Standard Operating Procedures for the Rapid Screening of Species' Risk of Establishment and Impact in the United States

U.S. Fish and Wildlife Service

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Important Notes Regarding This Document

This Standard Operating Procedure (SOP) is intended to explain the purpose of the Ecological Risk Screening Summary (ERSS) process and provide rigorous, repeatable steps necessary to obtain the species data to complete a risk assessment. Several important points regarding this document must be clearly noted:

- The ERSS process is intended for use by people with a background in the taxa or species being assessed or (at the least) a background in biology, ecology, or invasive species and that have, preferably, been trained in the Ecological Risk Screening Summary process.

- The ERSS process is a process that has been designed to be useful for terrestrial and freshwater animal and plant taxa. The process is not currently applicable to marine species as the tool was not developed with consideration of marine environments and climate variables. The process has not yet been tested on pathogens.

- The draft version of the ERSS SOP underwent peer review without constraint on taxonomic groups for which the procedures could be used to assess risk. The process for the peer review followed U.S. Fish and Wildlife Service (Service) procedures, and the Office of Management and Budget's criteria of peer review for influential scientific information. Five independent expert reviewers, with expertise in invasive species biology, invasive species risk assessment, decision-support modeling, aquatic species biology, aquaculture, and fisheries, participated in the peer review process. Peer reviews were conducted individually, all comments were considered, and the SOP was revised where necessary. All peer review comments and the Service's response to those comments are available to the public on the Service's website (www.fws.gov/science/peer_review_agenda.html).

- As part of the peer review, several reviewers commented on the need for a separate background and justification document for the ERSS process. The document describes the history of the ERSS development and provides justification for the use of climate matching and history of invasiveness as a basis for preventative risk assessment. It is titled Ecological Risk Screening Summaries: Development Background and Justification for the Use of Climate Matching and History of Invasiveness for Invasive Species Risk Assessment. It is a companion to this document and can be found online at the Service's Fisheries and Aquatic Conservation website (https://www.fws.gov/injuriouswildlife/Injurious_prevention.html).

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PART 1
INTRODUCTION

BACKGROUND

Each year thousands of nonnative species and millions of individual organisms are imported into the U.S. and moved among States. Although only a small fraction of these escape from intended uses and ultimately end up causing harm to society, those that do collectively cost billions of dollars annually in losses and damages, including loss of crops and fisheries, damage to utility operations and water supplies, and risk to human health from zoonosis (animal to human disease transmission) (Pimentel et al. 2005). The most cost-effective and efficient approach to reduce the effects of these invasive species is to prevent them from entering the country or being moved among states in the first place.

Invasive species become classified as injurious when, through the rule-making process under Title 18 of the Lacey Act (18 U.S.C. 42), a species has been determined to cause or likely cause harm to human beings, to the interests of agriculture, horticultural, forestry, or to wildlife or the wildlife resources of the United States. The U.S. Fish and Wildlife Service (Service) has the authority to list wildlife (wild mammals, wild birds, fish, reptiles, amphibians, mollusks, and crustaceans) as injurious. Because Federal law prohibits importation and interstate transport of animal species listed as injurious by the Lacey Act (18 U.S.C. 42; 50 CFR 16), listing a species as injurious can be effective in preventing the introduction, establishment, and spread of invasive species. More information on injurious wildlife can be found at www.fws.gov/injuriouswildlife/.

Deciding which of the thousands of imported species to list as injurious[1], however, is not an easy task. Clearly some sort of assessment process is needed to allow for the rapid screening and prioritization of species as described in Implementation Task P.1.2 from the 2008-2012 National Invasive Species Management Plan (NISC 2008), which stated: "*Develop screening processes to evaluate invasiveness of terrestrial and aquatic nonnative wildlife (e.g., fish, mollusks, crustaceans, mammals, birds, reptiles and amphibians) moving in trade.*" Risk assessments to identify potentially invasive species can help anticipate problems and focus management. Natural resource management aimed at preventing invasive species introductions and minimizing new invasive species incursions is critical to reduce negative effects on society and the economies on which our society depends. To facilitate this decision-making, the Service has developed a rapid risk screening tool, called the Ecological Risk Screening Summary process to provide efficient risk assessments of species that are or may be imported to the United States.

[1] Although the procedures described a risk assessment process that may be applied to both wildlife and plants, it is important to note that the U.S. Fish and Wildlife Service lacks the authority to list plants as injurious species.

PURPOSE

According to the Food and Agriculture Organization of the United Nations (Reeuwijk and Houba 1998): "*A Standard Operating Procedure is a document which describes the regularly recurring operations relevant to the quality of the investigation. The purpose of a SOP is to carry out the operations correctly and always in the same manner*." Key goals of this specific SOP are to standardize data collection and interpretation of risk assessments, and to assure the credibility of resulting reports for transparency and repeatability. In addition, following this SOP closely and documenting the steps in the process allows for the development of a high quality administrative record.

HOW THE ERSS PROCESS WORKS

The rapid risk screening process uses international databases, scientific literature, and either one of two climate matching tools: Climatch or RAMP. Climatch (Australian Bureau or Rural Sciences 2010 - see Section 3G for more info) is a peer-reviewed Australian model that matches the climate of a species (via 16 climate variables) in its native and nonnative ranges with similar climates in the United States. RAMP (Sanders et al. 2014) is a peer-reviewed climate matching tool developed by the Service that implements the Climatch algorithm using ArcGIS as the operating platform. The results of both methods give an approximate geographic range in the United States in which the climate is similar to other locations where the species is established. The species' history of invasiveness in other parts of the world is then factored into the risk-screening process.

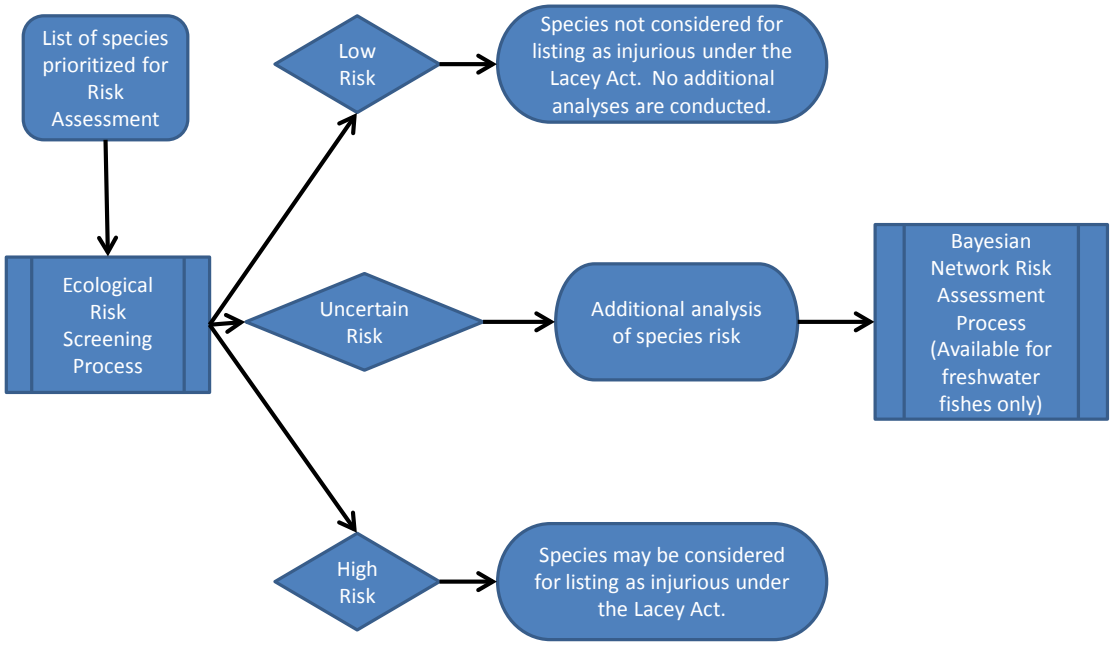
THE OUTPUT

The final output of this process, a report called an ERSS, allows users to determine a high, low, or uncertain level of risk that a nonnative species will find a suitable climate in the United States and cause adverse ecological effects. This information can then be provided to government, industry, and other stakeholders to highlight high-risk species and more efficiently protect the biosecurity of the United States through either regulatory or non-regulatory risk management actions.

LINK TO BAYESIAN NETWORKS

When the overall risk level of a species is determined to be uncertain, and that species is a freshwater fish, the Service has developed a second peer-reviewed tool – a Bayesian network risk assessment model called the Freshwater Fish Invasive Species Risk Assessment Model (FISRAM) – for predicting the invasiveness of a fish species based on the known and projected characteristics of the species. The Bayesian network, however, is not part of the ERSS process, but rather is a next step in the risk assessment process and is not covered in this document (see Figure 1). FISRAM will be available in the near future on the Service's Prevention web page at:
https://www.fws.gov/injuriouswildlife/Injurious_prevention.html.

Figure 1. The ERSS process and its resulting species risk classification outputs of Low, High, and Uncertain. When freshwater fishes are classified as Uncertain Risk, the Bayesian Network risk assessment process may be used. That process is not covered under this SOP.



USING THE ERSS REPORTS

The completed ERSSs are intended to identify species for which preventative measures could be taken, in two ways: 1) to inform the injurious wildlife listing process; and 2) to inform the public (such as States) and private sectors (such as importers of live animals) of the risks of importing or transporting certain species. All ERSSs that have gone through internal, Fish and Wildlife Service review will be posted at webpage https://www.fws.gov/injuriouswildlife/Injurious_prevention.html. These ERSSs will be conveniently organized by level of risk as determined using the ERSS process and then, within the levels of risk (i.e., High, Low, and Uncertain), the species will be organized by taxa.

For the injurious wildlife listing process, species deemed through the ERSS process as high or uncertain risk will be reviewed for possible injurious wildlife listings under Title 18 of the Lacey Act. It is important to clarify, however, that a species that has gone through the ERSS process is not exempt in any way from all of the required steps in the

injurious wildlife process, including opportunities for public comment; the ERSS process is a screening process that simply helps prioritize species for further scrutiny.

To help inform the public, completed ERSSs will be posted on the Service website to let the public know the high and uncertain risk species they may choose to voluntarily avoid importing or transporting and the low risk species to consider as more responsible alternatives. Live animal importers could use the results to facilitate more responsible decision making in the importation and movement of live animals. The completed ERSSs could also lead to State regulatory, legislative, or other measures (targeted prevention efforts, developing watch lists and monitoring programs, etc.) that prevent the introduction of species into their jurisdictions.

For more information on injurious wildlife, please visit our website at www.fws.gov/injuriouswildlife/ and www.fws.gov/injuriouswildlife/Injurious_prevention.html

PART 2
GUIDELINES FOR CONDUCTING AN ERSS

ASSESSOR QUALIFICATIONS

It is recommended that the preparation of an ERSS be conducted by a single individual with subject matter expertise, preferably with a specific background in the taxa or species being assessed or a background in biology, ecology, or invasive species. If this is not possible, then the Assessor should at least be fully conversant with this SOP and should, as needed, consult the peer-reviewed literature outlined both in this document and in the companion Background and Justification document referred to in the notes on page "i".

INDIVIDUAL ASSESSMENT

Conducting an ERSS in a group setting is not recommended due to the potential for a variety of knowledge levels, and a group member who may be particularly vocal or opinionated but who may not possess the requisite expertise. To avoid bias or lack of objectivity, it is strongly recommended that group dynamics be avoided whenever possible, instead focusing on a hierarchical review process (see next section).

DEVELOPMENT PROCESS

The recommended development process for conducting an ERSS occurs in a series of stages as follows[2]:

> **ORIGINAL AUTHOR → TECHNICAL REVIEWER → EDITORIAL/POLICY REVIEWER → INJURIOUS WILDLIFE LISTING ASSESSOR**

Whenever possible, as a form of quality control, the individuals assigned to the roles listed in the process above should not be the same individuals. The original author compiles data from literature and database searches, cites and records all references incorporated into the administrative record, complete the Climate Match analysis, and produces an ERSS incorporating all of this information. The reviewers assess the accuracy and completeness of the ERSS and its accompanying administrative record. If the ERSS indicates the species is high risk, then either regulatory or non-regulatory risk management action may be warranted. The ERSS provides structured information to help base decisions on which, if any, risk management actions are prudent and appropriate. If the ERSS indicates uncertain risk, then the species would require further assessment using a separate decision support tool, such as the Bayesian network model FISRAM for freshwater fish species. The ERSS and its accompanying administrative record will be used in the injurious wildlife listing, Bayesian network model, and/or other decision support processes.

[2] *While this description of the stages of the ERSS development process is our preference for how they will be developed, we can't unequivocally commit to this approach and bind the agency's capabilities in the future. Rather, we will balance the fiscal and staffing realities of the agency in delivering its conservation mission with the benefit of keeping these roles differentiated.*

DATA QUALITY STANDARDS

The ERSS should be a compilation of facts, data, and actual occurrences of species effects, instead of hypothetical circumstances. A risk assessor's primary source of information will be from expert-validated native and invasive species information systems listed throughout this SOP, and peer-reviewed scientific literature. Information from white papers and other gray literature can be used and noted, but should not be used as the sole basis for risk in an ERSS. In addition:

- The assessors (authors) need to clearly indicate whether primary sources were accessed or whether the information was retrieved from a secondary source. Citations from secondary source should correctly cite the primary source.
- Data cited from "white papers" and "gray literature" such as non-peer reviewed websites, newspapers, or other non-scientific literature may be included as references. However, assessors do need to understand the differences between actual data, opinions, and recommendations in white papers.
- A newspaper article that has documented evidence of species' presence and impacts may be used.

It is important to note that even peer-reviewed scientific journal articles and book chapters contain conjecture. That conjecture cannot be used as evidence of history of invasiveness, which is described in detail later in this SOP.

HOW MUCH IS ENOUGH?

One of the main difficulties in developing an ERSS is that for many species the information being sought is typically either very general (because that is typically all the information that is available) or non-existent, which makes it very difficult to set data thresholds and limits. The risk assessors are expected to review multiple sources for each section, select the most reliable, credible, clear, and convincing entry, and add new information from other sources if it exists.

Although a risk assessor may feel inclined to stop after finding information in the first few databases they consult, they should not do so and should consult as many of the databases listed within the SOP as possible within a reasonable time. Experience has shown that further investigation beyond initial findings sometimes reveals that a species' status is not as clear as initially thought. If all websites recommended in this SOP are visited, including Google Scholar (scholar.google.com), and little information has been found, and new sources are consulted that may have become available since this SOP was last updated, then the lack of data should be noted, and searching can stop. Ultimately, what is desired for each section of an ERSS is the best available information that can be derived from the recommended information sources.

As part of the risk assessment process, and to help reviewers understand how much research was completed and which databases were and were not used, the risk assessor should also complete the Record of Online Data Searches and the Quality Assurance/Quality Control (QA/QC) Checklist in Appendix A, to help clarify exactly what databases were, and were not used, for the ERSS.

GENERAL NOTES

The development of an ERSS report consists mainly of copying and pasting large amounts of quoted material from various websites and scientific journals. Because the layout of the ERSS report is based, in part, from the most popular information sources for aquatic invasive species, it is possible that quoted material could span multiple headings within the ERSS template. When this occurs, the reference for the quoted material should be repeated for each new heading. This is to prevent confusion and make apparent the source of the quoted material. The following requirements must be adhered to at all times when gathering information for an ERSS:

- Copy and paste all appropriate information into the ERSS template. The following guidelines should be followed to copy and paste large amounts of quoted material from either websites or scientific journals.
  - Surround all copy-pasted materials with quotation marks. **Quotation marks must only be used when the information quoted is an exact quote** (i.e., text cut and pasted without alteration).
  - To prevent confusion, repeat the citation for quoted material for each new heading with an ERSS.
  - Sometimes a paragraph from a quoted source that is being used for one section will contain some information that is more appropriate for a different section (e.g., information on human uses contained in a paragraph that otherwise belongs in biology). Break apart the paragraph and insert each part of the paragraph in the appropriate section.
  - Use brackets within quoted material to designate material that has been added to a quotation. This should only be done when the meaning of the original material is unclear.
  - If errors are discovered within quoted source material, include the error in the quote followed by "*[sic]*", to indicate the error was part of the original quote.
  - When deleting extraneous, non-vital information from within quoted material, use an ellipsis (three periods in a row) in brackets (like this "[...]") to show that the ellipsis was not part of the original passage.
- Carefully document and credit references for pictures and figures using formats found in Appendix B.
- Save all accessed websites as PDFs to include as part of the administrative record for the ERSS. In many web browsers, there is an option to print to PDF within the browser. Use that option, where it is available.

CREATING AN ADMINISTRATIVE RECORD

The author of an ERSS should file a detailed administrative record with each completed and reviewed ERSS. This record should include a list of all cited references and a clear indication of whether primary sources were accessed or whether the information was retrieved from a secondary source. Citations from secondary sources should correctly cite the primary source. This includes, but is not limited to, information retrieved from databases such as FishBase. The administrative record should also include a saved PDF of all source information cited (articles, databases, reports, screenshots) at the time they are accessed as well as the Record of Online Data Searches and the QA/QC Checklist (see Appendix A).

These files should be saved in a single location and sent to ERSS reviewers and then to Headquarters along with the completed and reviewed ERSS. Anyone using an ERSS should be able to easily determine the source of the information (reference list) and also be able to obtain a saved copy of that specific information (reference file). This level of documentation is required for the administrative record for injurious wildlife listings and improves public transparency of the document.

PART 3
STANDARD OPERATING PROCEDURES FOR DEVELOPING ECOLOGICAL RISK SCREENING SUMMARIES

The following information is intended to guide the reader through the steps necessary to complete an Ecological Risk Screening Summary. Each of the following sections, which are organized to match the required flow of an ERSS report, contain descriptions of the data needed, specific data sources, and special instructions.

General Guidelines

- Provide as much relevant information as possible for each of the ERSS subheadings in parts 3A – 3D below without unnecessary repetition.
- A new heading can be added if important information is discovered that does not fit in the subheadings listed below.
- The source of the quoted material should be repeated for each new heading.

An empty ERSS template is provided in Appendix C, and an example of a completed ERSS is provided in Appendix D.

3A: ERSS Title Page Header Information

1) **Title Page Header** – An ERSS' title page header should contain the following items:

   a) Common and scientific name of the species;

   b) Details on the preparer and version of the ERSS document; and

   c) An applicable, and properly credited, photograph or drawing (if available).

2) **Data Sources and Specific Instructions –** Use the data sources and specific instructions below to create the information necessary for the title page header information.

