U.S. Fish & Wildlife Service

Standard Operating Procedure:
How to Prepare an "Ecological Risk Screening Summary"

U.S. Fish and Wildlife Service
Version 3, February 2024

Important Notes Regarding This Document

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

- The ERSS SOP 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 been trained in preparing ERSSs. The original version was released in September 2016 and entitled 'Standard Operating Procedures for the Rapid Screening of Species' Risk of Establishment and Impact in the United States'. The second version was released in February 2020 under the same title as the current version.

- The ERSS process is designed to be useful for terrestrial and freshwater animal and plant taxa. The process is not currently applicable to exclusively marine species as current climate matching tools were not developed with consideration of marine environments and climate variables. An appendix is included in this document with guidelines for addressing estuarine species or species that migrate between marine and nonmarine environments. The ERSS process has not been tested on pathogens.

- The draft version of the ERSS SOP underwent peer review in 2013 without constraint on taxonomic groups to which the process could be applied. The process for the peer review followed U.S. Fish and Wildlife Service (Service) procedures and the Office of Management and Budget's standards for 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 process was revised where necessary. All peer review comments and the Service's response to those comments are available to the public as part of the ERSS supporting documentation on the Service's website.

- Further background for the ERSS process is included in a journal article published in *Management of Biological Invasions* (Marcot et al. 2019). The article provides justification for the use of climate matching and history of invasiveness as a basis for preventative risk assessment. Note that some of the ERSS structure and language described in this SOP is slightly different than that described by Marcot and colleagues (2019). Despite these updates, intended to improve the clarity and completeness of the ERSS product, the foundational elements of climate matching and history of invasiveness remain the same.

- All examples and technical directions in this SOP assume use of the following software: Microsoft Office 365, Google Chrome Version 104.0.5112.81, and ArcGIS Pro version 3.1. Earlier or later versions of the software listed may have different functionality. Mention of commercial products does not necessarily entail endorsement by the U.S. Federal Government.

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Abbreviations

AFS = American Fisheries Society

CHELSA = Climatologies at High resolution for the Earth's Land Surface Areas

DOI = digital object identifier

ERSS = Ecological Risk Screening Summary

FAO = Food and Agriculture Organization of the United Nations

FISRAM = Freshwater Fish Injurious Risk Assessment Model

GBIF = Global Biodiversity Information Facility

HOI = History of Invasiveness

IPCC = Intergovernmental Panel on Climate Change

ITIS = Integrated Taxonomic Information System

NAS = U.S. Geological Survey's Nonindigenous Aquatic Species Database

ORAC = Overall Risk Assessment Category

ppt = parts per thousand

QA/QC = quality assurance/quality control

RAMP = Risk Assessment Mapping Program

RODS = Record of Online Data Searches

Service = U.S. Fish and Wildlife Service

SOP = Standard Operating Procedures

SSP = Shared Socioeconomic Pathway

USFWS = U.S. Fish and Wildlife Service

WOAH = World Organisation for Animal Health

WoRMS = World Register of Marine Species

Part 1. Introduction

A. Background

Each year, thousands of nonnative species and millions of individual organisms are imported into the United States and moved among States. Although only a small fraction of these organisms escape from intended uses and ultimately cause harm to society and the environment, those that do collectively cost billions of dollars annually in losses and damages, including loss of crops and fisheries, competition with or predation on native species, damage to utility operations and water supplies, and risk to human health from zoonosis (animal to human disease transmission; Pimentel et al. 2005; Fantle-Lepczyk et al. 2022). The most cost-effective and efficient approaches to reduce the effects of these invasive species are to prevent them from entering and establishing in the United States and, if they do become established, to limit secondary spread (Vander Zanden and Olden 2008; Cuthbert et al. 2022).

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. Invasive species become classified as injurious when, through the Service's rule-making process or by Congressional action under Title 18 of the Lacey Act (18 U.S.C. 42; 50 CFR 16), a species has been determined to cause or likely cause harm to human beings, to the interests of agriculture, horticulture, forestry, or to wildlife or the wildlife resources of the United States. Because Federal law prohibits importation and transport of injurious wildlife between the listed jurisdictions in the shipment clause (the continental United States, the District of Columbia, Hawaii, the Commonwealth of Puerto Rico, and any possession of the United States; 18 U.S.C. 42), 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 on the injurious wildlife program page of the Service's website.

Deciding which of the thousands of imported species to list as injurious[1] or otherwise prioritize for management is not an easy task. An assessment process is necessary to enable 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 directs the Federal Government to: "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 may be used to identify potentially invasive species and can help anticipate problems and focus management. Natural resource management aimed at preventing invasive species introductions and minimizing new invasive species spread is critical to reduce negative effects on society and the economies on which our society depends. To facilitate this decision-making, the Service developed a rapid risk screening tool, the Ecological Risk Screening Summary (ERSS) process, to provide rapid risk assessments of species that are being or may be imported to the United States or transported from one ecoregion to another.

[1] Although the SOP describes 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.

B. Purpose

According to the Food and Agriculture Organization of the United Nations (FAO; 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 Standard Operating Procedure (SOP) are to standardize data collection and interpretation for development of ERSS reports 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 leads to the development of a high-quality administrative record.

C. How the ERSS Process Works

The rapid risk screening process uses international and regional databases, scientific literature, and climate matching to classify the risk of invasiveness of a species if introduced within the United States outside its native range. ERSS assessors collect, summarize, and synthesize information on the introduction history and documented impacts of introduction of the species, as well as information on species distribution, biology, and ecology. Assessors also conduct a climate matching analysis using a peer-reviewed model to quantify climate similarity between the target region of the United States and locations where the species is currently established. The synthesis of introduction and impact history and the results of the climate matching analysis lead the assessor to the classification of species risk as either High, Low, or Uncertain. This process is founded on the work of Hayes and Barry (2008), who identify climate, history of invasive success, and propagule pressure as non-taxon-specific predictors of introduced species establishment success (for further detail, see Marcot et al. 2019). The ERSS report produced through this rapid risk screening process can be provided to government, industry, and other interested parties to highlight species' risk of invasiveness and more efficiently protect the biosecurity of the United States through either regulatory or nonregulatory risk management actions, or identify species for which additional risk assessment is needed. Two levels of internal review of each ERSS report provide quality assurance and quality control prior to release of the document.[2]

D. Link to Other Risk Assessment Methods

The ERSS process is a tool for rapidly screening species for invasiveness potential. In some situations, an ERSS report may provide adequate information to support decision making (see part 1E). However, in many cases, the ERSS report may serve as a starting point for further risk analysis.

When the overall risk posed by a freshwater fish species is classified as Uncertain by the ERSS process, risk may be further evaluated using the Freshwater Fish Injurious Species Risk Assessment Model (FISRAM), a peer-reviewed tool developed by the Service (Marcot et al. 2019). FISRAM is a Bayesian network risk assessment model for predicting invasiveness or

[2] In cases of urgent management need, draft ERSS reports may be shared confidentially with the Service's governmental partners. The report is posted publicly once the final/editorial review is complete. See part 2B for more information.

injuriousness based on the known and projected characteristics of the species. FISRAM is not part of the ERSS process, but it can be the next step in refining understanding of risk for freshwater fishes. A model diagram and the FISRAM SOP are available among the ERSS supporting documents on the Service's website.

Standard methods for further evaluation of other taxa classified as Uncertain risk are not currently available from the Service. However, additional risk assessment and risk screening tools for various taxa are available from other sources, including the Fish Invasiveness Screening Kit (Copp et al. 2005a,b; Vilizzi et al. 2019), Aquatic Species Invasiveness Screening Kit (Copp et al. 2016), and Weed Risk Assessment (Pheloung et al. 1999; USDA 2019).

E. Using the ERSS Reports

The completed ERSS reports are intended to identify species for which preventative measures could be taken. Prior to an introduction event, ERSS reports can be used to: 1) inform the Service's injurious wildlife listing process; 2) inform our co-managers (such as other Federal agencies, the States, and Tribes), the public (such as hobbyists) and private sectors (such as importers of live animals) of the risks of importation, transportation, or establishment of certain species; and 3) to prioritize species for invasive species surveillance at ports of entry and invasion hotspots. In the event of a new introduction, ERSS reports can provide decision makers with information needed when evaluating response options (Meyers et al. 2020).

Species found by the ERSS process to be High or Uncertain risk may be further reviewed for potential injurious wildlife listings under Title 18 of the Lacey Act. **It is important to clarify 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 listing process, including opportunities for public comment; the ERSS process is a screening process that simply helps prioritize species for further scrutiny.** More information on injurious wildlife listing can be found on the injurious wildlife program page of the Service's website.

To help inform co-managers and the public, completed ERSS reports are posted in the ERSS library on the Service's website. Completed ERSS reports assist States in evaluating whether regulatory, legislative, or other measures (e.g., targeting prevention efforts, developing watch lists and monitoring programs, decision-making in potential rapid response scenarios) may be needed to prevent the introduction or establishment of species in their jurisdictions. Live-animal and plant importers can use the results to facilitate responsible decision-making in the importation and movement of live organisms. Members of the public can also use these reports to learn about High and Uncertain risk species they may choose to voluntarily avoid purchasing or transporting and Low risk species to consider as more responsible alternatives.

Recommended citation for this SOP:

U.S. Fish and Wildlife Service. 2024. Standard operating procedure: how to prepare an "Ecological Risk Screening Summary." Version 3. Available: *URL* (*insert access date*).

Recommended citation for ERSS reports:

U.S. Fish and Wildlife Service. *Web version date*. *Species name* Ecological Risk Screening Summary. U.S. Fish and Wildlife Service. Available: *URL for the report* (*insert access date*).

Part 2. General Guidelines for ERSS Preparation

A. Assessor Qualifications

It is recommended that the initial preparation of an ERSS be conducted by a single individual with subject matter expertise, preferably with a specific background in the taxon or species being assessed or, at a minimum, a background in biology, ecology, or invasive species. The assessor should at least be fully conversant with this SOP and should, as needed, consult the peer-reviewed literature referenced in this document. Additionally, assessors should be competent at conducting a thorough literature review and critically evaluating information sources. Available information on species occurrences, biology, and impacts may be of varying quality. The assessor should be able to apply the data quality standards described below to discern what information is valid to use in justifying the species assessment.

B. Development Process

Conducting an ERSS in a group setting is not recommended because the clear formula for data gathering and assessment make collaborative assessment inefficient. However, a hierarchical review process allows for a high degree of quality assurance and quality control (QA/QC) in the final product. The recommended development process for conducting an ERSS occurs in stages as follows[3]:

Drafter (Original Assessor) → Technical Reviewer → Final (Editorial and Policy) Reviewer

Whenever possible, as a form of quality control, the individuals assigned to the three roles in the process above should not be the same. The original assessor compiles data from literature and database searches, cites and records all references incorporated into the administrative record, completes the climate matching 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. Although their duties overlap, the technical reviewer should focus primarily on the accuracy and completeness of the information presented in the ERSS, while the final reviewer should primarily focus on internal consistency of the report, compliance with this SOP, and accessibility of the report to diverse audiences.

C. Data Quality Standards

The ERSS should be a compilation of facts, peer-reviewed data, and actual occurrences of species impacts, instead of hypothetical circumstances. A risk assessor's primary sources of information will be expert-validated native and invasive species information systems (appendix A) and peer-reviewed scientific literature. Information from white papers and other gray literature can be used and noted, but these sources should not be used as the sole basis for assessing risk in an ERSS unless no other information is available.

[3] 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.

It is important to note that even peer-reviewed scientific journal articles and book chapters contain conjecture. That conjecture can be informative, but it cannot be used as evidence of history of invasiveness (see part 3F).

D. How Much is Enough?

One of the main difficulties in developing an ERSS is that, for many species, the available information is either very general or else nonexistent, which makes it very difficult to set data thresholds and limits. The risk assessors are expected to review multiple sources for each section, select and compile the most reliable, credible, clear, and convincing information, and add new relevant information from other sources if it exists. As part of the ERSS process, the risk assessor should complete the Record of Online Data Searches (RODS; appendix B) to help reviewers understand how much research was completed and which databases were and were not searched.

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 appendix A 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. In situations where multiple reliable sources report conflicting information, the assessor should include information from both sources and clearly acknowledge the uncertainty implied by the conflicting reports.

If all websites recommended in appendix A of this SOP are visited, including searching for peer-reviewed literature, and little information has been found, and new sources are consulted that may have become available since appendix A was last updated, then the lack of data should be noted, and searching can stop.

Conversely, the assessor should keep in mind that the ERSS is intended as a rapid assessment, and it should not take more than a couple of days to write, even for the most complicated species. If information is abundant, it can be useful to ask the question, "What information would a natural resource manager want to know about this species?" in determining what information to include and what to exclude. Ultimately, what is desired for each section of an ERSS is the best available information that can be derived from the recommended information sources.

E. Creating an Administrative Record

The assessor should file a detailed administrative record with each drafted and reviewed ERSS. The administrative record should include a copy of all sources (articles, databases, reports, and images) cited in the ERSS, as well as the RODS (see appendix B), and a copy of the Risk Assessment Mapping Program (RAMP) species folder (USFWS 2024). Webpages should be saved at the time they are cited because of the potential for web copy to change over time; PDFs are preferred as a file format, although screenshots are acceptable. In Google Chrome, webpages can be saved as PDFs via the "Print" function. When a distribution map is taken from a webpage, save a PDF of the entire webpage, in addition to an image file of the map.

The administrative record should be saved in a single location and made available to ERSS reviewers along with the completed ERSS. Anyone reviewing an ERSS should be able to access a saved copy of all source information, as it appeared at the time it was cited. This level of documentation is required for the administrative record for injurious wildlife listings and enhances transparency of the ERSS process.

F. Ensuring Accessibility

ERSSs must be compliant with Section 508 of the Rehabilitation Act of 1973 (29 U.S.C. 794d; standards on electronic accessibility). Guidelines specific to ERSS reports are included in part 3 of this SOP. For additional details, see the Department of Interior's Section 508 policies or the General Service Administration's resource on creating accessible documents.

G. Stylistic Considerations

The development of an ERSS report consists mainly of copying and pasting large amounts of quoted material from various websites and scientific journals. However, there are a few sections of the ERSS in which the author is responsible for summarizing and synthesizing information in writing. Authors should endeavor to be clear and succinct in their writing. For technical issues, follow the U.S. Government Publishing Office style manual, in particular:

- Spell out "United States" when it is used as a noun (e.g., contiguous United States) and use the abbreviation "U.S." when it is an adjective (e.g., U.S. territories).

- Capitalize "State" when referring to one or any of the 50 United States.

- Capitalize "Federal" when used as an adjective describing a proper noun (e.g., Federal Government), but not when used as an adjective in a general sense or as an adverb (e.g., federally listed species).

Additionally, within the ERSS:

- Capitalize the names of categories (e.g., High, Medium, Low) of assessment elements (see parts 3F-3K) to distinguish between the defined categories and more generic uses of the words.

- Insert a nonbreaking space (CTRL+SHIFT+SPACE) between genus and species names to avoid splitting the full name of a species across multiple lines of text.

Part 3. Technical Instructions for Writing an ERSS

The following information is intended to guide the reader through the steps necessary to complete an ERSS. Parts 3B through 3M, which are organized to match the required format of an ERSS report, contain descriptions of the data needed, specific data sources in some cases, and special instructions.

Here and in the appendices of this SOP, the following conventions are used:

- *Italicized* words show **where the assessor needs to fill in relevant information** for the subject species or data source. Remove the italicization after filling in the text appropriately, except in the case of scientific names which should always be italicized.
    - A single italicized word or phrase indicates the type of information to fill in, e.g., replace "*Author*" with "David et al."
    - A "/" indicates to select one of the words or phrases provided, e.g., replace "*High/Medium/Low*" with "Medium."
- Note boxes provide **definitions, computer software tips, and tips on handling special situations** when writing an ERSS.

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

A. General Instructions

Provide as much relevant information as possible without unnecessary repetition.

Use of Quoted Material

The development of an ERSS report involves copying and pasting large amounts of quoted material from various databases and scientific journal articles. To copy and paste quoted material from either websites or scientific journals:

1) Surround all direct quotes with quotation marks.

2) Reference the source of quoted material under each new heading.

3) If the quoted material contains information relevant to multiple sections of the ERSS within a single paragraph, break apart the paragraph and insert the relevant part of the paragraph in the appropriate section. Use ellipses within brackets (i.e., "[…]") to denote where a quotation has been cut or spliced mid-sentence.

4) Use brackets within quoted material to designate material that has been added to a quotation. Material should be added only when the meaning of the original material is unclear when taken out of the source context. Examples:

- Replace numeric citations (numbered within the source material) with name-date citations in the style used by the Journal of Fish and Wildlife Management (appendix J). For example, "Max length : 18.9 cm TL male/unsexed; (Ref. 89110)" should be changed to "Max length : 18.9 cm TL male/unsexed; [Huo et al. 2012]."

- Add the country or U.S. State where a river or city is located if not otherwise clear from the quotation: "Species is present in the Song Da [Black River, Vietnam]."

- If a figure or table reference cannot be removed, indicate that it is present in the source material: "Figure 2 [in source material] indicates that phosphorous concentrations would not have been a limiting factor […]"

- Add the full scientific name of a species not defined elsewhere in the quote or in the ERSS, or if there is other potential for name confusion: "some of the hybrid populations [of *Ludwigia pilosa* × *L. sphaerocarpa*] occur in central and southern Florida"

5) If errors are discovered within quoted source material, include the error as written in the quotation followed by "[sic]", to indicate that the error was part of the original quotation.

6) If the source uses a different scientific name for the species, indicate the name used. Example: "this species [*Cyclops abyssorum divergens* as *C. singularis*]"

7) Re-read the quotation to make sure letters and symbols copied correctly.

Use of Digital Images

The University of Washington Library (2014) summarizes this 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."

Be aware that **many images posted on websites cannot be re-posted or copied without permission** from the creator. All images produced by the U.S. Federal Government are in the public domain and may be used without restriction. Images licensed under "Creative Commons" may also be reused without permission but they have additional terms of use (see Note, below). **If there is uncertainty about whether you have permission to use the image, do not use it.**

> Note: There are six different types of Creative Commons licenses, representing different combinations of legal rights: Attribution (BY), Attribution-ShareAlike (BY-SA), Attribution-NoDerivs (BY-ND), Attribution-NonCommercial (BY-NC), Attribution-NonCommercial-ShareAlike (BY-NC-SA), and Attribution-NonCommercial-NoDerivs (BY-NC-ND). Detailed descriptions of the licenses are available from the Creative Commons organization. For ERSS development, make sure to credit the creator of the image (required by "BY" licenses) and do not make changes (e.g., cropping, color adjustment) to any images with "ND" as part of the license. The CC0 license is equivalent to the public domain.

Some databases automatically gather images from the web. It is not uncommon for license information associated with the image to be gathered incorrectly. It is good practice to trace the image back to the original source to obtain the correct license information.

> Note: Google Image Search provides a tool for filtering images by usage rights. On the results page of an image search, click the "Tools" button just below the search bar. In the options that appear on the next line, click on "Usage Rights" and select "Creative Commons licenses." Verify the usage rights on the source website for the image.

Citations are required for all images, even those in the public domain:

1) When citing images, as much of the following information as possible should be included within the caption:

   - Creator name
   - Repository information (museum, library, or other owning institution)
   - License information (e.g., "public domain," "Creative Commons BY 2.0")
   - Image source (e.g., database, website, book)
   - Date accessed

2) Example image citations:

   - For title page photo: "*Author*. Licensed under *license information*. Available: *URL* (*month and year accessed*)."
   - For a figure within the body of the report: "Figure *X*. *Description of figure* from *Author* (*year*; *license information*)."

Though not mandatory due to the general lack of images for many species, whenever possible, photographs should adhere to the following standards:

1) In color

2) Resolution – 300 dpi or greater

3) Size – 4” x 6” or 6” x 4”

4) JPEG or PNG file formats

Formatting for Accessibility

Ensure document accessibility (complying with Section 508 of the Rehabilitation Act of 1973, 29 U.S.C. 794d) for all ERSS reports as follows:

1) Use the ERSS style template (available as a separate document upon request) to facilitate Section 508 compliance.

    - The template can be attached to an existing document by navigating to Developer Tab > Document Template. Choose “Attach” on the “Templates” tab of the dialog box, navigate to and select the .dotx template file, and check the “Automatic update” box.

    Note: The Developer Tab may need to be turned on in Microsoft Word. The tab can be made visible via File > Options > Customize Ribbon.

2) Under File > Info, fill in the document title (such as, “Electric Eel (*Electrophorus electricus*) ERSS”) and change the author to “USFWS” (or the name of the author, if not a Service employee, and their organization).

3) In Microsoft Word, identify headings and facilitate document navigation with text styles (Home tab). Use the following conventions (already specified if using the document template):

    - Designate the species name with “Title”;

    - Designate each section heading with the style “Heading 1”;

    - Designate each subsection heading with “Heading 2”;

    - Designate each sub-subsection (e.g., “Native Range” and “Introduced Range” under “Distribution Outside the United States” in ERSS section 2) with “Heading 3”; and

    - Designate author information with “Author Line”.

4) Use page breaks, tabs, and paragraph options instead of strings of single spaces or repeated line breaks.

    - Click the paragraph mark (¶) on the Home tab in Microsoft Word to view hidden formatting symbols.

- To keep lines of text together on the same page without using page breaks, select relevant text and right-click > Paragraph … > Line and Page Breaks, then check the boxes for "Keep with next" and "Keep lines together" under the "Pagination" option.

5) Insert alt text for all photos, images, and maps.

   - Access alt text by right-clicking on the image and selecting "Edit Alt Text..."
   - Alt text should describe what is displayed for those using a screen reader. Alt text should not repeat the caption because screen readers will read the caption, too.
   - Do not include citations in alt text.

6) Use tables sparingly. Paraphrase instead of directly quoting small tables or portions of tables. When tables are used:

   - Do not split or merge cells.
   - On Layout tab, select "Repeat Header Rows" for the table header row(s).
   - Right-click within the table to access the Table Properties dialog box. In the "Row" tab, make sure "Allow row to break across pages" is unchecked and in the "Alt Text" tab, provide a brief description of the table.

7) Microsoft Word's built-in "Check Accessibility" tool can be used to identify figures and tables that are missing alt text. It is not a substitute for checking headers, image positioning, and table properties manually.

B. ERSS Title Page Header Information

The **ERSS title page header** should contain the following information: common and scientific names of the species, details on the assessor and reviewers and date of each version of the ERSS document, organism type and Overall Risk Assessment Category (ORAC), and a properly credited photograph or drawing (if available) of the species being evaluated.

Common Name

Data Definition

The **common name** indicates how the species is usually referenced in nonscientific contexts.

Specific Instructions

1) The **preferred source for common names** depends on the type of organism:

   - For fish, use the American Fisheries Society (AFS) common name if available (check the current AFS name list). If not available, use the FAO common name if available, followed by the common name provided by the Integrated Taxonomic Information System (ITIS) if available.

- For all species other than fish, use the common name provided by ITIS if available.

2) If **no English common name is available from the above-listed sources**, then use the most common English name present in the literature, with preference for names used in expert-validated databases and peer-reviewed literature over trade names.

3) If **no English common name is available from any source**, provide a familiar name for the taxon (e.g., carp, catfish, cichlid, tilapia, clam, mussel, snail, amphipod, crayfish, shrimp) and state that there is no common name (e.g., with scientific name: "*Cyprinus barbatus* (a carp, no common name)").

Scientific Name

Data Definition

The **scientific name** is a unique identifier for the species, typically used in scientific contexts.

Specific Instructions

1) For **fish**, use the following sources in this order (based on reliability and update frequency):

   - Eschmeyer's Catalog of Fishes (preferred source for current accepted fish names)
   - AFS Name Book (if the species occurs in North America)
   - FishBase
   - ITIS

2) For **plants**, use the following sources in this order:

   - World Flora Online (preferred source for current accepted plant names)
   - ITIS

3) For **all other taxa**, use the following sources in this order:

   - World Register of Marine Species (WoRMS) (information on nonmarine species is available by turning off the "marine only" filter)
   - ITIS

4) If none of the preferred databases provides an accepted scientific name, then pause and consider whether an ERSS will be useful if there is no reliable name for the species. If making the decision to move forward with an ERSS, either use the name most commonly used in the scientific literature or the name most commonly used by other databases listed in appendix A (or elsewhere) and ensure that the source(s) is documented.

Preparer and Version Details

Data Definition

The **preparer and version details** document the individuals involved in preparation of the ERSS for internal use, and the agency author and date of the report for external use.

Specific Instructions

1) The **drafter** of an ERSS must put their name and the month and year of the ERSS report below the species name in a right-justified format (Author Line style). See placement in appendix C template.

2) The **technical reviewer** must add their name and the month and year of review beneath the original author's name.

