. 2009. Temporal Change in Regional Reference Condition as a Potential Indicator of Global Climate Change: Analysis of the Ohio Regional Reference Condition Database (1980–2006).	Temperature and flow	Summary Report Weighted Average Results
Brandt, Darren. 2001. Temperature Preferences and Tolerances for 137 Common Idaho Macroinvertebrate Taxa. Idaho Department of Environmental Quality.	Temperature	Summary Report

Why are their multiple records for one taxon?

Data has been compiled from numerous different sources. Traits information for a taxon can differ depending on the source. That is why each taxon-citation combination has been entered as a unique record.

7. DOWNLOAD THE DATA

Click on the 'Download traits information to Excel' button at the bottom of the page.



Database search

Here is your search critera:

Taxa List:('Abedus','Abedus herberti','Abedus indentatus','Ablabesmyia','Ablabesmyia annulata','Ablabesmyia aspera','Ablabesmyia cinctipes','Ablabesmyia hauberi')
State
List:('Arizona','Arkansas','California','Colorado','Connecticut','Delaware','Florida','Georgia','Hawaii','Idaho','Illinois','Indian
Traits Groups: ('Mobility','Morphology','Resource Acquisition Preference')

Please select the items to download:

Select All | Uncheck All

	Taxon	TSN	Citation	Country	Region	State	Data Source
☑ 3654	Abedus	103721	Aquatic Insects and Oligochaetes of North and South Carolina.	United States	Gulf Coast / Delta Area (TX – FL)	Mississippi	Vieira, N.K.M., N.L. Poff, D.M. Carlisle, S.R. Moulton II, M.K. Koski, and B.C.Kondratieff. 2006. A database of lotic invertebrate traits for North America: U.S. Geological Survey Data Series 187. Available at: http://pubs.water.usgs.gov/ds187
☑ 3663	Ablabesmyia	128079	Secondary production of Chironomidae (Diptera)	United States		Indiana	Vieira, N.K.M., N.L. Poff, D.M. Carlisle, S.R. Moulton II, M.K. Koski, and B.C.Kondratieff. 2006. A database of lotic invertebrate traits for North America: U.S. Geological Survey Data Series 187. Available at: http://pubs.water.usgs.gov/ds187
☑ 3666	Ablabesmyia	128079	Freshwater Biological Traits Table for Maine	United States		Maine	EPA GCRP State Biomonitoring Data Climate Change Pilot Project 2010: Freshwater Biological Traits Table for Maine (traits data came from several different sources (main sources were Vieira et al. 2006 and the Poff et al. 2006 trait matrix).
☑ 3660	Abedus herberti	103731	An Introduction to the Aquatic Insects of North America	United States		Arizona	Vieira, N.K.M., N.L. Poff, D.M. Carlisle, S.R. Moulton II, M.K. Koski, and B.C.Kondratieff. 2006. A database of lotic invertebrate traits for North America: U.S. Geological Survey Data Series 187. Available at: http://pubs.water.usgs.gov/ds187

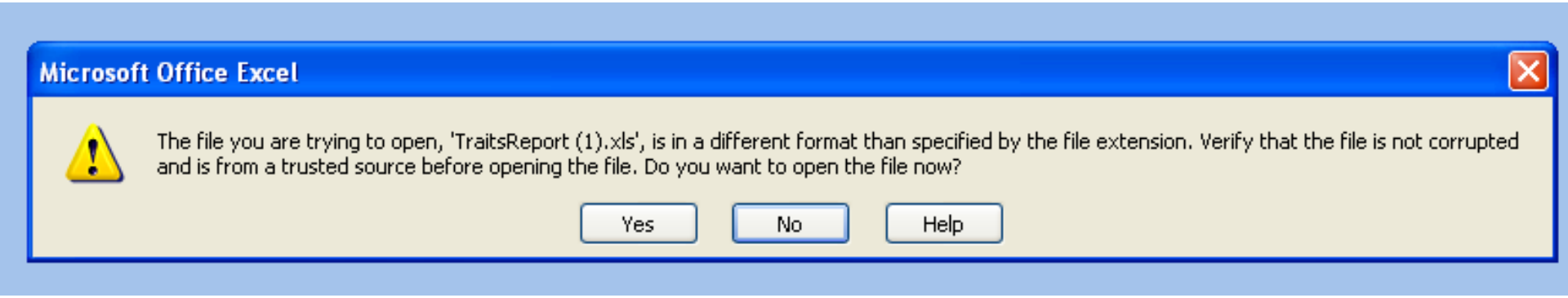
Download Traits Information to Excel

Click on this!

8. RETRIEVE THE EXCEL FILE FROM YOUR DOWNLOAD FOLDER

The Excel file will be named ‘TraitsReport.’

When you go to open the file, you will most likely receive an error message like the one shown below. Do not be alarmed. Just click ‘Yes’ and the file should open without a problem.



Congrats! You have completed your first successful download!

Future improvements

- adding fish and periphyton data
- adding more functionality (i.e. new queries, automated import function, interactive map).

Improvements will likely be made to the database in phases.

USGS and EPA have also discussed the possibility of collaborating on this project.

There also is potential for collaboration with European researchers with the online Taxa and Autecology Database for Freshwater Organisms

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We are looking for feedback!

- We would appreciate any suggestions or feedback regarding the Freshwater Biological Traits Database. If you have comments and/or questions, please contact Britta Bierwagen (Bierwagen.Britta@epa.gov).

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And contributions…

- This is intended to be a ‘living’ database, and we encourage you to contribute data and provide suggestions or feedback on how we can expand and improve on it in the future

EPA United States Environmental Protection Agency

You are welcome to take it for a test drive…

URL

http://traits.tetratech-ffx.com/index.cfm

Username: Traits

Password: Alogon2010

The traits database is under development. This prototype contains draft and test data and is for demonstration purposes only.