> ***Note:*** *The full taxonomy is included in Section 2 of the ERSS. See that section for a more detailed description of the data field.*

   a) **Common and Scientific Names** – Search for the common and scientific names for the assessed species.

      i) **Common Names**
         (1) **For Fish Species** - Use **Fishbase** – www.fishbase.us
            (a) On the main Fishbase page, look for the section called "Classification/Names" to find the American Fisheries Society (AFS) assigned common name.
            (b) Click on the link at the bottom of that section called "Common Names."

(c) Look for the English name that has "AFS" in the column labeled 'Type."
(d) If no AFS name is available, then use the most common English name listed.

> ***Note:*** *The Fishbase website is sometimes non-responsive. If this happens, try one of the mirror websites listed at the top of the Fishbase index page.*

(2) **For Other Species** – Use ITIS – the Integrated Taxonomic Information System – www.itis.gov/ – Use the common name listed, which is the fourth entry in the "Taxonomy and Nomenclature" box in a species' full ITIS record.

ii) **Scientific Names**
(1) **For Fish Species** - Use the following sources to acquire the full taxonomic hierarchy:
(a) Catalog of Fishes – www.calacademy.org/scientists/projects/catalog-of-fishes – then
(b) The AFS Name Book (if the species occurs in North America and if the book is available to the risk assessor); then
(c) FishBase – www.fishbase.org/ – and then finally,
(d) ITIS – www.itis.gov/.
(2) **For Other Species** - Use ITIS – www.itis.gov/
(a) Use the genus and species names in the header, but note that the entire taxonomic hierarchy is used in Section 2 of an ERSS.
(b) If the subject species is not a fish, and ITIS provides no scientific name, then use the name either associated in scientific literature or from other databases listed throughout this document (or elsewhere), and ensure that the source(s) is documented.

b) **Preparer and Version Details** – Include details on the preparer and version of the ERSS document.
i) The author of an ERSS should put their name and the date of the ERSS report below the species name in a right justified format. See examples in Appendices C and D.
ii) Reviewers should add their names beneath the original author's name.
iii) When an ERSS has gone through its final technical and policy reviews and is ready for posting on the Service website, the author's and reviewer's names are replaced with the words "Web Version" and a date.

c) **Photographs** – Search for applicable photograph(s) of the assessed species, carefully documenting and crediting any images used.
i) **Citing Photographs** – Like all other resources used for the development of an ERSS, images must also be cited, even if the image is very small or in the public domain. If an image is used that was not created by the ERSS assessor, then a citation must be provided. When citing images, whenever possible as much of the following information should be located within the caption:

(1) Image title
(2) Creator name
(3) Repository Information (museum, library, or other owning institution)
(4) Image Source (database, website, book, etc.)
(5) Date accessed

ii) **Responsible Use of Digital Images** – The University of Washington Library (2014) summarizes the issue very well: "*Digital images are electronic resources that need to be used responsibly and with an awareness of copyright and ethical use best practices. Most databases and websites provide information about how their images can be used. It is important to read this information carefully, and comply with all usage guidelines. Usage guidelines can vary considerably, so be alert to differences and details.*"

iii) In addition to potentially finding images in the various databases listed elsewhere in this document, useful images may be found on the following sites:
(1) **Invasive.Org** – University of Georgia's Center for Invasive Species and Ecosystem Health – www.invasive.org/images.cfm
(2) **Wikimedia Commons** – commons.wikimedia.org/wiki/Main_Page

> ***Note:*** *Keep in mind, that since anyone can contribute to Wikimedia, one must be careful to be sure the image is of the correct species.*

(3) **USFWS Image Library** – digitalmedia.fws.gov/

iv) Graphic Standards – Though not mandatory due to the general lack of images for many of these species, whenever possible, photographs should be color and should adhere to the following standards:
(1) Resolution – 300 dpi
(2) Size – 4" x 6" or 6" x 4"
(3) File formats – JPEG or Raw

v) When no photographs are available a drawing or sketch could be used.

vi) If no images at all are available, place a text box where the image should be and state within the box: "No useable images available for this species."

3B: ERSS Section 1 - Native Range and Status in the United States

1) **Data Descriptions –** For Section 1 of an ERSS, search for information for the following four sets of information, using data sources and special instructions in number 2 below; the first three subheadings (native range, status, and means of introduction into the United States) are mandatory and the fourth (remarks) is used when necessary.

a) **Native Range –** The native distribution of the species. May include countries, states, regions, and geographic areas such as a specific river basin or specific habitats.

b) **Status in the United States –** Whether the species has been reported in the United States and if so, where. Often limited to state-level data but may include

more detailed occurrence information. In addition to whether the species has been found in the U.S., this is also the place to mention:

i) If the species is in trade within the U.S.
ii) If the species has any special status in the State, such as being banned for importation into the State, or listed as a State-designated noxious weed or invasive species, or if the species is listed as a Federally listed noxious weed.
iii) Note: For clarity, if no data on trade or status can be found, the ERSS should clearly state that fact so that readers know that an attempt was made to find this information.

c) **Means of Introduction into the United States –** How the species was introduced to and spread within the United States. This should include, when known, both the pathways and vectors. Although these terms can sometimes be difficult to separate, the pathway is generally regarded as the reason why a species is transported (the activity that facilitates the movement), whether accidentally or deliberately, and the vector is exactly how a species is transported (the physical things the species move on, in, or with). For example, commercial shipping is a pathway, and ballast water, hull fouling, and stowaways are all vectors associated with commercial shipping.

d) **Remarks –** Determine whether there are any special circumstances or additional information that is key to the overall interpretation of the ERSS that should be highlighted. Include any additional information that is important to the reader's understanding of the ERSS. This may include:

i) Contradictory information on the range of the species
ii) Recent taxonomic changes
iii) Other commonly used names
iv) Difficulty in correctly identifying this species
v) Information on congeners (species that are members of the same genus) and hybridization

2) Data Sources and Specific Instructions – Using the data sources and specific instructions below, search for the information necessary to create the native range and status information relevant to the species being assessed.

a) **Data Sources for Aquatic Animals** - Search the following websites to determine if a species is established in the U.S.:

i) **Nonindigenous Aquatic Species Database – U.S. Geological Survey (USGS) –** nas.er.usgs.gov/queries/SpSimpleSearch.aspx
ii) For Fishes – **Fishbase** – www.fishbase.us **–** can also be used to find native ranges. Data on a species' native range can be found under the "Distribution" heading.

> ***Note:*** *This heading in Fishbase often includes information on introduced ranges which are not appropriate to include in this section; that information goes under the heading "Distribution Outside the United States" in Section 2 of an ERSS.*

iii) For Crayfishes – **The Crayfish and Lobster Taxonomy Browser –** iz.carnegiemnh.org/crayfish/NewAstacidea/index.asp

b) **Data Sources for Plants** – Search the following websites to determine status in the U.S.:
   i) **EDDMaps website** – www.eddmaps.org/distribution/
   ii) **Invasive Plant Atlas of the United States –** www.invasiveplantatlas.org/distribution.html

   > ***Note:*** *The atlas' index page is a huge list of plants - use the database's search tool or your browser's find function to find specific plants. It is linked to EDDMaps above, but may have additional information.*

   iii) **Introduced/Invasive/Noxious Plants Web Page – USDA-NRCS Plants Database** – plants.usda.gov/java/noxComposite?stateRpt=yes

   > ***Note:*** *The upper part of the web page has links to State noxious weed lists and other resources that may be useful. The lower section has links to large number of plants.*

   iv) **Federal Noxious Weed List 2012 – USDA-APHIS** – www.aphis.usda.gov/plant_health/plant_pest_info/weeds/downloads/weedlist.pdf
   v) **iMap Invasives** – www.imapinvasives.org/login.html

   > ***Note:*** *iMapInvasives is an online tool for reporting and data management of invasive animals, insects, and plants. However, it is only for participating states. As of September 2016, current participants include 9 States (AZ, FL, ME, NY, OR, PA, VT, VA, and WV) and the Canadian Province of Saskatchewan.*

c) **Data Sources for both Terrestrial and Aquatic Species** – The following websites can be used to determine if a terrestrial species is established in the U.S. and can sometimes be good alternate sites to use for aquatic species:
   i) **Global Biodiversity Information Facility (GBIF)** – data.gbif.org/welcome.htm
   ii) **Nature Serve Explorer** – www.natureserve.org/explorer/index.htm
   iii) **Discover Life** – www.discoverlife.org/

d) **For Snails and Slugs – Alien non-marine snails and slugs of priority quarantine importance in the United States: A preliminary risk assessment** – naldc.nal.usda.gov/download/36420/PDF

> ***Note:*** *This PDF provides risk rankings for some snails and slugs. Use the Find function within your PDF browser as the species are discussed in at least three different sections of this paper. Some of the species also have some impact or disease related information which is useful in Sections 2 and 3 of an ERSS. The document's citation is Cowie 2009; if PDF hyperlink does not work, the full reference can be found in the references (Section 3J).*

e) **Other Resources** – If a species is not covered in the databases and websites listed above, expand the search to other databases to determine native range, non-indigenous occurrences, and how the introductions occurred. Other online resources to research, as appropriate, include those listed below, as well as those listed in parts 3C and 3D of this SOP. As mentioned earlier in part 2, if a risk assessor has checked all the appropriate sources listed throughout this SOP (see parts 3B-3D and the Record of Online Data Searches in Appendix A), then the lack of data should be noted, and searching can stop. Other peer-reviewed resources not listed in this SOP, however, can still be consulted.

i) **Invasive Species Compendium** – www.cabi.org/isc/
ii) **Global Invasive Species Database** – www.issg.org/database/welcome/
iii) **Encyclopedia of Life** – www.eol.org
iv) **NIS Base** – Nonindigenous Species Database Network – www.nisbase.org
v) **BISON** – Biodiversity Information Serving Our Nation – bison.usgs.ornl.gov
vi) **WoRMs** – The World Register of Marine Species – www.marinespecies.org
vii) **VertNet** – A single integrated data portal for four classic vertebrate networks (FishNet, MaNIS, HerpNET, ORNIS) – www.vertnet.org
viii) **Aqua Map** – www.aquamaps.org/main/home.php
ix) **National Exotic Marine and Estuarine Species Information System (NEMESIS - Smithsonian Environmental Research Center)** – invasions.si.edu/nemesis/browseDB/intro.html

> ***Note:*** *Although the climate matching process is not currently possible for marine species due to the lack of weather stations beyond the coastline in marine environs, NEMESIS may be useful for estuarine species.*

x) **Web of Science** – www.webofscience.com

> ***Note:*** *Web of Science is an online subscription-based scientific citation indexing service maintained by Thomson Reuters that provides a comprehensive citation search. The subscription is for institutions only.*

xi) **U.S. Fish and Wildlife Service Online Library** – fwslibrary.on.worldcat.org/atoztitles/browse/collections – For U.S. Fish and Wildlife Service employees, navigate through a USFWS network site (or using a VPN).

f) **Congeners and Hybridization** – Sometimes an invasive species will hybridize with a native species, producing a hybrid species. Although rare, this is most likely to occur with congeners (species that are members of the same genus). Use GBIF to determine if the assessed species has congeners within the U.S.

i) Search for the genus of the assessed species within GBIF.
ii) In the genus information provided by GBIF, the third box down should contain taxonomic information. The left side of the box should read "Subordinate Taxa." These are all the species of the same genus as the assessed species that have records within GBIF.

iii) Look at each species to see if it occurs in the U.S., keep a record of the number congeners found. Although the possibility is remote, these species should be listed in the remarks section of the ERSS as they have the greatest likelihood of hybridizing with the assessed species.

3C: ERSS Section 2 - Biological and Ecological Information

1) **Data Descriptions –** For Section 2 of an ERSS, search for information for the following 11 data fields, using data sources and special instructions in number 2 below. Each of the data fields should be placed as a subheading within Section 2 of an ERSS (see template, Appendix C). The headings in Section 2 of an ERSS were designed to correspond to many of the major headings in Fishbase.

   a) **Taxonomic Hierarchy and Taxonomic Standing –** The complete taxonomic hierarchy for the organism including the Kingdom, Phylum, Class, Order, Family, Genus, and Species. The descriptors and taxonomic authorities that often occur after the scientific names are not needed.
      i) May also include subgroups such as infraclass, superorder, etc.
      ii) Include whether the taxonomy is considered valid.
      iii) If available, note any recent taxonomic revisions, related species and races, hybrids, and varieties.

   b) **Size, Weight, and Age Range –** The length or age at maturity, size range, maximum length, common length, maximum weight, and maximum age as available.

   c) **Environment –** A basic description of the physical conditions necessary for survival of the species, not including climate. For an aquatic organism, for example, this may include water temperature, salinity, pH, dissolved oxygen content, depth range, turbidity, velocity, etc.

   d) **Climate/Range –** The general climate (temperate, tropical, etc.), air temperature range, and latitude range where the species can survive.

   e) **Distribution Outside the United States**
      i) **Native –** The native range of the organism outside the United States. Often the same as "Native Range" in Section 1 of the ERSS.
      ii) **Introduced –** The introduced range of the organism outside the United States. If possible, include whether the species is known to be established in each location.

   f) **Means of Introduction Outside the United States** – How the species was introduced to new range outside of the United States. This includes pathways and vectors (see part 3B 1(c) above for description of pathways and vectors). If possible, provide a general summary of historical information on introduction, transport routes, and spread.

g) **Short Description –** A physical description of the species that may be used for identification purposes.

h) **Biology –** The basic biology of the species. May include information on habitat use, feeding, reproduction, development, genetics, activity patterns (e.g. migration, hibernation), adaptations for survival, patterns in population size or density, etc. as available.

i) **Human uses –** Actual and potential human uses of the species and its current status in trade. May include information related to consumption by humans, use in the pet trade, ornamental uses, use for materials, use as bait, etc. U.S. trade should be reiterated from "Status in the U.S." above.

j) **Diseases –** Pathogens and parasites known to be carried by the species. Make note of those which are on the World Organisation for Animal Health's list of notifiable diseases (known as "OIE-listed"[3]).

k) **Threat to humans –** Characteristics of the species that pose a threat to humans. May include that the species is venomous, poisonous (toxic), traumatogenic (causes injury), a potential pest, carries a zoonotic disease, etc.
   i) The distinction between this subheading and the Impacts of Introduction section below is that this section if for threats to humans, regardless of whether there is evidence of those threats actually having an impact.
   ii) Note that impacts to wildlife should be documented in the Impacts to Introduction section below.

2) **Data Sources and Specific Instructions** – For Section 2 of an ERSS, search for information for all of the 11 biology and ecology subheadings listed above, and considering the specific instructions below relevant to the species being assessed.

a) For **Taxonomic Hierarchy,** use ITIS – www.itis.gov/
   i) See part 3A(2) for details on acquiring full taxonomic information.

b) For **all other subheadings** in Section 2 of an ERSS, search all appropriate sources listed in part 3B(2) to document as much biological and ecological information regarding the species, placing the information under the appropriate headings within the ERSS template.

c) **Diseases** – World Organisation for Animal Health – www.oie.int/animal-health-in-the-world/

[3] The World Organisation for Animal Health was formerly known as the Office International des Epizootics (OIE); despite the name change, they have kept the "OIE" acronym.

i) If the species is a fish, mollusk, crustacean, amphibian, or one of several mammal species, then determine whether there is an OIE-reportable disease is documented for the species.
ii) The list of current OIE reportable diseases should be located on left-hand side of the web page.
iii) If the species is associated with other non-OIE reportable diseases, pathogens or parasites, those should be listed here as well but clearly marked as non-OIE reportable.

Example - Using Fishbase (www.fishbase.us/search.php):

1) *Copy and paste relevant information from the 11 subheadings listed in 1 above. The headings in Section 2 of an ERSS were designed to correspond to many of the major headings in Fishbase.*
2) *Note whether the species is listed as "Potential Pest," and list that information in the Risk Screening Template under "Threat to Humans"*
   a) *Remember to also include whether the species is venomous, toxic, traumatogenic, etc. If the user comes across other information on human threats in the literature/other databases it should be included here.*
3) *Links to More Information - Near the bottom of a Fishbase record is a heading titled "More Information" with a series of links to other information within Fishbase (Introductions, Diseases, etc.).*
4) *Click on the "Diseases" link under more information, and then copy that list into the risk screening report. Note whether a disease is OIE reportable (see Diseases above).*

3D: ERSS Section 3 - Impacts of Introductions

1) Based on the data description below, search for information on impacts of introduction for the species being assessed, using data sources and special instructions in number 2 below.

   a) **Data Description – Impacts of Introduction –** Include all information on the effects of the assessed species, within a nonnative habitat, including those affecting native species, the environment, the economy, or human health. Pay special attention to those impacts related to criteria under the Lacey Act, including impacts to human beings, to the interests of agriculture, horticultural, forestry, or to wildlife or the wildlife resources of the United States. Details that may be useful include:
      i) Specifically what ecological, social, or economic constructs or functions were impacted?
      ii) What was/were the magnitude of the impacts?
      iii) Is the species listed on international, Federal, or State invasive/prohibited/ restricted lists? If so, then provide the jurisdictions that promulgated rules to restrict possession/trade/transport.

b) **Important Notes**
   i) It is most important to seek peer-reviewed literature documenting details of assessed and documented impacts, and to copy from, and cite, that literature. While "potential impacts" can certainly be reported, they cannot be used as the sole basis on which a species is assessed.
   ii) Conduct searches of world databases, and ensure that you include AFS-formatted references.
   iii) Remember to watch for material that uses a numeric citation system and be sure to include the full references in the ERSS and in its Reference sections.
   iv) Provide as much relevant information on impacts as possible without unnecessary repetition.
   v) See Appendix C for an ERSS template and Appendix D for a completed example of an ERSS.

2) **Data Sources and Specific Instructions** – Search for information on impacts of introduction, based on the specific instructions provided below, that are relevant to the species being assessed.

a) Primary sites to search for information on impacts include the following resources (but other sources listed throughout this SOP may also be useful as well):
   i) **Invasive Species Compendium** – Centre for Agricultural Bioscience International – www.cabi.org/isc
   ii) **Global Invasive Species Database (GISD)** – www.issg.org/database/welcome/
   iii) **Nonindigenous Aquatic Species Database** – U.S. Geological Survey – nas.er.usgs.gov/queries/SpSimpleSearch.aspx

b) For fish species, an additional source for impacts is the "Introductions" link located under the "More Information" heading on a species' page within **FishBase** (www.fishbase.us/search.php). Clicking this link produces a table with all known introductions of the species and the cited research that presents these findings. Many times these papers also list potential or actual impacts for the species in introduced habitats.