3) When an ERSS has gone through its technical and policy reviews and is **ready for posting** on the Service website, the author's and reviewer's names are replaced with:

   U.S. Fish & Wildlife Service, *draft month and year*
   Revised, *revision month and year*
   Web Version, *date of final edits*

> Note: If updating a previously published web version, start the author list the same way as for a new document. An ERSS may be updated for a variety of reasons, including incorporating new or improved science and techniques, or due to new information that may result in a change in the ORAC.

Organism Type and Overall Risk Assessment Category

Data Definition

The **organism type** provides context for the reader if the scientific or common name of the species is unfamiliar to them.

The **ORAC** field in the title page header allows the reader to know the risk determination for the subject species at a glance. Much more information on the ORAC and determination process is available in part 3K.

Specific Instructions

1) For the organism type, choose the appropriate category from the following: **fish, mollusk, crustacean, bird, amphibian, reptile, mammal, alga, bryophyte, fern, clubmoss, conifer, flowering plant.** If none of the categories fit, Service employees should consult a Program Lead for further guidance.

2) For the ORAC, fill in the appropriate category **after the ERSS is otherwise complete**.

Photographs

Data Definition

One (typically) or more **photographs** provide a quick visual reference as context for the reader if the species is unfamiliar to them.

Specific Instructions

Search for photograph(s) of the assessed species, carefully documenting and crediting any images used. Refer to Use of Digital Images in part 3A.

1) All images, species photos, and figures from journal articles need to be licensed for reuse. You may need to check a journal's main information page if you cannot find clear license information in the article.

2) Position images "In Line with Text" and provide alt text for each image.

3) When no photographs are available, a drawing or sketch may be used with the same citation and licensing considerations as for photographs.

4) If no images at all are available, place an image of a camera where the image should be and state: "No photo available."

    - Alt text should read: "Image of camera indicating no photo available."

    - There is an image of a camera with "No photo available" text included in the ERSS drafting template (appendix C).

C. ERSS Section 1 — Native Range and Status in the United States

Using the data sources in appendix A, search for the information necessary to describe the native range and status information relevant to the species being assessed. Risk assessors are not limited to the data sources in appendix A. Any additional sources should be evaluated for scientific credibility. If a species is not covered in the databases and websites listed in appendix A, expand the search to other databases and primary literature to determine native range, nonindigenous occurrences, and how the introductions occurred. If a risk assessor has checked all the appropriate sources and limited information was found, then the lack of data should be noted, and searching can stop.

Native Range

Data Definition

Native Range describes the native distribution of the species. The description may include countries, States, regions, and geographic areas such as a specific river basin or specific mountain range.

Specific Instructions

1) In general, if a native range description uses geographic references (e.g., names of small or foreign waterbodies) that would not be familiar to the average reader, insert geographic context such as the State or country name, in brackets.

2) When a waterbody spans multiple States or countries, indicate which of those States or countries are included within the species' native range, if known.

Status in the United States

Data Definition

Status in the United States describes the status of the species within the United States, including introduction, establishment, trade, and regulatory status.

Specific Instructions

1) Report whether the species has been **reported in the wild in the United States** and if so, where, **including both native and nonindigenous occurrences**.

   - If possible, identify which occurrences represent **established populations**. Establishment status is often reported at the State level, but include more detailed information if available. For clarity, if no data on establishment status can be found, the ERSS should clearly state that fact so that readers know that an attempt was made to find this information.

   - If a species was stocked, indicate the period of time during which stocking occurred. If historical or current status of stocking is unknown, indicate as such.

   - If a species has both native and nonnative occurrences within the contiguous United States this needs to be explained. If necessary for clarity, a map clearly showing the native and nonnative range of the species may be included here.

   - If the species has not been reported in the wild in the United States, clearly state so.

2) Report whether or not the species is **in trade within the United States**.

   - It is acceptable to include information from a retailer's website to document trade.

   - For clarity, if no data on trade can be found, the ERSS should clearly state that fact so that readers know that an attempt was made to find this information.

3) Under the sub-subheading of "Regulations," report whether the species has **any special Federal or State regulatory status**, such as being banned for importation into the State, listed as a State-designated noxious weed or invasive species, or if the species is listed by the Federal Government as injurious under the Lacey Act or as a noxious weed. Include any regulations at higher taxonomic levels that cover the species. Make sure to use the regulatory term(s) used by the regulating jurisdiction. Reference the relevant regulation. Direct

quotations or detailed explanation of each regulation is unnecessary. It is acceptable to group jurisdictions that all use the same term.

> Note: The fish family Salmonidae and 20 genera of salamanders have been listed as **injurious wildlife** by the Service due to the risk of disease transmission. When screening a species within one of these taxa, language similar to the following should be added to this section: "All species in *family or genus* were officially listed as injurious wildlife species by the U.S. Fish and Wildlife Service in *year* under 18 U.S.C. 42(a)(1) because of the risk that they carry certain pathogens harmful to other wildlife (*insert citation for the Federal Register notice of the rule*). *Add importation details here, e.g.,: The importation of any live salmonid, live eggs or gametes, or dead uneviscerated salmonid fish into the United States, any territory of the United States, the District of Columbia, the Commonwealth of Puerto Rico, or any possession of the United States, or any shipment between the continental United States, the District of Columbia, Hawaii, the Commonwealth of Puerto Rico, or any possession of the United States is prohibited unless accompanied by an approved heath certification. Dead eviscerated salmonids are not considered injurious.*"

Means of Introduction into the United States

Data Definition

Means of Introduction into the United States describes how the species was introduced to and spread within the United States.

Specific Instructions

1) Include, when known, both the pathways and vectors of introduction.

   - The **pathway** is generally regarded as the reason why a species is transported (the activity that facilitates the movement), whether accidentally or deliberately.

   - The **vector** is exactly how a species is transported (the physical things the species move on, in, or with).

   - Example: Commercial shipping is a *pathway*; ballast water, hull fouling, and contaminated cargo are all *vectors* associated with commercial shipping.

2) If no information was found for this section or the species has not been reported in the United States, clearly state so.

Remarks

Data Definition

Remarks describes whether there are any special circumstances or additional information that is key to the overall interpretation of the ERSS that should be highlighted.

Specific Instructions

The length of this subsection is highly variable, depending on the subject species.

1) Address confusing or contradictory information found elsewhere in the ERSS. For example:

- State **other common names** applied to the species; note when a common name is used for multiple species.

- Highlight any **recent taxonomic changes**, particularly if the sources cited within the ERSS use different scientific names to refer to the subject species.

> Note: If the source of taxonomic information for the ERSS (i.e., Catalog of Fishes, WoRMS, or World Flora Online) uses a **different accepted name** for the species than the majority of recent literature on the species, an acknowledgment of this situation should be given. For example: "The taxonomic authorities used in this Ecological Risk Screening Summary are defined in a Standard Operating Procedure, which can be found online (https://www.fws.gov/node/415801). This report follows the chosen taxonomic authority for *group of organisms* (*name of taxonomic database*; *citation for taxonomic database*) in treating *scientific name* as the accepted scientific name for the subject taxon. However, there is substantial uncertainty surrounding the taxonomy of this species and several recent publications recognize *alternative scientific name* as the valid scientific name. Information for this assessment was searched for using the accepted name (*scientific name*) according to *taxonomic database named above* and the following synonyms: *list scientific name synonyms*."

- Highlight **contradictory information on the range** of the species.

> Note: For species that are **native in all or most of the contiguous United States** but are of interest to noncontiguous areas an ERSS must still be completed before a climate supplement (see appendix E) can be prepared. The text should read: "Although *scientific name* is native to *much/most/all* of the contiguous United States, it is considered *invasive in/of concern to noncontiguous area*. As per the Service ERSS standard operating procedures, to determine the full extent of the risk posed by *scientific name* to *noncontiguous area*, an ERSS for the contiguous United States is completed before a more specific climate match can be completed for *noncontiguous area*."

> Note: Add the following language if a fish species has been **intentionally and legally stocked** in an area of the United States where it is not native: "*Scientific name* has been intentionally stocked outside its native range within the United States by State fishery managers to achieve fishery management objectives. State fish and wildlife management agencies are responsible for balancing multiple fish and wildlife management objectives. The potential for a species to become invasive is now one important consideration when balancing multiple management objectives and advancing sound, science-based management of fish and wildlife and their habitat in the public interest."

2) Additionally, this subsection is the place to put **any other information that the assessor deems pertinent to the ERSS** but does not fit in other subsections. For example:

- If the current ERSS is an update of an ERSS that was **previously published**, note this.
    - Example: "This ERSS was previously published in *month and year of Web Version date*. Revisions were completed to incorporate new information and conform to updated standards."
    - If the accepted scientific name has also changed since that previous publication, state the name under which the ERSS was previously published.
- Note any reported **difficulty in correctly identifying** this species. Example: "Species is commonly confused with the congener *P. miles* so the available information often includes both species."
- If this species is able to **hybridize** with other species or exists in multiple varieties or growth forms, mention this. However, any detailed information about hybridization (e.g., fertile or non-fertile offspring) should be included in the Biology (or, if appropriate, Impacts of Introduction) section.

> Note: If working on a species with an **unusual genetic situation** (e.g., triploid grass carp), additional clarifications may be needed in this section. Service employees, please consult with a Program Lead.

- Information on international regulations pertaining to the species can be mentioned here. A full summary of international regulations is not expected as it is outside of the scope of the ERSS. Similarly, conservation status of a species within its native range (e.g., listed as threatened or endangered) may be mentioned here but is not required.

3) If there is no information for this section, state: "No additional remarks."

D. ERSS Section 2 — Biology and Ecology

For section 2 of an ERSS, search for information for the following 11 data fields, using specific instructions below and information sources in appendix A. Each of the data fields should be placed as a subheading within section 2 (see drafting template, appendix C). If a species is not

covered in the databases and websites listed in appendix A, expand the search to other databases and primary literature. If a risk assessor has checked all the appropriate sources, then the lack of data should be noted, and searching can stop.

Taxonomic Hierarchy and Taxonomic Standing

Data Definition

Taxonomic Hierarchy describes the complete biological classification (taxonomic hierarchy) for the organism including the kingdom, phylum, class, order, family, genus, and species.

Taxonomic Standing confirms the accepted scientific name used for the species, according to taxonomic authorities.

Specific Instructions

1) Quote or reference the preferred data source for the subject species scientific name when stating the taxonomic standing (see part 3B).

2) ITIS is the preferred data source for the taxonomic hierarchy unless the subject species is not included in the ITIS database.

   - The descriptors and taxonomic authorities that often occur after the scientific names are not needed and can be deleted when copying and pasting information from ITIS.

   - In contrast to all other parts of section 2 of the ERSS, quotation marks are not needed around the taxonomic hierarchy because, typically, it is not a direct quote.

   Note: If the subject species is included in the ITIS database under a name other than the accepted scientific name, use the ITIS hierarchy to the point where it diverges from the accepted name or (particularly if the hierarchy diverges at a high taxonomic level) use another source that does use the accepted name.

3) List **synonyms** that were used to search for information. Search for information under synonyms if:

   - The species has recently (within the last 50 years) undergone a change in accepted name, or

   - The species was known by a synonym for a significant time (e.g., several years' worth of literature about the species may be published using the synonym).

Size, Weight, and Age Range

Data Definition

Size, Weight, and Age Range describes the length or age at maturity, size range, maximum length, common length, maximum weight, and maximum age as available.

Specific Instructions

Define any taxon-specific measurement abbreviations that appear in quoted material (e.g., TL [total length], SVL [snout-vent length], CW [carapace width]).

Environment

Data Definition

Environment describes the basic physical conditions necessary for survival of the species, not including climate.

Specific Instructions

1) Identify and report **physical habitat characteristics** for the species.

   - For aquatic organisms, such characteristics may include water temperature, salinity, pH, dissolved oxygen content, depth range, turbidity, and water velocity.

   - Clearly indicate whether reported water temperature tolerance refers to outdoor temperatures, aquarium settings, or other settings where seasonal temperature fluctuations are muted (e.g., thermal spring, cave system).

   - If found, elevation should be included, especially if the species is only known from high elevations.

2) **Do not include air temperature** in this subsection; see Climate subsection, below.

> Note: If the species spends part of its lifecycle in a marine environment, see appendix F (ERSS Writing for Species Not Restricted to Freshwater) for additional instructions.

Climate

Data Definition

Climate describes the general climate (temperate, tropical, etc.), air temperature range, and latitude range where the species can survive.

Specific Instructions

1) Report **air temperature** tolerance in this subsection. Water temperature tolerance belongs in the Environment subsection.

2) Even general climatic zone information (e.g., temperate, tropical) must be sourced and cited as in all other subsections.

Distribution Outside the United States

Data Definition

Distribution Outside the United States describes the native range of the organism outside the United States ("Native Range") and the introduced range of the organism outside the United States ("Introduced Range").

Specific Instructions

1) The native range reported here should be identical to the native range reported in section 1 of the ERSS unless the species is native to any or all of the United States.

> Note: If the species is **native to the United States**, do not repeat the information pertaining to the United States from section 1, instead state: "Part of the native range for this species is within the United States, see section 1 for a complete description of the native range." Repeat the information on the native range outside of the United States.

2) In reporting the introduced range, include **whether the species is known to be established** (i.e., surviving and reproducing successfully in the wild) in each location.

Means of Introduction Outside the United States

Data Definition

Means of Introduction Outside the United States describes how the species was introduced to a new range outside of the United States.

Specific Instructions

1) Similar to Means of Introduction in the United States in section 1, this subsection should reference **both pathways and vectors** (see part 3C).

2) If possible, provide a **general summary** of historical information on introduction, transport routes, and spread.

Short Description

Data Definition

Short Description provides the reader with a physical description of the species.

Specific Instructions

1) Remember to keep this subsection brief.

2) Focus on information that may be used for identification purposes. However, the description does not need to be sufficient for species identification on its own.

Biology

Data Definition

Biology describes the basic biology of the species.

Specific Instructions

1) Information in this section could include habitat use, feeding, reproduction, development, genetics, activity patterns (e.g., migration, hibernation), adaptations for survival, and patterns in population size or density, as available.

2) When in doubt, focus on aspects of the species biology that may be relevant to its impacts of introduction or management of introductions.

Human Uses

Data Definition

Human Uses describes actual and potential human uses of the species and its current status in trade.

Specific Instructions

1) **U.S. trade information** should be reiterated from "Status in the United States" in section 1 of the ERSS.

2) If possible, include specific information on the **duration and volume** of the species in trade.

3) Examples of human uses to report here include consumption by humans and other ornamental, medicinal, research, entertainment, spiritual, or agricultural uses.

Diseases

Data Definition

Diseases describes pathogens and parasites known to be carried by the species.

Specific Instructions

1) For **vertebrate, crustacean, and mollusk species**, this subsection should begin with a bolded statement on whether species is reported to carry any diseases that are on the World Organisation for Animal Health (WOAH)'s list of notifiable diseases.

    - If no records of WOAH-listed diseases were found, state this.

    - Include the citation for the disease list.

2) For **other invertebrate or plant species**, skip the statement about WOAH-listed diseases. (WOAH does not list diseases for these hosts.)

Threat to Humans

Data Definition

Threat to Humans describes characteristics of the species that pose a threat to humans.

Specific Instructions

1) Report here if the species is venomous, poisonous, traumatogenic (causes bodily injury), a potential pest, or carries a zoonotic disease (animal to human transmission).

    - Information can come from the **native or invaded range** of the species.

    - Include **threats posed by all members of a genus or family** (e.g., envenomation from freshwater stingrays or shock from electric fish) regardless of whether the subject species itself is named as a threat in the source material.

2) If there is documentation of the threat having an impact in the invaded range, the information should also be included in the Impacts of Introductions section (see part 3E).

E. ERSS Section 3 — Impacts of Introductions

Search for information on documented impacts of introduction for the species being assessed, using data sources in appendix A and specific instructions below.

It is important to seek peer-reviewed literature documenting details of assessed and documented impacts, and to copy from, and cite, that literature. Sources of peer-reviewed literature include Web of Science, Google Scholar, and for Service personnel, the Service's Conservation Library (see appendix A). All sources on Web of Science have been peer-reviewed, giving high confidence in their scientific credibility. In contrast, Google Scholar returns a mix of peer-reviewed and non-peer-reviewed literature. However, Google Scholar is more likely to provide access to sources published outside of North America and Europe.

If the full text of an article cannot be accessed via the above sources, Service employees may request a copy from library@fws.gov. Be sure to send the full citation and indicate from which program the request originates (e.g., Fish and Aquatic Conservation, Refuges). These requests are often fulfilled within one to two days.

Data Definition

Impacts of Introductions refers to the documented effects of the assessed species within a nonnative habitat, including effects on native species, the environment, the economy, or human health.

Specific Instructions

1) Include the specific ecological, social, or economic **constructs or functions affected**, as well as the **magnitude** of the impacts.

2) Provide as much relevant information on impacts as possible without unnecessary repetition.

3) Pay special attention to **impacts related to criteria for injurious wildlife listing** under the Lacey Act:

   - Impacts to human beings;
   - Impacts to agriculture, horticulture, or forestry; or
   - Impacts to wildlife or the wildlife resources of the United States.

4) While potential impacts can certainly be reported, **they cannot be used as the sole basis on which a species is assessed**. Any potential impacts must be clearly identified as potential and not documented impacts.

5) Information on impacts to other nonnative species may be included if needed to document an impact to human health or the economy. Otherwise, impacts to other nonnative species should not be included.

6) If the species is **listed on international, Federal, or State invasive, prohibited, or restricted lists**, summarize the information found and reported in section 1 (see part 3C). Name the jurisdictions that promulgated rules to restrict possession, trade, or transport.

> Note: The fish family Salmonidae and many salamander genera have been listed as **injurious wildlife** by the Service due to the risk of disease transmission. When screening a species within one of these taxa, language similar to the following should be added to this section: "All species in the family Salmonidae are listed as injurious species in the United States due to the risk of carrying certain pathogens, thus prohibiting their importation unless imported live with a health certification or dead and eviscerated (USFWS 1967)."

F. ERSS Section 4 — History of Invasiveness

Data Definition

History of Invasiveness (HOI) refers to the categorization of historical impacts of introduction based on the existence and quality of evidence for establishment outside the native range, adverse impacts of introduction, and trade history.

There are four HOI categories (High, Low, Data Deficient, and No Known Nonnative Population) with the following definitions:

1) **High** HOI indicates that BOTH:

   - The species is **established** outside its native range, and
   - One or more sources provide **clear, convincing, and reliable** documentation of negative impacts of introduction (see definition of impacts of introduction in 3E).

2) **Low** HOI indicates that EITHER:

- The species is **established** outside of its native range, but there is **clear, convincing, and reliable** documentation of **no significant negative impacts** of introduction (see part 3E) that are attributable to the subject species; or

- The species has been transported beyond its native range due to **substantial trade** for at least 10 years with **no or very little evidence of establishment** outside its native range.

> Note: The Service's frame of reference for "substantial trade" is trade volume in the millions of organisms. This is not intended as a precise threshold.

3) **Data Deficient** HOI indicates that the species is established beyond its native range, but EITHER:

- There was no evidence found of negative impacts, no evidence found of lack of negative impacts (see Low HOI, above), or no evidence found of substantial trade for at least 10 years; or

- There is information available indicating possible negative impacts or possible lack of negative impacts. However, this information fails to meet the requirement of **clear, convincing, and reliable** documentation that would qualify the species as having High HOI or Low HOI.

4) **No Known Nonnative Population** HOI indicates that EITHER:

- No evidence was found of the species having ever been transported (through trade or other mechanisms) outside its native range, so presumably the species has had **no opportunity to become established** and exhibit any negative impacts of introduction; or

- The species is cryptogenic (status as a native or nonnative species is unknown); or

- The species distribution is unknown (including whether it has been introduced outside its native range); or

- There is evidence of the species having been introduced beyond its native range, but **no evidence of establishment in the wild and no evidence of substantial trade** for at least 10 years as defined above.

Specific Instructions

1) Determine the HOI category using information gathered on the assessed species, the HOI category definitions, and the decision tree in figure 2.

2) In the narrative for this section:

- **Summarize** the evidence in sections 1 through 3 of the ERSS relating to the species' HOI, including:
    - Introductions
    - Establishment
    - Impacts
    - Existing regulations
    - Trade

> Note: If trade data are available for a limited period (e.g., a single month or year), clearly state so when extrapolating data for comparison with the threshold of "substantial trade [millions of organisms] for substantial time [10 or more years]."

- **Explain** how the information fulfills the criteria for the HOI category.
- Pay particular attention to the differences between the definitions of Low, Data Deficient, and No Known Nonnative Population HOI categories when assessing a species without documented negative impacts of introduction.
    - **The difference between Low and Data Deficient HOI lies in the documentation of no negative impacts of introduction.** Think about the aphorism popularized by astronomer Carl Sagan: "Absence of evidence is not evidence of absence." Data Deficient HOI involves the absence of evidence of negative impacts, while Low HOI involves the evidence of absence of negative impacts. Data Deficient HOI is much more common than Low HOI.
    - **The difference between Low and No Known Nonnative Population HOI lies in the documentation of substantial trade.** There must be documentation of substantial trade for at least 10 years to classify a species as having Low HOI as opposed to No Known Nonnative Population HOI. No Known Nonnative Population HOI is much more common than Low HOI.

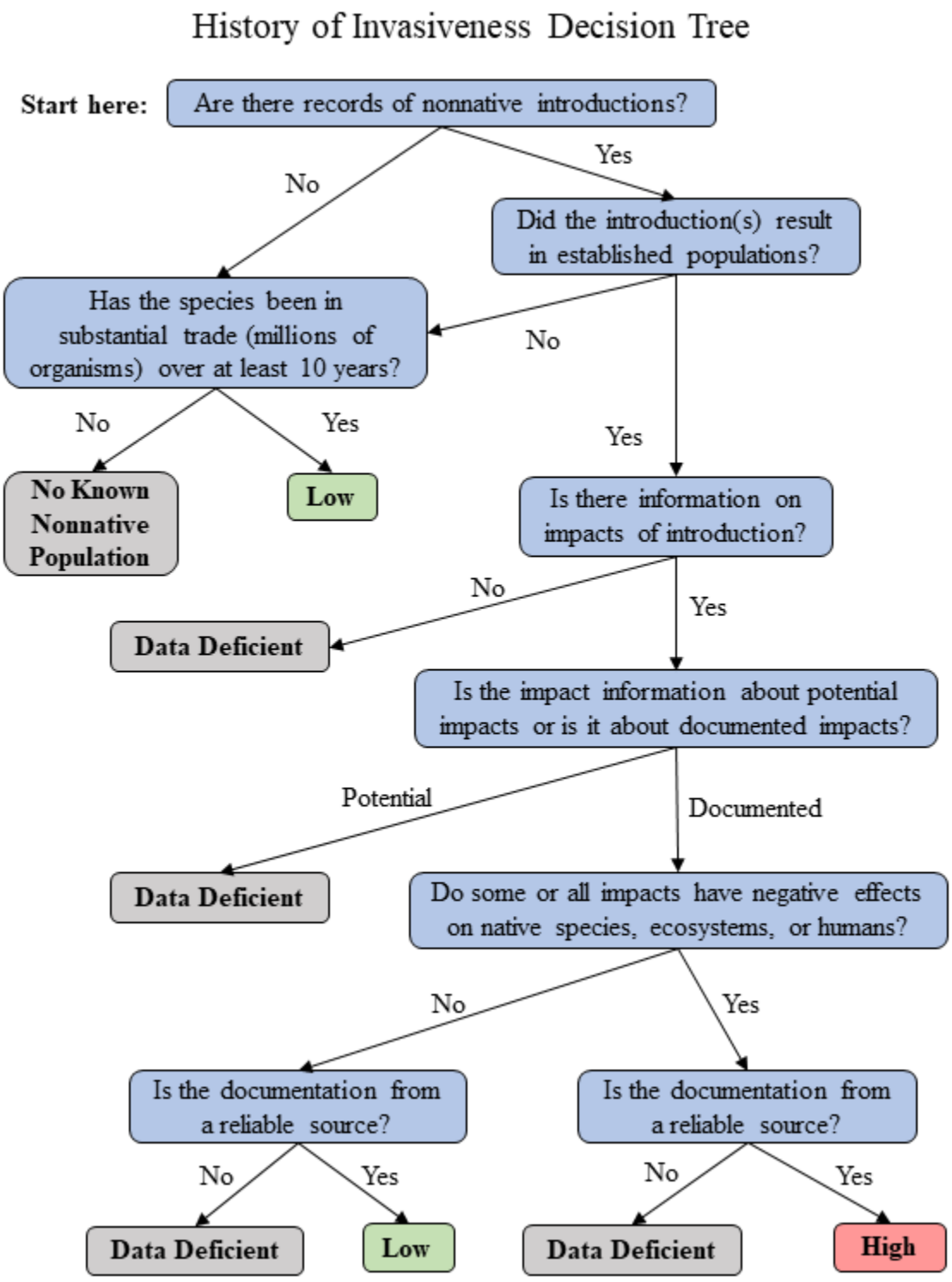

Figure 2. A decision tree to assist assessors with selecting the correct History of Invasiveness (HOI) category based on the information in the ERSS. Use the narrative category descriptions in part 3F to confirm or revise the result of the decision tree.