> ***Note:*** *The Introductions information in Fishbase is linked to the Food and Agriculture Organization of the United Nations' Database on Introductions of Aquatic Species (DIAS) (see next section); although it can still be beneficial to check both locations for impact information.*

c) **Database on Introductions of Aquatic Species (DIAS)** - Food and Agriculture Organization of the United Nations – www.fao.org/fishery/introsp/search/en
   i) Use search field to search for aquatic species name
      (1) Search results from DIAS consist of a series of records of introductions from one place to another. These records may or may not be useful as many seem to have little useful information; however they sometimes contain information on ecological effects. The records may also provide links to a fact sheet if one exists.

ii) Note Ecological Effects – "Some";
(1) Note Ecological Effects type – "Adverse"
(2) In the Risk Screening Template, note what locations and what adverse effects may be documented.

> ***Note:*** *Some DIAS records list "Probably Some" under the ecological effects heading. Although this should be noted, and discussed in Impacts of Introduction, it is not enough to establish a history of invasiveness (see 3I below) and more detailed information should be sought.*

d) **Other websites** that provide some limited information on impacts include:
i) **National Invasive Species Database (NISbase)** – www.nisbase.org/nisbase/index.jsp
ii) **Delivering Alien Invasive Species Inventories for Europe (DAISIE)** – www.europe-aliens.org/speciesSearch.do
iii) **European Network on Invasive Alien Species (NOBANIS)** – www.nobanis.org/Search.asp
iv) **Baltic Sea Alien Species Database** – www.corpi.ku.lt/nemo/alien_species_directory.html
v) **Invasive Species of Japan** – www.nies.go.jp/biodiversity/invasive/index_en.html

e) The **Global Invasive Species Information Network** – http://gisin.org/ – This site a comprehensive list of databases that one can search in a variety of ways.

> ***Note:*** *If GISIN is responding slowly, the many databases used by GISIN can also be accessed directly instead of using GISIN as the search engine. If accessed directly, however, many of the databases are in languages other than English.*

f) **Google Scholar** – scholar.google.com/
i) Queries that can produce results include the scientific name plus "invasive," "impacts," "introduced," "exotic," and "alien." A search on a common name can sometimes bring up results as well.
(1) If any of the searches yield results on impacts, provide the exact link from the search by copying and pasting the internet address into the ERSS.
(2) Paste sources as headings, and descriptions of impacts (one or several scientific publications) under each source heading.
(3) Ensure that all pasted materials are placed within quotes (when they are exact quotes) and ensure that all scientific literature is properly cited in the Reference section.

g) **Other resources**
i) Resources listed in 3(B)(2)(e)above (EOL, BISON, NISBase, Web of Science, etc.)
ii) Two PDF documents on Japan and Asia:

(1) **List of Invasive Species in Japan** - Japanese Ministry of the Environment, Nature Conservation Bureau – www.env.go.jp/nature/intro/1outline/files/siteisyu_list_e.pdf
(2) **Invasive Alien Species in South-Southeast Asia** – www.gefforestinvasivessea.org/docs/Resources/IAS%20in%20SEA%20-%20GISP.pdf

3E: ERSS Section 4 - Global Distribution

1) **Data Definition – Global Distribution –** Place maps displaying the global distribution of the species.
   a) The map should include a caption and, where applicable, a legend.

> ***Note:*** *If the established locations are across many parts of the world the resolution of the map from GBIF can make individual locations difficult to discern. If this is the case, consider adding more than one map of various established locations as necessary.*

2) **Data Sources and Specific Instructions** – Search for the information on global distribution, and considering the specific instructions below relevant to the species being assessed. Data from the Global Biodiversity Information Facility is often used for this section.

   a) **Access maps showing distribution in the world**
      i) Global Biodiversity Information Facility (GBIF) **–** data.gbif.org/welcome.htm
      ii) Conduct species search by scientific name
      iii) Then click on species (May need to "Accept Terms")
      iv) Scroll down to map – May need to zoom.

> ***Note:*** *If zooming is required, when you place the cursor onto the map, you will see a small red square appear. Initially, you can only zoom in to the scale shown on that small square. However, after the page reloads with the zoomed in map, you will then see a small icon at the upper right corner of the map (with 4 small arrows) that will allow you to zoom back out a certain degree. This can be done more than once until you get the needed magnification.*

   b) **Search for Outliers and Anomalies –** When viewing the GBIF data, it is important to remember to identify established population locations only, and therefore some points in the GBIF data will need to be removed for the ERSS.
      i) To do this, compare the map to the known native range, introduced range, and other information you have already gathered on the species in question.
      ii) Look for outlier points after this comparison and zoom in on them. Once you have zoomed in on the points in question scroll down below the map to where it says, "View all occurrences of [species name] within the viewed area [coordinates]." Click on this link.

iii) Under table of results, you can view each individual record by then clicking on the word "View". Within the provided information on the record, be sure that:
   (1) The Longitude and Latitude are correct for the provided location,
   (2) That the map location makes sense (i.e. a fish species captured from an aquatic environment not dry land), and
   (3) That the collector/collecting organization has not simply provided a location for its library or catalogue (this seems to occur more frequently in Scandinavia and/or Germany).
   (4) If the record appears genuine, it may be included, if not note that you are not including this point in the text of this section and the reason it is not included, and perform the climate match without it.

c) **Save the Map** – Noting any data points which will not be used (see above), save the map for incorporation into the ERSS.
   i) To do this, use the Shift-Print Screen function or a graphic capturing tool to capture a copy of the image.

> ***Note:*** *The GBIF website has one quirk to be aware of. If your cursor strays onto the map, the red square that appears for zooming will not go away. To remove the square and get a clean image the map must be reloaded.*

   ii) Format map using image editing software and remove any erroneous points as necessary.
   iii) Save the map as "*.png" file or "*.jpg" file as a record for the ERSS file (See Fig. 2 below).
   iv) Caption formatting for global distribution map (Fig. 2) should read: "*Figure <x>. Known global established locations of <scientific name>. Map from <citation>.*"
   v) Insert the map from the image editing software into the ERSS.
   vi) Print out the map so that you can use the locations in climate matching (see part 3G: ERSS Section 6 below).

Figure 2: Example of a **Global Distribution Map** acquired from GBIF using the instructions above (2a-c). See above for recommended caption.

3F: ERSS Section 5 - U.S. Distribution

1) **Data Descriptions – U.S. Distribution** – Place maps displaying the distribution of the species within the United States (if the species is present in the United States).

   a) The map should include a caption and, where applicable, a legend.

   b) If the species is not known to occur in the United States, then simply state: "*This species has not been reported in the United States*"

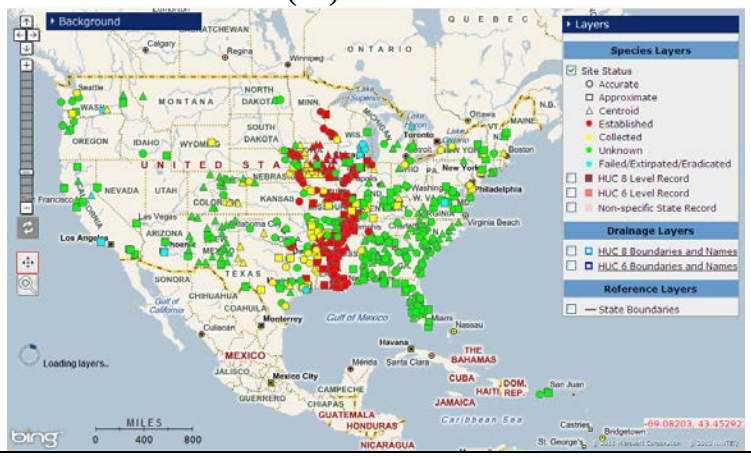
2) **Data Sources and Specific Instructions** – Search for the information on U.S. distribution, using the specific instructions below relevant to the species being assessed. If the species is an aquatic animal, start with the excellent point maps produced by the USGS Nonindigenous Aquatic Species database.

   a) **For Aquatic Invasive Animals** - Check the USGS Nonindigenous Aquatic Species Database (nas.er.usgs.gov/queries/SpSimpleSearch.aspx) to determine if a point map exists for the species.

   > ***Note:*** *If the species under assessment has never been introduced into the U.S. then the NAS Database will not contain any data. This should be corroborated by consulting other databases listed in the SOP.*

      i) Searching by scientific or common name will generate a table of results with one or more records. If a point map exists for the species, there will be a "point map" link in the 6th column of the table. Select that link to generate a point map for the species.
         (1) On the right side of the resulting map, in the "Layers" box, under the "Species Layers" subheading, select "Population status/spatial accuracy" and deselect "Number of specimen records."
         (2) Additional consideration – In the box on the upper left side of the map, in the box labelled "Background," try switching the map view to "Basic" because you can see the states more clearly.
      ii) If a point map exists, check to see if the map includes established populations (bright red circles, squares, and triangles indicate established populations)
      iii) If there are established populations, then save the map and copy it into the ERSS using the methods suggested above. Include the legend so readers can know what each shape and color indicates.
      iv) Print out the map, so that you can use the established locations in climate matching.
      v) U.S. distribution map (Fig. 3) caption should read: "*Figure <x>. Distribution of <scientific name> in the United States. Map from <citation>.*"

Figure 3: Example of a **U.S. Distribution Map** acquired from the NAS Database using the instructions above (2b). See above for recommended caption.



b) **For Non-Aquatic Animals** – If the species is not an aquatic animal, use other sources mentioned throughout this SOP to document any occurrences within the U.S. Insert and cite relevant maps into the ERSS.

c) **For Plants** – Search the following websites to determine distribution of plants in the U.S.:

i) **USGS Nonindigenous Aquatic Species Database** – nas.er.usgs.gov/queries/SpSimpleSearch.aspx

(1) Follow the steps outlined above in part 2(a) of this section if information is found for the subject species.

ii) **EDDMAPS website** – www.eddmaps.org/distribution/

iii) **Invasive Plant Atlas of the United States** – www.invasiveplantatlas.org/distribution.html

> ***Note:*** *Index page is a huge list of plants - use find function in your browser to find specific plants.*

iv) **Introduced/Invasive/Noxious Plants Web Page – USDA-NRCS Plants Database** – plants.usda.gov/java/noxComposite?stateRpt=yes

> ***Note:*** *The upper part of the web page has State "noxious" weed lists. The lower section has links to large number of plant species.*

v) **iMap Invasives** – www.imapinvasives.org/GIST/ESA/index.html

> ***Note:*** *The iMapInvasives website is an online tool for invasive species reporting and data management (invasive animals, insects, and plants). However, it is only for participating states. As of January 2015, the following States and 1 Canadian Province can use the site: Arizona, Florida, New York, Maine, Oregon, Pennsylvania, Vermont, Virginia, and Saskatchewan.*

3G: ERSS Section 6 - Climate Matching

The risk assessor can use either the Australian Bureau of Rural Science's Climatch program (Australian Bureau of Rural Sciences 2010) or the U.S. Fish and Wildlife Service's Risk Assessment Mapping Program (RAMP; Sanders et al. 2014) to perform the climate matching part of the ERSS process.

Climatch is a peer-reviewed Australian model that matches the climate of a species (via 16 climate variables) in its native and nonnative ranges with similar climates in the United States. The Climatch web site is located at: data.daff.gov.au:8080/Climatch/. Instructions on how to conduct a climate match using the Climatch online software are detailed in the standard operating procedures listed below. If Climatch is unavailable or the risk assessor has access to ArcGIS, however, we recommend the use of RAMP instead.

The Service developed RAMP to improve upon the Climatch online software. RAMP is a peer-reviewed climate matching tool that implements the Climatch algorithm that is currently used by Climatch (developed by Joe Crombie, 2008) and CLIMATE for Mac (Pheloung, 1996) and Windows (developed by Simon Barry, 2006); RAMP uses ArcGIS as the operating platform. If the risk assessor is licensed to use ArcGIS, and wishes to use RAMP, then a request can be made using the contact information listed at https://www.fws.gov/fisheries/contact.html. The RAMP system is accompanied by a User's Guide that should be followed to conduct climate matching in a manner similar to that described, for Climatch, below.

1) **Data Descriptions – Climate Matching Using Climatch Online Software–** In Section 6, the maps generated for ERSS Sections 4 and 5 (Parts 3E and 3F above) are used to run a climate match for the assessed species. The user's manual for the Climatch online software is included within this SOP as an embedded PDF in Appendix F.

    a) **Climatch Source Map -** A map displaying the weather stations that were selected as the source locations for Climatch. The map should include a caption.

    b) **U.S. Climate Match Map -** A map displaying the Climatch climate match with the United States (see example Fig. 4). This match is usually run for the contiguous United States by default, but if a risk assessment is needed for a more specific region a climate match can be done that includes Alaska and Hawaii or for a specific State, region or territory. The map should include a caption and a legend if necessary.

    c) **Table of Climate Match Scores -** A table that includes the count for each Climatch score and the Climate 6 Proportion.

2) **Data Sources –** The climate match is conducted by using the Australia Bureau of Rural Science's Climatch program.

a) To initiate a Climatch go to: data.daff.gov.au:8080/Climatch/
   i) Click on the blue Start icon with the picture of Australia on it.
   ii) The Climatch user's manual can be found as an imbedded PDF document in Appendix F and at the following internet address: data.daff.gov.au:8080/Climatch/docs/climatch_manual.doc

3) **Specific Instructions**

a) **Step 1: Designating Source Region Weather Stations** – Choose the weather stations closest to the locations where the assessed species is established (both its native range and its introduced range).
   i) On the left side of the page, make sure the "Source Region" tab is active (upper left side, just under the dark heading).
   ii) Map Navigation - Use the ZOOM (magnifying glass) and PAN (hand) buttons on the left side of the page to focus on the areas of the map where the species occurs.
   iii) Select Stations. Stations selected should be those in GBIF (excluding outliers), and USGS NAS if **established** in the U.S. (use red established points only). Please see important note in Part 3E(2)(b) above on searching for outliers and anomalies.
      (1) Freehand Tool - The Freehand Select Tool is used most often –
         (a) Select weather stations (polygon) in concordance with maps compiled based on information from GBIF and USGS NAS, scientific publications, and any other reliable sources.
         (b) Cite sources, and paste source maps into the Risk Screening Report Template (see Parts 3E (ERSS Sec. 4: Global Distribution) and Part 3F (ERSS Sec. 5: U.S. Distribution) above)
         (c) Your selected stations will show as red pixels. Right click to deselect stations.
      (2) There is a method to download location data from GBIF, and also upload the coordinate data to Climatch and load a pre-selected subset of weather stations. These options are outlined in the text box below.

To Download Records From GBIF:
- Occurrence data can be downloaded for a given species from GBIF (www.gbif.org) and clicking on "xxx,xxx,xxx Occurrences" (the number increases daily).
- Then select "search, view and download".
- Add filters such as scientific name
- Download the filtered subset of records.
- Once downloaded, there is a zip file with an "occurrences.txt" inside. The latitude/longitude fields from this text file can be extracted into a separate file and then uploaded to Climatch.

To Upload Coordinate Data to Climatch:
- Start with a tab delimited text file containing coordinate pairs. Latitude should come first in each pair of coordinates, and they should be separated by a tab.
- Go to data.daff.gov.au:8080/Climatch/climatch.jsp and click the "lat/lon" icon under the "Source Region" tab.
- Click "Choose File" and browse to the above text file.

- At this point one can make adjustments to underlined/bold values in the following statement "Select up to **1** station(s) within approximately **50** kilometres."
- Click "Upload File" when the desired selection criteria is set.
- Click "Ok" on popup progress window.
- Click "Done"

To Load a Pre-selected Subset of Weather Stations:

- If one already has a ".clm" file that was generated to select specific weather stations, it can be loaded instead of hand selecting all the desired stations on each Climatch run.
- Click on "Target Region"
- Click the "Load an existing ".clm" File" button (to the left of the lat/lon button used in the previous section)
- Browse and find ".clm" file
- Click "Upload File"
- Click "Ok" in popup progress window.
- At this point the match is ready to run.

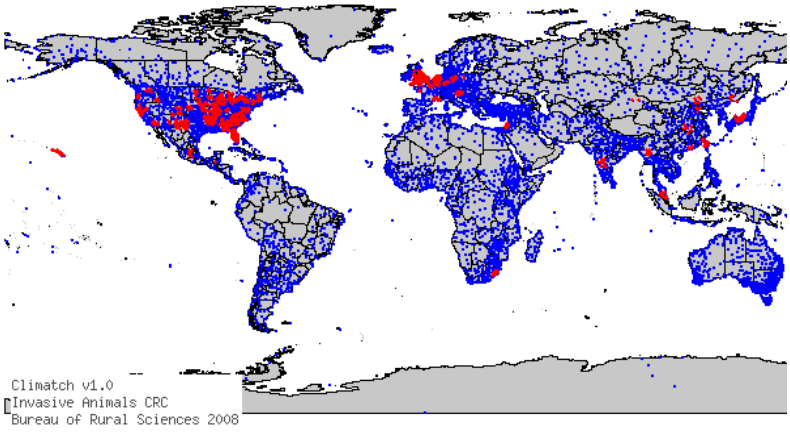
iv) Save **Climatch Source Map** (floppy disk icon on lower left) as "*.png" file, and copy/insert into the Risk Screening Report Template (as per instructions in Part 3E - ERSS Section 4).

(1) Save the source map ".clm" file. If the climate match needs to be run again, the user can upload the ".clm" file instead of selecting all the points again.

> ***Note:*** *If the point selection tools do not seem to be working properly, try a different web browser.*

(2) Caption for the Climatch source map (Fig. 4) should read: "Figure <X>. Climatch *(Australian Bureau of Rural Science 2010) source map showing weather stations selected as source locations (red) and non-source locations (blue) for <scientific name> climate matching. Source locations from <citation>.*"

Figure 4: Climatch Source Map showing weather stations used in the Climate matching process. See above for recommended caption.



b) **Step 2: Designating Target Region Weather Stations** – In this step, choose the weather stations that are being compared to the source region data.
   i) On the left side of the page, make sure the "Target Region" tab is active
   ii) On the left side, in the "Data Set" pull-down menu, choose "World Stations"
   iii) Select Stations – **The contiguous U.S. is used as the default for rapid screening;** other geographic settings (continental U.S, all of the U.S., specific regions or States) can also be used for more geographic-specific risk assessments.
      (1) Using the same navigation and selection techniques as you did in Step One, Select weather stations (polygon) for U.S.