G. ERSS Section 5 — Global Distribution

Search for geographically referenced information, preferably in map form, on the global distribution of the species being assessed, using data sources in appendix A and specific instructions below.

Data Definition

The **global distribution map**(s) shows geographically referenced observations of the species throughout the world.

Specific Instructions

1) Start by searching the Global Biodiversity Information Facility (GBIF).

   - Use of GBIF is integrated into RAMP (Sanders et al. 2023), used in the climate matching analysis (section 7), so it is important to include the GBIF distribution map for the species if one exists.

   > Note: For species with scientific name synonyms, GBIF includes all occurrences attributed to synonyms on the occurrence map for the GBIF accepted scientific name. The reverse is not true. Pay particular attention to which occurrences are included or excluded from a given map if GBIF uses a different accepted scientific name than the accepted scientific name used in the ERSS.

2) Maps from other databases and literature may be used provided they are published under a reuse license and they add meaningful information to the ERSS.

3) If there are no points in GBIF or other mapping databases (appendix A), and it is possible to generate a distribution map based on species location descriptions cited in sections 1 and 2 or coordinates given in an article, a map may be generated using Google Maps, Google Earth, or ArcGIS with appropriate credit given to that software.

   > Note: If only general locations are listed in the literature (i.e. a lake or river basin) find a map of that location(s) with appropriate usage rights. Clearly state that the map represents the verbal description of the species range, not georeferenced species occurrences. The uncertainty due to the lack of georeferenced occurrences should be noted in the Summary of Climate Matching Analysis (see part 3I).

4) Examine GBIF or other distribution maps to distinguish established population locations from other types of occurrences (see appendix H for more detailed instructions using GBIF as a model). **Only established population locations in nonmarine environments will be used to select source points for the climate match.**

   - Check for internal consistency in the ERSS regarding the species range.

     - Compare the map to the known native range, introduced range, and other information regarding the established range in sections 1 and 2 of the ERSS.

- Note any points that are inconsistent with the established range information in sections 1 and 2; these are "outliers" and must be evaluated to determine if they represent legitimate species occurrences.

- Access the record information for any outlier points. Within the provided information on the record, be sure that:

  - The longitude and latitude are consistent with any verbal description of the collection location;

  - The collection location makes sense (e.g., a freshwater species should not be reported from a marine environment);

  - The specimen was obtained in the wild (e.g., not from a market, pet shop, museum, aquarium, laboratory, or botanical garden); and

  - For aquatic species, the location is not a thermal spring or other environment where the water remains at a constant or warmer temperature despite seasonal changes in air temperature.

    - Such locations should not be used for the climate matching analysis as global climate datasets do not account for the different ambient water conditions present at those locations; including this location will bias the predicted risk of establishment reported by the climate match analysis.

    - Mention the occurrence under "Remarks" in ERSS section 1, noting that the species has survived or established in thermal springs (or other environment).

- Make note of the findings on outlier points to include in the explanatory text for this section (see (6) below).

  - If a record appears genuine and representative of an established population, it may be included in the climate matching analysis.

  - If the record information for the outlier raises doubts that it represents an established population, make note that the point will not be used to select source points for the climate match and the reason it will not be included.

> Note: Occurrences of eradicated populations may be included in the climate matching analysis only if they meet all the following conditions: (1) a population was established prior to eradication; (2) eradication occurred due to human intervention, as opposed to natural or unknown causes; and (3) eradication occurred within the last 50 years.

5) Save and insert the map in the ERSS.

- Include at least a little bit of coastline or country borders and do not zoom in so close that it is not possible to recognize the location.

- The map(s) must include a **caption**.
    - The caption should identify the countries (or general regions of the world in the case of a broad distribution) where points are located.
    - If the map does not contain coastline or country borders, describe the location context in the figure caption.
    - If occurrences are shown in multiple colors or shapes and the map does not include a legend, the meaning of this symbology must be explained in the caption.
    - Recommended format: "Figure *X*. Global distribution of *scientific name* reported from *countries or regions*. Map from *citation*."
- Save both an **image file** (JPEG or PNG) of the map for incorporation into the ERSS and a **PDF of the webpage** in the administrative file.

6) Provide one or more brief paragraphs below the map(s) **noting any discrepancies** between the verbal description of species range in ERSS sections 1 and 2 and the visual description provided by the map(s) in this section.

- For parts of the range missing from the map(s), state that there is a lack of georeferenced occurrences in the missing parts of the range.
- Name any **outliers** that were determined not to represent established populations. State that they will not be used to select source locations for the climate match and why. Group points by the reason they will not be used.
    - Example: "Locations in France and the Atlantic Ocean were not used to select source points for the climate match because the listed coordinates do not match the collection location."
    - Example: "Locations in India and South Africa were not used to select source points for the climate match because the specimens were not collected from the wild."
- It may also be helpful to note in the explanatory text why an outlier point was determined to be valid and used to select source locations for the climate match.

Figure 3. Example of a species distribution map from GBIF.

H. ERSS Section 6 — Distribution Within the United States

Search for geographically referenced information, preferably in map form, on the U.S. distribution of the species being assessed, using data sources in appendix A and specific instructions below.

Data Definition

The **U.S. distribution map**(s) shows geographically referenced observations of the species within the United States and its territories.

> Note: If the species has not been reported in the wild in the United States, then simply state: "This species has not been reported in the wild in the United States." No map is necessary in this situation.

Specific Instructions

1) Recommended sources for U.S. distribution maps include the U.S. Geological Survey's Nonindigenous Aquatic Species database (NAS), EDDMapS, and GBIF-US (see appendix A for details on the use of these databases).

2) Maps from other databases and literature may be used provided they are published under a reuse license and add meaningful information to the ERSS.

3) If there are no points in any mapping databases (appendix A), and it is possible to generate a distribution map based on species location descriptions cited in section 1 or coordinates given in an article, a map may be generated using Google Maps, Google Earth, or ArcGIS with appropriate credit given to that software.

4) Search for **outliers and anomalies** using the same methods as outlined in part 3G.

> Note: Occurrences in NAS are reported with a status classification (established, locally established, collected, eradicated, failed, or unknown). This information can be helpful in assessing outliers and anomalies because only established (including locally established) and certain eradicated (see Note box in part 3G, step 4 under Specific Instructions) population locations will be used to select source points for the climate match. See appendix A for more details on accessing occurrence records in NAS.

5) Save and insert the map in the ERSS.

- Include at least a little bit of coastline or country or State borders and do not zoom in so close that it is not possible to recognize the location.

- The map(s) must include a **caption**.

  - The caption should identify the U.S. States and territories (or general regions of the United States in the case of a broad distribution) where points are located.

  - If the map does not contain coastline or country or State borders, describe the location context in the figure caption.

  - If occurrences are shown in multiple colors or shapes and the map does not include a legend, the meaning of this symbology must be explained in the caption.

  - Recommended format: "Figure *X*. Distribution of *scientific name* in the United States reported from *States or, if too many, regions*. Map from *citation*."

- The map(s) must have **alt text**. Recommended format: "Map of the contiguous United States showing known locations where *scientific name* has been reported. *Describe locations of observations.*"

- Save both an **image file** (JPEG or PNG) of the map for incorporation into the ERSS and a **PDF of the webpage** in the administrative file.

6) Provide one or more brief paragraphs below the map(s) **noting any discrepancies** between the verbal description of U.S. range in ERSS section 1 and the visual description provided by the map(s) in this section.

- For parts of the range missing from the map(s), state that there is a lack of georeferenced occurrences in the missing parts of the range.

- Name any **outliers** that were determined not to represent established populations. State that that will not be used to select source locations for the climate match and why. Group points by the reason they will not be used. See examples in part 3G.

- It may also be helpful to note in the explanatory text why an outlier point was determined to be valid and used to select source locations for the climate match.

Figure 4. Example of a United States distribution map acquired from the NAS database. The shaded area represents the native range of the species and the orange points represent nonnative occurrences of the species.

I. ERSS Section 7 — Climate Matching

The climate matching component of an ERSS is completed using the Service's RAMP tool (Sanders et al. 2023).[4] RAMP uses data from the Climatologies at High resolution for the Earth's Land Surface Areas (CHELSA) project (Karger et al. 2017, 2018) to estimate climatic similarity between the current established locations of a species and potential regions of introduction. Details on the purpose, development, and use of RAMP are available within a separate SOP, available in the ERSS supporting documents on the Service's website. RAMP was peer reviewed under Office of Management and Budget criteria for influential science (OMB 2004); peer review documentation is also available in the ERSS supporting documents. If a risk assessor outside of the Service has a license for ArcGIS Pro and wishes to use RAMP, then a request for a copy of the tool can be sent to ais_risk_assessment@fws.gov.

Data Definitions

The **source map** (figure 5) displays the source points selected for the climate match.

[4] If the ERSS process is being applied outside of the Service and the use of RAMP is not feasible (see the RAMP SOP for software requirements), then the Australian Bureau of Agricultural and Resource Economics and Sciences' Climatch program (ABARES 2020) is an acceptable alternative. See appendix G for further information on Climatch.

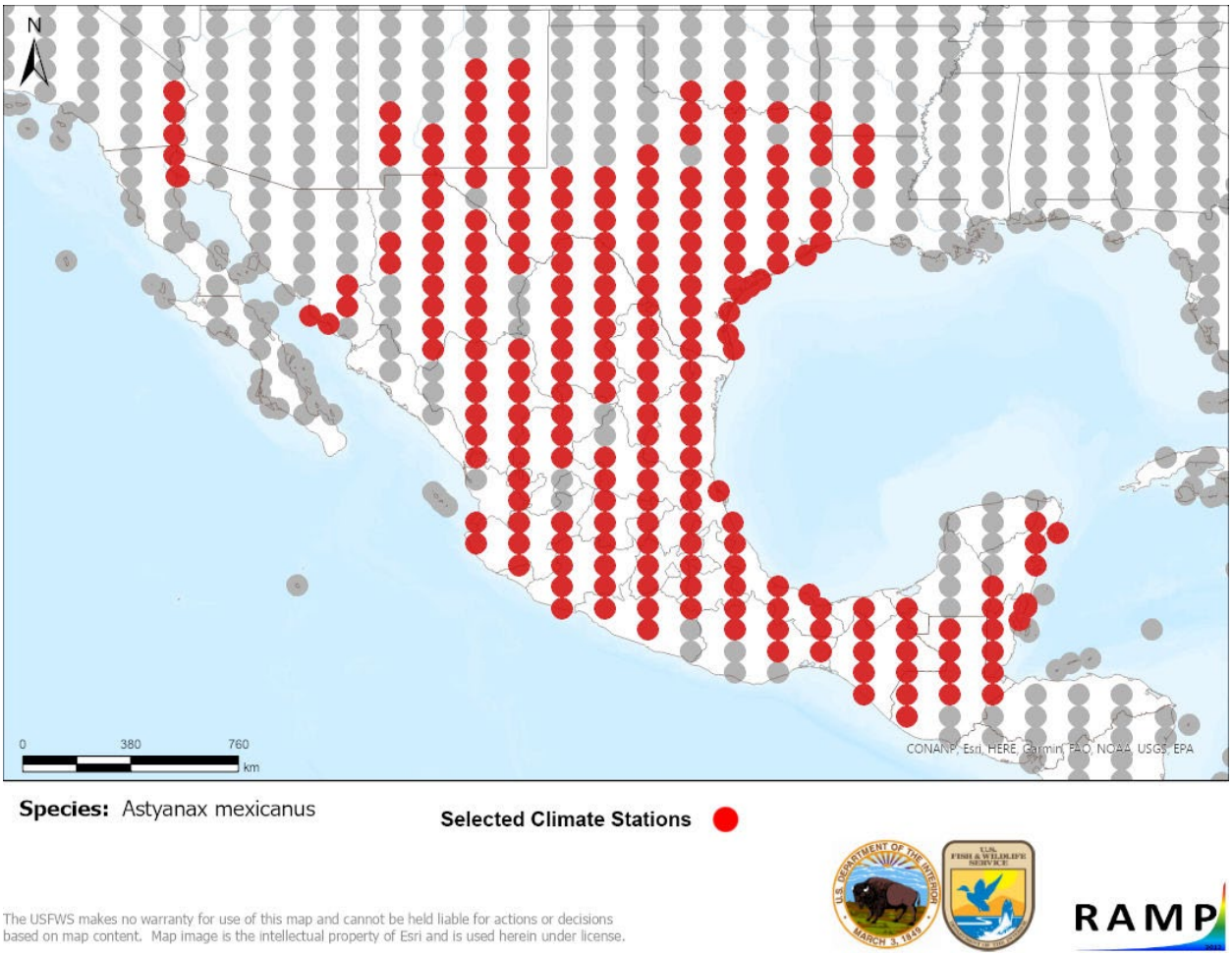

Figure 5. Example RAMP source map showing weather stations selected (red) and not selected (gray) in the climate matching process.

The **climate match results map** (figure 6) displays the climate match results for the contiguous United States. The climate match in the ERSS is run for the contiguous United States always, but if an assessment is needed for a noncontiguous area, a climate match supplement (appendix E) can be written for Alaska, Hawaii, American Samoa, Guam, the Northern Mariana Islands, Puerto Rico, or the U.S. Virgin Islands.

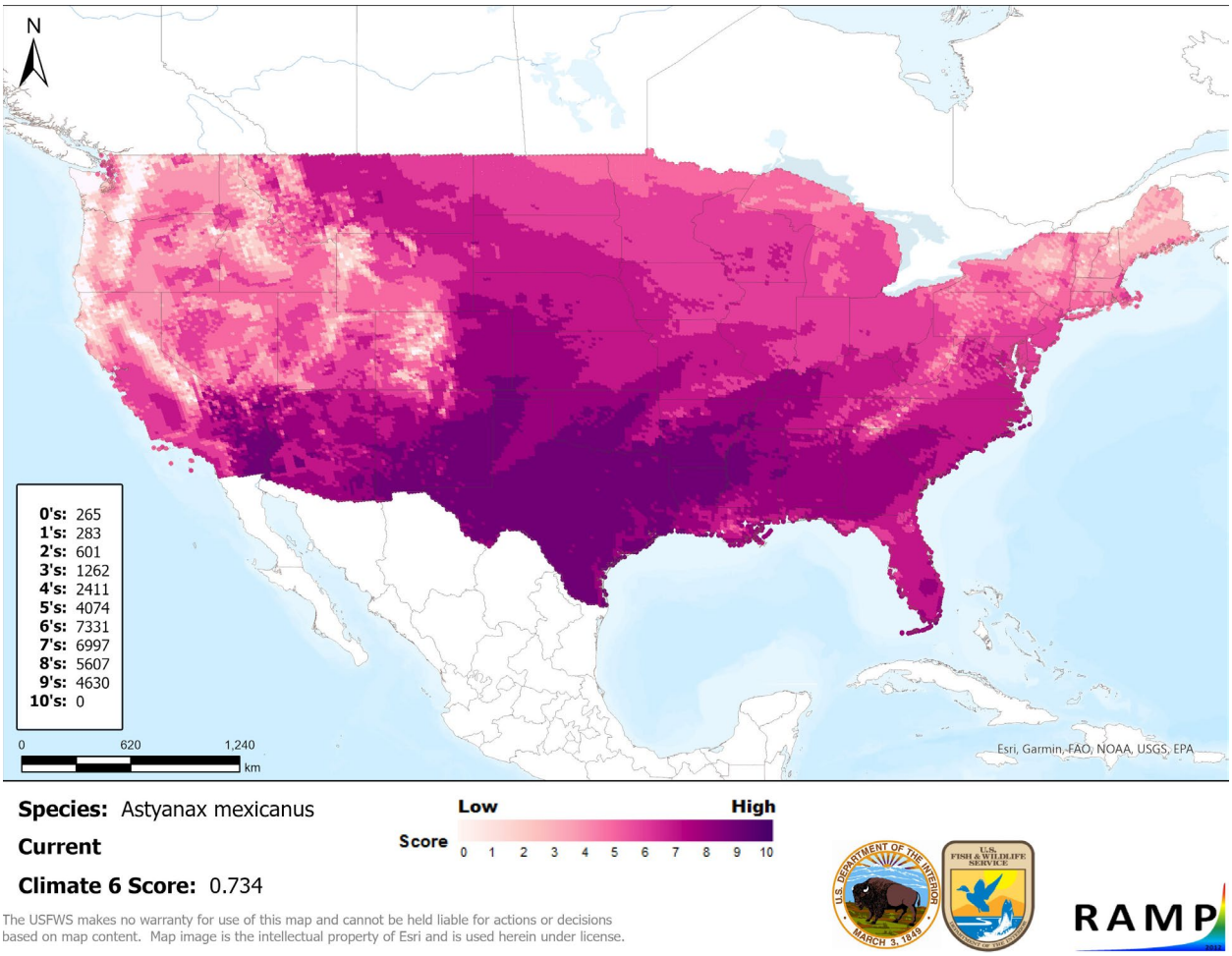

Figure 6. Example of a climate match results map from RAMP showing variability in climate match (represented by varying shades of pink and purple) across the contiguous United States.

The **table of climate match scores** displays the count of target points for each **target point score** (0–10). The climate match to the contiguous United States is comprised of tens of thousands of target point scores. Each target point score represents the similarity of the climate at the given target point to the climate at the source points. A score of 10 is a perfect climate match between the source locations and the target point, and a score of 0 is no match. If using RAMP, this table is included automatically in the climate match results map (figure 6).[5] In the climate match results map, the target point scores are represented visually with a color ramp: darker shades of purple correspond to higher target point scores and therefore higher climate match.

The **Summary of Climate Matching Analysis** is a verbal description of the results of the climate matching analysis including local and summarized measures of climate match, and what these measures indicate about species potential for establishment in the contiguous United States. This summary is placed at the beginning of section 7, prior to the maps.

[5] If Climatch is used instead of RAMP, a table that includes the count of target points for each target point score (0–10) and the Climate 6 score must be created by the assessor and inserted in the ERSS (see appendix G).

The Summary of Climate Matching Analysis includes:

1) A verbal description of the distribution of target point scores across the climate match results map, comparing and contrasting different geographic areas. In general, target point scores of approximately 0-3 may be described as "low" match, approximately 4-6 as "medium" match, and approximately 7-10 as "high" match.

2) The **Climate 6 score**, a summary statistic that is positively related to the probability that the species will establish successfully within the target region (see appendix I). The Climate 6 score is calculated as:

$$\textbf{Climate 6 score} = \frac{\textbf{Count of target points with scores } \geq \textbf{6}}{\textbf{Count of all target points}}$$

3) The degree of **Establishment Concern** warranted for the target region, based on the value of the Climate 6 score. Establishment Concern is categorized as Yes (there is establishment concern) or Doubtful, and is one of two Assessment Elements that contribute to the Overall Risk Assessment Category (see part 3K).

Specific Instructions

1) Carry out the climate matching analysis in RAMP.

   - Step-by-step instructions for using RAMP are available in part 3 of the RAMP SOP (USFWS 2024).

   - Make sure to modify the climate matching source locations as needed.

     - **Remove outliers** identified in sections 5 and 6 as not representing established populations.

     - **Add valid source locations** found outside of GBIF (e.g., in another database or in a journal article).

2) Insert the source map into the ERSS.

   - The source map can be imported into Microsoft Word from the RAMP species folder.

   - Write a **caption** for the source map.

     - Clearly state the overall geographic area of the map.

     - Identify specific countries or States with selected source points.

     - Cite all references used to identify source locations (e.g., GBIF).

     - Recommended format: "RAMP (Sanders et al. 2023) source map showing weather stations in *geographic area* selected as source locations (red; *list countries with selected source points*) and non-source locations (gray) for *scientific name* climate

matching. Source locations from *citation*. Selected source locations are within 100 km of one or more species occurrences, and do not necessarily represent the locations of occurrences themselves."

- Insert **alt text** for the source map.
    - Briefly describe the overall distribution of the points on the map.
    - Recommended format: "Map of *geographic area* showing selected source locations for *scientific name* climate matching. *Describe locations of source points*."

3) Insert the climate match results map into the ERSS.

- The results map can be imported into Microsoft Word from the RAMP species folder.
- Write a **caption** and **alt text** for the results map.
    - Recommended format for the caption: "Map of RAMP (Sanders et al. 2023) climate matches for *scientific name* in the *contiguous United States or appropriate region* based on source locations reported by *citation*. Counts of climate match scores are tabulated on the left. 0/Pale Pink = Lowest match, 10/Dark Purple = Highest match."
    - Recommended format for the alt text: "Map of the contiguous United States showing results of climate matching for *scientific name*. A text description of the results was provided at the beginning of section 7."

4) Write the Summary of Climate Matching Analysis.

- This summary is placed at the beginning of section 7, prior to the maps.
- The summary should be written in **past tense** because it is a report on the results of the climate matching analysis.
- Describe the climate match in terms of **areas of high, medium, or low match** within the contiguous United States.

> Note: If a species is native to part or most of the contiguous United States, clearly differentiate the climate match results between the native and nonnative areas. For example: "The climate match for *Sander vitreus* was generally very high in its native range in the Great Lakes and Mississippi River basins. However, it was also high across much of the rest of the contiguous United States." Or "*Elodea nuttallii* is native to most of the contiguous United States and the corresponding climate match was mostly high."

- Report the **overall Climate 6 score** for the contiguous United States.

- **Translate the Climate 6 score to the appropriate level of Establishment Concern**. Climate 6 scores of 0.002 and above warrant establishment concern, while establishment is doubtful with Climate 6 scores below 0.002.

- Recommended format: "The climate match for *scientific name* was high in *describe specific areas of high match on the map*. *Similarly, describe specific areas of medium match and low match.* The overall Climate 6 score (Sanders et al. 2023; 16 climate variables; Euclidean distance) for the contiguous United States was *Climate 6 score*, indicating that *there is establishment concern/establishment is doubtful* for this species [*if the species is native to the contiguous United States, add:* outside its native range]. The Climate 6 score is calculated as: (count of target points with scores ≥ 6)/(count of all target points). Establishment concern is warranted for Climate 6 scores greater than or equal to 0.002 based on an analysis of the establishment success of 356 nonnative aquatic species introduced to the United States (USFWS 2024)."

Note: If there are **factors that may substantially influence quality or interpretation** of climate matching results, the Summary should also mention these. Such factors may include:

- lack of occurrence data for substantial areas of the species established range (likely to underestimate climate match to the target region),

- climate matching source locations derived from generalized reports of occurrences rather than georeferenced occurrence data (increasing uncertainty in the results),

- salinity requirements (see appendix F), or

- migratory life histories (e.g., "This climate matching analysis included locations occupied by *scientific name* during breeding, migratory, and nonbreeding periods of the life cycle. Therefore, the climate match reflects climates where the species can survive, but there may be stricter climatic requirements for where it can reproduce").

5) **Insert the following statement** on a separate line below the Summary of Climate Matching Analysis and before the source map: "Projected climate matches in the contiguous United States under future climate scenarios are available for *scientific name* (see appendix). These projected climate matches are provided as additional context for the reader; future climate scenarios are not factored into the Overall Risk Assessment Category."

J. ERSS Section 8 — Certainty of Assessment

Data Definition

The **Certainty of Assessment** describes the assessor's degree of confidence in the conclusions of the ERSS based on the amount and quality of information available regarding the species, its distribution, and its adverse impacts.

There are three Certainty of Assessment categories:

1) **High** certainty indicates that the risk assessor is **highly confident** in the HOI category and Establishment Concern, based on existing evidence that is provided and referenced within the ERSS.

    - High certainty means that **scientifically credible and defensible information** is being used to draw conclusions about both the subject species' HOI and Establishment Concern for the United States.

    - Examples:

        - If the species is **established** outside its native range, then abundant, clear, and convincing information is available about both the subject species' distribution and its impacts of introduction from peer-reviewed scientific literature.

        - If the species is **not established** outside its native range, then abundant, clear, and convincing information is available about the subject species' distribution including its lack of establishment and one or more credible and reliable sources provide trade data showing millions of individuals in trade over at least 10 years.

2) **Medium** certainty indicates that there is sufficient information relating to the HOI and the species distribution and that the Certainty of Assessment is neither High (see definition above) nor Low (see definition below).

    - Examples:

        - Most of the data and information about the subject species HOI and distribution are available only from gray literature or other non-peer-reviewed sources.

        - Peer-reviewed information is available on impacts of introduction, but the information was not obtained in a scientifically rigorous manner (e.g., observational studies or summaries of anecdotal reports).

        - Some peer-reviewed studies conclude there are impacts, while others find no impacts.

        - Otherwise-credible trade data cannot be compared directly to the threshold time period established for Low HOI (see part 3F) and must be extrapolated from a shorter time period.

        - The full text of key studies is not available in English (e.g., journal articles in another language with English abstract) and therefore cannot be fully evaluated.

3) **Low** certainty indicates that the risk assessor is uncertain of the HOI category, Establishment Concern, or both.