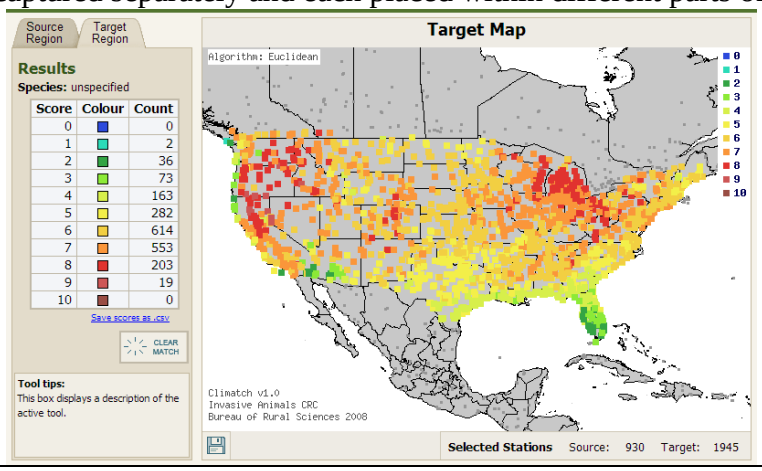
> ***Note:*** *After you have selected the U.S. Stations, then save the file as a ".clm" file. You can then load that file anytime you wish by clicking on the lower-left icon under the heading "Select Stations" and then browsing to select the file you saved with U.S. weather stations selected.*

c) **Step 3: Run the Climate Match**
   i) Using the default settings (contiguous U.S., see preceding section above), click the "Run Match" button on the left side.

> ***Note:*** *Although the default setting for ERSS reports is usually the contiguous U.S., an ERSS could also be completed for all of the U.S. (including AK and HI), the continental U.S. (including AK), or for a specific part of the U.S. (by States or for specific regions, for example).*

   ii) The results include both a table on the left that displays the match classes and accompanying match counts and a map on the right side showing the distribution of the climate matches (see Fig. 5).
   iii) Copy and paste the map as in Figure 6 below, then enter the data from the table on the left side into the spreadsheet program as outlined below and placed within the ERSS as in Step 5 below.

Figure 5: Screenshot showing full Climatch results, including both map and the table of climate scores. This view is not placed in the ERSS as is, but rather the map and the scores are captured separately and each placed within different parts of the ERSS.



d) **Step 4: Incorporate Climate Matching Results Into ERSS** - Both the **U.S. Climate Match Map** and the scores must be saved and pasted into the ERSS Template (Appendix C).

i) To save the target map, click the small disk symbol below the map on the left. When you click on the disk symbol a small dialog box will pop up asking you to choose a file format - save the file as a "*.png" file).

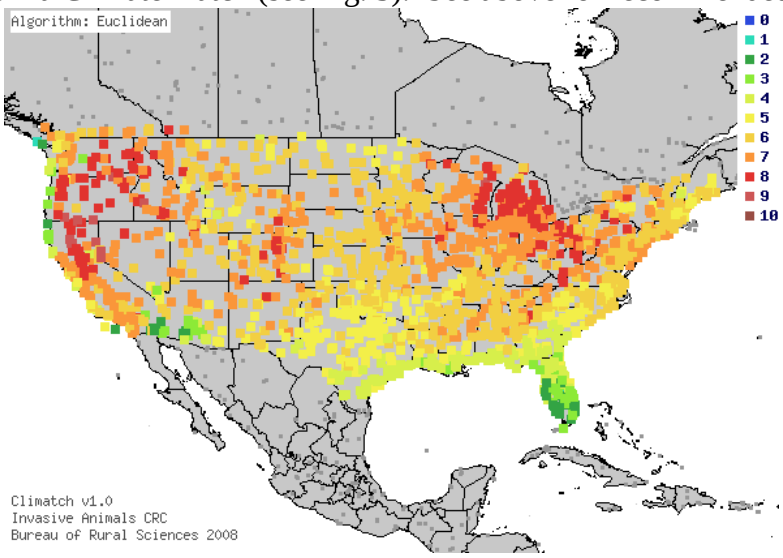
ii) To save the Climate Match Results (the scores), click on the very small text below the scores that says "*save scores as .csv*."

(1) The "*.csv" file can then be opened and edited in Microsoft Excel.

> ***Note:*** *If you try to open the file from within Excel using the "open" command, you need to make sure that Excel is looking for "All Files" and not just the default "All Excel Files."*

(2) Caption for the **U.S. Climate Match Map** (Fig.6) should read: "*Figure <X> (below). Map of Climatch (Australian Bureau of Rural Science 2010) climate matches for <scientific name> in the contiguous United States based on source locations reported by <citation>. 0= Lowest match, 10=Highest match.*"

Figure 6: Example of a **U.S. Climate Match Map** showing distribution of the climate matches for a species within the contiguous U.S., copied from the right side of the results screen from a Climate match (see Fig. 5). See above for recommended caption.



e) **Step 5: Climate 6 Ratio Calculations**

i) For the desired setting (Continental U.S. as default, or other desired setting) calculate Climate 6 Ratio ((Sum of Counts for Climate Scores 6-10)/(Sum of all Climate scores)) and provide a table within the ERSS report with the Climate 6 calculations.

ii) Using a spreadsheet program such as Excel, provide these outputs in ERSS report. To calculate the Climate 6 score (see Tables 1 and 2 below):

(1) Enter all the scores into the spreadsheet and sum all the scores.
(2) Add up the Climatch Scores for scores 6 through 10.
(3) Divide that number by the total Climatch score. This is your Climate 6 score.
(4) Use the Climate 6 score to categorize the score (high, med, low) in Section 8 of the ERSS.

Table 1: Climate 6 Score, and its relationship with Climate Match Category. These relationships were based on analysis of data for 255 species established in 10 countries (Bomford 2008). See Appendix G for more details about how the climate match categories were derived.

Climate 6: Proportion of (Sum of Climate Scores 6-10)/(Sum of total Climate Scores)	Climate Match Category
0.000≤X≤0.005	Low
0.005<X<0.103	Medium
≥0.103	High

iii) Cut and paste the **Table of Climate Match Scores** from the spreadsheet program or create a new table within the ERSS report to show the Climatch scores (See Table 2 below).

> ***Note:*** *If the numbers in the spreadsheet are large enough, the table may not lend itself to a landscape layout, if that is the case then present the table in a portrait format instead.*

(1) Caption for **Table of Climate Match Scores**: "*Table <X>. Climatch (Australian Bureau of Rural Science 2010) climate match scores for <scientific name> for <region of the U.S.>.*"

Table 2: Example of a **Table of Climate Match Scores** and the **Climate 6 Calculations** for insertion into an ERSS report. See above for recommended caption.

Climate Match	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Count	1	0	3	1	3	7	88	275	614	283	721
Climate 6 Proportion = Sum of Climate Scores 6-10 / Sum of Total Climate Scores = **0.992 (High)**											

3H: ERSS Section 7 - Certainty of Assessment

1) **Data Definition – Certainty of Assessment –** For Section 7, use the information generated in the previous 6 sections to describe the amount of information available regarding the species, and its adverse impacts, to help determine a level of certainty for the Overall Risk Assessment Category of the species. The level of certainty is a combination of: 1) data quality (scientific credibility and reliability) and quantity, and, 2) how those factors affect the certainty of the Overall Risk Assessment

Category. This is most important in relation to scientific documentation of impacts of introduction (i.e., history of invasiveness), and the information necessary to document the species distribution, which is used to match climate there with climate in the United States.

2) **Specific Instructions for Certainty of Assessment** – Based on the quality and quantity of the information for the assessed species, the assessor should assign a level of certainty to the ERSS and corroborate that certainty level with a supporting narrative.

3) **Certainty Categories**

   a) **High Certainty** – The risk assessor is highly certain of ERSS risk categorization, which is based on existing evidence that is provided and referenced within the ERSS. High Certainty means that clear, convincing, and scientifically credible and defensible information, data and associated syntheses are being used to draw conclusions about the subject species history of invasiveness, and climate match with the United States.
      i) One could conclude High Certainty when abundant, clear, and convincing information is available, about the subject species' history of invasiveness and distribution, from peer-reviewed, scientific literature.
      ii) One could also conclude High Certainty, if the subject species is documented as established outside of its native range, and one or more credible and reliable scientific studies concluded that no significant history of invasiveness resulted from establishment of the subject species.

   b) **Medium Certainty –** Medium certainty means that there is a "preponderance of evidence" (Weiss 2003) relating to the history of invasiveness and the species distribution and that the Certainty of the Assessment is neither High (see 3H(3)(a) above) nor Low (see 3H(3)(c)) below.
      i) For example, the risk assessor may conclude Medium Certainty when most of the data and information about the subject species history of invasiveness and distribution are available only from gray literature.

   c) **Low Certainty–** The risk assessor is uncertain of the ERSS risk categorization. In this case, no, or very limited, information/data available about the subject species.
      i) Limited and/or equivocal evidence exists that is not scientifically defensible, about the subject species:
         (a) History of invasiveness, and/or
         (i) World distribution, so that climate matching with the United States will not provide scientifically defensible results.

4) **Narrative** – The Certainty category should be accompanied by a narrative that clearly explains the reasons for the risk assessor's choice. Things that should be discussed here include the quality and quantity of the data (including the number of peer-

reviewed studies indicating impacts or lack thereof), taxonomic issues, distribution issues, whether the species is cryptogenic (status as a native or non-native species is unknown), and anything else that the risk assessor feels the reader should know about the ERSS.

3I: ERSS Section 8 - Risk Assessment

1) **Data Descriptions** – For Section 8, summarize the information from the preceding sections of the ERSS along with the risk categories assigned to the assessment elements (history of invasiveness, and climate match). Follow the format in Ecological Risk Screening Summary examples.

   a) **Summary of Risk to the United States** – This section is a narrative summary and synthesis of the entire ERSS document. Included in this section are, at a minimum, important information on the biology, ecology, distribution, impacts, uses, and threats posed by the species. Especially important are a summary and synthesis of the history of invasiveness, climate match with the United States, the Certainty of the Assessment, and the Overall Risk Assessment Category for the species.

   b) **Assessment Elements** – The scores for each element of the risk assessment, as determined using the guidelines in the SOP, are presented in bulleted form:
      (1) **Example** (Format is Bold, with 12 and 16 point font):

> **Assessment Elements**
> - **History of Invasiveness (Sec. 3):** High
> - **Climate Match (Sec. 6):** High
> - **Certainty of Assessment (Sec. 7):** High
>
> **Overall Risk Assessment Category:** High

2) **Specific Instructions**

   a) **Summary of Risks**
      i) The risk assessor should summarize the information within the ERSS that has led them to their overall risk assessment category.

> **Note:** An example might read as follows: *"L. fortunei currently has no known populations in United States waters. However, it has caused significant environmental problems in South America, where it became established in 1991. This species was likely introduced through ballast water releases, and has spread rapidly through a large portion of South America. The climate match in the United States is high, leading to the belief that this species poses a large risk to American waters should it be introduced."*

      ii) See other examples in the sample of a completed ERSS in Appendix D and in existing ERSS reports located on the Service's Injurious Wildlife web page, at: www.fws.gov/injuriouswildlife/Injurious_prevention.html.

b) **History of Invasiveness**: High, Low, None Documented, or Uncertain
   i) Specifically, provide clear, convincing, and scientifically reliable and credible evidence of the history of invasiveness. Sources of information used to categorize history of invasiveness are either scientific resources outlined in this SOP, or other reliable sources. Significant adverse effects and detailed descriptions of those effects, are listed in the Impacts of Introductions section, and cited in the References sections.
      (1) **High** – Species is established outside its native range, and one or more sources provide clear, convincing, and scientifically credible, reliable, and defensible documentation of negative impacts of introduction. Pertinent information is quoted in Section 3D, Impacts of Introduction, and cited in the References sections.
         (a) As per Section 3D, Impacts of Introduction is defined as the effects of the assessed species, within a nonnative habitat, including those affecting native species, the environment, the economy, or human health (e.g. impacts to human beings, to the interests of agriculture, horticultural, forestry, or to wildlife or the wildlife resources of the United States).
      (2) **Low**
         (a) The species is established outside of its native range, but scientifically defensible studies conclude that there are no significant negative impacts of introduction that are attributable to the subject species; or
         (b) The species has been transported beyond its native range due to substantial trade [millions of organisms[4]] for substantial time [10 or more years[5]] without no or very little evidence of establishment outside its native range.
      (3) **None Documented** –The species has been established beyond its native range, but no scientifically credible studies exist documenting negative impacts of introduction.
      (4) **Uncertain**
         (a) There is no evidence of the species having ever been transported (through trade or other mechanisms) outside its native range, so the species has had no opportunity to become established and exhibit any negative impacts of introduction; or
         (b) The species is cryptogenic (status as a native or non-native species is unknown); or
         (c) The species' distribution is unknown (including whether it has been introduced outside its native range).

[4] The bracketed materials provide only the Service's frame of reference, instead of a precise amount of propagule pressure.

[5] The bracketed materials provide only the Service's frame of reference, instead of a precise time period. Risk screenings conducted, by trained risk assessors, using a combination of data, models (including climate matching), qualitative information, and risk assessor structured, expert judgment. The risk screening approach has been standardized as much as possible, is not completely automated. Trained risk assessors use guidance provided in this SOP, including the bracketed frame of reference, and decide on Overall Risk Assessment categories using history of invasiveness, Climate Match, and the quality and quantity of the information available about the subject species.

c) **Climate Match** – Summarize the Climate 6 score developed in Part 3G (ERSS Section 6 - Climate Matching). List the categorical result (High, Medium, or Low), and either jurisdictions or regions of the U.S. where climate match is high.

d) **Certainty of Assessment** – List the categorical result (High, Medium, or Low) from see Part 3H (ERSS Section 7) above.

e) **Overall Risk Assessment Category** – This final piece of information is a rating of Low, High, or Uncertain based on the information below (Format is Bold, 14 Point Font). See table 3 for a summary of all the combinations of Climate 6 score and history of invasiveness.
   i) **High –** To receive an overall risk of High, a species must have both (1 and 2 below) of the following:
      (1) Medium or High Climate 6 score; and
      (2) High history of invasiveness. Scientific evidence is clear, convincing, and scientifically credible, reliable, and defensible.
   ii) **Low –** To receive an overall risk of Low a species must have both of the following:
      (1) Climate 6 score is categorically Low; and
      (2) Low history of invasiveness (see 2(b) in this section).
   iii) **Uncertain** – A species is given an overall risk of Uncertain, for any of the following combinations of Climate 6 score and history of invasiveness:
      (1) Climate 6 score is Low and history of invasiveness is High
      (2) Climate 6 score is High or Medium and history of invasiveness is Low.
      (3) Climate 6 score is Low, Medium, or High and history of invasiveness is None Documented.
      (4) Climate 6 score is Low, Medium, or High and history of invasiveness is Uncertain.

Table 3: Overall Risk Categories acquired by combining Climate Match (Climate 6 Score) with History of Invasiveness.

Overall Risk Category		**Climate Match**		
		High	**Medium**	**Low**
History of Invasiveness	**High**	**High**	**High**	**Uncertain**
	Low	**Uncertain**	**Uncertain**	**Low**
	None Documented	**Uncertain**	**Uncertain**	**Uncertain**
	Uncertain	**Uncertain**	**Uncertain**	**Uncertain**

3J: ERSS Sections 9 and 10 - References

1) **Data Descriptions –** For Sections 9 and 10, all peer-reviewed and other scientific literature cited within the ERSS must be included in one of the two reference sections.

   a) **Section 9 – References Actually Used within the ERSS** – This section is for citations that were directly accessed by the risk assessor; these sources were quoted or paraphrased within the ERSS.

   b) **Section 10 – Reference**s **Quoted but not Accessed** – This section is for citations that occur within quoted material, but that were not accessed by the risk assessor.

2) **Specific Instructions**

   a) All references should use standard AFS formatting (see Appendix B for more details and links to the reference guides).

   b) Remember to italicize species names within references.

   c) When citing online references, the date cited should be the date the site was edited, not the date the site was accessed. If including the date the site was accessed, that information should be included at the end of the reference.
      i) Example: Froese, R., and D. Pauly. Editors. 2012. FishBase. Available: www.fishbase.us/summary/Alburnus-alburnus.html (April 2012).

   d) When placing quoted material within an ERSS, be aware of databases and journals that use a numerical citation system, placing the actual references on another web page or at the end of a document (FishBase and CABI are two examples where this occurs). When this occurs, the references must be retrieved from the reference section of database and the numerical citations replaced with the references within the quoted text (and added to Section 10 unless accessed by the risk assessor).

   e) When a reference in Section 10 fails to include all or part of the information for a citation, the following information shall be placed in the reference section after the available information: "[Source material did not give full citation for this reference]."

   f) Although the rapidity in which an ERSS is prepared often makes it difficult to use personal communications, it is certainly acceptable to do so, provided the risk assessor has sufficient time to seek out the assistance of experts in the appropriate fields of study. Personal Communications should follow this format in References:
      i) Berzins, A. 1960. Washington County's Oral History Program, Dixie State College, St. George, UT.
      ii) Personal communications within quoted material do not need to be cited in Section 10.

PART 4
FINAL NOTE AND REFERENCES

Final Note

After all the steps in Part 3 have been completed, the risk assessor should have a completed Ecological Risk Screening Summary ready for sharing with others. The final step in the ERSS process is to use the Record of Online Data Searches and the QA/QC Checklist (Appendix A) to ensure that all parts of the ERSS have been thoroughly completed, and research and administrative path is clearly documented. Remember that all documentation used to build the ERSS, including the QA/QC Checklist, should be kept in PDF format to be used as part of the administrative record, particularly if the results of the ERSS are ultimately used to pursue an injurious wildlife listing for the species.

As previously mentioned, species with an Overall Risk category of "high" or "uncertain" may be reviewed for possible injurious wildlife listings under Title 18 of the Lacey Act. It is important to emphasize, however, that a species that has gone through the ERSS process is not exempt in any way from all of the required steps in the injurious wildlife process, including opportunities for public comment. The ERSS risk assessment process is a screening process that simply helps prioritize species for further scrutiny.

References

Australian Bureau of Rural Sciences. 2010. Climatch. Available: data.daff.gov.au:8080/Climatch/.

Bomford, M. 2008. Risk assessment models for establishment of exotic vertebrates in Australia and New Zealand. Invasive Animals Cooperative Research Centre, Canberra. Available: www.pestsmart.org.au/wp-content/uploads/2010/03/Risk_Assess_Models_2008_FINAL.pdf

Cowie, R. H., R. T. Dillon, Jr., D. G. Robinson, and J. W. Smith. 2009. Alien non-marine snails and slugs of priority quarantine importance in the United States: A preliminary risk assessment. American Malacology Bulletin 27: 113-132.

NISC (National Invasive Species Council). 2008. 2008-2012 National Invasive Species Management Plan. National Invasive Species Council, Department of the Interior, Washington, D.C.

Pimentel, D., R. Zuniga, and D. Morrison. 2005. Update on the environmental and economic costs associated with alien-invasive species in the United States. Ecological Economics 52: 273-288.

Reeuwijk, L.P. and V.J.G, Houba. 1998. Guidelines for Quality Management in Soil and Plant Laboratories. Food and Agriculture Organization of the United Nations. FAO Soils Bulletin – 74. Available: www.fao.org/docrep/W7295E/w7295e04.htm

Sanders, S., C. Castiglione, and M. Hoff. 2014. Risk Assessment Mapping Program: RAMP. US Fish and Wildlife Service.

University of Washington Library. 2014. Guide to high-quality image databases and resources. Interdisciplinary image content, search strategies, evaluating images, & image citation guide - Image Copyright and Ethical Use. Available: guides.lib.washington.edu/content.php?pid=56693&sid=2775267 (January 2015).

Weiss, C., 2003. Expressing scientific uncertainty. Law, Probability and Risk (2), 25e46.

PART 5
APPENDICES

Appendix A

Record of Online Data Searches and ERSS QA/QC Checklist

This appendix includes two separate parts to help improve the quality of both the final ERSS reports and the administrative record necessary if an injurious wildlife listing is pursued for a species.

PART ONE – Online Data Searches – This table allows an ERSS author to show which online resources were and were not used in an ERSS. This table will be available on the FWS web page as a separate document and should be included as part of the administrative record for a completed ERSS.

PART TWO – QA/QC Checklist – This checklist allows the ERSS author or a reviewer to determine if all aspects of the ERSS have been completed properly.

PART ONE – RECORD OF ONLINE DATA SEARCHES

The citations for the quoted scientific information within an ERSS help the reader understand the origins of the material that goes into the final risk assessment for a species. It is also important, however to document exactly how much research was conducted for an ERSS, including online resources consulted, whether data was found, and whether that data was used within an ERSS. Documenting online resources that both were and were not used:

- Contributes to a better understanding of the validity of an ERSS;
- Allows for a quicker review of an ERSS; and
- Facilitates easier updating of an ERSS in the future.

In the table on the next page, indicate which databases were and were not used for the ERSS. Important items to consider include:

- Has all information used from the databases consulted below been properly cited and referenced?
- Have copies of all information quoted from the online databases consulted been saved as PDFs for the administrative record?
- For the table cell labelled "Justification/Web Site," copy and paste internet addresses when appropriate, or give details on why a web site was not consulted, or data not used.

Record of Online Data Searches for ERSS of _____ <species>			
Online Databases <u>Most Commonly</u> Used For ERSS Development	**Was Data Source Consulted?**	**Was Data Found?**	**Was Data Used in the ERSS?**
Fishbase	___Y ___N	___Y ___N	___Y ___N
Justification/Web site:			
ITIS – Integrated Taxonomic Identification System	___Y ___N	___Y ___N	___Y ___N
Justification/Web site:			
Catalog of Fishes	___Y ___N	___Y ___N	___Y ___N
Justification/Web site:			
GBIF (Global Biodiversity Information Facility)	___Y ___N	___Y ___N	___Y ___N
NAS (Nonindigenous Aquatic Species) Database (USGS)	___Y ___N	___Y ___N	___Y ___N
Justification/Web site:			
EDDMaps	___Y ___N	___Y ___N	___Y ___N
Justification/Web site:			
Invasive Species Compendium (CABI)	___Y ___N	___Y ___N	___Y ___N
Justification/Web site:			
Global Invasive Species Database	___Y ___N	___Y ___N	___Y ___N
Justification/Web site:			
<u>Other</u> Online Databases Used	**Was Data Source Consulted?**	**Was Data Found?**	**Was Data Used in the ERSS?**
Alien non-marine snails and slugs of priority quarantine importance in the United States	___Y ___N	___Y ___N	___Y ___N
Justification/Web site:			
Aqua Map	___Y ___N	___Y ___N	___Y ___N
Justification/Web site:			
BISON	___Y ___N	___Y ___N	___Y ___N
Justification/Web site:			
Database on Introductions of Aquatic Species (DAISIE)	___Y ___N	___Y ___N	___Y ___N
Justification/Web site:			
Delivering Alien Invasive Species Inventories for Europe	___Y ___N	___Y ___N	___Y ___N
Justification/Web site:			
Discover Life	___Y ___N	___Y ___N	___Y ___N
Justification/Web site:			
European Network on Invasive Alien Species (NOBANIS)	___Y ___N	___Y ___N	___Y ___N
Justification/Web site:			
Encyclopedia of Life	___Y ___N	___Y ___N	___Y ___N
Justification/Web site:			
Federal Noxious Weed List	___Y ___N	___Y ___N	___Y ___N
Justification/Web site:			

Record of Online Data Searches for ERSS of _____ <species>			
Online Databases Most Commonly Used For ERSS Development	**Was Data Source Consulted?**	**Was Data Found?**	**Was Data Used in the ERSS?**
Google Scholar	___Y ___N	___Y ___N	___Y ___N
Justification/Web site:			
iMap Invasives	___Y ___N	___Y ___N	___Y ___N
Justification/Web site:			
Introduced/Invasive/Noxious Plants Web Page – USDA	___Y ___N	___Y ___N	___Y ___N
Justification/Web site:			
Invasive Alien Species in Japan [PDF doc]	___Y ___N	___Y ___N	___Y ___N
Justification/Web site:			
Invasive Alien Species in South-SE Asia [PDF doc]	___Y ___N	___Y ___N	___Y ___N
Justification/Web site:			
Invasive Plant Atlas of the United States	___Y ___N	___Y ___N	___Y ___N
Justification/Web site:			
List of Invasive Species in Japan [PDF doc]	___Y ___N	___Y ___N	___Y ___N
Justification/Web site:			
NISbase (National Invasive Species Database)	___Y ___N	___Y ___N	___Y ___N
Justification/Web site:			
Nature Serve Explorer	___Y ___N	___Y ___N	___Y ___N
Justification/Web site:			
NEMESIS (Nat'l Exotic Marine/Est. Spp. Info. Sys.)	___Y ___N	___Y ___N	___Y ___N
Justification/Web site:			
The Crayfish and Lobster Taxonomy Browser	___Y ___N	___Y ___N	___Y ___N
Justification/Web site:			
VertNet	___Y ___N	___Y ___N	___Y ___N
Justification/Web site:			
Web of Science	___Y ___N	___Y ___N	___Y ___N
Justification/Web site:			
WoRMS	___Y ___N	___Y ___N	___Y ___N
Justification/Web site:			
Other databases used:			
_____	___Y ___N	___Y ___N	___Y ___N
Justification/Web site:			
_____	___Y ___N	___Y ___N	___Y ___N
Justification/Web site:			

PART TWO – QA/QC CHECKLIST

The following pages are designed to be a checklist to help both the ERSS author and/or a separate reviewer to determine if an ERSS is complete.

Subject Species Scientific Name	Subject Species Common Name

Name of Reviewer	Date Reviewed

General Questions	
• Has an administrative record for the ERSS been included?	___Y ___N
• Has the Record of Online Data Searches been completed? (Part One of this appendix)?	___Y ___N
• Has the format of the ERSS Template been followed?	___Y ___N
• Are there citations at the beginning of each subheading? (Quote material that spans multiple subheadings must still be referenced at each subheading for clarity)	___Y ___N
Comments:	

Title Page Header	
• Were scientific and common names obtained via ITIS? If not, indicate where the info was obtained:	___Y ___N
• Are the preparer and version details complete?	___Y ___N
• Are any species photographs or artwork properly cited?	___Y ___N
Comments:	

Section 1 – Native Range and Status in the United States

- Was information sought, from multiple sources in the above list of online databases, for all 4 headings in Section 1? Indicate yes or no in the table below.

Native Range	___Y ___N
Status in the United States	___Y ___N
Means of Introduction	___Y ___N
Remarks	___Y ___N

• Have copies of all species entries from the databases consulted for this section been properly cited and referenced and saved as PDFs for the administrative record?	___Y ___N
Comments:	

Section 2 – Biological and Ecological Information

- Was information sought, from multiple sources in the above list on online databases, for all 11 headings in Section 2? Indicate yes or no in the table below.

Taxonomic Hierarchy	___Y ___N
Size, Weight, Age Range	___Y ___N
Environment	___Y ___N
Climate/Range	___Y ___N
Distribution Outside The U.S.	___Y ___N
Means Of Introduction Outside The U.S.	___Y ___N
Short Description	___Y ___N
Biology	___Y ___N
Human Uses	___Y ___N
Diseases	___Y ___N
Threats To Humans	___Y ___N

• Were any OIE-reportable diseases documented for the assessed species?	___Y ___N
• Have copies of all species entries from the databases consulted for this section been properly cited and referenced and saved as PDFs for the administrative record?	___Y ___N
Comments:	

Section 3 – Impacts of Introduction

• Was information sought from multiple sources for impacts of introduction?	___Y ___N
• Have copies of all species entries from the databases consulted for this section been properly cited and referenced and saved as PDFs for the administrative record?	___Y ___N
Comments:	

Section 4 – Global Distribution

• Was GBIF consulted for global distribution? o If not, indicate where the info was obtained:	___Y ___N
• Was the data for global distribution reviewed for outliers and anomalies?	___Y ___N
• Was the map used for this section saved for the administrative record?	___Y ___N
Comments:	

Section 5 – U.S. Distribution	
• Indicate which database was used for U.S. distribution:	___Y ___N
• Was the data for U.S. distribution reviewed for outliers and anomalies?	___Y ___N
• Was the map used for this section also saved for the administrative record?	___Y ___N
Comments:	
Section 6 – Climate Matching	
• If Climatch was used, then was the ".clm" file generated within Climatch saved for the administrative record?	___Y ___N
• Was the U.S. Climate Match map saved for the administrative record?	___Y ___N
• Has the table with the Climate 6 Proportion been doubled-checked for accuracy?	___Y ___N
Comments:	
Section 7 – Certainty of Assessment	
• Has the Certainty of the Assessment been adequately explained?	___Y ___N
Comments:	
Section 8 – Risk Assessment	
• Does the section have a paragraph summarizing pertinent details from the risk assessment?	___Y ___N
• Have each of the elements of the risk assessment (history of invasiveness; climate match) been adequately explained?	___Y ___N
Comments:	
Section 9 – References Used Within the ERSS	
• Has all of the quoted material within the ERSS been properly cited in Section 9?	___Y ___N
Comments:	
Section 10 – References Quoted But Not Accessed	
• Have all of the references in the ERSS within quoted material that were not accessed by the ERSS assessor been properly cited in Section 10?	___Y ___N
Comments:	

Appendix B

AFS Standard Formatting for References Excerpt from the Guide to Authors Transactions of the American Fisheries Society

The following information is taken directly from pages 205 and 206 of the Guide to Authors for the Transactions of the American Fisheries Society.

Guide to Authors
Transactions of the American Fisheries Society 140:201–206, 2011

ISSN: 0002-8487 print / 1548-8659 online
DOI: 10.1080/00028487.2011.566490

The document can be found at: fisheries.org/docs/pub_tafs.pdf.

A more detailed chapter from the AFS Style Guide, too large to be included as an appendix here, can also be found at: fisheries.org/docs/pub_style9.pdf. The entire AFS Style Guide can also be obtained at: fisheries.org/docs/pub_stylefl.pdf.

Excerpt from the Guide to Authors, Transactions of the American Fisheries Society

"*Reference formats*.—Text citations should conform to the author–year system. Examples of common types are as follows:

(Johnson 1995)
(Johnson and Smith 1996)
(Johnson et al. 1997, 1998) [three or more authors]
(Johnson et al. 1999, 2001; Smith 2000)
(Johnson 2000a, 2000b)
(Johnson, in press)
(E. M. Johnson, National Marine Fisheries Service, personal communication)

Note that with one exception citations should be listed in chronological order; the exception is that all citations to the same author(s) should be grouped together (see the fourth example above).

In reference lists, references should be in strict alphabetical order by authors' last names; if there are two or more references with the same authors, those references should then be listed chronologically. All authors must be named in references.

Detailed information on reference formats may be found in chapter 8 of the AFS style guide. The more common types are as follows:

Articles in journals

Pace, M. L., and J. D. Orcutt. 1981. The relative importance of protozoans, rotifers, and crustaceans in a freshwater zooplankton community. Limnology and Oceanography 26:822–830.

Note that (1) except for the first author, authors' initials come before their last names; (2) only the first word of the title of the article is capitalized (along with any other words that would be capitalized in ordinary text); and (3) the name of the journal is given in full.

Books

Krebs, C. J. 1989. Ecological methodology. Harper and Row, New York.

Chapters in books

Omernik, J. M. 1995. Ecoregions: a spatial framework for environmental management. Pages 49–62 *in* W. S. Davis and T. P. Simon, editors. Biological assessment and criteria: tools for water resource planning and decision making. Lewis Publishers, Boca Raton, Florida.

Government reports

Reports that are issued on a regular basis are treated much like articles in journals (the principal difference being that page numbers should not be given); other reports are treated like books:

Everest, F. H., C. E. McLemore, and J. F. Ward. 1980. An improved tri-tube cryogenic gravel sampler. U.S. Forest Service Research Note PNW-350. [journal format]

USEPA (U.S. Environmental Protection Agency). 1998. Water quality criteria and standards plan: priorities for the future. USEPA, 822-R-98-003, Washington, D.C. [book format]

Electronic Publications

Formats for references to electronic publications are still evolving. The important thing is to give the reader enough information to be able to locate the reference easily.

If a book or report is only available online or is available in print form but was accessed online, the reference should be formatted as follows:

Baldwin, N. A., R. W. Saalfield, M. R. Dochoda, H. J. Buettner, and R. L. Eshenroder. 2000. Commercial fish production in the Great Lakes, 1867–1996. Great Lakes Fishery Commission, Ann Arbor, Michigan. Available: www.glfc.org/databases/. (September 2000).

The month and year in parentheses indicate when the site was last accessed.

If a journal is available in print form, authors should use the standard reference format even if they accessed the article online. If a journal is only available electronically, the format depends on the way(s) in which articles are designated. Two possible formats are as follows:

Gallagher, M. B., and S. S. Heppell. 2010. Essential habitat information for age-0 rockfish along the central Oregon coast. Marine and Coastal Fisheries: Dynamics, Management, and Ecosystem Science [online serial] 2:60–72. DOI: 10.1577/C09-032.1

Kimmerer, W. J. 2004. Open-water processes of the San Francisco Estuary: from physical forcing to biological responses. San Francisco Estuary and Watershed Science [online serial] 2(1): article 1."

Appendix C

A Template for Completing Ecological Risk Screening Summaries

This appendix contains a template that should be used in conjunction with the Standard Operating Procedures to complete an Ecological Risk Screening Summary.

U.S. Fish and Wildlife Service

Common Name (Scientific *Name*)
Ecological Risk Screening Summary

Author, Month Year
[Affiliation needed only if author is not USFWS]

Photo Goes Here

Photo: [Photo Credit]

1 Native Range and Status in the United States

Provide information for as many of the headings as possible, replacing the explanatory text below under each heading. New headings may be added as necessary.

Note: Development of ERSS reports often includes copying and pasting large amounts of quoted material from various websites or scientific journals. Because this template was based, in part, from the most popular sources for aquatic invasive species, it is possible that quoted material could span multiple headings within the ERSS template. When this occurs, the reference for the quoted material should be repeated for each new heading. This is to prevent confusion and make the source of the quoted material more readily apparent.

Native Range

The native distribution of the species. May include countries, states, regions, and geographic areas such as a specific river basin or specific habitats.

Status in the United States

Whether the species has been reported in the United States and if so, where. Often limited to state-level data but may include more detailed occurrence information. In addition to whether the species has been found in the U.S., this is also the place to mention:

- *If the species is in trade within the U.S.*
- *If the species has any special status in the State, such as being banned for importation into the State, or listed as a State-designated noxious weed or invasive species, or if the species is listed as a Federally listed noxious weed.*
- *Note: For clarity, if no data on trade or status can be found, the ERSS should clearly state that so users know that an attempt was made to find this information.*

Means of Introductions in the United States

How the species was introduced to and spread within the United States. This should include, when known, both the pathways and vectors. Although these terms can sometimes be difficult to separate, the pathway is generally regarded as the reason why a species is transported (whether accidentally or deliberately), and the vector is exactly how a species is transported (i.e. on, in, or with what?). For example, commercial shipping is a pathway, and ballast water, hull fouling, and stowaways are all vectors associated with commercial shipping.

Remarks

Determine whether there are any special circumstances or additional information that is key to the overall interpretation of the ERSS that should be highlighted. Include any additional information that is important to the reader's understanding of the ERSS. This may include:

- *Contradictory information on the range of the species*
- *Recent taxonomic changes*
- *Other commonly used names*
- *Difficulty in correctly identifying this species*
- *Information on congeners and hybridization*

Include any additional information that is important to the reader's understanding of the ERSS. Examples include things such as:

- *"Species is commonly confused with the congener P. miles so the available information often includes both species;" or*
- *"This species is also commonly referred to as the Peacock Bass;" or*
- *"The population in Florida is now believed to be extirpated, although studies have not confirmed this information."*

2 Biology and Ecology

Provide information for as many of the headings as possible. New headings may be added as necessary. References for the quoted material should be repeated for each new heading (see note above).

Taxonomic Hierarchy and Taxonomic Standing

The complete taxonomic hierarchy for the organism including at least the Kingdom, Phylum, Class, Order, Family, Genus, and Species. The descriptors and taxonomic authorities that often occur after the scientific names are not needed.

- *May also include subgroups such as infraclass, superorder, etc.*
- *Include whether the taxonomy is considered valid.*
- *If available, note any recent taxonomic revisions, related species and races, hybrids and varieties.*

Size, Weight, and Age Range

The length or age at maturity, size range, maximum length, common length, maximum weight, and maximum age as available.