- Examples:
    - Very limited or no information is available regarding the species' HOI or distribution.
    - The information, particularly regarding HOI, is not scientifically defensible.
    - The distribution information is so incomplete that the climate matching with the United States will not provide scientifically defensible results.
    - Identification of the subject species is very difficult or controversial, so there is doubt as to whether information regarding distribution or HOI is accurately attributed to the subject species.

Specific Instructions

1) Determine the Certainty of Assessment category using the information generated in the previous seven sections, the Certainty of Assessment category definitions, and the decision tree in figure 7.

2) In the narrative for this section, state the Certainty of Assessment category and **clearly explain the reasons for the category choice**.

    - The most important considerations are the quality of scientific documentation of impacts of introduction (informing HOI) and the completeness and quality of documentation of species distribution (informing the climate matching analysis).
    - Mention, as appropriate, other sources of uncertainty including:
        - Need to extrapolate trade data
        - Taxonomic confusion
        - Cryptogenicity, i.e., status as a native or nonnative species is unknown, or the species is notably difficult to distinguish from other established species
        - Partial marine range (see appendix F for specific guidance)
        - Establishment in thermally controlled environments (e.g., thermal springs or power plant discharge areas) not included in the climate match
        - Anything else that the risk assessor feels affects the certainty of the ERSS

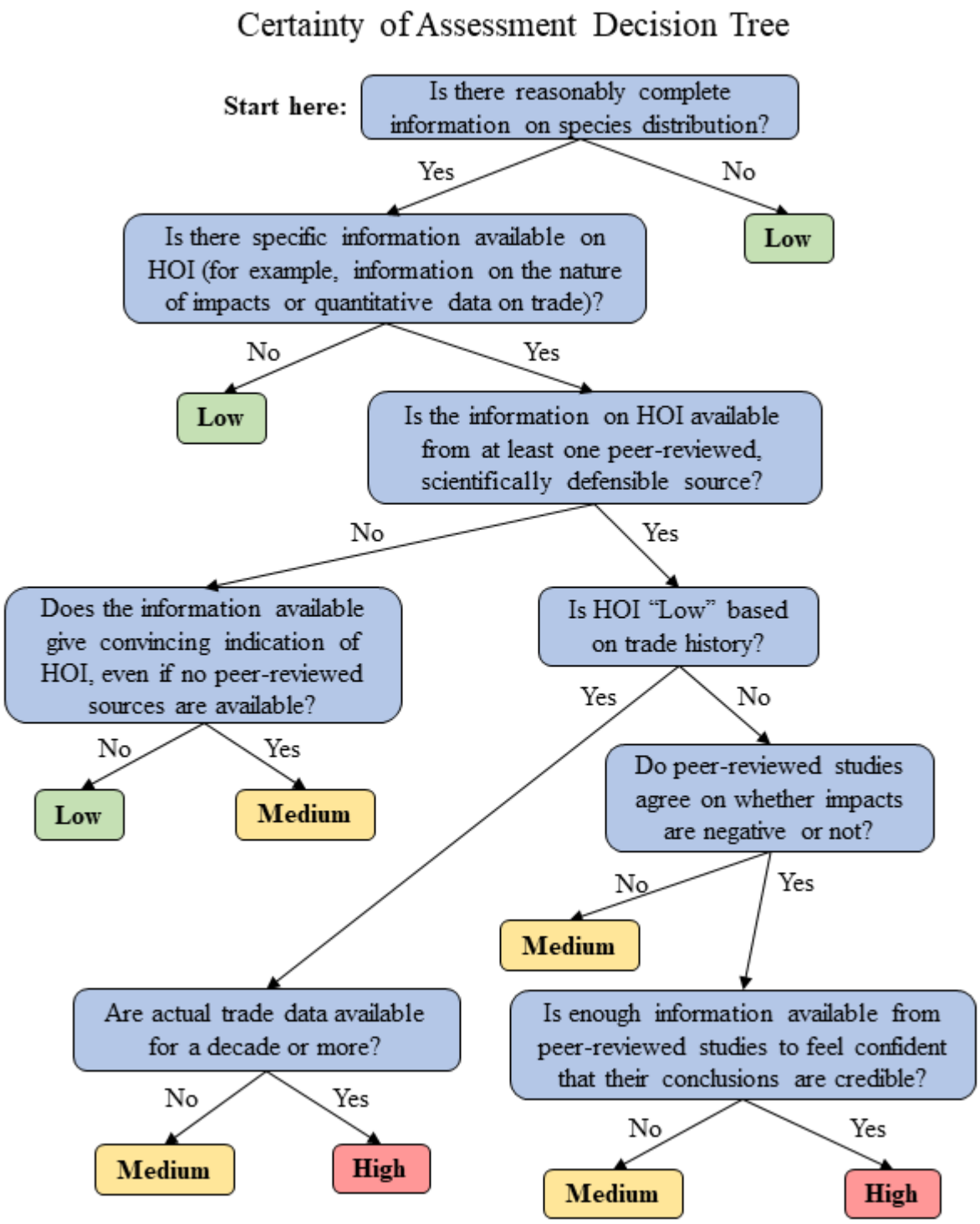

Figure 7. A decision tree to assist assessors with selecting the correct Certainty of Assessment category based on the information in the ERSS, including distribution and history of invasiveness (HOI). Use the narrative category descriptions in part 3J to confirm or revise the result of the decision tree.

K. ERSS Section 9 — Risk Assessment

Data Definition

The **Summary of Risk to the United States** is a narrative summary and synthesis of the entire ERSS document.

The **Assessment Elements** summarize, in list format, the categories determined for each component of the risk assessment.

Assessment Elements

- **History of Invasiveness (see Section 4): Data Deficient**
- **Establishment Concern (see Section 7): Yes**
- **Certainty of Assessment (see Section 8): Low**
- **Remarks, Important additional information: None**
- **Overall Risk Assessment Category: Uncertain**

Figure 8. Example of the assessment elements list from an ERSS.

The **Overall Risk Assessment Category** (ORAC) classifies the risk posed by the subject species to the contiguous United States.

There are three categories for the ORAC (table 1):

1) **High** ORAC indicates that BOTH of the following are true:
   - HOI = High
   - Establishment Concern = Yes
2) **Low** ORAC indicates that BOTH of the following are true:
   - HOI = Low
   - Establishment Concern = Doubtful
3) **Uncertain** ORAC indicates any of the following conditions:
   - HOI = High AND Establishment Concern = Doubtful, or
   - HOI = Low AND Establishment Concern = Yes, or
   - HOI = Data Deficient, regardless of Establishment Concern, or
   - HOI = No Known Nonnative Population, regardless of Establishment Concern, or
   - If the species cannot reproduce in non-marine environments because the climate match for marine reproduction cannot be assessed in an ERSS (see appendix F).

Table 1. Overall Risk Assessment Categories determined by combining the Establishment Concern category (Yes or Doubtful) with the History of Invasiveness category (High, Low, Data Deficient, or No Known Nonnative Population).

History of Invasiveness	Establishment Concern: Yes	Establishment Concern: Doubtful
High	**High**	*Uncertain*
Low	*Uncertain*	**Low**
Data Deficient	*Uncertain*	*Uncertain*
No Known Nonnative Population	*Uncertain*	*Uncertain*

Specific Instructions

1) Determine the ORAC using the verbal category definitions and table 1.

2) **Summarize** the information within the ERSS, with an emphasis on HOI, climate match with the contiguous United States and corresponding Establishment Concern, Certainty of Assessment, and the ORAC for the species.

   - Begin with a general statement about what the organism is and where it lives.
   - Summarize important information on the biology and ecology (such as WOAH-listed diseases), uses, regulations, introductions, impacts, and threats posed by the species.
   - State the HOI category and summarize the justification in a single sentence.
   - State the level of Establishment Concern and summarize any regions of the country with a high climate match, especially if Establishment Concern is rated as Doubtful.
   - State the certainty category and summarize the justification in a single sentence.
   - End with a statement of the ORAC.
   - Be sure all information in this section was mentioned in a previous section of the ERSS; **no new information should be introduced in this section**.
   - Examples:
     - "*Ludwigia ovalis* is a perennial plant that grows in lake and pond beds and is also used in the aquarium trade in the United States and abroad. The species is native to China, Taiwan, Japan, and the Korean Peninsula. Its History of Invasiveness is classified as No Known Nonnative Population because of a lack of documented introductions into the wild outside the native range and limited data to characterize the volume and duration of trade in this species. The climate matching analysis for the contiguous United States indicates establishment concern for this species; high climate matches were concentrated in the eastern and central contiguous United States while much of the land west of the Rocky Mountains had a low match. The Certainty of Assessment is Low due to the lack of information on impacts of

introduction. The Overall Risk Assessment Category for *Ludwigia ovalis* is Uncertain."

- Other examples may be found in the example ERSS in appendix D and in the ERSS library on the Service's website.

Notes on special situations:
- If part of the species' range is marine, note that the marine portion of the distribution is not included in the climate match. See appendix F for additional instructions.

- If the source points for the climate match were only a general representation of the range of the species, state this and explains how it impacts the results of the climate match.

- If the species is native to part of the contiguous United States, clearly indicate where the climate match results represent the native range of the species. For example: "Local climate matches were high, both in the species native range in the Great Lakes and Mississippi River basins, and in areas outside its native range." Or "The climate match is high for most of the contiguous United States, where the plant is native."

- If a species has been or may be introduced within the United States for fishery management purposes, state so.

3) Fill in the Assessment Elements list.

- **History of Invasiveness** – List the categorical result (High, Low, Data Deficient, or No Known Nonnative Population) as determined in part 3F (ERSS section 4).

- **Establishment Concern** – List the categorical result (Yes or Doubtful) as determined in part 3I (ERSS section 7).

- **Certainty of Assessment –** List the categorical result (High, Medium, or Low) as determined in part 3J (ERSS section 8).

- **Remarks/Important additional information -** This section is used to re-emphasize important issues that may affect the interpretation and use of the ORAC.

  - Examples: WOAH-listed diseases, threat of human injury or illness, major taxonomic uncertainty (e.g., unresolved taxonomy, problems with type specimen), sources of major uncertainty in the climate match (e.g., reproduction in marine environments, establishment in thermal springs), stocking for fishery management purposes.

  - This information should already be stated elsewhere in the ERSS and also be included in the summary paragraph at the beginning of section 9. **No new information should be listed here.**

- If there are no additional remarks, state so.

- **Overall Risk Assessment Category –** List the ORAC as determined from the HOI and Establishment Concern categories (table 1).

4) Now that the ORAC is known, fill in the ORAC field on the first page of the ERSS.

L. ERSS Sections 10 and 11 — Literature Cited

Data Definition

Literature Cited lists all sources (peer-reviewed literature, online databases, agency reports, etc.) directly accessed by the risk assessor and quoted or paraphrased within the ERSS.

Literature Cited within Quoted Material lists all sources (peer-reviewed literature, online databases, etc.) not accessed by the risk assessor but mentioned within quoted material in the ERSS.

Specific Instructions

1) All references should follow the Journal of Fish and Wildlife Management Style Guide (see appendix J for examples).

   - Correct citations for commonly used databases can be found in appendix A. For Service employees, the "ERSS Database Manual" resource document contains the information found in appendix A and any updates since the last publication of this SOP.

   - Remember to italicize scientific names within references.

   - When citing online references, the date for the citation should be the publication date of the page or the date of last edit, if available, or if not available, the date the site was accessed. The month and year of access should be included at the end of the reference.

     - Example: Froese R, Pauly D, editors. 2019. *Alburnus alburnus*. FishBase. Available: www.fishbase.us/summary/Alburnus-alburnus.html (March 2019).

2) When a primary source accessed by the risk assessor fails to include all or part of the information for a citation in section 11, add the following after the available information: "[Source material did not give full citation for this reference.]"

3) Although the rapidity with 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 be cited following Journal of Fish and Wildlife Management style.

- Personal communications within quoted material do not need to be cited in section 11. However, if available, identifying information such as type of communication or the person's affiliation should be added to the quoted text in brackets.

    - Example: "(A. Berzins, [Dixie State College,] personal communication)."

M. ERSS Appendix — Future Climate Matching

RAMP offers the ability to calculate climate matches for each of four future climate projections using five global climate models. Each projection represents one of two Shared Socioeconomic Pathways (SSP) defined in the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (SSP3 or SSP5; IPCC 2021) and one of two time steps (2055, representing the period 2041-2070, and 2085, representing the period 2071-2100). **The projected future climate matches are provided for informational purposes only and do not affect the risk assessment summary and classification given in section 9.**

Data Definitions

The **Summary of Future Climate Matching Analysis** describes the results of future climate matches, including information regarding Climate 6 scores and changes from the current climate match (see 3H for definitions).

Future climate match results maps depict the median projected future climate match for a given SSP and time step, summarized across all five global climate models.

The **figure of projected future Climate 6 scores** depicts the variability in Climate 6 score between the five different climate models for each future climate scenario.

Climate match difference maps depict the difference between the median projected future climate match for a given SSP and time step, summarized across all five global climate models, and the current predicted climate match.

Specific Instructions

1) Calculate and summarize the climate match for all **four future climate scenarios** (each of the two SSPs at both the 2055 and 2085 time steps).

    - **Use the same source points** for future climate matching as were used for current climate matching. Assuming the current climate match has been calculated already and the species folder is saved and accessible to RAMP, run Step 2 in RAMP, selecting the option to "Use Previous Selection." Run Step 3 in RAMP, selecting "All Models" under Climate Model. (Alternatively, current and future climate matches can be calculated simultaneously during the first use of RAMP for a species with the "All Models" option for Climate Model in Step 3.)

    - Run Step 4 in RAMP, selecting the appropriate species and any one of the CSV files that has the correct target region and date in the file name.

    - Refer to the RAMP SOP (USFWS 2024) for further instructions on using RAMP.

2) Insert the future climate match results maps as a four-panel figure (example in figure 9) that allows for comparison across SSPs and time steps. This figure will be labeled as figure A1.

- The future climate match results maps can be imported into Microsoft Word from the RAMP species folder.

- Reduce the size of each map so they will fit two across on the page and crop off the legend (each map will be roughly 3¼" wide and 2½" tall after resizing and cropping).

- Organize the maps as follows:

  - SSP3 projections in the left column, SSP5 projections in the right column;

  - 2055 time step in the top row, 2085 time step in the bottom row;

  - Add one copy of the legend image below the bottom row of maps and save the combined maps and legend as a single image.

- Write a **caption** and **alt text** for the four-panel figure.

  - Recommended format for figure caption: "Maps of median RAMP (Sanders et al. 2023) climate matches projected under potential future climate conditions using five global climate models for *scientific name* in the contiguous United States. Climate matching is based on source locations reported by *citation*. Shared Socioeconomic Pathways (SSPs) used (from left to right): SSP3, SSP5 (IPCC 2021). Time steps: 2055 (top row) and 2085 (bottom row). Climate source data from CHELSA (Karger et al. 2017, 2018); global climate models used: GFDL-ESM4, UKESM1-0-LL, MPI-ESM1-2-HR, IPSL-CM6A-LR, and MRI-ESM2-0. 0/Pale Pink = Lowest match, 10/Dark Purple = Highest match."

  - Recommended format for alt text: "Maps of the contiguous United States showing median climate matches for *scientific name* under future scenarios SSP3 and SSP5 in 2055 and 2085 from five global climate models. Description of results can be found at the beginning of this appendix."

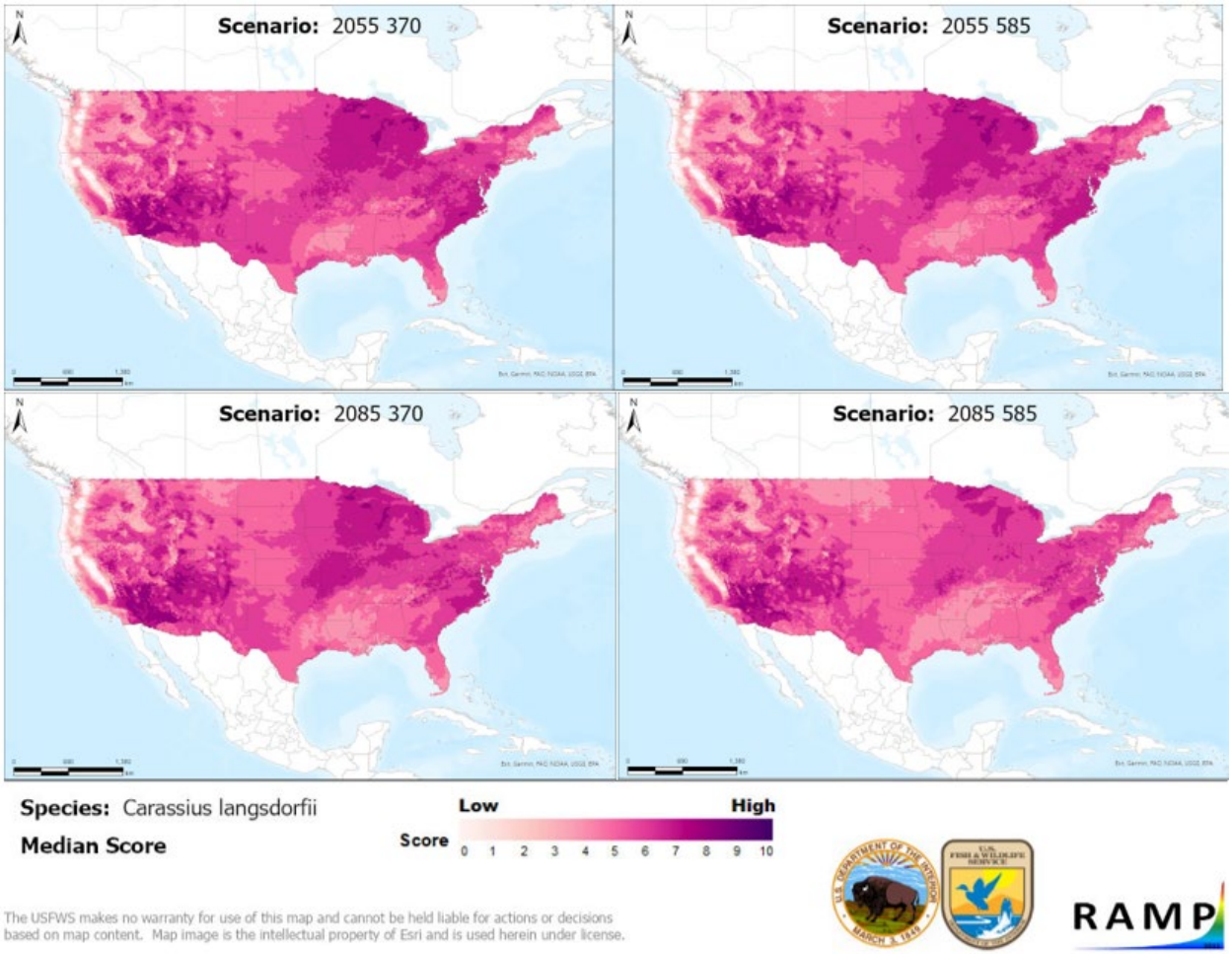

Figure 9. Example of a four-panel figure showing future climate scenario results maps.

3) Create a four-panel figure depicting the projected Climate 6 scores for each future climate scenario and model (example in figure 10). This figure will be labeled as figure A2.

   - Find the Climate 6 scores for each model and scenario in the "ClimateSix" CSV file, located in the Output folder within the RAMP species folder.

   - Use Program R, Microsoft Publisher, or your preferred software to create the figure.

     - Draw lines representing values from 0 to 1 for each of the four future climate scenarios. Arrange the lines in a 2x2 grid, similar to the future climate match results maps.

     - Label each line with the name of a scenario (clockwise from top left): SSP3 2055, SSP5 2055, SSP5 2085, SSP3 2085.

     - On the appropriate line, place five hatch marks representing the Climate 6 scores calculated with each of the five global climate models for the given scenario.

   - Write a **caption** and **alt text** for the four-panel figure.

- Recommended format for figure caption: "Comparison of projected future Climate 6 scores (Bomford 2008; RAMP SOP) for *scientific name* in the contiguous United States for each of five global models under the four combinations of Shared Socioeconomic Pathway (SSP) and time step. SSPs used (from left to right): SSP3, SSP5 (Karger et al. 2017, 2018; IPCC 2021). Time steps 2055 (top row) and 2085 (bottom row). Climate source data from CHELSA (Karger et al. 2017, 2018); global climate models used: GFDL-ESM4, UKESM1-0-LL, MPI-ESM1-2-HR, IPSL-CM6A-LR, and MRI-ESM2-0."

- Recommended format for alt text: "Four-panel image of number lines representing the range of possible Climate 6 scores (0-1). In each panel, hatch marks represent the Climate 6 score calculated for *scientific name* from each of five global climate models for one of four SSP-time step combinations. Details on the range of Climate 6 scores can be found at the beginning of the appendix."

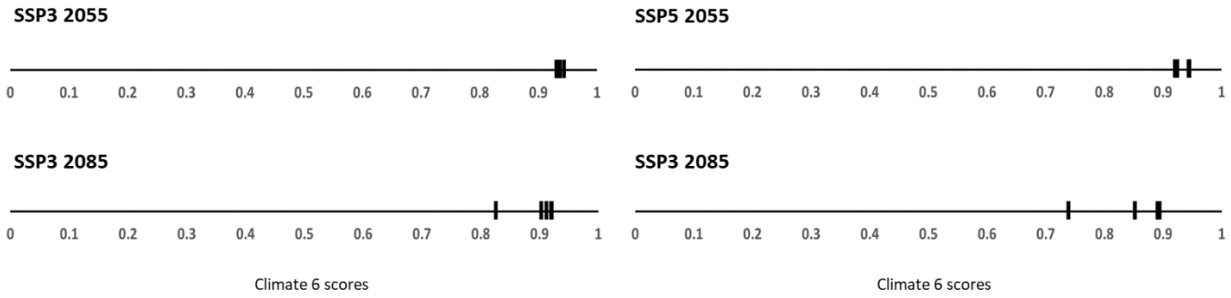

Figure 10. Example of a four-panel figure showing Climate 6 scores across four climate scenarios and five global climate models.

4) Insert the climate match difference maps as a four-panel figure (example in figure 11) that allows for comparison across SSPs and time steps. This figure will be labeled as figure A3.

- The climate match difference maps can be imported into Microsoft Word from the output folder within the RAMP species folder.

- Reduce the size of each map so they will fit two across on the page and crop off the legend (each map will be roughly 3¼" wide and 2½" tall after resizing and cropping).

- Organize the maps as follows:

  - SSP3 projections in the left column, SSP5 projections in the right column;

  - 2055 time step in the top row, 2085 time step in the bottom row;

  - Add one copy of the legend image below the bottom row of maps and save the combined maps and legend as a single image.

- Write a **caption** and **alt text** for the four-panel figure.

- Recommended format for figure caption: “RAMP (Sanders et al. 2023) maps of the contiguous United States showing the difference between the current climate match target point score (figure 4) and the median target point score for future climate scenarios (figure A1) for *scientific name* based on source locations reported by *citation.* Shared Socioeconomic Pathways (SSPs) used (from left to right): SSP3, SSP5 (IPCC 2021). Generations 2055 (top row) and 2085 (bottom row). Climate source data from CHELSA (Karger et al. 2017, 2018); global models used: GFDL-ESM4, UKESM1-0-LL, MPI-ESM1-2-HR, IPSL-CM6A-LR, and MRI-ESM2-0. Shades of blue indicate a lower target point score under future scenarios than under current conditions. Shades of red indicate a higher target point score under future scenarios than under current conditions. Darker shades indicate a larger degree of change.”

- Recommended format for alt text: “Maps of the contiguous United States showing the difference in climate matching results between current climate and medians of future scenarios for *scientific name*. Future scenarios are SSP3 and SSP5 in 2055 and 2085. Description of results can be found at the beginning of this appendix.”

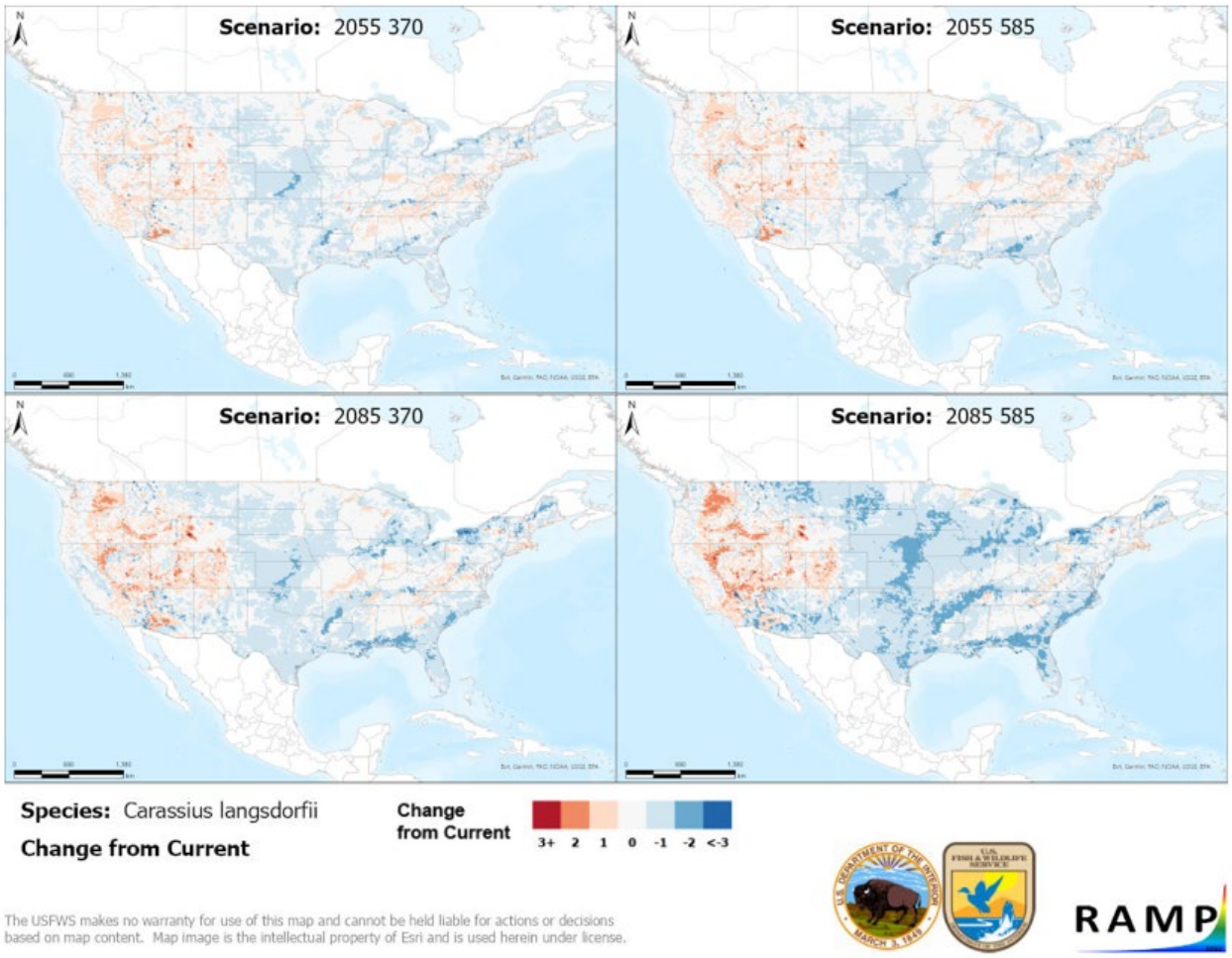

Figure 11. Example of a four-panel figure showing climate match difference maps.

5) Write a summary of the future climate matching results and insert it at the beginning of the appendix.

   - Insert the following standard text before describing the future climate matching results: "Future climate projections represent two Shared Socioeconomic Pathways (SSP) developed by the Intergovernmental Panel on Climate Change (IPCC 2021): SSP5, in which emissions triple by the end of the century; and SSP3, in which emissions double by the end of the century. Future climate matches were based on source locations reported by *citation(s) for sources used for climate match in section 7*."

   - Refer to part 3I for details on how to write climate matching summaries, covering climate match across the contiguous United States, Climate 6 score, and Establishment Concern.

   - It is unnecessary to describe the results for each scenario in detail; **focus on patterns and trends across all four scenarios**.

6) In a literature cited section for the ERSS appendix, list references used to select source points, along with the citations for RAMP and for future climate data (see template in appendix C of this document).

Part 4. Final Note

After all the steps in part 3 have been completed, the risk assessor should have a completed ERSS ready for technical review. The RODS (appendix B), ERSS Technical Review Checklist (appendix K), and ERSS Final Review Checklist (appendix K) can now be used by reviewers to ensure that all parts of the ERSS have been thoroughly completed, and that the research and administrative path is clearly documented. Remember that all documentation used to build the ERSS, including the RODS and review checklists, should be kept in PDF or Word 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.

It is recommended that the RODS be completed by the risk assessor while completing the ERSS. The technical reviewer will complete the ERSS Technical Review Checklist. When updating an already existing ERSS, a new RODS and ERSS Technical Review Checklist need to be completed. The RODS will be filled out by the assessor updating the information. The technical reviewer will complete another ERSS Technical Review Checklist.

As previously mentioned, species ERSS reports with an ORAC of High or Uncertain may contribute useful information for 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 required steps in the injurious wildlife process, including opportunities for public comment. The ERSS process is a screening process that simply helps the Service prioritize species for further scrutiny.

Part 5. Literature Cited

[ABARES] Australian Bureau of Agricultural and Resource Economics and Sciences. 2020. Climatch. Version 2.0. Available: https://climatch.cp1.agriculture.gov.au/ (August 2022).

Bomford M. 2008. Risk assessment models for establishment of exotic vertebrates in Australia and New Zealand. Canberra, Australia: Invasive Animals Cooperative Research Centre.

Copp GH, Garthwaite R, Gozlan RE. 2005a. Risk identification and assessment of non-native freshwater fishes: concepts and perspectives on protocols for the UK. Lowestoft, UK: Cefas. Cefas Science Technical Report. Available: www.cefas.co.uk/publications/techrep/tech129.pdf (August 2022).

Copp GH, Garthwaite R, Gozlan RE. 2005b. Risk identification and assessment of non-native freshwater fishes: a summary of concepts and perspectives on protocols for the UK. Journal of Applied Ichthyology 21:371–373.

Copp GH, Vilizzi L, Tidbury H, Stebbing PD, Tarkan AS, Miossec L, Goulletquer P. 2016. Development of a generic decision-support tool for identifying potentially invasive aquatic taxa: AS-ISK. Management of Biological Invasions 7(4):343–350.

Cuthbert RN, Diagne C, Hudgins EJ, Turbelin A, Ahmed DA, Albert C, Bodey TW, Briski E, Essl F, Haubrock PJ, Gozlan RE, Kirichenko N, Kourantidou M, Kramer AM, Courchamp F. 2022. Biological invasion costs reveal insufficient proactive management worldwide. Science of The Total Environment 819:153404.

Fantle-Lepczyk JE, Haubrock PJ, Kramer AM, Cuthbert RN, Turbelin AJ, Crystal-Ornelas R, Diagne C, Courchamp F. 2022. Economic costs of biological invasions in the United States. Science of The Total Environment 806:151318.

Hayes KR, Barry SC. 2008. Are there any consistent predictors of invasion success? Biological Invasions 10:483–506.

[IPCC] Intergovernmental Panel on Climate Change. 2021. Climate change 2021: the physical science basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press.

Karger DN, Conrad O, Böhner J, Kawohl T, Kreft H, Soria-Auza RW, Zimmermann NE, Linder P, Kessler M. 2017. Climatologies at high resolution for the Earth land surface areas. Scientific Data 4:170122.

Karger DN, Conrad O, Böhner J, Kawohl T, Kreft H, Soria-Auza RW, Zimmermann NE, Linder HP, Kessler M. 2018. Data from: Climatologies at high resolution for the earth's land surface areas. EnviDat. Available: https://doi.org/10.16904/envidat.228.v2.1.

Marcot BG, Hoff MH, Martin CD, Jewell SD, Givens CE. 2019. A decision support system for identifying potentially invasive and injurious freshwater fishes. Management of Biological Invasions 10:200–226.

Meyers NM, Reaser JK, Hoff MH. 2020. Instituting a national early detection and rapid response program: needs for building federal risk screening capacity. Biological Invasions 22:53–65.

[NISC] National Invasive Species Council. 2008. 2008-2012 National Invasive Species Management Plan. Washington D.C.: National Invasive Species Council, Department of the Interior.

[OMB] Office of Management and Budget. 2004. Final information quality bulletin for peer review. Issued December 16, 2004. Washington, D.C. Available: https://obamawhitehouse.archives.gov/sites/default/files/omb/assets/omb/memoranda/fy2005/m05-03.pdf.

Pheloung PC, Williams PA, Halloy SR. 1999. A weed risk assessment model for use as a biosecurity tool evaluating plant introductions. Journal of Environmental Management 57:239–251.

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

Reeuwijk LP, Houba VJG. 1998. Guidelines for quality management in soil and plant laboratories. Food and Agriculture Organization of the United Nations. FAO Soils Bulletin 74.

Sanders S, Castiglione C, Hoff M. 2023. Risk Assessment Mapping Program: RAMP. Version 5.0. U.S. Fish and Wildlife Service.

[USDA] U.S. Department of Agriculture. 2019. Guidelines for the USDA-APHIS-PPQ weed risk assessment process. Version 2.3. Raleigh, North Carolina: U.S. Department of Agriculture, Plant Epidemiology and Risk Analysis Laboratory, Center for Plant Health Science and Technology. Available: https://www.aphis.usda.gov/plant_health/plant_pest_info/weeds/downloads/wra/wra-guidelines.pdf (August 2022).

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

[USFWS] U.S. Fish and Wildlife Service. 2024. Standard operating procedures for the Risk Assessment Mapping Program (RAMP). Version 3. Available:

https://www.fws.gov/media/standard-operating-procedures-risk-assessment-mapping-program-ramp (February 2024).

Vander Zanden MJ, Olden JD. 2008. A management framework for preventing the secondary spread of aquatic invasive species. Canadian Journal of Fisheries and Aquatic Science 65:1512–1522.

Vilizzi L, Copp GH, Adamovich B, Almeida D, Chan J, Davison PI, Dembski S, Güler Ekmekçi F, Ferincz Á, Forneck SC, Hill JE, Kim JE, Koutsikos N, Leuven RSEW, Luna SA, Magalhães F, Marr SM, Mendoza R, Mourão CF, Neal JW, Onikura N, Perdikaris C, Piria M, Poulet N, Puntila R, Range IL, Simonović P, Ribeiro F, Tarkan AS, Troca DFA, Vardakas L, Verreycken H, Vintsek L, Weyl OLF, Yeo DCJ, Yiwen Zeng Y. 2019. A global review and meta-analysis of applications of the freshwater Fish Invasiveness Screening Kit. Reviews in Fish Biology and Fisheries 29:529–568.

List of Appendices

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Appendix A. Recommended Data Sources for ERSS Writing

A. Important Note

The purpose of this appendix is to provide a centralized location in the SOP to document the different databases most frequently used in drafting ERSS reports. This is an effort to standardize the usage of databases between different assessors and provide a support tool to new assessors. Assessors are not limited to the databases listed; other databases may be used. It is important to remember to check the scientific quality of any new database before using.

B. Structure of the Appendix

Directly under each database name is the link to the appropriate home or search page where the instructions start.

The next few lines are an example citation in Journal of Fish and Wildlife Management format for that database. The information in italics is specific to the page being accessed and should be replaced with the correct information for each ERSS. For some databases, a note below the citation describes where to find specific information that is needed for the citation.

Following the citation information is a brief description of the information available in the database and instructions for navigating the database and extracting information relevant to ERSS preparation.

C. Useful Tools

Find: To use this, press the 'Ctrl' and 'F' key[6] simultaneously. This brings up a search box in the top right corner of the page. Type all or part of the species name into this box to highlight instances of the search term on the page. Use the arrow keys in the box or press 'Enter' to toggle between instances of the search term. Note that this tool will not work on image-only PDFs.

Print Screen: Some databases do not have the built-in function to save maps as images. In this case use the 'Print Screen' key on the keyboard to make a copy of the current monitor display. Paste this into any program that allows the manipulation of images. Use a crop function to select only the map and then save that as an image for use in the ERSS. Refer to SOP section 3A on the proper use and attribution of digital images.

Snip & Sketch: This tool can be used in similar scenarios as Print Screen. Press the Windows logo key simultaneously with 'Ctrl' and 'S' to bring up the snipping tool. Choose the desired shape for snipping and then move the cursor over the area to be copied. The copied area will be saved to the clipboard initially, from which it can be pasted into a Word document or saved in the appropriate folder.

[6] Keyboard shortcuts in this section apply to Windows operating systems. Computers designed for other operating systems may have different keyboard shortcuts.

D. Database Comparisons

Table A-1. Taxa covered by each database. Database abbreviations are defined in alphabetical order in part E of this appendix.

Database	Aquatic	Terrestrial	Algae	Amphibians	Birds	Fish	Invertebrates	Mammals	Plants	Reptiles
AKEPIC	Yes	Yes	No	No	No	No	No	No	Yes	No
AlgaeBase	Yes	No	Yes	No	No	No	No	No	No	No
AmphibiaWeb	Yes	Yes	No	Yes	No	No	No	No	No	No
AquaNIS	Yes	No	Yes	No	No	Yes	Yes	No	Yes	No
APASD	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No
Birds of the World	Yes	Yes	No	No	Yes	No	No	No	No	No
CABI	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Catalog of Fishes	Yes	No	No	No	No	Yes	No	No	No	No
Crayfish and Lobster Taxonomy Browser	Yes	No	No	No	No	No	Yes	No	No	No
EASIN	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
eBird	Yes	Yes	No	No	Yes	No	No	No	No	No
EDDMapS	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FAO	Yes	No	No	No	No	Yes	Yes	No	Yes	No
FishBase	Yes	No	No	No	No	Yes	No	No	No	No
GBIF	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
GBIF-US	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
GLANSIS	Yes	No	Yes	No	No	Yes	Yes	No	Yes	No
GISD	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
GloBI	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
iMapInvasives	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
India Biodiversity Portal	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Invasive Plant Atlas	Yes	Yes	No	No	No	No	No	No	Yes	No
Invasive Species of Japan	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Database	Aquatic	Terrestrial	Algae	Amphibians	Birds	Fish	Invertebrates	Mammals	Plants	Reptiles
ITIS	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
IUCN Red List	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
MyBIS	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
NAS	Yes	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
NatureServe	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
NEMESIS	Yes	No	Yes	No	No	Yes	Yes	No	No	No
NISIC	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
NOBANIS	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
POWO	Yes	Yes	No	No	No	No	No	No	Yes	No
SeaLifeBase	Yes	No	No	Yes	Yes	No	Yes	Yes	Yes	Yes
USDA PLANTS	Yes	Yes	No	No	No	No	No	No	Yes	No
VertNet	Yes	Yes	No	Yes	Yes	Yes	No	Yes	No	Yes
WFO	Yes	Yes	No	No	No	No	No	No	Yes	No
WoRMS	Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes

Table A-2. Databases where different types of information may be found. Database abbreviations are defined in alphabetical order in part E of this appendix.

Database	Taxonomy	Images*	Range	Maps	Biology	Introductions	Impacts
AKEPIC	No	No	Yes	Yes	Yes	Yes	Yes
AlgaeBase	Yes	No	Yes	No	Yes	No	No
AmphibiaWeb	No	Yes	Yes	Yes	Yes	No	No
AquaNIS	Yes	No	Yes	No	Yes	No	No
APASD	No	No	Yes	No	Yes	Yes	Yes
Birds of the World	No	Yes	Yes	Yes	Yes	Yes	Yes
CABI	Yes	Yes	Yes	No	Yes	Yes	Yes
Catalog of Fishes	Yes	No	Yes	No	No	No	No
Crayfish and Lobster Taxonomy Browser	Yes	No	Yes	Yes	Yes	Yes	No
EASIN	Yes	No	Yes	Yes	Yes	Yes	Yes
eBird	No	Yes	Yes	Yes	No	No	No
EDDMapS	Yes	Yes	Yes	Yes	Yes	Yes	No
FAO	No	No	No	No	No	Yes	No
FishBase	Yes	Yes	Yes	Yes	Yes	Yes	Yes
GBIF	Yes	Yes	No	Yes	No	No	No
GBIF-US	No	Yes	No	Yes	No	No	No
GLANSIS	No	Yes	Yes	Yes	Yes	Yes	Yes
GISD	No	No	Yes	No	Yes	Yes	Yes
GloBI	No	No	No	No	Yes	No	No
iMapInvasives	No	No	No	Yes	No	Yes	No
India Biodiversity Portal	Yes	Yes	Yes	Yes	Yes	No	No
Invasive Plant Atlas	No	Yes	Yes	Yes	Yes	Yes	Yes
Invasive Species of Japan	No	No	Yes	Yes	Yes	Yes	Yes
ITIS	Yes	No	No	No	No	No	No
IUCN Red List	Yes	No	Yes	No	Yes	Yes	No
MyBIS	Yes	Yes	No	Yes	Yes	Yes	No
NAS	No	Yes	Yes	Yes	Yes	Yes	Yes
NatureServe Explorer	Yes	No	Yes	No	Yes	Yes	Yes
NEMESIS	Yes	No	Yes	No	Yes	Yes	Yes

Database	Taxonomy	Images*	Range	Maps	Biology	Introductions	Impacts
NISIC	No	Yes	Yes	Yes	Yes	Yes	Yes
NOBANIS	Yes	No	Yes	Yes	Yes	Yes	Yes
POWO	No	Yes	Yes	Yes	No	Yes	No
SeaLifeBase	Yes	No	Yes	No	Yes	Yes	Yes
USDA PLANTS	Yes	Yes	No	Yes	No	Yes	No
VertNet	No	No	No	Yes	No	No	No
WFO	Yes	Yes	Yes	No	Yes	No	No
WoRMS	Yes	No	Yes	No	Yes	No	No

* Before exporting and using any image, ensure that it is in the public domain or licensed for reuse under a Creative Commons license. All images produced by the Federal Government are in the public domain, but not all images in Federal Government products have been produced by the Federal Government.

E. List of Databases

[AKEPIC] Alaska Exotic Plants Information Clearinghouse
https://accs.uaa.alaska.edu/invasive-species/non-native-plants/

[AKEPIC] Alaska Exotic Plants Information Clearinghouse. *Year of access*. Alaska Exotic Plants Information Clearinghouse database. Anchorage: Alaska Center for Conservation Science, University of Alaska. Available: http://aknhp.uaa.alaska.edu/apps/akepic/ (*month and year of access*).

ABOUT: AKEPIC houses information sheets, risk assessments, and georeferenced occurrence data on nonnative species to Alaska that are present within the State or have been designated as watch list species.

TO USE: AKEPIC data is accessible in list format or through a mapping application. The links to both options are available on the home page linked above.

To use the plant list, select the option for "AKEPIC Plant List" on the home page. Enter a species name in the search box at the top right of the table to filter the list to that species. For some species, icons to the right of the species name allow you to download a species profile or an Alaska-specific risk assessment.

To use the mapping application, select the option for "Non-native Plant Data" on the home page and agree to the terms of use. The main screen shows a composite map for all nonnative plant species. To view a single species map, enter a species name in the search box in the middle of the legend. When you click on a species name in the results below the search box, a map of occurrences for just the selected species opens in an inset window. You can view the date of the occurrence record and the size of the infestation by scrolling over individual occurrence points.

One or more icons may appear on the right side of the results table on the main screen. These icons allow you to download the occurrence data, species profile, risk assessment, or taxonomic information.

AlgaeBase
http://www.algaebase.org/

Guiry MD, Guiry GM. *Year of access*. *Scientific name*. AlgaeBase. Galway: National University of Ireland. Available: *URL for species page* (*month and year of access*).

ABOUT: AlgaeBase provides taxonomic and basic biological information on freshwater, marine, and terrestrial algae species worldwide.

TO USE: Type the genus or species name into the appropriate search box in the upper left and click the magnifying glass to search. Select the appropriate species from the results list to access the species page.

AmphibiaWeb

https://amphibiaweb.org/

AmphibiaWeb. *Year of access*. *Page title*. AmphibiaWeb. Berkeley: University of California. Available: *URL for species page* (*month and year of access*).

ABOUT: AmphibiaWeb houses species accounts (their own and those by external authors), photos, and distribution information on amphibian species globally. Species pages may have links to other relevant databases (e.g., the Amphibian Disease Portal).

TO USE: Click on "Search the Database" and then type the species scientific name or genus into the appropriate search box and click the "Search" button at the top left of the page to search.

AquaNIS

http://www.corpi.ku.lt/databases/index.php/aquanis/species/open

Page author(s). *Year of access*. *Page title*. In AquaNIS editorial board. Information system on aquatic non-indigenous and cryptogenic species. Version 2.36+. Available: *page URL* (*month and year of access*).

> Note: The author's name can be found at the bottom of the species page. If there is a specific reference for a piece of information in AquaNIS, it is at the bottom of the information box. Place these references in brackets at the end of the quoted statements in the ERSS (see part 3A of this SOP) and include the full citations in section 11 of the ERSS.

ABOUT: AquaNIS includes nonnative species accounts and accounts of individual introduction events. The primary geographic focus is on Europe and neighboring regions, but other locations around the world do occasionally appear in the introduction event accounts.

TO USE: Select the starting letter of the species name. Use the Find command to search the page for the species. If species is included in the database, click on the species name to access the page.

On the left side of the page, there is a link to "Introduction events' accounts." To use this feature, again select the starting letter of the species name. Use the Find command to search the page for the species. Click on the "View" icon in the far right column to see the full record on the introduction event. The "Population status" field near the bottom of the page may indicate whether the introduction resulted in population establishment.

[APASD] Asian-Pacific Alien Species Database
http://www.naro.affrc.go.jp/archive/niaes/techdoc/apasd/

National Institute for Agro-Environmental Sciences. 2007. *Page title*. Asian-Pacific Alien Species Database. Available: *page URL* (*month and year of access*).

ABOUT: APASD provides information on nonnative species and their introduction history within the Asia-Pacific region. Introductions to Japan and Taiwan are particularly well represented.

TO USE: From the homepage, click on "Enter APASD" to begin. Choose the appropriate taxon. There is no built-in option to sort or search the list of species for each taxon, so use the Find command to search the page for the species. If the species is included in the database, click on the "Details" link to access the page. Be aware that if the species is present in multiple countries, there will be links for each country (and the list of species accounts is organized by country, not by species name). In this case, cite the database as a whole rather than a single species page.

Birds of the World
https://birdsoftheworld.org/bow/home

Author name(s). *Year*. *Page title*. In *Editor name(s)*, editor*(s)*. Birds of the World. Ithaca, New York: Cornell Lab of Ornithology. Available: *page URL* (*month and year of access*).

> Note: Each species page may have unique authors or editors. Refer to the recommended citation at the bottom of the species page to fill in the components of the citation above.

ABOUT: Birds of the World is an eminent resource on the biology, ecology, and distribution of avian species around the world. Although impacts of introductions are not a focus of this resource, limited information may be available in the "Distribution," "Demography and Populations," or "Conservation and Management" sections of the species account. **Birds of the World requires a subscription, so Service employees must be connected to a Service network to use it.**

TO USE: Type the genus or species name into the search box. As the search results populate below the search box, select the appropriate species name to be taken to the species page. Note that if you only type in a partial name and hit the "Enter" key, you will be taken to the page for the first species listed in the search results.

CABI Invasive Species Compendium

https://www.cabidigitallibrary.org/product/qi

For pages with an author listed:
Author. *Year of last page revision*. *Page title*. In CABI Compendium. Wallingford, United Kingdom: CAB International. Available: *page URL* (*month and year of access*).

For pages with no author listed:
CABI. *Year of last page revision*. *Page title*. In CABI Compendium. Wallingford, United Kingdom: CAB International. Available: *page URL* (*month and year of access*).

> Note: The above citations are for datasheets found within CABI. The author(s) of the page is found at the top of the page under the species name. The year of the last page revision is found at the top of the page above the species name.
>
> Any journal articles accessed through CABI should be cited according to Journal of Fish and Wildlife Management guidelines for citing journal articles.

ABOUT: CABI contains species datasheets as well as journal article abstracts and some full-text journal articles.

TO USE: Type the species name in the search box and click "Search." There are options to refine search results on the left side of the page if needed (e.g., filter by content type or taxonomic group). Click on the appropriate search result to access a datasheet or article.

Catalog of Fishes

http://researcharchive.calacademy.org/research/ichthyology/catalog/fishcatmain.asp

Fricke R, Eschmeyer WN, van der Laan R, editors. *Year of access*. Eschmeyer's catalog of fishes: genera, species, references. California Academy of Science. Available: http://researcharchive.calacademy.org/research/ichthyology/catalog/fishcatmain.asp (*month and year of access*).

ABOUT: Catalog of Fishes is the ultimate authority on fish scientific names for the ERSS. If the scientific name differs between Catalog of Fishes and WoRMS, ITIS, or other databases, the one listed in Catalog of Fishes is to be used for the ERSS. Note differences in valid scientific name between the databases in the Remarks subsection of the ERSS.

TO USE: Type the species name in the search box. Make sure the "SPECIES" radio button is selected. Click "Search." This will provide a list of results. Use the Find command to search for the species name. There may be one or more entries in which the name is listed (as original name, in bold italics, or as valid name currently or previously, in regular italics).

Alternatively, access this database through FishBase by clicking on "sp." next to "Catalog of Fishes" under the "Classification / Names" heading on a species page. Accessing Catalog of

Fishes this way returns only the entry for which the species name is the currently valid scientific name.