Environment

A basic description of the physical conditions necessary for survival of the species, not including temperature. For an aquatic organism, for example, this may include water temperature, salinity, pH, dissolved oxygen content, depth range, turbidity, velocity, etc.

Climate/Range

The general climate (temperate, tropical, etc.), temperature range, and latitude range where the species can survive as available.

Distribution Outside the United States

Native

The native range of the organism outside the United States. Often the same as "Native Range" in Section 1 of the ERSS.

Introduced

The introduced range of the organism outside the United States. If possible, include whether the species is known to be established in each location.

Means of Introduction Outside the United States

How the species was introduced to its new range outside of the United States. This includes pathways and vectors (see Part 3B 1(c) of the ERSS SOP for description of pathways and vectors). If possible, provide a general summary of historical information on introduction, transport routes, and spread.

Short description

A physical description of the species that may be used for identification purposes.

Biology

The basic biology of the species. May include information on habitat use, feeding, reproduction, development, genetics, activity patterns (e.g., migration, hibernation), adaptations for survival, patterns in population size or density, etc. as available.

Human uses

Actual and potential human uses of the species and its current status in trade. May include information related to consumption by humans, use in the pet trade, ornamental uses, use for materials, use as bait, etc. U.S. trade should be reiterated from "Status in the U.S." above.

Diseases

Pathogens and parasites known to be carried by the species. Make note of those which are OIE-reportable.

Threat to humans

Characteristics of the species that pose a threat to humans. May include that the species is venomous, poisonous (toxic), traumatogenic (causes injury), a potential pest, carries a zoonotic disease, etc. Threats to agriculture, horticulture, or forestry should also be highlighted.

3 Impacts of Introductions

This section is extremely important; document as much information as possible on impacts. Include all information on the effects of the assessed species due to its introduction in a nonnative habitat including those affecting native species, the environment, the economy, or human health. Details that may be useful include:

- *Specifically what ecological, social, or economic constructs or functions were impacted?*
- *What was/were the magnitude of the impact(s)?*
- *Is the species listed on international, Federal, or State invasive/prohibited/restricted lists? If so, then provide the jurisdictions that promulgated rules to restrict possession/trade/transport.*

4 Global Distribution

< Insert Global Distribution Map here >

Caption: "*Figure <x>. Known global established locations of <scientific name>. Map from <citation>*"

5 Distribution within the United States

< Insert U.S. Distribution Map here (established point locations map if possible) >

Caption: "*Figure <x>. Distribution of <scientific name> in the United States. Map from <citation>*."

6 Climate Matching

Summary of Climate Matching Analysis

If Climatch is used, then state: The Climate 6 score (Australian Bureau of Rural Sciences 2010; 16 climate variables; Euclidean Distance) for the [insert either Continental United

States. or United States] was [insert the Climate 6 score, and state whether that score is categorically high, medium, and low].

If RAMP is used, then state: The Climate 6 score (Sanders et al. 2014; 16 climate variables; Euclidean Distance) for the [insert either Continental U.S. or U.S.] was [insert the Climate 6 score, and state whether that score is categorically high, medium, and low], and [high in States or Regions].

< Insert Climatch Source Map here >
Caption:
If Climatch is used then "*Figure <X>. Climatch (Australian Bureau of Rural Science 2010) source map showing weather stations selected as source locations (red) and non-source locations (blue) for <scientific name> climate matching. Source locations from <citation>.*"

If RAMP is used, then "*Figure <X>. RAMP (Sanders et al. 2014) source map showing weather stations selected as source locations (red) and non-source locations (gray) for <scientific name> climate matching. Source locations from <citation>*.

< Insert US Climate Match Map here >
Caption:
If Climatch is used, then "Figure <X> (below). Map of Climatch (Australian Bureau of Rural Science 2010) climate matches for <scientific name> in the contiguous United States based on source locations reported by <citation>. 0= Lowest match, 10=Highest match."

If RAMP is used, then "*Figure <X> (below). Map of RAMP (Sanders et al. 2014) climate matches for <scientific name> in the [insert whether Continental United States or United States] based on source locations reported by <citation>. 0= Lowest match, 10=Highest match.*"

< Insert Table of Climate Match Scores from Excel here >
Caption:
If Climatch is used, then "*Table <X>. Climatch (Australian Bureau of Rural Science 2010) climate match scores for <scientific name> for <region of the U.S.>.*"

Note: if RAMP is used, then this table is not necessary. That table is part of the RAMP Climate match map.

Climate Match	0	1	2	3	4	5	6	7	8	9	10
Count											
Climate 6 Proportion = Sum of Climate Scores 6-10 / Sum of Total Climate Scores = _____ (State: High, Medium, or Low)[6]											

[6] The High, Medium, and Low Climate match Categories are based on the following table:

Climate 6: Proportion of (Sum of Climate Scores 6-10) / (Sum of total Climate Scores)	Climate Match Category
0.000≤X≤0.005	Low
0.005<X<0.103	Medium
≥0.103	High

7 Certainty of Assessment

Summarize information available on species, especially impacts and determine the certainty of the assessment.

8 Risk Assessment

Summary of Risk to the Contiguous United States

Summarize and describe the assessment elements from Assessment Elements below. If the ERSS is performed for an area other than the contiguous United States, don't forget to change the above heading.

Assessment Elements

- **History of Invasiveness (Sec. 3):** [High, Low, None Documented, or Uncertain]
- **Climate Match (Sec.6):** [High, Medium, or Low]
- **Certainty of Assessment (Sec. 7):** [High, Medium, or Low]
- **Remarks/Important additional information** [parthenogenic, genetically modified, human health impacts, etc.]
- **Overall Risk Assessment Category: [High, Low, or Uncertain]**

9 References

Note: The following references were accessed for this ERSS. References cited within quoted text but not accessed are included below in Section 10.

[References accessed by risk assessor go here - Use AFS format—see Appendix B]

Australian Bureau of Rural Sciences. 2010. Climatch. Available: data.daff.gov.au:8080/Climatch/.

Benson, A. 2011. *Species X*. USGS Nonindigenous Aquatic Species Database, Gainesville, FL. Available: nas.er.usgs.gov/queries/FactSheet.aspx?speciesID=xxx. October 2011 (*date NAS database was developed*).

Sanders, S., C. Castiglione, and M. H. Hoff. 2014. Risk Assessment Mapping Program: RAMP. US Fish and Wildlife Service.

10 References Quoted But Not Accessed

Note: The following references are cited within quoted text within this ERSS, but were not accessed for its preparation. They are included here to provide the reader with more information.

[References not accessed by risk assessor but occurring within quoted material go here]

Appendix D

Example of a Completed Ecological Risk Screening Summary

This appendix is an example of a completed Ecological Risk Screening Summary. The following example used Climatch for conducting the climate matching. Additional examples can be found on the Service's Injurious Wildlife web page, at: www.fws.gov/injuriouswildlife/Injurious_prevention.html.

This ERSS and the others provided on the USFWS website, were completed before the finalization of this SOP. Where there are differences in formatting, the ERSS SOP should be regarded as the final word on ERSS content, structure, and layout.

U.S. Fish and Wildlife Service

Bleak (*Alburnus alburnus*)
Ecological Risk Screening Summary

Grace Loppnow - 07/21/2014

Photo (edited): © M. Petrtyl from EOL (2014).

1 Native Range, and Status in the United States

Native Range
From Kottelat (1997):

"Europe and Asia: most of Europe north of Caucasus, Pyrénées and Alps, eastward to Ural and Emba. Naturally absent from Iberian Peninsula, Adriatic and Aegean basins (except Maritza drainage), Italy, Ireland, Great Britain (except southeast), Norway and Scandinavia north of 67°N, Caspian basin south of Volga."

Status in the United States
This species has not been reported in the United States.

Means of Introductions to the United States
This species has not been reported in the United States.

Remarks
N/A

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From ITIS (2012):

"Kingdom Animalia
Phylum Chordata
Subphylum Vertebrata
Superclass Osteichthyes
Class Actinopterygii
Subclass Neopterygii
Infraclass Teleostei
Superorder Ostariophysi
Order Cypriniformes
Superfamily Cyprinoidea
Family Cyprinidae
Genus Alburnus
Species Alburnus alburnus (Linnaeus, 1758)

Taxonomic Status: Valid."

Size, Weight, Age

From Kottelat (1997):

"Maturity: Lm 9.9, range 9 - ? cm; Max length : 25.0 cm TL male/unsexed; (Billard 1997); common length : 15.0 cm TL male/unsexed; (Billard 1997); max. published weight: 60.0 g (Billard 1997)."

Environment

From Kottelat (1997):

"Freshwater; brackish; benthopelagic; pH range: 7.0 - ? ; dH range: 10 - ?; potamodromous (Riede 2004); depth range 1 - ? m (Billard 1997)."

Climate/Range

From Kottelat (1997):

"Temperate; 10°C - 20°C (Baensch and Riehl 1991); 68°N - 35°N, 6°W - 60°E."

Distribution Outside the United States

Native

From Kottelat (1997):

"Europe and Asia: most of Europe north of Caucasus, Pyrénées and Alps, eastward to Ural and Emba. Naturally absent from Iberian Peninsula, Adriatic and Aegean basins (except Maritza drainage), Italy, Ireland, Great Britain (except southeast), Norway and Scandinavia north of 67°N, Caspian basin south of Volga."

Introduced

From Kottelat (1997):

"In Anatolia, Marmara basin. Locally introduced in Spain, Portugal and Italy. At least one country reports adverse ecological impact after introduction."

Introduced from the U.K. to Cyprus. Population established (Welcomme 1988).

Introduced from unknown location to Cap Djinet dam, Africa. Population established but isolated or rare (Kara 2011).

Means of Introduction Outside the United States

From Vinyoles et al. (2007):

"New introductions seem to be the result of deliberate actions by anglers that use the bleak either as prey for piscivorous species or as live bait which is frequently released to the water after angling sessions."

"In the Iberian rivers of Mediterranean type water regulation, dam construction and excessive water extraction have contributed to a progressive substitution of rheophilic habitats by more lentic ones, and alterations have occurred simultaneously with bleak expansion (Copp, 1990; Elvira et al., 1998). In this study a relationship between expansion of the bleak and the construction of dams has been found. Thus, our findings suggest that the species dispersal is more significant in regulated rivers. In non-regulated rivers upstream of dams, the majority of the bleak were located in close proximity to dams (or just in the reservoirs), suggesting that they play an important role in bleak expansion. In its original distribution area the bleak occupies habitats with slow water (Brabrand, 1983). The attenuation of natural flow fluctuations in water bodies caused by dams has already been associated with the presence of other introduced species (Bernardo et al., 2003; Clavero et al., 2004)."

From CABI (2014):

"The bleak is without interest to the aquarium trade, but is widely used as bait in recreational fishing of game-fish (i.e. mainly predator fish). It is also used as a food supply (i.e. forage species) for stocks of introduced predators (e.g. black bass

(*Micropterus* spp.). The main pathway of fish introductions is through recreational fishing in many developed countries; therefore, angling is the main activity responsible for the presence of bleak in watersheds. Due to its high mobility, interconnections between watersheds also present a risk of further spread."

From Kottelat (1997):

Introduced to Cyprus accidentally (Welcomme 1988).

Short description

From Kottelat (1997):

"Dorsal spines (total): 2 - 4; Dorsal soft rays (total): 7-9; Anal spines: 3; Anal soft rays: 14 - 20; Vertebrae: 41 - 44. Diagnosed from congeners in Europe by the possession of the following characters: origin of anal fin below branched dorsal rays 4-5; lateral line with 45-48 + 3 scales; anal fin with 17-20½ branched rays; 16-22 gill rakers; ventral keel exposed from anus to pelvic base; lateral stripe absent in life, faint or absent in preserved specimens; and mouth slightly superior (Kottelat and Freyhof 2007). Caudal fin with 19 rays (Spillman 1961 and Keith and Allardi 2001)."

From CABI (2014):

"Species within the genus *Alburnus* are quite similar, and the help of a taxonomist is required for proper identification."

Biology

From Kottelat (1997):

"Inhabits open waters of lakes and medium to large rivers. Forms large aggregations in backwaters and other still waters during winter. Adults occur in shoals near the surface. Larvae live in littoral zone of rivers and lakes while juveniles leave shores and occupy a pelagic habitat, feeding on plankton, drifting insects or invertebrates fallen on the water surface (Kottelat and Freyhof 2007). Feeds mainly on plankton, including crustaceans (Billard 1997) and insects (Vostradovsky 1973). Spawns in shallow riffles or along stony shores of lakes, occasionally above submerged vegetation (Kottelat and Freyhof 2007)."

Human uses

From Kottelat (1997):

"Fisheries: minor commercial; aquaculture: commercial; bait: usually."

"Excellent as bait for carnivorous fishes. May be captured using the smallest hook and a fly as bait. Its flesh is tasty (Billard 1997). Of little interest to commercial or sport fisheries in its native range because of its small size (Welcomme 1988). Scales were

previously utilized in making Essence d"Orient, a coating for artificial pearls (Kottelat and Freyhof 2007)."

From CABI (2014):

"The bleak is without interest to the aquarium trade, but is widely used as bait in recreational fishing of game-fish (i.e. mainly predator fish). It is also used as a food supply (i.e. forage species) for stocks of introduced predators (e.g. black bass (*Micropterus* spp.)."

Diseases
None reported.

Threat to humans
None reported.

3 Impacts of Introductions

From Vinyoles et al. (2007):

"In Cyprus, its high fecundity allowed the bleak to outcompete other species (Welcomme, 1988. Welcomme stated "Stunted populations: May serve as a useful forage fish but large numbers create nuisance."). According to J. Carbonero (pers. comm., 2006) the same situation exists in Iberian rivers. Other factors that may contribute to the adaptability of the bleak include its ability to exploit a widespread spectrum of prey (Vollestad, 1985; Chappaz *et al*., 1987; Biro & Musko, 1995; Vasek & Kubecka, 2004; Mehner *et al*., 2005) and its temperature tolerance (from mountain lakes to the River Ebro with summer temperatures around 30°C)."

From Horppila et al. (1992):

"Enclosure experiments in the field showed the impacts of planktivorous bleak on water quality; in an enclosure with a density of 1 fish m^{-2} average daily algal production (1370 mg C m^{-2}) and chlorophyll-*a* concentration (50-90 µg l^{-1}) were more than twice that in an enclosure without fish. The field studies suggested that a bleak population can increase algal productivity and biomass."

From CABI (2014):

"Introduced *A. alburnus* does not represent a risk for humans but it may cause changes in ecosystems (i.e. altering food web structures and nutrient cycling). It has been proven to hybridize very easily with other cyprinids (Blachuta and Witkowski, 1984; Crivelli and Dupont, 1987), namely with species of *Squalius* (Wheeler, 1978; Witkowski and Blachuta, 1980; Kammerad and Wuestemann, 1989). There is great concern about possible hybridization with closely related endangered species (Vinyoles et al., 2007)."

From Kottelat (1997):

"Interferes with [and] probably interbreeds with native congeners [in Italy] (Bianco 2013)."
From ALARM Project (2011):

"Impacts on invaded ecosystem: The bleak is a small cyprinid that feeds mainly on zooplankton. Its native distribution area ranges from the eastern slopes of the Pyrenees to the Urals (Doadrio 2001). Although its impact on the native fish fauna has not been studied in depth, there is concern that it may out-compete native fish due to its high reproductive output. Another potential source of danger is hybridization with native fish. Hybridization has already been reported with cyprinid species of genera *Squalius, Blicca, Rutilus* and *Abramis*. Besides its impact on native fish fauna, it also affects the trophic dynamic of reservoirs, which are the main source of water for human populations. It feeds on cladocerans and other small invertebrates which play an important role in these ecosystems and whose activity directly affects the water quality."

Important note: Although *Alburnus alburnus* is known to hybridize with members of the genera *Squalius*, *Blicca*, *Rutilus* and *Abramis*, these genera are not established in the United States (GBIF 2014).

4 Global Distribution

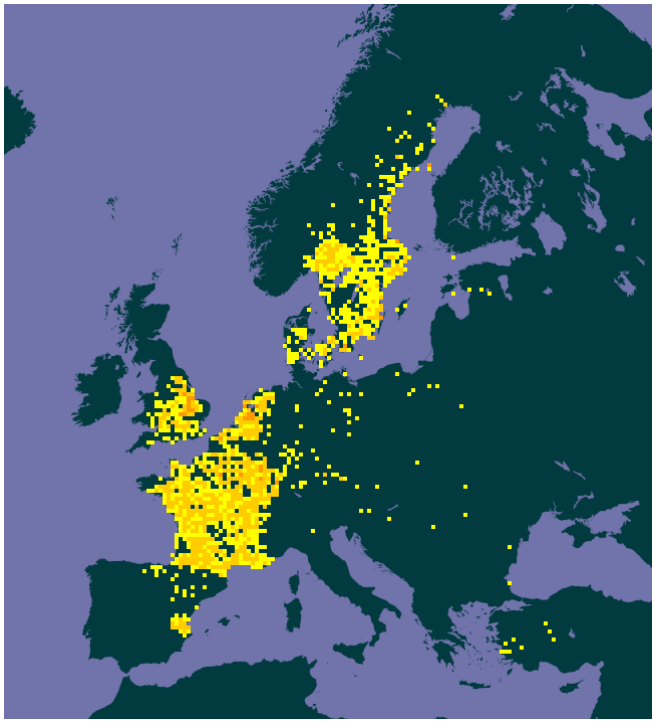


Figure 1 (above)**.** Global distribution of *Alburnus alburnus*. Map from GBIF (2014). Points in Russia, India, and off the coast of France were not included due to incorrect coordinates.

5 Distribution within the United States

This species has not been reported in the United States.

6 Climatch

Summary of Climate Matching Analysis

The climate match (Australian Bureau of Rural Sciences 2008, 16 climate variables; Euclidean Distance) was high in the Great Lakes and in parts of New England, the Mountain West, and the West Coast. Medium matches covered the rest of the U.S. except low matches in the Gulf Coast, Florida, and the extreme Southwest. Climate 6 match indicated that the contiguous U.S. has a high climate match. The range for a high climate match is 0.103 and greater; climate match of *Alburnus alburnus* is 0.381.