Crayfish and Lobster Taxonomy Browser

https://www.invertebratezoology.org/NewAstacidea/index.asp

Fetzner JW. *Year of access*. *Scientific name*. The crayfish and lobster taxonomy browser: a global taxonomic resource for freshwater crayfish and their closest relatives. Available: *page URL* (*month and year of access*).

ABOUT: This database provides high-level information on species distribution and habitat.

TO USE: Sort the list of species or use the Find function in your internet browser to locate the hyperlink for the species of interest. Use scientific name synonyms as needed (e.g., many crayfish in the common North American genus *Faxonius* were listed under the genus *Orconectes* as of February 2024). Click on the species name hyperlink to be taken to the database entry for that species. Click on the "+" next to each folder to view information on the species by topic or click on "open all" at the top of the folder list.

[EASIN] European Alien Species Information Network

https://easin.jrc.ec.europa.eu/spexplorer/search/

European Commission – Joint Research Centre. *Year of access*. European Alien Species Information Network. Available: https://easin.jrc.ec.europa.eu/ (*month and year of access*).

ABOUT: This website contains information on nonnative species in Europe including their distributions, introduction history, and introduction pathways.

TO USE: Enter the species name in the "Search Species Name" field and then click the "Search Species" button at the bottom of the page. Once the results have loaded, click on the species name to see information on distribution, introduction history, and introduction pathways.

To view the species distribution map, check the box to the left of the name. Scroll to the bottom of the page and click on "Map Selected Species." The default map will show distribution by country. To view the species distribution in more detail, click on the arrow next to the layer name in the top right corner of the map and select the radio button for "EEA 10X10Km grid."

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eBird

https://ebird.org/explore

eBird. *Year of access*. eBird: an online database of bird distribution and abundance. Ithaca, New York: Cornell Lab of Ornithology. Available: http://www.ebird.org (*month and year of access*).

ABOUT: eBird stores and maps observations of bird species uploaded by community observers. The site has a relatively robust quality control process for verifying outlier data.

TO USE: Enter the species name in the "Enter species name" search field and select the appropriate species from the results that populate below the search field. In the middle of the species page, there is a map of reported occurrences with the native range shown in shades of purple and the introduced range shown in shades of orange. You can zoom in and out on the map, but you will need to create a free account with eBird to access most of the mapping options.

When logged in to your account, click on the "Large map" link in the Range Map section of a species page. Here, uncheck the box next to "Not reported" to see only locations where the species is present and check the box next to "Exclude escapees" to see only established populations. Zoom in to see point locations and click on a point location to view details on the record(s) at that location.

For ERSS writing, it will be impractical to download georeferenced occurrence data directly from eBird (there is an approval process), but the basic occurrence data on eBird are shared with GBIF.

[EDDMapS] Early Detection & Distribution Mapping System

http://www.eddmaps.org/distribution/
https://www.eddmaps.org/Species/

EDDMapS. *Year of access*. Early Detection and Distribution Mapping System. Tifton: University of Georgia – Center for Invasive Species and Ecosystem Health. Available: http://www.eddmaps.org/ (*month and year of access*).

ABOUT: EDDMapS is primarily a mapping tool for nonnative and pest species. Maps can be set to show point observations or aggregated observations.

TO USE: Starting at either link above, type the all or part of the species name in the search box on the right side of the page above the table of species. The database will automatically filter the species listed in the table as text is entered. Click on the species name to go to the map and information sheet (as available) for that species. On the species page, the buttons under the species name allow for toggling between the information sheet, a table of occurrences, and maps of occurrences at various levels of data aggregation.

To evaluate records for a particular location, click on that location to pull up one or more detailed observation records with the information needed to evaluate an observation. Save any record details accessed as a PDF.

FAO Database on Introductions of Aquatic Species

https://www.fao.org/fishery/en/introsp/search

[FAO] Fisheries and Agriculture Organization of the United Nations. *Year of access*. *Scientific name*. Rome: FAO Fisheries and Aquaculture Division. Available: https://www.fao.org/fishery/en/introsp/search (*month and year of access*).

ABOUT: This database lists recorded introductions and many entries have some further information on means of introduction.

TO USE: Type the species name in the search box and click the magnifying glass icon to search. This will generate a list of records. Save the list of records as a PDF. Click on each record to access the details. Save these detail pages to the PDF.

Use quotations around the target species name to limit the results to only records pertaining to the target species; otherwise, the search results may include species that are taxonomically related to the target species or species that have similar names.

FishBase

http://www.fishbase.org/search.php

Froese R, Pauly D, editors. *Year of access*. *Page title*. FishBase. Available: *page URL* (*month and year of access*).

ABOUT: FishBase contains basic information about fish species. The ERSS subsections were structured with many of the same headings as the subsections of the FishBase.

TO USE: If the main FishBase page is down, try one of the many mirror sites (fishbase.us, fishbase.de, fishbase.fr, fishbase.se, fishbase.ca, and others).

There are many ways to search FishBase. Type just the genus name into the "Genus" search box or just the specific epithet into the "Species" search box, or type the entire species name into the "Genus + Species" search box. If using the "Genus" or "Species" searches, a list of matching species will be provided. Click on the appropriate species name to access the species page. If using the "Genus + Species" search box, this will go directly to the species page or provide a list of possible matches if a direct match does not exist.

On the species page, there are links to the right of the main headings that can be used to access further information. There are also links to further information at the bottom of the page. If accessing any of those links, save the pages to the PDF.

The references can be found by clicking on the "References" link. Save this page to the PDF. **The reference numbers in the quoted material must be replaced by the correct reference in Journal of Fish and Wildlife Management style**. The replacement information must be placed within brackets in the ERSS.

On the main species page, click on "Common names" to access the list of common names for the species. Look for the AFS accepted name, which will be labeled with "AFS" in the "Type" column. If an AFS name is not available, use an FAO accepted name, and if that is not available, the most common English common name.

[GBIF] Global Biodiversity Information Facility

https://www.gbif.org/species/search

GBIF Secretariat. *Publication year*. GBIF backbone taxonomy: *scientific name*. Copenhagen: Global Biodiversity Information Facility. Available: *page URL* (*month and year of access*).

> Note: The publication year for the site is available near the bottom of the species page, where the citation is given. Note that the citation format given on the website is not the same as the Journal of Fish and Wildlife Management format required for an ERSS.

ABOUT: GBIF collects and displays point data on global species occurrences from a wide variety of sources. This is the database from which RAMP automatically draws source points, and it is typically the source of the map for section 5 of the ERSS.

TO USE: Type the species name in the white box in the top left that says "Search," then click the magnifying glass icon. If there is more than one possible match, a list will appear in the main part of the page; click on the appropriate species. GBIF will place the closest match at the top of the list.

On the species page, the base map and symbol shape can be changed by clicking on the paint roller icon at the bottom right of the map image. Changing from the default option to the "Light," "Dark," or "Roads" base maps on the "Custom" tab can be useful in figuring out where points lie with respect to international borders or water bodies.

To evaluate individual points, maneuver the map by zooming in and dragging the focus so that the point of interest is the only one visible, then click the "Explore Area" button at the bottom right of the map. This will bring up a list of the occurrences located in the current map view. Click on an occurrence to view the details. If the point is included or excluded in the climate match for any reason found in the details page, make sure to save the details page as a PDF.

GBIF-US
https://www.gbif.us/

GBIF-US. *Year of access*. Species occurrences: *scientific name*. Available: *DOI link* (*month and year of access*).

> Note: To obtain the correct Digital Object Identifier (DOI) link (https://doi.org…) for the data, you need to start the data download process. This will require you to have a GBIF log in. Click on the "Download" tab at the top of the map. Then click on "continue." At this point it may ask for your log in credentials. After that, click on "Simple" and the DOI link will be displayed as part of the suggested citation at the top of the page.

ABOUT: GBIF-US operates as the U.S. node to the GBIF database, displaying species occurrence data within the United States, U.S. territories, and Exclusive Economic Zones. GBIF-US is the successor to the U.S. Geological Survey database known as BISON (Biodiversity Information Serving Our Nation).

TO USE: Click on the Data tab at the top of the page. Then click on the "Scientific Name" box and enter the species name. This will filter the records down to just your species. To get a map, click on the "Map" tab at the top of the records table. Then zoom in until the map is focused on the area of interest. Use the computer's Snip tool or screenshot the map and crop it as needed. Then save the resulting image.

To evaluate any point that may be erroneous, zoom in until you can click on the single point. The record information will pop up in a side window.

[GLANSIS] Great Lakes Aquatic Nonindigenous Species Information System
https://www.glerl.noaa.gov/glansis/nisListGen.php

Author name(s). *Year of access*. *Page title*. Gainesville, Florida: U.S. Geological Survey, Nonindigenous Aquatic Species Database, and Ann Arbor, Michigan: NOAA Great Lakes Aquatic Nonindigenous Species Information System. Available: *page URL* (*month and year of access*).

> Note: Author names are found in the citation given at the bottom of each individual species account. Be aware that the citation format on the website is not the same as the Journal of Fish and Wildlife Management format required for an ERSS.

ABOUT: GLANSIS contains biological, ecological, distribution, introduction, and impact information for nonnative species found in the Great Lakes or that may be introduced to the Great Lakes in the future. Many times, this is the same information as is available in NAS but the two databases have different species lists. GLANSIS may contain additional information on Great Lakes-specific impacts not found in NAS.

TO USE: The default species category is "Nonindigenous+Range Expanders." If the species of interest has not been detected in the Great Lakes to date, change the species category selection to "Watchlist Species." Next, enter the genus name in the "Genus" box and enter the species name in the "Species" box. Both names are not needed; searches can be conducted by genus, species, or common name or any combination of those. Click the "Submit" button. If there is only one possible match, the website will go directly to that species page. If there is more than one possible match, the website will provide a list of potential matches. Click on the species name to be taken to the species page.

[GISD] Global Invasive Species Database

http://www.iucngisd.org/gisd/

[GISD] Global Invasive Species Database. 2017. Species profile: *page title*. Gland, Switzerland: Invasive Species Specialist Group. Available: *page URL* (*month and year of access*).

> Note: The citation format given on the website is not the same as the Journal of Fish and Wildlife Management format required for an ERSS.

ABOUT: This database contains comprehensive information on the included invasive species.

TO USE: There are two ways to search for a species: 1. Type the species name into the search box at the top of the page and click "Search." In the results list, click on the appropriate species name to be taken to the species page. 2. Click "Advanced Search Options," then click the arrows (not the boxes) on the Taxonomy tab to navigate through the taxonomic hierarchy to the genus of interest. (TIP: Use the taxonomy from ITIS to do a tree search). This tree search will only include taxonomy for species contained in the database, so if the genus of interest is not listed, then no species from that genus is included in the database. Click on the check box next to the genus name of interest and then click "Search" on the right side to retrieve results. In the results list, click on the appropriate species name to be taken to the species page.

The "How To Use" link at the top of each page has instructions for navigating within the species account. You can also download a PDF version of the species account using the "Full Account (PDF)" button at the top right of the page. However, this document does not include much of the information found in the "Distribution," "Impact," and "Management" tabs of the online version of the species account.

[GloBI] Global Biotic Interactions

https://www.globalbioticinteractions.org/

Poelen JH, Simons JD, Mungall CJ. 2014. Global Biotic Interactions: an open infrastructure to share and analyze species-interaction datasets. Ecological Informatics 24:148–159.

ABOUT: GloBI provides information on organism interactions that are sourced from peer-reviewed papers, published datasets, and other scholarly sources. This is a good source for information on food items and parasites.

TO USE: In the query template, leave the first box empty and type the species name into the second box. Hit the "Enter" key to search. The results will appear in table format. The second column indicates the type of relationship. The ones that say "host of" indicate that the species listed in the third column is a parasite or disease of the species of interest.

Due to the format of the information presented, it is most easily communicated in a paraphrased manner instead of a direct quote, e.g.: "Poelen et al. (2014) list *species 1, species 2, disease 1*, … as *parasites/diseases* of *target species*." However, accessing the cited reference(s) directly to learn more about the interaction and citing from those sources is encouraged.

Google Scholar

https://scholar.google.com/

Directly cite any articles used in Journal of Fish and Wildlife Management format.

ABOUT: Google Scholar is the academic literature version of the ubiquitous Google search.

TO USE: Type the species name and any other search terms into the search bar. Use quotation marks around the species name to indicate that the terms must be present together in that order. Google has a help page on other operators that can be used to refine searches, for example by excluding unwanted words from the results.

Save copies of all articles referenced in the ERSS. There is no need to save a PDF of the search results list.

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iMapInvasives

https://www.imapinvasives.org/

iMapInvasives. *Year of access*. iMapInvasives: NatureServe's online data system supporting strategic invasive species management. NatureServe. Available: http://www.imapinvasives.org (*month and year of access*).

ABOUT: iMapInvasives displays maps of nonnative species occurrences. Data are available from participating States and Provinces only. As of February 2024, the active participants were Arizona, Maine, New Brunswick, New York, Nova Scotia, Oregon, Pennsylvania, Prince Edward Island, and Saskatchewan. Some data are available for inactive participants: Florida, Kentucky, New Hampshire, Vermont, Virginia, West Virginia.

TO USE: At the top of the page, select either "Public Map" or "Login." The public map allows you to view the data but you will need to create a free account if you want to download

occurrence records for use in climate matching. On the map, click on "Filter Records" to search for a particular species name. If logged into your account, toggle off the "Species List" to search the entire database instead of just your primary jurisdiction. Click "Filter" and only observations for that species will show on the map. To export data for use in climate matching, click on the "Export" tool (only available when logged in to your account) and then export the records in CSV format.

India Biodiversity Portal
http://indiabiodiversity.org/

India Biodiversity Portal. *Year of publication or "No date." Page title*. India Biodiversity Portal, species page. Available: *page URL* (*month and year of access*).

ABOUT: This database contains biological, ecological, and distribution information on species reported from India, either native or nonnative.

TO USE: There are two ways to use this database. The first option is to type the species name in the search box at the top of the page. Click the magnifying glass and choose the correct species from the list of results. The second option is to navigate via the "Species" or "Observations" tabs to access the species page and georeferenced occurrences, respectively. Use the filter pane on the left side of the page to filter by scientific name.

Critically evaluate the reported occurrences on the maps; some may represent a centralized location for a species list rather than actual collection points.

Invasive Plant Atlas of the United States
https://www.invasiveplantatlas.org/distribution.html

Swearingen J, Bargeron C. 2016. Invasive plant atlas of the United States. Athens, Georgia: University of Georgia Center for Invasive Species and Ecosystem Health. Available: http://www.invasiveplantatlas.org/ (*month and year of access*).

ABOUT: This website includes images and species distribution maps for plants that are nonnative in part or all of the United States. For some species, there is additional biological and ecological information as well as links to further resources.

TO USE: Use the Find command in your web browser to search the page for the species name. Click on the appropriate species name to access the information page.

Note that maps within the Invasive Plant Atlas are sourced directly from the EDDMapS database. More options for viewing the maps can be accessed via EDDMapS (see entry on EDDMapS for more information).

Invasive Species of Japan
http://www.nies.go.jp/biodiversity/invasive/index_en.html

[NIES] National Institute for Environmental Studies. *Year of access*. *Page title*. Invasive species of Japan. Tsukuba, Japan: National Research and Development Agency, National Institute for Environmental Studies. Available: *page URL* (*month and year of access*).

ABOUT: This database reports on nonnative species in Japan with a focus on the history and impacts of introduction.

TO USE: Click on the appropriate taxon button. Use the Find command in your web browser to search the list for the species name. Click on the species name to access the information page. Alternatively, enter the species name in the search box and click "Google Custom Search." Select the link with the appropriate species name to access the information page.

[ITIS] Integrated Taxonomic Information System
https://www.itis.gov/

[ITIS] Integrated Taxonomic Information System. *Year of access*. *Page title*. Reston, Virginia: Integrated Taxonomic Information System. Available: *page URL* (*month and year of access*).

ABOUT: This website is the main source for information for the "Taxonomic Hierarchy and Taxonomic Standing" section. Note that if the valid name according to ITIS is different from the one listed in Catalog of Fishes, WoRMS, or World Flora Online, the one in the latter databases takes precedence over ITIS for the ERSS.

TO USE: Type the species name in the search box and hit 'Search'. This opens a search results page; click on the appropriate species name to access the species page. If there are no results, try different spellings or just searching by the genus. If there are still no results, the species is not included in the database and the taxonomic information must be found elsewhere.

There is always a search box at the bottom of each page to start a new search.

IUCN Red List of Threatened Species
http://www.iucnredlist.org/

Author name(s). *Year of publication*. *Page title*. The IUCN Red List of Threatened Species *IUCN list year*. Available: *page URL* (*month and year of access*).

> Note: Citation information for these pages is found at the top of each individual species account, just under the title and abstract. Be aware that the citation format given on the website is not exactly the same as the Journal of Fish and Wildlife Management format required for an ERSS.

ABOUT: The IUCN Red List database contains distribution, biology, and habitat information. Do not use the distribution maps provided; they are generalized at best.

TO USE: Type the species name into the search box at the top of the home page and click on the magnifying glass icon. Choose the correct species from the results page, if available, to be taken to the species account.

Before saving the web page as a PDF, scroll to the list of sections in the account and click on the italicized "Expand all" text so that all information on the page becomes visible. Preformatted PDF versions of the species account are also available under "Download" at the top right side of the page.

[MyBIS] Malaysia Biodiversity Information System

http://www.mybis.gov.my/one/discover.php

[MyBIS] Malaysia Biodiversity Information System. *Year of access*. *Page title*. Available: *page URL* (*month and year of access*).

ABOUT: MyBIS hosts accounts of both native and nonnative species present in Malaysia. The amount of information in species accounts is highly variable.

TO USE: Type the species name in the search box at the left of the page under "Search by keyword." Click the yellow "Search" button and a list of results will appear to the right. Click on the appropriate species to access the species page.

[NAS] U.S. Geological Survey Nonindigenous Aquatic Species Database

https://nas.er.usgs.gov/queries/SpSimpleSearch.aspx

Author name(s). *Publication year*. *Page title*. Nonindigenous Aquatic Species Database. Gainesville, Florida: U.S. Geological Survey. Available: *page URL* (*month and year of access*).

> Note: Citation information for these pages is found at the bottom of each fact sheet. Be aware that the citation format given on the website is not the same as the Journal of Fish and Wildlife Management format required for an ERSS.

ABOUT: NAS is the main hub for reporting nonnative species occurrences in the United States. The database includes both species accounts (with information on biology, ecology, nonnative occurrences, and impacts) and a flexible mapping application.

TO USE: Enter the genus name in the "Genus" box and enter the species name in the "Species" box. Both names are not needed; searches can be conducted by genus, species, or common name or any combination of these. Click the "Submit" button. If there is only one possible match it will go directly to that species page. If there is more than one possible match, you will be taken to a results list. In the results list, under "More info," select the "Species Profile" option to view a narrative about the species and its introduction history in the United States; select the "Point Map" option to view a map of reported species occurrences in the United States.

On the mapping page, select the radio button for "Individual Specimens" on the "Species" tab. On the same tab, you can choose to include or exclude occurrences from any subspecies or hybrids listed. This may be helpful, for example, if the taxonomy has been revised recently and the taxonomic reference for the ERSS treats a subspecies differently than NAS. To investigate a particular occurrence, click on the point on the map to highlight it, then go to the "Records" tab to see the corresponding record highlighted. Clicking on the number in the "Specimen ID" field will bring you to a full page entry on that particular reported occurrence with information on potential introduction pathway, status of the introduction, and other relevant comments.

Use the browser back button to return to the search screen or hover over "Database & Queries" then "NAS Database" then click on "Text Queries" to get back to the main search page.

NatureServe Explorer

http://explorer.natureserve.org/

NatureServe. *Year of access*. NatureServe Explorer: an online encyclopedia of life. Arlington, Virginia: NatureServe. Available: http://explorer.natureserve.org (*month and year of access*).

ABOUT: This database includes information on species life history, ecology, range, and status in North America. It covers both native and nonnative species.

TO USE: Type the species name in the search box and hit the 'Enter' key. This will bring up a search results page that will either list any potential species matches or return no results. Click on the appropriate species name to access the species page.

NEMESIS – National Exotic Marine and Estuarine Species Information System

https://invasions.si.edu/nemesis/

Fofonoff PW, Ruiz GM, Steves B, Simkanin C, Carlton JT. 2018. *Page title*. National Exotic Marine and Estuarine Species Information System. Edgewater, Maryland: Smithsonian Environmental Research Center. Available: *page URL* (*month and year of access*).

ABOUT: NEMESIS contains detailed information on history and impacts of introductions of the species it covers. Physicochemical habitat tolerances are also reported, which are useful for the Environment section of the ERSS.

TO USE: Type the species name into the search box at the top right of the page. Click the "Search Taxa" button. Search results will appear on a new page. Click the appropriate species name to access the species information.

Do not use the regional distribution maps; they are too generalized for the ERSS.

[NISIC] National Invasive Species Information Center

https://www.invasivespeciesinfo.gov/species-profiles-list

For species profile:

[NISIC] National Invasive Species Information Center. *Year of access*. *Scientific name*. Beltsville, Maryland: National Agricultural Library. Available: *page URL* (*month and year of access*).

> Note: Directly cite any linked resources used in Journal of Fish and Wildlife Management format.

ABOUT: NISIC provides hosts profiles of nonnative species containing basic information on introduction history and impacts. Typically, the profiles also contain a wealth of links to further resources.

TO USE: Type the species name into the search box above the table of species names and click on the magnifying glass icon. From the results that appear in the table, click on the name of the appropriate species to be taken to the species page. A small amount of information is available directly on the species page, while much more information is available through the linked resources.

[NOBANIS] European Network on Invasive Alien Species

https://www.nobanis.org/search-alien-species/

NOBANIS. *Year of access*. *Page title*. European Network on Invasive Alien Species. Available: *page URL* (*month and year of access*).

If downloading a factsheet from a species page, use the following citation format instead:

Author name(s). *Factsheet publication year*. NOBANIS – invasive alien species fact sheet – *scientific name*. Online database of the European Network on Invasive Alien Species – NOBANIS. Available: *factsheet URL* (*month and year of access*).

> Note: Citation information for these factsheets is found at the top of each factsheet but be aware that the citation format given is not the same as the Journal of Fish and Wildlife Management format required for an ERSS.

ABOUT: NOBANIS species profiles feature a table of introductions to European countries and current species status within those countries.

TO USE: Type the species name into the "Species" search box, then click on the magnifying glass button. Search results will appear at the bottom of the page. Click on the appropriate species name. If a factsheet is available, it will be listed under "Resources." Also on the species page, in the table showing introduction history, click the arrow icon in the last column to be taken to more detailed information on that introduction.

[POWO] Plants of the World Online

http://www.plantsoftheworldonline.org/

[POWO] Plants of the World Online. *Year of access*. *Scientific name*. Plants of the World Online. London: Royal Botanic Gardens, Kew. Available: *page URL* (*month and year of access*).

ABOUT: For the ERSS, the most useful part of this database is likely the description of the native and introduced (if relevant) range. The accepted taxonomy in this database may not match World Flora Online. Please remember that, for plants, the ERSS should follow the taxonomy as accepted by World Flora Online.

TO USE: Type the species name into the search box. Select the appropriate species from the results page.

The geographic place names used in POWO come from the World Geographical Scheme for Recording Plant Distributions created by the International Working Group on Taxonomic Database (TDWG). Specifically, POWO reports "Botanical Countries" in which a species has been reported. Botanical country names can be translated to more familiar political boundaries using the resources linked at https://www.tdwg.org/standards/wgsrpd/ or by exploring the TWDG Level 3 map at https://observablehq.com/@barnabywalker/world-geographical-scheme-for-recording-plant-distributi.

SeaLifeBase

http://www.sealifebase.org/search.php

Palomares MLD, Pauly D, editors. *Year of access*. *Page title*. SeaLifeBase. Available: *page URL* (*month and year of access*).

ABOUT: SeaLifeBase is similar to FishBase but it is not limited to fish species.

TO USE: There are many ways to search SeaLifeBase. Type just the genus name into the 'Genus' search box, the specific epithet into the 'Species' search box, or the entire species name into the 'Genus + Species' search box. If using the 'Genus' or 'Species' searches, a list of matching species will be provided. Click on the appropriate species to access the species page. If using the 'Genus + Species' search box, this will go directly to the species page or provide a list of possible matches if a direct match does not exist.

On the species page, there are small headings to the right of the main headings that can be used to access further information. There are also links to further information at the bottom of the page. If accessing any of those links, save the pages to the PDF.

The references can be found by clicking on the "References" link. Save this page as a PDF. The reference numbers in the quoted material must be replaced by the correct reference in Journal of Fish and Wildlife Management style. The replacement information must be placed within brackets in the ERSS.

USDA PLANTS

https://plants.usda.gov/java/

USDA, NRCS. *Year of access*. *Scientific name*. The PLANTS database. Greensboro, North Carolina: National Plant Data Team. Available: *page URL* (*month and year of access*).

ABOUT: USDA Plants contains general taxonomic and distribution information on plants found in the United States and its territories. The species pages may also contain helpful links to further information.

TO USE: At the top left of the homepage is a search box. Type the scientific name here. Make sure there are no misspellings otherwise it will not return any search results. Also, make sure the box below says 'Scientific Name'. Click 'Go'. This search function remains on the left of every page.

The species pages are made up of different tabs; remember to save each tab used to a PDF.

USFWS Conservation Library

https://fwslibrary.on.worldcat.org/discovery

Directly cite any articles used in Journal of Fish and Wildlife Management format.

ABOUT: If the full text of an article is not accessible through Google Scholar or Web of Science, Service employees may obtain access through the Conservation Library.

TO USE: Type search terms into the search box and click 'Search'. Search terms could be a species name or the title of a journal or article. On the results page, use the filters on the left side

of the page to refine the search as desired. It may be particularly helpful to toggle off the option to "Expand Search with Related Terms."

If a full text version of an article cannot be obtained through the catalog, Service employees may email library@fws.gov with the full citation and their program (e.g., Fish and Aquatic Conservation) to request the full text via Interlibrary Loan.

VertNet

http://www.vertnet.org/index.html

VertNet. *Year of access*. VertNet. Available: http://www.vertnet.org/index.html (*month and year of access*).

ABOUT: VertNet is a source of global distribution maps for vertebrate species.

TO USE: Type the species name in quotation marks in the search box at the bottom left of the page. Click the 'Search Now' button. This will bring up a table with any species occurrences matching the species name. Click the 'Map' tab at the top of the table. If there are more than 100 occurrences, click the blue 'Load more…' button in the top right of the map until the map displays all points. Use the Print Screen function in your web browser to save a copy of the map for the ERSS.

The search box responds to Boolean operators if you need to filter the results by location, for example.

Web of Science

https://www.webofscience.com/wos/woscc/basic-search
https://login.fwslibrary.idm.oclc.org/login?url=http://www.webofscience.com (internal Service link)

Directly cite any articles used in Journal of Fish and Wildlife Management format.

ABOUT: Web of Science is a search engine specifically for high quality, peer-reviewed journal articles. The tool requires a subscription, so **Service employees must be connected to a Service network to use it**.

TO USE: On the Documents tab, type the species name in quotations into the search box. Click '+ Add Row' to add additional search terms as needed or use Boolean operators to add search terms into the same field as the species name. Click the 'Search' button. On the search results page there are filters on the left to help refine the results if needed.

[WFO] World Flora Online
http://www.worldfloraonline.org/

[WFO] World Flora Online. *Year of access*. World Flora Online – a project of the World Flora Online Consortium. Available: http://www.worldfloraonline.org (*month and year of access*).

ABOUT: This database should be used to find the accepted scientific name of a plant species for an ERSS.

TO USE: Type the species scientific or common name in the search box and hit 'Enter'. This will give a list of names, look for the name identified as 'accepted'. Click on the species name to access the individual page.

[WoRMS] World Register of Marine Species
http://www.marinespecies.org/aphia.php?p=search

Author name(s). *Publication year*. *Page title*. World Register of Marine Species. Available: *page URL* (*month and year of access*).

> Note: The author's name and date can be found at the bottom of the species page following the 'Taxonomic citation:' heading, not the names listed under the 'Taxonomic edit history:' heading.

ABOUT: WoRMS contains taxonomic and sometimes general biological information. Despite the name, it is not strictly limited to marine species. This database should be used to find the accepted scientific name of most types of organisms (excluding fish and plants) for an ERSS.

TO USE: Type the species name into the search bar and uncheck the 'marine or brackish' box. Click 'Search'. The results page will show all potential matches, including any synonyms in the database. Click on the appropriate name to view the species page.

Appendix B. 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 ERSS 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 were found, and whether those data were 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 updating of an ERSS in the future.

On the following pages, 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 "URL and Comments" copy and paste internet addresses or search terms used when appropriate or give details on why a website was not consulted or data not used.

Online Databases and Information Sources for ERSS Development	
Species Name:	**Date:**

On the following pages, document your information search. In the "URL and Comments" section:

- Insert direct link or search terms if a resource is ***used*** in the ERSS.
- Insert justification if a resource or data is ***not used*** in the ERSS.

Further information and instructions for each database are available in appendix A of this SOP.

- ALL SPECIES -

ITIS (Integrated Taxonomic Identification System)
Consulted? ☐ Yes ☐ No Data Found? ☐ Yes ☐ No Data Used? ☐ Yes ☐ No
URL and Comments:

GBIF (Global Biodiversity Information Facility)
Consulted? ☐ Yes ☐ No Data Found? ☐ Yes ☐ No Data Used? ☐ Yes ☐ No
URL and Comments:

GBIF-US
Consulted? ☐ Yes ☐ No Data Found? ☐ Yes ☐ No Data Used? ☐ Yes ☐ No
URL and Comments:

USGS NAS (Nonindigenous Aquatic Species) Database
Consulted? ☐ Yes ☐ No Data Found? ☐ Yes ☐ No Data Used? ☐ Yes ☐ No
URL and Comments:

EDDMapS
Consulted? ☐ Yes ☐ No Data Found? ☐ Yes ☐ No Data Used? ☐ Yes ☐ No
URL and Comments:

CABI (Invasive Species Compendium) (do not use aggregated occurrence data for climate matching)
Consulted? ☐ Yes ☐ No Data Found? ☐ Yes ☐ No Data Used? ☐ Yes ☐ No
URL and Comments:

GISD (Global Invasive Species Database)
Consulted? ☐ Yes ☐ No Data Found? ☐ Yes ☐ No Data Used? ☐ Yes ☐ No
URL and Comments:

FAO Database on Introductions of Aquatic Species
Consulted? ☐ Yes ☐ No Data Found? ☐ Yes ☐ No Data Used? ☐ Yes ☐ No
URL and Comments:

U.S. Register of Introduced and Invasive Species (Download most recent version as .xlsx or .txt)
Consulted? ☐ Yes ☐ No Data Found? ☐ Yes ☐ No Data Used? ☐ Yes ☐ No
URL and Comments:

IUCN Red List (do not use maps; they have known inaccuracies)
Consulted? ☐ Yes ☐ No Data Found? ☐ Yes ☐ No Data Used? ☐ Yes ☐ No
URL and Comments:

NatureServe Explorer
Consulted? ☐ Yes ☐ No Data Found? ☐ Yes ☐ No Data Used? ☐ Yes ☐ No
URL and Comments:

National Invasive Species Information Center
Consulted? ☐ Yes ☐ No Data Found? ☐ Yes ☐ No Data Used? ☐ Yes ☐ No
URL and Comments:

GloBI (Global Biotic Interactions)
Consulted? ☐ Yes ☐ No Data Found? ☐ Yes ☐ No Data Used? ☐ Yes ☐ No
URL and Comments:

Google Scholar
Consulted? ☐ Yes ☐ No Data Found? ☐ Yes ☐ No Data Used? ☐ Yes ☐ No
Search Terms and Comments:

Web of Science **(Service employees click here)**
Consulted? ☐ Yes ☐ No Data Found? ☐ Yes ☐ No Data Used? ☐ Yes ☐ No
Search Terms and Comments:

Google (for trade information)
Consulted? ☐ Yes ☐ No Data Found? ☐ Yes ☐ No Data Used? ☐ Yes ☐ No
Search Terms and Comments:

- FOR PLANTS -

World Flora Online
Consulted? ☐ Yes ☐ No Data Found? ☐ Yes ☐ No Data Used? ☐ Yes ☐ No
URL and Comments:

Federal Noxious Weed List (PDF)
Consulted? ☐ Yes ☐ No Data Found? ☐ Yes ☐ No Data Used? ☐ Yes ☐ No
URL and Comments:

Invasive Plant Atlas of the United States
Consulted? ☐ Yes ☐ No Data Found? ☐ Yes ☐ No Data Used? ☐ Yes ☐ No
URL and Comments:

USDA PLANTS (Introduced/Invasive/Noxious Plants)
Consulted? ☐ Yes ☐ No Data Found? ☐ Yes ☐ No Data Used? ☐ Yes ☐ No
URL and Comments:

Plants of the World Online Consulted? ☐ Yes ☐ No Data Found? ☐ Yes ☐ No Data Used? ☐ Yes ☐ No URL and Comments:
- FOR ANIMALS -
WoRMS Consulted? ☐ Yes ☐ No Data Found? ☐ Yes ☐ No Data Used? ☐ Yes ☐ No URL and Comments:
Catalog of Fishes (use for valid scientific name for fish only) Consulted? ☐ Yes ☐ No Data Found? ☐ Yes ☐ No Data Used? ☐ Yes ☐ No URL and Comments:
USFWS List of Injurious Wildlife Consulted? ☐ Yes ☐ No Data Found? ☐ Yes ☐ No Data Used? ☐ Yes ☐ No URL and Comments:
FishBase or **SeaLifeBase** Consulted? ☐ Yes ☐ No Data Found? ☐ Yes ☐ No Data Used? ☐ Yes ☐ No URL and Comments:
VertNet Consulted? ☐ Yes ☐ No Data Found? ☐ Yes ☐ No Data Used? ☐ Yes ☐ No URL and Comments:
[Additional Database] (copy and paste this box as many times as needed): Consulted? ☐ Yes ☐ No Data Found? ☐ Yes ☐ No Data Used? ☐ Yes ☐ No URL and Comments:

Additional databases to search as appropriate (fill out "Additional Database" box above):

Taxon-specific

Alaska Exotic Plants Information Clearinghouse (AKEPIC)
AlgaeBase
AmphibiaWeb
Birds of the World
Crayfish and Lobster Taxonomy Browser
eBird

Region-specific

AquaNIS (Europe, adjacent regions)
Asian-Pacific Alien Species Database
European Alien Species Information Network (EASIN)
European Network on Invasive Alien Species (NOBANIS)
Great Lakes Aquatic Nonindigenous Species Information System (GLANSIS)
iMap Invasives (AZ, ME, NB, NY, OR, PA, SK)
India Biodiversity Portal
Invasive Species of Japan
Malaysia Biodiversity Information System
National Invasive Species Information Center (U.S.)

Habitat-specific

National Exotic Marine and Estuarine Species Information System (NEMESIS)

Appendix C. ERSS Drafting Template

This appendix contains a template that should be used in conjunction with the SOP to complete an ERSS report.

Please note that for the purposes of navigation within this SOP, heading text is not tagged as it should be for a published ERSS. See part 3 of this SOP for instructions on setting text styles for document accessibility.

The template refers to RAMP in the climate match sections. If Climatch is used instead, replace any references to RAMP with the corresponding information for Climatch (see appendix G).

U.S. Fish & Wildlife Service

Common Name (*Scientific name*)

Ecological Risk Screening Summary

Author Name, affiliation only if not USFWS, Month Year

Organism Type: *insert organism type from list in SOP*
Overall Risk Assessment Category: *insert ORAC after completing risk screening*

In place of the camera, insert an image above if available and include image credit:
Photo: *Author*. Licensed under *reuse license*. Available: *website* (*month and year accessed*). *Alt text:* Photo of *scientific name*. *Change "Photo" to "Image" when using an illustration.*

1 Native Range and Status in the United States

Native Range

From *author* (*year*):

Insert quotation.

Add more quotations in the same format as needed.

Status in the United States

From *author* (*year*):

Insert quotation.

Add more quotations in the same format as needed.

If no information found on presence or trade, instead insert: No records of *scientific name* in *the wild/in trade* in the United States were found.

Regulations

List regulating jurisdictions with the regulatory label used in each jurisdiction (e.g., "noxious weed," "prohibited invasive species") and source of regulatory information.

While effort was made to find all applicable regulations, this list may not be comprehensive.

If no information found on regulatory status, instead insert: No species-specific regulations on possession or trade were found within the United States.

Means of Introductions within the United States

From *author* (*year*):

Insert quotation.

Add more quotations in the same format as needed.

If no information found, instead insert: No records of *scientific name* in the wild in the United States were found.

Remarks

From *author* (*year*):

Insert quotation.

Add more quotations in the same format as needed.

If no information found, instead insert: No additional remarks.

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From *author* (*year*):

Insert taxonomic hierarchy, no quotation marks.

According to *author* (*year*), *valid scientific name* is the current valid name for this species.

If additional synonyms were used to search for information, insert:
The following synonyms of *valid scientific name* from *citation* were used to search for information for this report: *list synonyms*.

Size, Weight, and Age Range

From *author* (*year*):

Insert quotation.

Add more quotations in the same format as needed.

If no information found, instead insert: No information was found on size, weight, or age range of *scientific name*.

Environment

From *author* (*year*):

Insert quotation.

Add more quotations in the same format as needed.

If no information found, instead insert: No information was found on environment used by *scientific name*.

Climate

From *author* (*year*):

Insert quotation.

Add more quotations in the same format as needed.

If no information found, instead insert: No information was found on climate used by *scientific name*.

Distribution Outside the United States

Native

From *author* (*year*):

Insert quotation.

Add more quotations in the same format as needed.

Introduced

From *author* (*year*):

Insert quotation.

Add more quotations in the same format as needed.

If no information found, instead insert: No records were found for introduction of *scientific name* in the wild outside the United States.

Means of Introduction Outside the United States

From *author* (*year*):

Insert quotation.

Add more quotations in the same format as needed.

If no information found, instead insert: No records were found of introduction of *scientific name* in the wild outside the United States.

Short Description

From *author* (*year*):

Insert quotation.

Add more quotations in the same format as needed.

If no information found, instead insert: No information was found to provide a description of *scientific name*.

Biology

From *author* (*year*):

Insert quotation.

Add more quotations in the same format as needed.

If no information found, instead insert: No information was found on the biology of *scientific name*.

Human Uses

From *author* (*year*):

Insert quotation.

Add more quotations in the same format as needed.

If no information found, instead insert: No information was found on human uses of *scientific name*.

Diseases

ONLY if species is a vertebrate, mollusk, or crustacean: ***Scientific name*** **has been documented as** ***susceptible to/a carrier of pathogen name*****, a disease listed by the World Organisation for Animal Health (*****year accessed*****).** *or* **No information was found associating** ***scientific name*** **with any diseases listed by the World Organisation for Animal Health (*****year accessed*****).**

For all species:
From *author* (*year*):

Insert quotation.

Add more quotations in the same format as needed.

If no information found, instead insert: No information was found on diseases associated with *scientific name*.

Threat to Humans

From *author* (*year*):

Insert quotation.

Add more quotations in the same format as needed.

If no information found, instead insert: No information was found on threats to humans from *scientific name*.

3 Impacts of Introductions

From *author* (*year*):

Insert quotation.

Add more quotations in the same format as needed.

If introductions occurred but no information on impacts was found, instead insert: No information available on impacts of reported introductions.

If no introductions were found, instead insert: No records of introductions were found for *scientific name*; therefore, there is no information on impacts of introduction.

Summarize the species regulations listed in Section 1.

4 History of Invasiveness

The History of Invasiveness for *scientific name* is classified as *HOI category*. *Provide justification.*

5 Global Distribution

Insert Global Distribution Map here. Alt text: Map of *geographic area* showing locations where *scientific name* has been reported. *Provide brief description of where the locations are.*
Figure *X*. Reported global distribution of *scientific name*. Map from *citation*. Observations are reported from *countries or regions*. *Note any points that appear on the map that do not represent established populations.*

Identify any areas of missing data.

6 Distribution Within the United States

Insert United States Distribution Map here. Alt text: Map of *geographic area* showing locations where *scientific name* has been reported. *Provide brief description of where the locations are.*
Figure *X*. Reported distribution of *scientific name* in the United States. Map from *citation*. Observations are reported from *States, or if too many to list, regions*. *Note any points that appear on the map that do not represent established populations.*

Identify any areas of missing data.

If no records found in section 1: Status in the United States, no map is necessary. Instead insert: No records of *scientific name* in the wild in the United States were found.

7 Climate Matching

Summary of Climate Matching Analysis

Describe areas of the map that have high, medium, and low matches. The overall Climate 6 score (Sanders et al. 2023; 16 climate variables; Euclidean distance) for the contiguous United States was *Climate 6 score*, indicating that *Yes, there is establishment concern/establishment is Doubtful* for this species [*if the species is native to the contiguous United States, add:* outside its native range]. The Climate 6 score is calculated as: (count of target points with scores ≥ 6)/(count of all target points). Establishment concern is warranted for Climate 6 scores greater than or equal to 0.002 based on an analysis of the establishment success of 356 nonnative aquatic species introduced to the United States (USFWS 2024).

Projected climate matches in the contiguous United States under future climate scenarios are available for *scientific name* (see Appendix). These projected climate matches are provided as additional context for the reader; future climate scenarios are not factored into the Overall Risk Assessment Category.

Insert RAMP source map here. Alt text: Source map of *region* showing selected source locations for *scientific name* climate match to the contiguous United States. *Describe locations of source points.*

Figure *X.* RAMP (Sanders et al. 2023) source map showing weather stations in *general geographic area* selected as source locations (red; *list countries containing selected source points*) and non-source locations (gray) for *scientific name* climate matching. Source locations from *citation*. Selected source locations are within 100 km of one or more species occurrences, and do not necessarily represent the locations of occurrences themselves.

Insert RAMP climate match results map here. Alt text: Map of the contiguous United States showing results of climate matching for *scientific name*. A text description of the results was provided at the beginning of section 7.
Figure *X.* Map of RAMP (Sanders et al. 2023) climate matches for *scientific name* in the contiguous United States based on source locations reported by *citation*. Counts of climate match scores are tabulated on the left. 0/Pale Pink = Lowest match, 10/Dark Purple = Highest match.

8 Certainty of Assessment

The Certainty of Assessment for *scientific name* is classified as *Certainty of Assessment category*. *Provide justification*.

9 Risk Assessment

Summary of Risk to the Contiguous United States

Scientific name, *common name*, is a *type of organism* that is native to *native range*. *Summarize important information on biology, ecology, uses, regulations, introductions, impacts, and/or threats (roughly 2-4 sentences)*. The History of Invasiveness for *scientific name* is classified as *High/Low/Data Deficient/No Known Nonnative Population* due to *justification*. The climate matching analysis for the contiguous United States indicates *establishment concern/doubtful establishment* for this species [*if the species is native to the contiguous United States, add:* outside its native range]. *Summarize notable features of the climate match e.g., location with highest match (aside from native range, if applicable)*. The Certainty of Assessment for this ERSS is classified as *High/Medium/Low* due to *justification*. The Overall Risk Assessment Category for *scientific name* in the contiguous United States is *High/Low/Uncertain*.

Assessment Elements

- **History of Invasiveness (see section 4): *High/Low/Data Deficient/No Known Nonnative Population***
- **Establishment Concern (see section 7): *Yes/Doubtful***
- **Certainty of Assessment (see section 8): *High/Medium/Low***
- **Remarks, Important additional information: *parthenogenic, genetically modified, human health impacts, etc., or None***
- **Overall Risk Assessment Category: *High/Low/Uncertain***

10 Literature Cited

Note: The following references were accessed for this ERSS. References cited within quoted text but not accessed are included below in section 11.

Insert references accessed by risk assessor here, in alphabetical order.

Sanders S, Castiglione C, Hoff M. 2023. Risk Assessment Mapping Program: RAMP. Version 5.0. U.S. Fish and Wildlife Service.

[USFWS] U.S. Fish and Wildlife Service. 2024. Standard operating procedure: how to prepare an "Ecological Risk Screening Summary." Version 3.

World Organisation for Animal Health. *Year of access*. Animal diseases. Paris: World Organisation for Animal Health. Available: https://www.woah.org/en/what-we-do/animal-health-and-welfare/animal-diseases/ (*month and year of access*). *Delete this citation if the species is not a vertebrate, crustacean, or mollusk.*

11 Literature Cited in Quoted Material

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, in alphabetical order. If there are no citations to be listed in this section, state: No references in this section.

Appendix

Summary of Future Climate Matching Analysis

Future climate projections represent two Shared Socioeconomic Pathways (SSP) developed by the Intergovernmental Panel on Climate Change (IPCC 2021): SSP5, in which emissions triple by the end of the century; and SSP3, in which emissions double by the end of the century. Future climate matches were based on source locations reported by *citation(s) for sources used for climate match in section 7*.

Under the future climate scenarios (figure A1), the highest climate match for *scientific name* is projected to occur in *location(s)*. *Describe other notable similarities and differences between the four future scenarios.* The Climate 6 scores for the individual future scenario models (figure A2) ranged from a low of *value* (model: *model, SSP, and time step that yielded the lowest Climate 6 score*) to a high of *value* (model: *model, SSP, and time step that yielded the highest Climate 6 score*). Future scenario Climate 6 scores were *above/below/distributed around* the Establishment Concern threshold, indicating that *Yes, there is establishment concern/establishment is Doubtful/establishment concern requires more investigation* for this species under future climate scenarios. The Climate 6 score for the current climate match (*value*, figure 4) falls

within/above/below the range of scores for future projections. *Describe areas with large increases or decreases in climate match in comparison to the current match.*

Insert four-image panel of RAMP future climate match results maps, two across and two down. Top row is time step 2055, SSP3 on the left, SSP5 on the right. Bottom row is time step 2085 with SSPs in same order. Alt text: Maps of the contiguous United States showing median climate matches for *scientific name* under future scenarios SSP3 and SSP5 in 2055 and 2085 from five global climate models. Description of results can be found at the beginning of this appendix.
Figure A1. Maps of median RAMP (Sanders et al. 2023) climate matches projected under potential future climate conditions using five global climate models for *scientific name* in the contiguous United States. Climate matching is based on source locations reported by *citation(s)*. Shared Socioeconomic Pathways (SSPs) used (from left to right): SSP3, SSP5 (IPCC 2021). Time steps: 2055 (top row) and 2085 (bottom row). Climate source data from CHELSA (Karger et al. 2017, 2018); global climate models used: GFDL-ESM4, UKESM1-0-LL, MPI-ESM1-2-HR, IPSL-CM6A-LR, and MRI-ESM2-0. 0/Pale Pink = Lowest match, 10/Dark Purple = Highest match.

Insert four-panel image of Climate 6 scores displayed on number lines. Alt text: Four-panel image of number lines representing the range of possible Climate 6 scores (0-1). In each panel, hatch marks represent the Climate 6 score calculated for *scientific name* from each of five global climate models for one of four SSP-time step combinations. Details on the range of Climate 6 scores can be found at the beginning of the appendix.
Figure A2. Comparison of projected future Climate 6 scores for *scientific name* in the contiguous United States for each of five global models under four combinations of Shared Socioeconomic Pathway (SSP) and time step. SSPs used (from left to right): SSP3, SSP5 (Karger et al. 2017, 2018; IPCC 2021). Time steps: 2055 (top row) and 2085 (bottom row). Climate source data from CHELSA (Karger et al. 2017, 2018); global climate models used: GFDL-ESM4, UKESM1-0-LL, MPI-ESM1-2-HR, IPSL-CM6A-LR, and MRI-ESM2-0.

Insert four-image panel of RAMP climate match difference maps, two across and two down. Top row is time step 2055, SSP3 on the left, SSP5 on the right. Bottom row is time step 2085 with SSPs in same order. Alt text: Maps of the contiguous United States showing the difference in climate matching results between current climate and medians of future scenarios for *scientific name*. Future scenarios are SSP3 and SSP5 in 2055 and 2085. Description of results can be found at the beginning of this appendix.
Figure A3. RAMP (Sanders et al. 2023) maps of the contiguous United States showing the difference between the current climate match target point score (figure 4) and the median target point score for future climate scenarios (figure A1) for *scientific name* based on source locations reported by *citation(s)*. Shared Socioeconomic Pathways (SSPs) used (from left to right): SSP3, SSP5 (IPCC 2021). Time steps: 2055 (top row) and 2085 (bottom row). Climate source data from CHELSA (Karger et al. 2017, 2018); global models used: GFDL-ESM4, UKESM1-0-LL, MPI-ESM1-2-HR, IPSL-CM6A-LR, and MRI-ESM2-0. Shades of blue indicate a lower target point score under future scenarios than under current conditions. Shades of red indicate a higher target point score under future scenarios than under current conditions. Darker shades indicate greater change.

Literature Cited

Copy references used for climate match source points or to evaluate the source points from the ERSS. Insert them in alphabetical order below.

[IPCC] Intergovernmental Panel on Climate Change. 2021. Climate change 2021: the physical science basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press.

Karger DN, Conrad O, Böhner J, Kawohl T, Kreft H, Soria-Auza RW, Zimmermann NE, Linder P, Kessler M. 2017. Climatologies at high resolution for the Earth land surface areas. Scientific Data 4:170122.

Karger DN, Conrad O, Böhner J, Kawohl T, Kreft H, Soria-Auza RW, Zimmermann NE, Linder HP, Kessler M. 2018. Data from: Climatologies at high resolution for the earth's land surface areas. EnviDat. Available: https://doi.org/10.16904/envidat.228.v2.1.

Sanders S, Castiglione C, Hoff M. 2023. Risk Assessment Mapping Program: RAMP. Version 5.0. U.S. Fish and Wildlife Service.