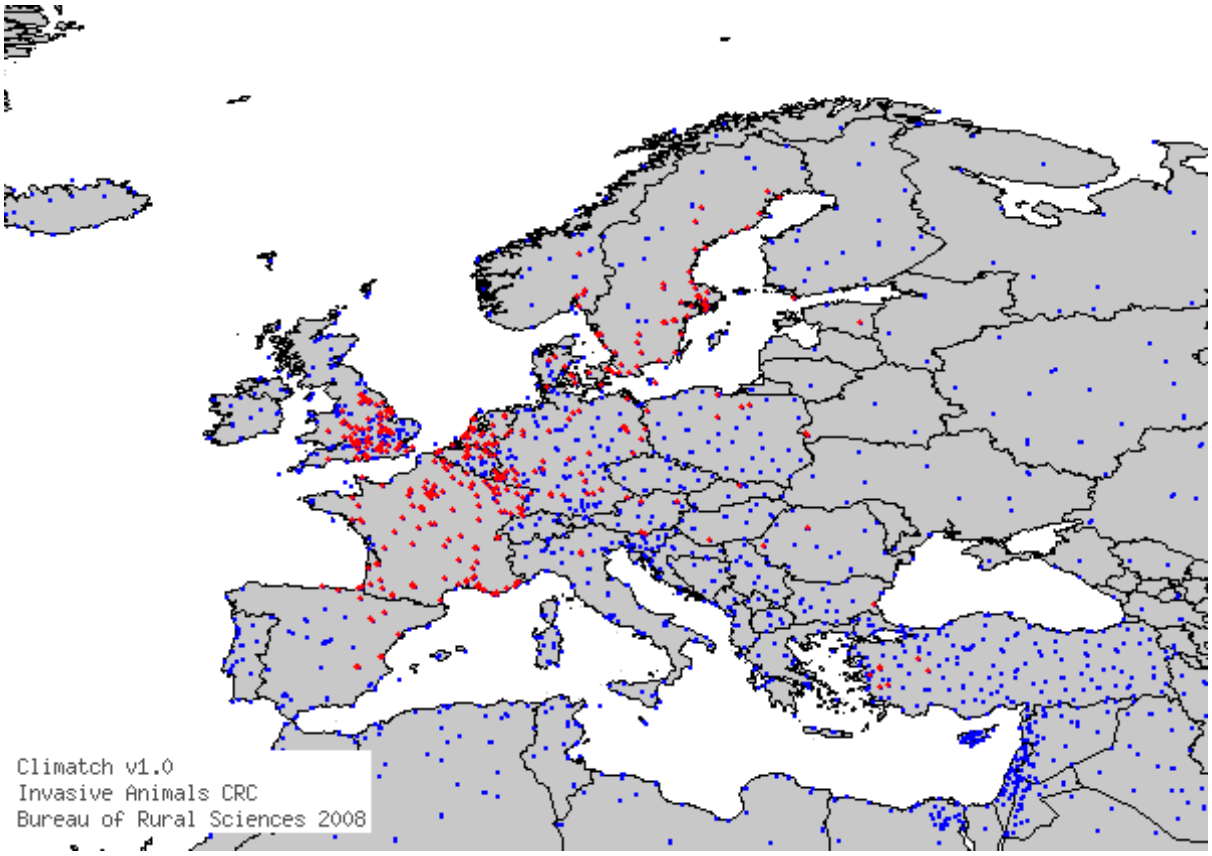


Figure 2 (above)**.** Climatch (Australian Bureau of Rural Sciences 2008) source map showing weather stations selected as source locations (red) and non-source locations (blue) for *Alburnus alburnus* climate matching. Source locations from GBIF (2014).

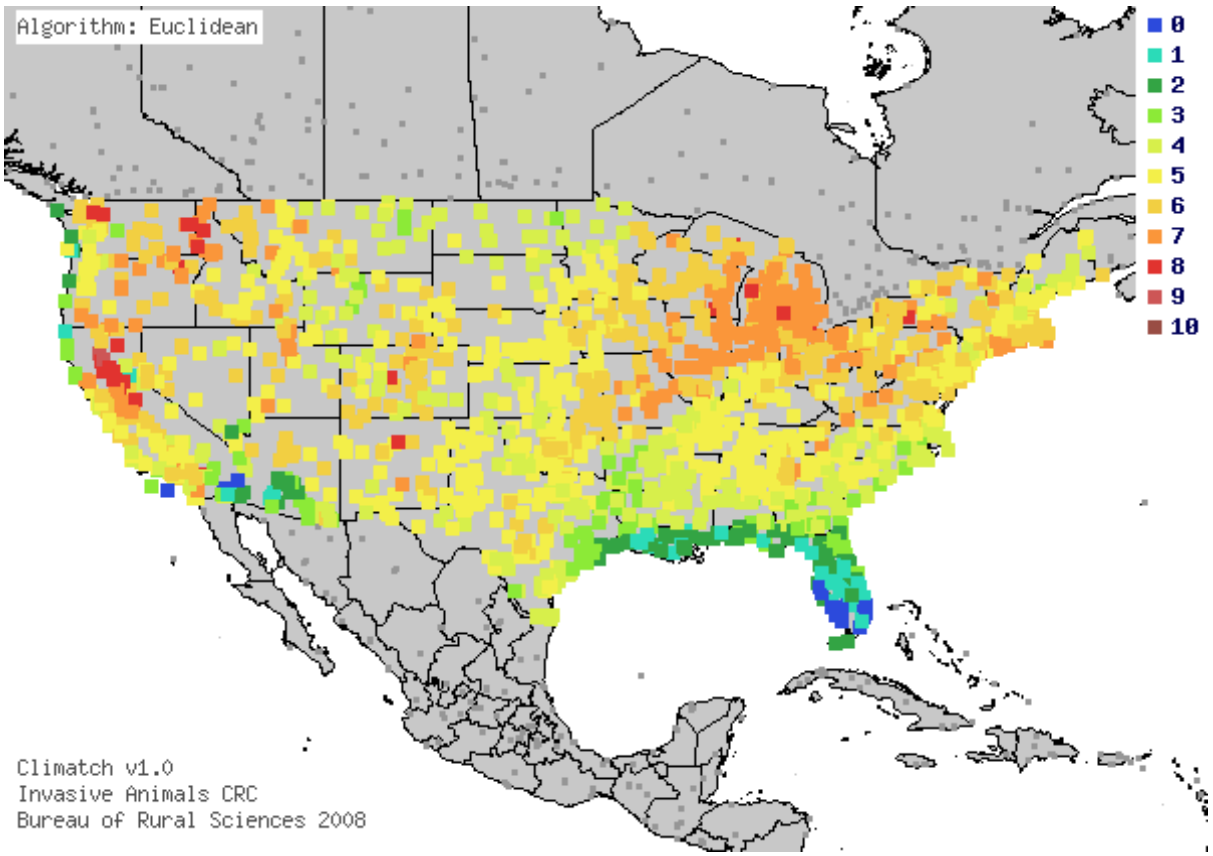


Figure 3 (above)**.** Map of Climatch (Australian Bureau of Rural Sciences 2008) climate matches for *Alburnus alburnus* in the contiguous United States based on source locations reported by GBIF (2014). 0= Lowest match, 10=Highest match.

Table 1 (below)**.** Climatch (Australian Bureau of Rural Sciences 2008) climate match scores.

Climate Match	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Count	26	52	87	114	321	621	475	243	33	2	0
Climate 6 Proportion = Sum of Climate Scores 6-10 / Sum of Total Climate Scores = 0.381 = **High**[7]											

[7] The High, Medium, and Low Climate match Categories are based on the following table:

Climate 6: Proportion of (Sum of Climate Scores 6-10) / (Sum of total Climate Scores)	Climate Match Category
0.000≤X≤0.005	Low
0.005<X<0.103	Medium
≥0.103	High

7 Certainty of Assessment

There is a good deal of information on the natural history and range of *Alburnus alburnus*. The only area that lacks definitive information is impacts from introduction. While there is a source that suggests they have outcompeted native species, one that has demonstrated increased algae and eutrophication rates, and several mentions of hybridization, more information would be needed to make this a high certainty of assessment. Therefore the certainty of assessment is medium.

8 Risk Assessment

Summary of Risk to the Contiguous United States

Alburnus alburnus is a freshwater and brackish water fish native to areas of Europe and Asia. This species has established populations in several countries outside of its native range including Spain, Italy, and Cyprus. The spread of this species has been facilitated by stream modifications and by intentional transportation to new areas for use as bait or forage fish for nonnative sport fish. This species can form high-density shoals. In some areas this species is competing with native fish for resources, causing increased algal biomass, and hybridizing with native fish, giving this species a high rating for invasiveness. Climate match with the U.S. is high, especially in the Great Lakes area. The overall risk for this species is high.

Assessment Elements

- **History of Invasiveness (See Section 3):** High
- **Climate Match (See Section 6):** High
- **Certainty of Assessment (See Section 7):** Medium
- **Overall Risk Assessment Category: High**

9 References

Note: The following references were accessed for this ERSS. References cited within quoted text but not accessed are included below in Section 10.

Australian Bureau of Rural Sciences. Climatch. 2008. Available: data.daff.gov.au:8080/Climatch/. (July 2014).

CABI. 2014. *Alburnus alburnus* [original text by A.M. Veiga]. *In*: Invasive species compendium. CAB International, Wallingford, UK. Available: www.cabi.org/isc/datasheet/95206. (July 2014).

[Note: Complete references not included in this example]

10 References Quoted But Not Accessed

Note: The following references are cited within quoted text within this ERSS, but were not accessed for its preparation. They are included here to provide the reader with more information.

ALARM (Assessing Large Scale Risks for Biodiversity with Tested Methods) Project. 2011. Available: www.alarmproject.net. (February 2011).

Baensch, H.A., and R. Riehl. 1991. Aquarien atlas. Bd. 3. Melle: Mergus, Verlag für Natur- und Heimtierkunde, Germany.

[Note: Complete references not included in this example]

Appendix E

Detecting Outlier Data Points in GBIF (Global Biodiversity Information Facility)

As one inspects geo-referenced location data for collected specimens with the intent to create a climate map for evaluating risk, sometimes there will be points on the map that may seem out of place. Perhaps they fall outside the described range, or maybe they appear to be outside the type of habitat expected for the species, or maybe they just don't feel right. These points are called outliers. Whatever the reason, these points need to be carefully examined in order for the researcher to decide to include or exclude them from the data. One outlying point in a climate matching scenario can vastly change the outcome! This appendix is meant to be a starting guide to help seek out and identify outliers when performing a climate match.

A few sideboards:

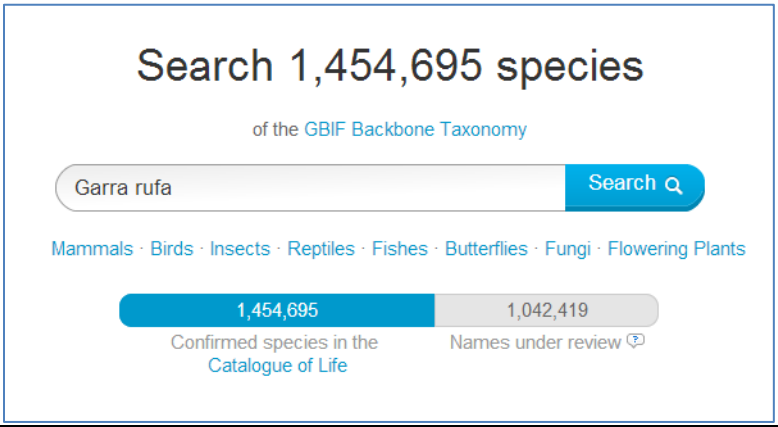
- Use of the Global Biodiversity Information Facility (GBIF) will be assumed, though some of this SOP can be used for identifying outliers using other systems with geo-referenced points.
- Points on GBIF maps within established native range of the species are assumed to be correct.
- Remember we are trying to map only ESTABLISHED population records.

---

1. To begin, open GBIF (www.gbif.org/species) in your internet browser.

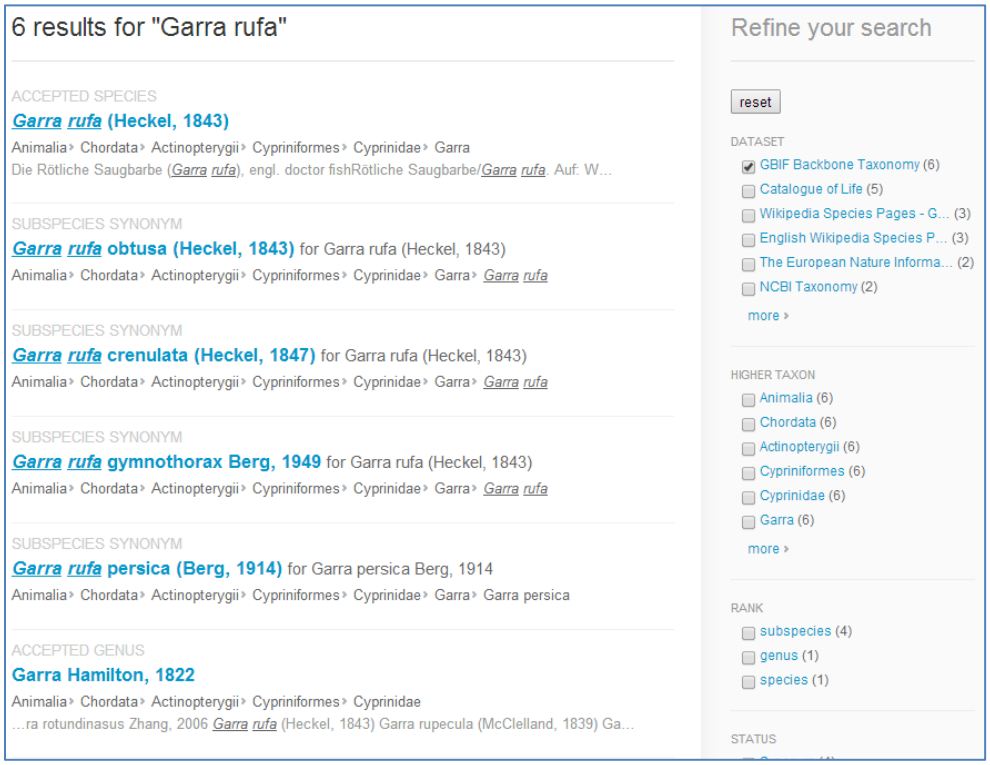
---

2. Enter the species name in the search area (for this example, *Garra rufa* will be used) and click the Search button:

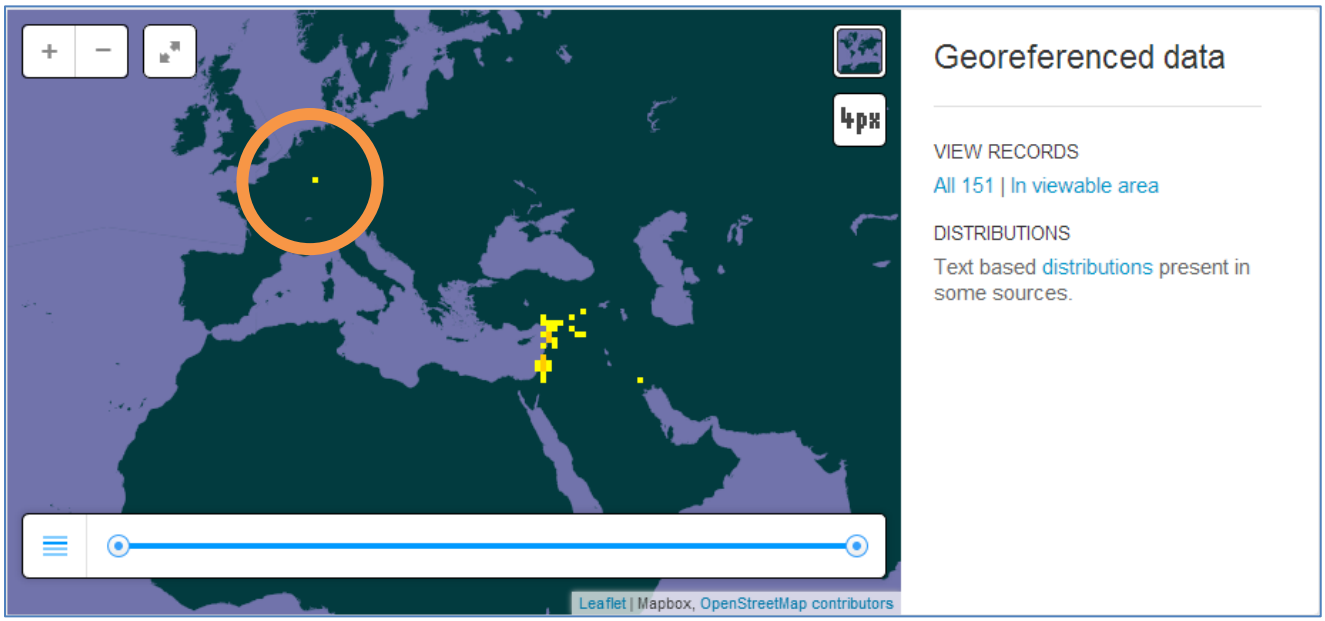


---

3. The results should look something like what is pictured below. Select the first option:



4. The map below is the resulting GBIF map showiong the global distribution data within GBIF. Notice the yellow mark in Europe which lies far outside most of the data points. The orange circle below was added to highlight the outlier:



5. At this point it is important to have a source that references the known distribution of this species. For example, Fishbase lists the following distribution for this species: “Eurasia: In the Jordan, Orontes, and Tigris-Euphrates river basins. Also in some coastal rivers in southern Turkey and northern Syria.” Fishbase also lists the following countries as having populations of this species: “Afghanistan, Iran, Iraq, Israel, Jordan, Lebanon, Syria, and Turkey.” For this species all points fall within that described range with the exception of the one point located in central Europe. This point should be further investigated as a potential outlier.

   This particular outlier was noticed because it is so far outside of the described range for this species, and because it is a single point so far from the mass of other locations for the species. However, outliers can occur for many reasons, some of those reasons will be seen as this outlier is investigated (proper habitat nearby, coordinate error, etc.). In the end, whether to include a point or not may come down to observer discretion, and this SOP will help to make that decision.

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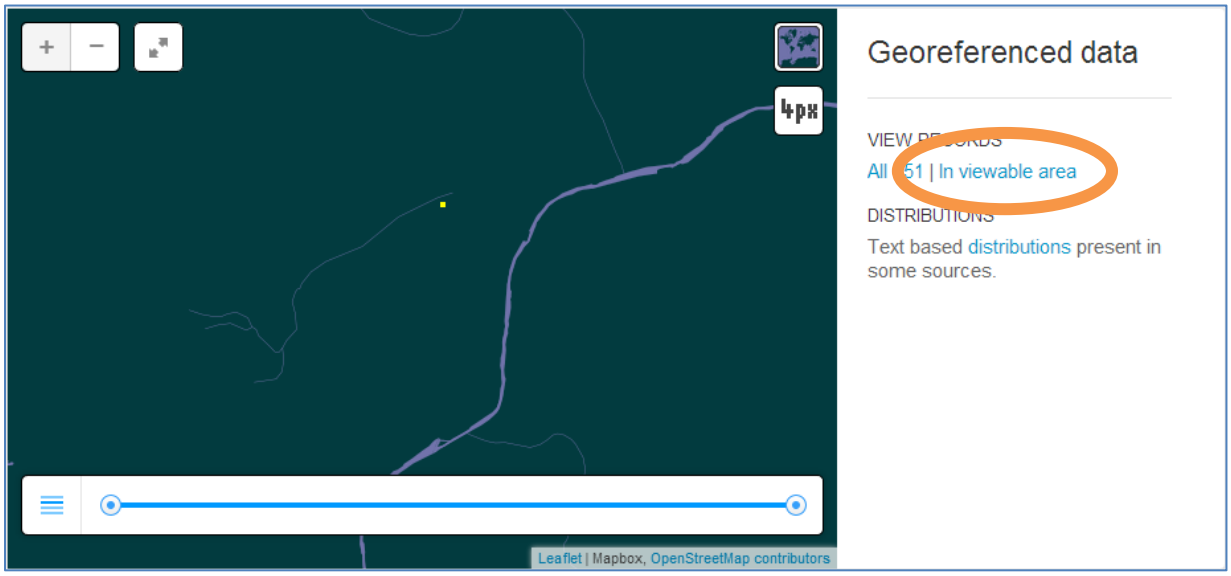
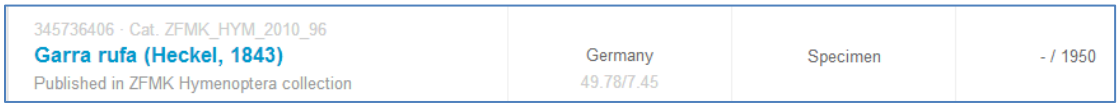
6. Zoom in on the map until the only point viewable on the map is the potential outlier, it should look like this:



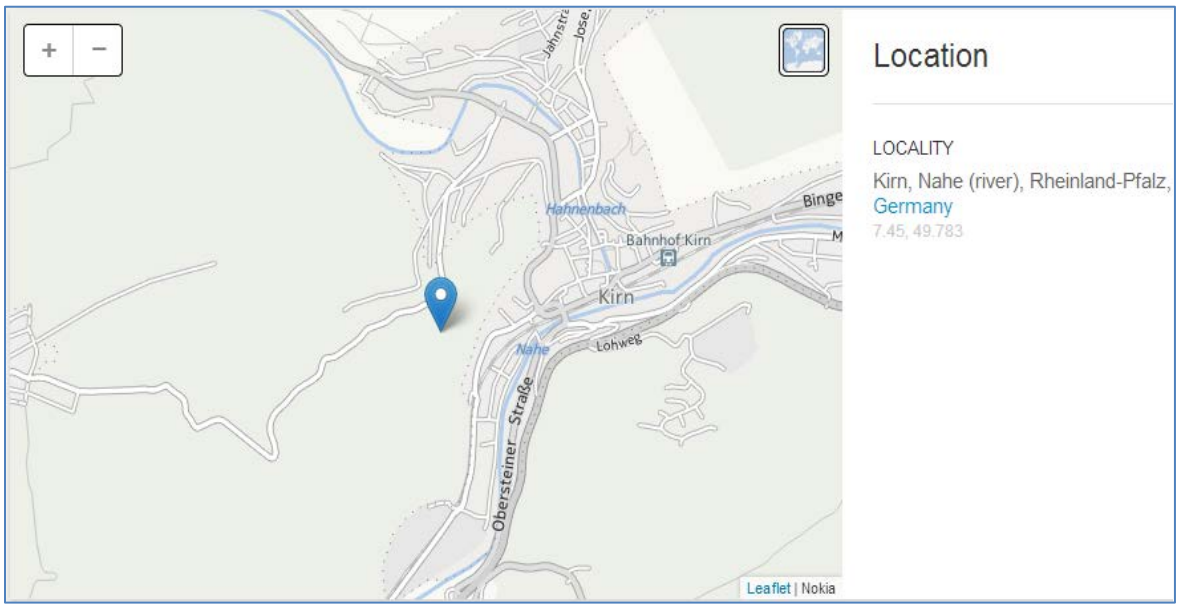
At this point select the link under VIEW RECORDS titled “In viewable area” (see orange circle above).

7. The “viewable area” link will take one to a records page. Sometimes there can be many records at a single location. This is often a good indication that the point in question may NOT be an outlier, because many records at a single location are a good indicator of establishment. Often, however, there is only one record at a single location, while this is not a definitive indication that this location is an outlier that should be excluded, it is the first clue that points towards exclusion. In this case, the records page looks like:

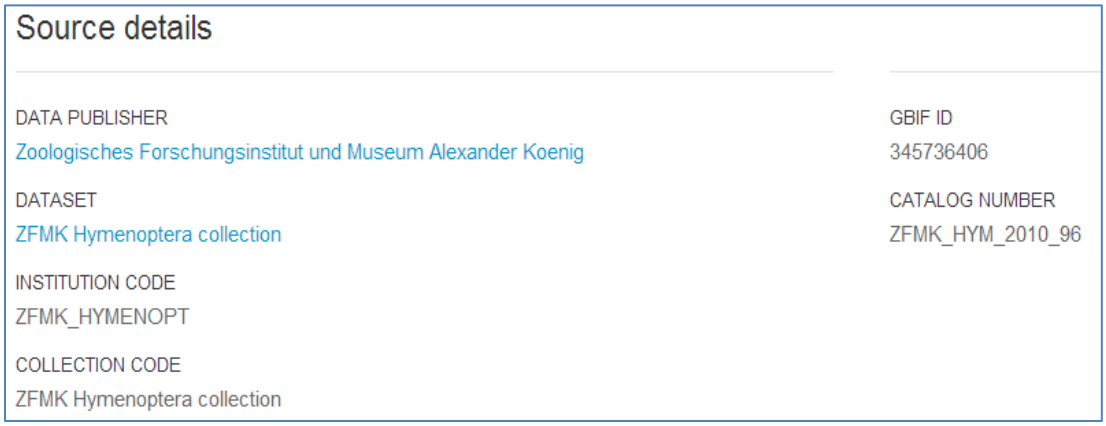


Click on *Garra rufa* (Heckel, 1843) to view more information on this record.

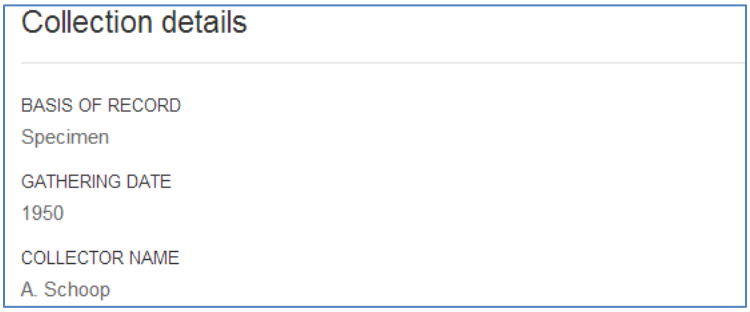
8. At this point GBIF presents a map with more physical features of the landscape around the record in question and several pieces of information about the record itself. First, zoom in on the map and if you are dealing with a fish species or other species that requires an aquatic habitat, ensure that there is an acceptable body of water near the geo-referenced record. Our example looks like this:



In this case two rivers are relatively close to the record that a simple estimation error in GIS data can explain why the point record does not occur precisely in a body of water. Below the map there is information about what collection (typically a museum) this specimen record is housed in:



In this case it is somewhat suspicious that the museum this is housed in is located nearby where the collection record occurred. Again this is not a definitive indication of an occurrence that should be excluded, but it is suspicious. Scroll down the page and look for collection details:

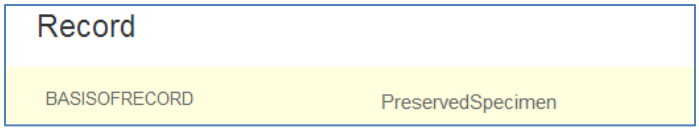


The details list the basis of record as “Specimen” which does not indicate whether or not this record should be excluded. There is only one gathering date, which again is another clue that points towards exclusion, since an established species would likely be able to be gathered many times near the same location, but is not definitive. Scroll to the bottom of the page looking for this box and link:

Click on the link for the “verbatim version”.

9. The verbatim version of the record is as descriptive as the record is going to get. At this point, if there is still no further information that is helpful in determining whether or not to exclude the occurrence record best judgment will need to be used and justification will need to be written into the ERSS.

For this example we are given one last piece of useful information:



The basis used for this record is a preserved specimen.

So, to review what has been discovered about this record:

- The species was not listed as a live specimen ("live specimen" is the typical designation when a species is recorded in an area where it was not previously known to exist)
- The record and the collection it is housed in are close together
- The record is a single record with no other nearby occurrences
- It is a single record from 1950 with no subsequent records from the same area

Based on the above points, the risk assessor concluded that this record should be excluded from the climate matching process.

Experienced users of GBIF have noted there are two locations where outliers seem to be more common: data points in Germany and near Oslo, Norway. Both locations seem to be data entered by museums and/or botanical gardens. Data points in these locations should be viewed with extra care.

Appendix F

Climatch User's Manual

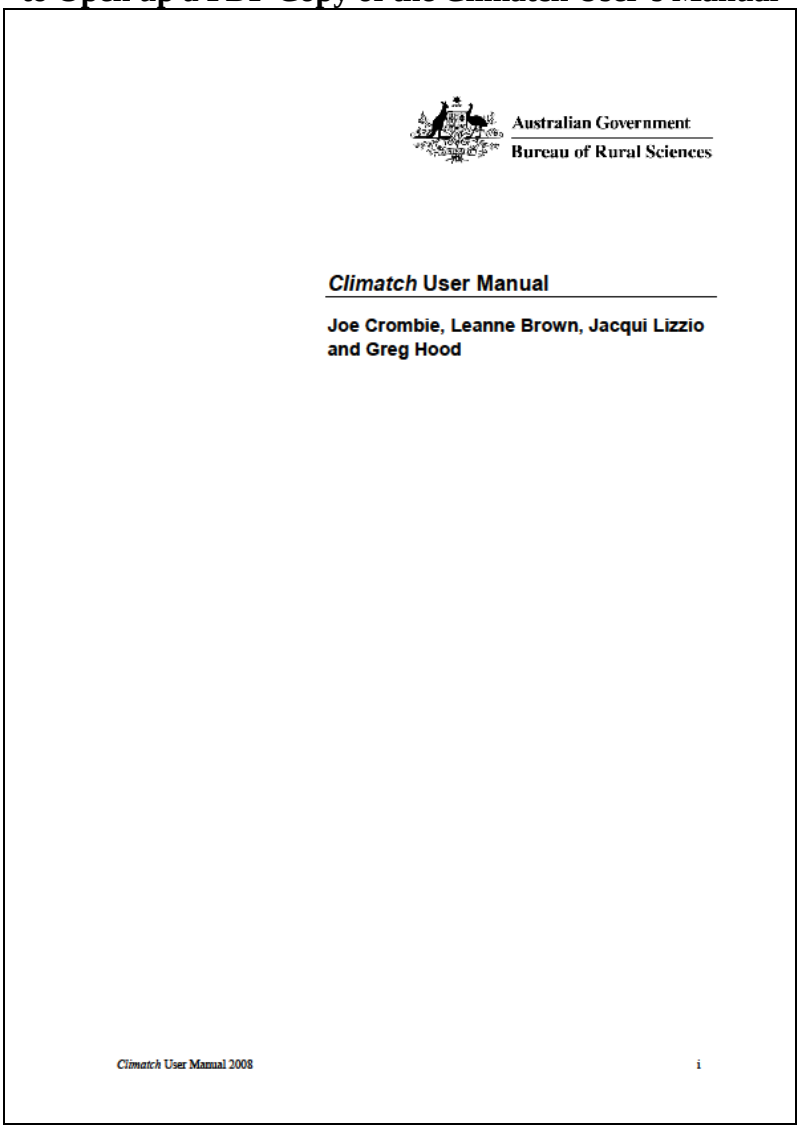
This appendix includes a full copy of the Climatch User's Manual as an inserted PDF document. It is provided to give the reader a more complete understanding of the Climate Matching Process. On the next page the reader should see a graphic resembling the first page of the Climatch User's Manual. Double clicking on that graphic should open a full copy of the manual. Reader's should also note that the internet address for the Climatch web site has changed since the user's manual was written and has not been updated within the manual. The correct address for both the Climatch online program and the user's manual are below.

- The citation for Climatch is: Australian Bureau of Rural Sciences. 2010. Climatch. Available: data.daff.gov.au:8080/Climatch/. (Accessed January 2011).

- The web site for the this user's manual is: data.daff.gov.au:8080/Climatch/docs/climatch_manual.doc

- A brief quick start guide can also be found on three small web pages at: data.daff.gov.au:8080/Climatch/climatch.jsp

Double-Click on the Graphic Below to Open up a PDF Copy of the Climatch User's Manual



Australian Government
Bureau of Rural Sciences

***Climatch* User Manual**

Joe Crombie, Leanne Brown, Jacqui Lizzio and Greg Hood

Climatch User Manual 2008 i

Appendix G

Derivation of Climate Match Categories

For the ERSS process, the results of the climate match (using Climatch) are used to generate a Climate 6 score (Bomford 2008), which is calculated as the sum of the climate scores 6 to 10 divided by the sum of all the climate scores. That resulting Climate 6 score then falls into one of three Climate Match Categories (Low, Medium, High – see table E-1 below). The Service believes that the categorical system provided by generating and using the Climate 6 Ratio is the most effective for our current needs. Climate categories were developed based on the most comprehensive dataset available (Bomford 2008). A more detailed description about the Climate 6 scoring approach follows.

Climate 6 Score: Proportion of (Sum of Climate Scores 6-10) / (Sum of total Climate Scores)	Climate Match Category
$0.000 \leq X \leq 0.005$	Low
$0.005 < X < 0.103$	Medium
≥ 0.103	High

Table E-1: Climate 6 Score and its relationship with Climate Match Category. These relationships were based on an analysis of data for 255 species established in 10 countries (Bomford 2008).

The Climate Match Categories (Low, Medium, and High) were based on an analysis of data for 255 species established in 10 countries (Bomford 2008). The Climate 6 scores showed that even species with near zero Climate 6 scores became established. The Service approach was to use those scores to develop statistically based Climate Match Categories. Statistical categories presently used by the Service are: High (≥ 20th percentile); Medium (>5th percentile and < 20th percentile); and Low (≤ 5th percentile). See Table E-1.

The statistical approach was applied after sorting Bomford's Climate 6 score data in tabular form. Data in that table, along with the statistical levels used to separate Climate Match Categories, determined the Climate 6 scores that are within each Climate Match Category (Table E-1). Figure E-1 was not used to develop the Climate Match Categories. Instead, that graph was developed to illustrate (for the peer review process) the Climate Match Categories developed using the statistical approach. In that graph, PESTAB (Probability of Establishment; from Bomford 2008), was the only other factor published by Bomford that could be graphed to view the Climate 6 scores. PESTAB was not used in developing the statistical categories. The graph simply illustrates statistical categories used by the Service, and an example of the Climate 6 scores for Bighead Carp in the U.S.

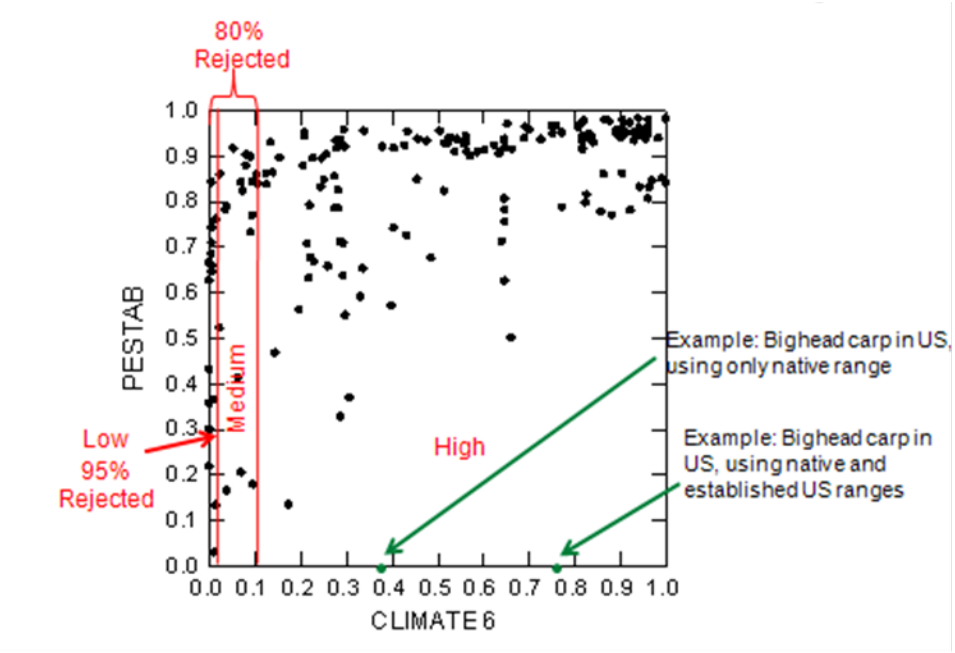


Figure E-1. Probability of establishment and Climate 6 Scores (Bomford 2008), and Fish and Wildlife Service-developed, statistically-based Climate Match Categories for 255 species in 10 countries.

Note that one example for the Climate 6 score for Bighead Carp in the U.S. is based on only the native range of the species, and yet even with an apparently low score (< 0.4) the species has become established widely in the United States.

Climate 6 scores are only a portion of the climate analysis, but scores are needed to provide a scoring index of climate niche that matches with the target region (typically the contiguous U.S.). In addition to the scores, each species' climate match is also illustrated on a map of the target region in an ERSS report. Climate matches of 6 and above are shown on that map in the ERSS, so risk assessors and risk managers can evaluate the spatial extent of high climate match in the contiguous U.S. That spatial information will be helpful, along with the Climate 6 scores and history of invasiveness, in supporting decisions on which, if any, risk management approaches are proposed for implementation.