Appendix D. Example of a Completed ERSS

This appendix is an example of a completed ERSS report. Additional examples can be found in the Service's online ERSS library. Some ERSS reports provided online were completed before the finalization of this updated SOP. Where there are differences in formatting, the current version of the ERSS SOP should be regarded as the final word on ERSS content, structure, and layout.

Please note that for the purposes of navigation within this SOP, heading text is not tagged as it should be for a published ERSS. See part 3A of this SOP for instructions on setting text styles for document accessibility.

U.S. Fish & Wildlife Service

Golden Topminnow (*Fundulus chrysotus*)

Ecological Risk Screening Summary

U.S. Fish and Wildlife Service, December 2022
Revised, January 2023

Organism Type: Fish
Overall Risk Assessment Category: Uncertain

Photo: Fredlyfish4. Licensed under Creative Commons Attribution-Share Alike 4.0 International. Available: https://commons.wikimedia.org/wiki/File:Fundulus_chrysotus_UMFS_2.jpg (December 2022).

1 Native Range and Status in the United States

Native Range

From Fuller (2019):

"Atlantic and Gulf Coastal Plain from Santee River drainage, South Carolina, to Trinity River drainage, Texas; Former Mississippi Embayment north to Kentucky and Missouri. East of Mississippi River, mostly restricted to lower Coastal Plain (Page and Burr 1991)."

Status in the United States

From NatureServe (2022):

"Range includes the North American Coastal Plain from the Waccamaw River drainage, South Carolina, to southern Florida, west to the Trinity River drainage, eastern Texas; Former Mississippi Embayment north to Kentucky and Missouri; east of the Mississippi River, this species occurs mostly on the lower Coastal Plain (Page and Burr 2011). Also occurs in North Carolina (Wayne Starnes, pers. comm., 2006)."

"National and State/Provincial Distribution:
United States: AL, AR, FL, GA, KY, LA, MO, MS, NC, OK, SC, TN, TX"

From McAllister et al. (2006):

"The golden topminnow, *Fundulus chrysotus* (Günther), is a small killifish that is distributed in the Coastal Plain from the Santee River drainage of South Carolina through Georgia, Florida, Alabama, Mississippi, and Louisiana, and northeastward from the Trinity River drainage of Texas and Oklahoma through eastern Arkansas up the Mississippi River Embayment to Tennessee, Kentucky and Missouri (Shute 1980, Etnier and Starnes 1993)."

"During the period from 1960 to 1987, Robinson and Buchanan (1988) reported 33 localities in the state [of Arkansas] for the species; however, prior to 1960, only 3 localities were known. In addition, Buchanan et al. (2003), Buchanan (2005), and Robinson (2005) reported this fish from the Red River drainage (rarely), 11 of 66 Arkansas reservoirs (1,380 specimens), and the Pine Bluff Arsenal (Jefferson County, 7 specimens), respectively. Additional fieldwork in Arkansas has revealed further distributional records in 27 counties for *F. chrysotus,* and we document 98 new locales herein."

"Between August 1996 and September 2005, golden topminnows were collected […] We document the collection of 3,619 *F. chrysotus* from 27 of 75 counties (36%) of Arkansas (Ashley, Bradley, Calhoun, Clark, Columbia, Crawford, Crittenden, Dallas, Desha, Drew, Hempstead, Hot Spring, Howard, Jackson, Jefferson, Lafayette, Lincoln, Little River, Lonoke, Miller, Ouachita, Poinsett, Prairie, Sebastian, Sevier, St. Francis, Union)."

From Edwards et al. (2021):

"Collections of Golden Topminnow were notable in that these collections are the first report of the Golden Topminnow in the upper San Marcos River, which is 230 river km upstream from the nearest known population in Bird's Creek in the lower reach of the Guadalupe River [Texas]."

Fuller (2019) report nonindigenous occurrences of *F. chrysotus* from two States: Arkansas (L'Anguille and Little Missouri basins) in 2019, and Texas (San Marcos basin) in 2020.

From Fuller (2019):

"Status: Probably established in Texas."

Fundulus chrysotus is available in the pet trade in the United States, although no estimates of trade volume are available.

From Wild Fish Tanks (2022):

"Golden Topminnow (*Fundulus chrysotus* Killifish)
$5.99 - $29.99"

Regulations

Fundulus chrysotus is listed as a conditionally approved animal in Hawaii (Hawaii Department of Agriculture 2019).

While effort was made to find all applicable regulations, this list may not be comprehensive.

Means of Introductions within the United States

From Edwards et al. (2021):

"It is unclear if the 2 Golden Topminnows collected in the upper San Marcos River represent a natural population expansion or resulted from human-mediated transport."

From Wills et al (1998):

"The golden topminnow, *Fundulus chrysotus* (Günther), is historically known in Missouri from only five specimens collected from two localities in Dunklin and Pemiscot counties, both in the "bootheel" region. No other *F. chrysotus* have been found in Missouri since 1944 and 1946, when these specimens were collected. The species has been considered extirpated in Missouri (Anon. 1997, Pflieger 1997). However, we recently collected six specimens of *F. chrysotus* during a survey of the fishes of the Saint John's drainage and the New Madrid floodway in New Madrid and Mississippi counties in the southwestern region of Missouri."

From Fuller (2019):

"Means of Introduction: Unknown."

Remarks

No additional remarks.

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

According to Fricke et al. (2022), *Fundulus chrysotus* is the current valid name for this species. Other non-valid synonyms of this species include: *F. kompi, F. scartes, Gambusia arlingtonia, Haplochilus chrysotus,* and *Zygonectes henshalli.* None of these synonyms have been in regular use within the past 50 years.

From ITIS (2022):

Kingdom Animalia
Subkingdom Bilateria
Infrakingdom Deuterostomia
Phylum Chordata
Subphylum Vertebrata
Infraphylum Gnathostomata
Superclass Actinopterygii
Class Teleostei
Superorder Acanthopterygii
Order Cyprinodontiformes
Suborder Cyprinodontoidei
Family Fundulidae
Genus *Fundulus*
Species *Fundulus chrysotus* (Günther, 1866)

Size, Weight, and Age Range

From Froese and Pauly (2022):

"Max length: 8.5 cm TL [total length] male/unsexed [Huber 1996] common length: 4.0 cm TL male/unsexed; [Hugg 1996]"

From Edwards et al. (2021):

"Age-0 fish grow rapidly, reaching 30 mm (SL [standard length]) within 3 months, and can become sexually mature within 10 months (Foster 1967). Lifespan of the Golden Topminnow is 2 years (Foster 1967)."

Environment

From NatureServe (2022):

"Habitat includes swamps, sloughs, backwaters, and pools of ditches and slow-moving creeks and small to medium rivers; these topminnows usually are associated with heavy submergent aquatic vegetation (Lee et al. 1980, Page and Burr 2011); occasionally they occurs [sic] in brackish water along the coast."

From Edwards et al. (2021):

"Baseflow of the upper San Marcos River [where *F. chrysotus* was collected] is primarily from spring outflows of the Edwards Aquifer, which provide year-round 20 – 24 °C water temperatures (Groeger et al. 1997)."

Climate

From Froese and Pauly (2022):

"Subtropical […]"

Distribution Outside the United States

Native

The native range of *Fundulus chrysotus* is not known to extend outside of the United States.

Introduced

No records were found for introductions of *Fundulus chrysotus* in the wild outside the United States.

Means of Introduction Outside the United States

No records were found for introductions of *Fundulus chrysotus* in the wild outside the United States.

Short Description

From Hendrickson and Cohen (2022):

"Life colors: Dark spots on body absent or small and not in rows; body mottled, barred or irregularly spotted; body barred or not but never with a dark spot on dorsal part of caudal peduncle (Hubbs et al.1991). The back is olive and has dark, narrow, predorsal stripe. There are considerable color differences between the sexes. Males have 7-11 vertical bars (often faint) and a scattering of red dots on the sides; both are best developed posteriorly. Males also have flecks of iridescent blue or gold along the sides of the head and body. The undersides of the head and body are white or silver. The caudal fin has four or five rows of red spots, and there are spots on both the dorsal and anal fins. Fins are yellow to white. The pectoral and pelvic fins are generally unpigmented, except for small melanophores along the fins rays. Females and juveniles lack the vertical bar, gold flecks, and red spots, but may have smaller bluish spots on the sides. Both sexes lack a suborbital bar and horizontal lateral band (Ross 2001)."

"Counts: Usually 10 anal fin rays; fewer than 15 scale rows from pelvic fin origin to isthmus; 30-40 longitudinal scale rows (Hubbs et al., 1991)."

"Body shape: Slender (Ross 2001). Eye contained fewer than one and one half times in snout (Hubbs et al. 1991)."

"Mouth position: Supraterminal (Goldstein and Simon 1999)."

Biology

From NatureServe (2022):

"**Immature Food Habits:** Invertivore
Adult Food Habits: Invertivore
Food Comments: Eats mainly insects and other aquatic invertebrates near or at the surface."

From Edwards et al. (2021):

"[…] feeding primarily on surface invertebrates (e.g., water beetles [Haliplidae], midges [Chironomidae]; Goldstein and Simon 1999, Hunt 1953). Its [*F. chrysotus*] reproductive season is April through September (De Vlaming et al. 1978, Foster 1967, Hellier 1967), with Golden Topminnow depositing multiple batches of eggs with adhesive threads on plants and substrates (Foster 1967, Leitholf 1917, Pflieger 1975)."

Human Uses

From Froese and Pauly (2022):

"Aquarium: commercial."

Fundulus chrysotus is available in the pet trade in the United States, although no estimates of trade volume are available.

From Wild Fish Tanks (2022):

"Golden Topminnow (*Fundulus chrysotus* Killifish)
$5.99 - $29.99"

Diseases

No information was found associating *Fundulus chrysotus* with any diseases listed by the World Organisation for Animal Health (2022).

According to Poelen et al. (2014), *Fundulus chrysotus* hosts the following parasites: *Eustrongylides ignotus* and *Neoechinorhynchus*.

From McAllister et al. (2019):

"Between March 2016 and March 2018, 52 golden topminnows, *Fundulus chrysotus*, were collected in the Arkansas […] Twenty-three (44%) were infected/infested, including 1 (2%) with *Calyptospora funduli*, 4 (8%) with *Myxobolus* sp., 9 (18%) with *Salsuginus* sp., 2 (4%) with *Homalometron* sp., 2 (4%) with metacercaria of *Clinostomum marginatum*, 4 (8%) with *Posthodiplostomum minimum*, 5 (10%) with immature *Proteocephalus* sp., 4 (8%) with larval

Eustrongylides sp., 5 (10%) with acanthocephalan cystacanths, 2 (4%) with *Leptorhynchoides* sp., 1 (2%) with *Neoechinorhynchus* sp., and 1 (2%) with *Lernaea cyprinacea*."

Threat to Humans

From Froese and Pauly (2022):

"Harmless"

3 Impacts of Introductions

From Fuller (2019):

"The impacts of this species are currently unknown, as no studies have been done to determine how it has affected ecosystems in the invaded range. The absence of data does not equate a lack of effects. It does, however, mean that research is required to evaluate effects before conclusions can be made."

Fundulus chrysotus is listed as a conditionally approved animal in Hawaii (Hawaii Department of Agriculture 2019).

4 History of Invasiveness

The History of Invasiveness for *Fundulus chrysotus* is classified as Data Deficient. There are records of occurrences outside of the native range (i.e., Texas and Arkansas) but they may not represent established populations. It is uncertain if these occurrences represent natural expansion or anthropogenic introductions, and no information exists regarding the negative impacts *F. chrysotus* may or may not have to native species outside of its native range.

5 Global Distribution

Figure 1. Reported global distribution of *Fundulus chrysotus.* Map from GBIF Secretariat (2022). Observations are reported from the southeastern United States. The occurrence in Michigan was excluded from the climate matching analysis as it represents a single lot of eight specimens housed in the Harvard University Museum of Comparative Zoology that were collected in the mid-1800s. No evidence suggests that there is an established population of *F. chrysotus* in Michigan. The point in the Gulf of Mexico was also excluded due to coordinate error.

6 Distribution Within the United States

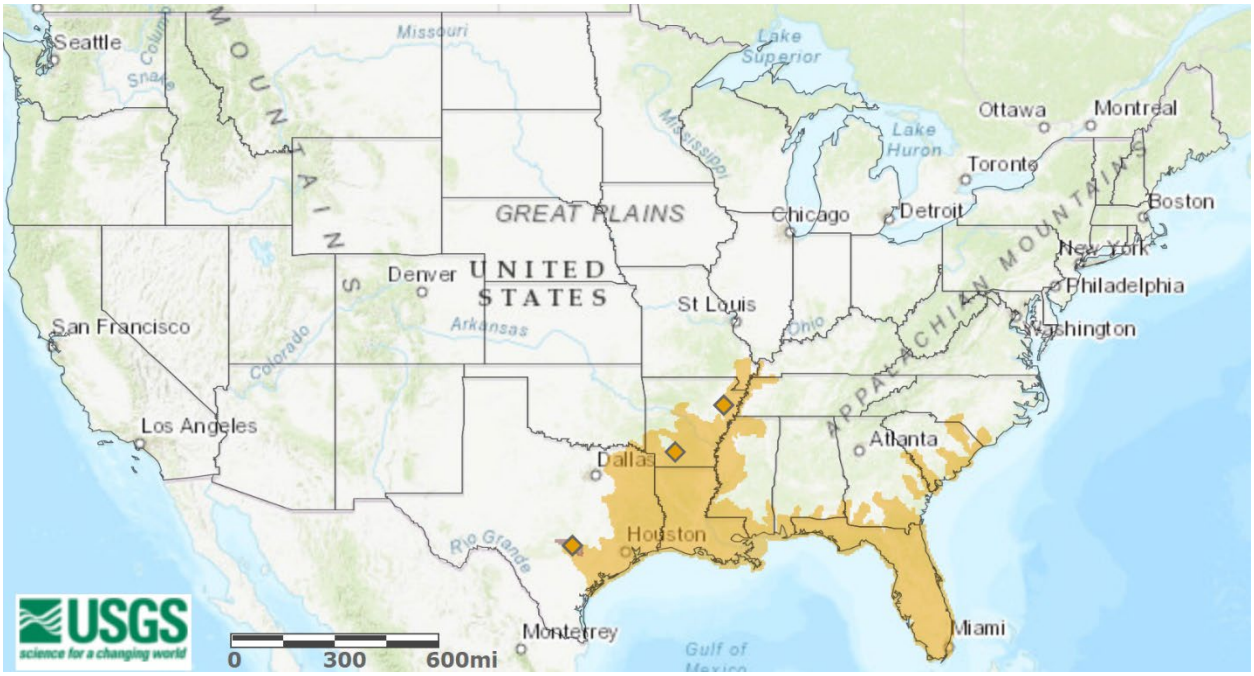


Figure 2. Reported distribution of *Fundulus chrysotus* in the United States. Map from Fuller (2019). Observations outside the native range are reported from Texas and Arkansas (orange diamonds); orange shading indicates the native range of this species.

7 Climate Matching

Summary of Climate Matching Analysis

The climate match for *Fundulus chrysotus* was variable for the contiguous United States with large areas of high match in the Southeast, areas of medium match in the Midwest and Northeast, and generally low matches in western and the northernmost States. The areas of highest match were found in coastal drainages from Texas to North Carolina and in the lower Mississippi River basin, where this species is native. The overall Climate 6 score (Sanders et al. 2023; 16 climate variables; Euclidean distance) for the contiguous United States was 0.463, indicating that there is establishment concern for this species outside its native range. The Climate 6 score is calculated as: (count of target points with scores ≥ 6)/(count of all target points). Establishment concern is warranted for Climate 6 scores greater than or equal to 0.002 based on an analysis of the establishment success of 356 nonnative aquatic species introduced to the United States (USFWS 2024).

Projected climate matches in the contiguous United States under future climate scenarios are available for *Fundulus chrysotus* (see appendix). These projected climate matches are provided as additional context for the reader; future climate scenarios are not factored into the Overall Risk Assessment Category.

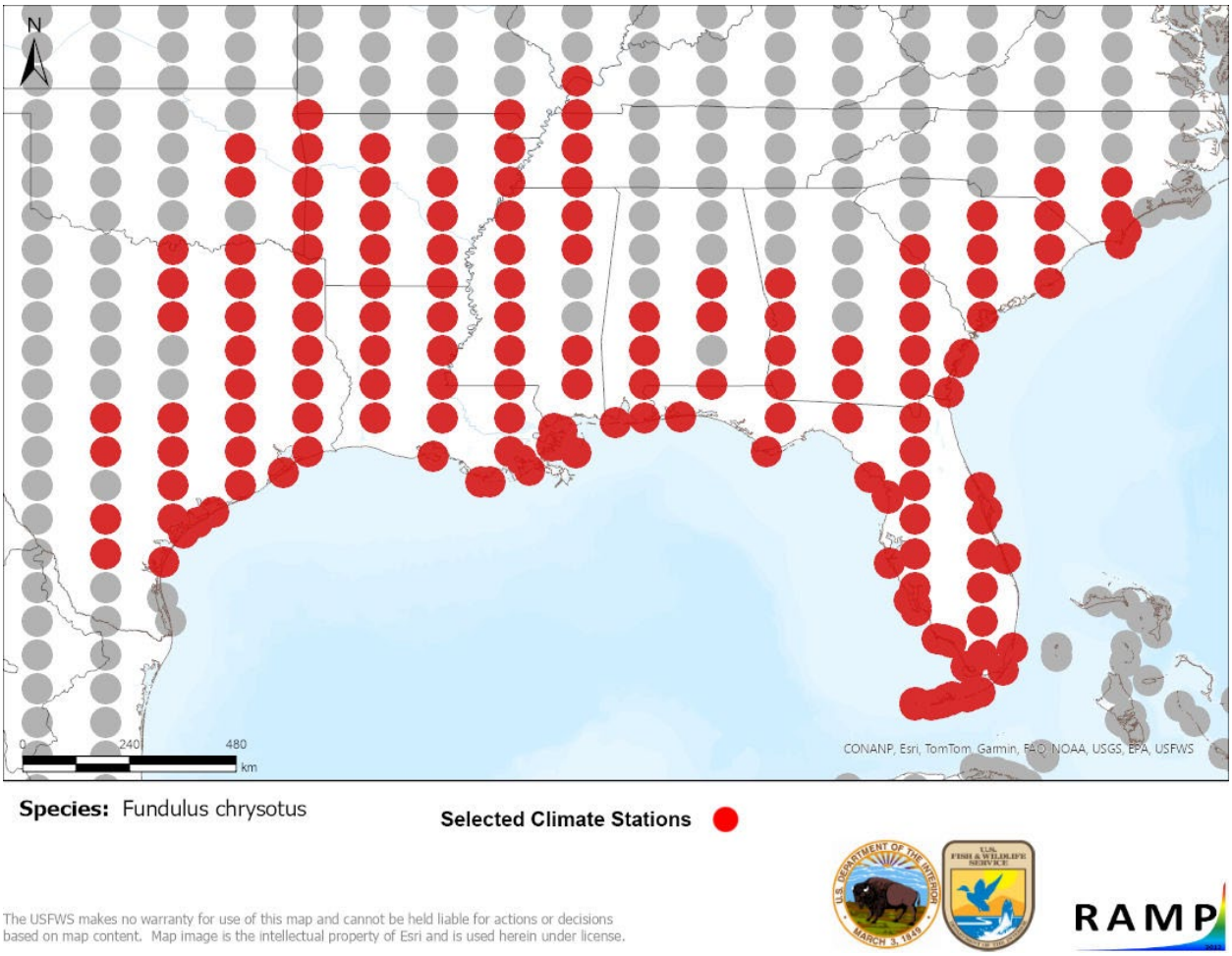


Figure 3. RAMP (Sanders et al. 2023) source map showing weather stations in the southeastern and central United States selected as source locations (red) and non-source locations (gray) for *Fundulus chrysotus* climate matching. Source locations from GBIF Secretariat (2022). Selected source locations are within 100 km of one or more species occurrences, and do not necessarily represent the locations of occurrences themselves.

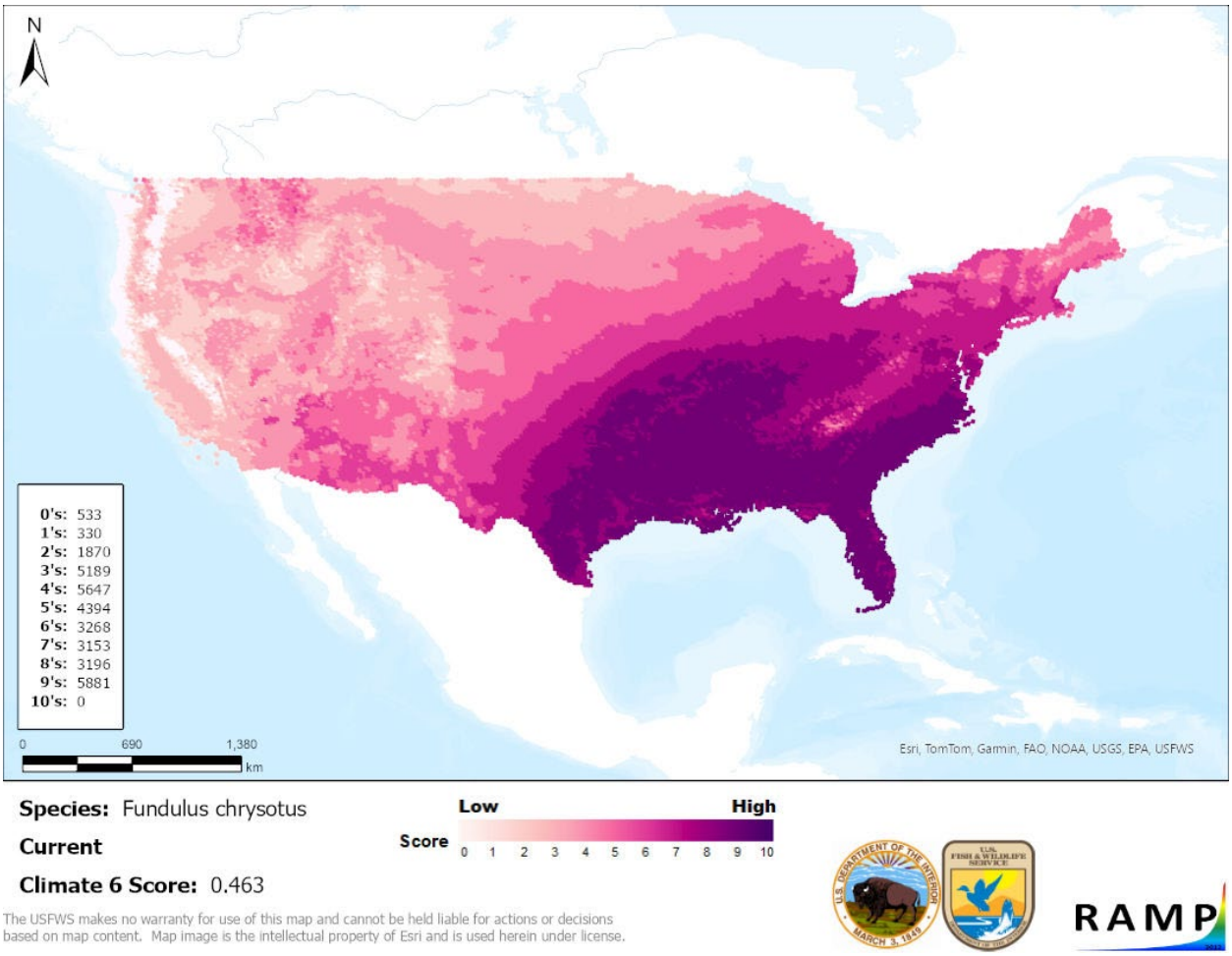


Figure 4. Map of RAMP (Sanders et al. 2023) climate matches for *Fundulus chrysotus* in the contiguous United States based on source locations reported by GBIF Secretariat (2022). Counts of climate match scores are tabulated on the left. 0/Pale Pink = Lowest match, 10/Dark Purple = Highest match.

8 Certainty of Assessment

The Certainty of Assessment for *Fundulus chrysotus* is classified as Low. There is reasonably complete information regarding the species distribution, however the History of Invasiveness of this species is Data Deficient due to a lack of information regarding impacts from introductions. Therefore, the overall certainty of this assessment is Low.

9 Risk Assessment

Summary of Risk to the Contiguous United States

Fundulus chrysotus, the Golden Topminnow, is a freshwater fish that is native to the Atlantic and Gulf Coastal Plains in the southeastern United States; it is mostly restricted to the lower Coastal Plain. There have been limited introductions in Arkansas and Texas, but no information is available regarding abundance or establishment, and no impacts of introductions have been documented. *F. chrysotus* is available via the pet trade but no estimates exist regarding quantity

or duration of trade. Hawaii lists *F. chrysotus* as conditionally approved for import; no other State regulations were found during this assessment. The History of Invasiveness for *F. chrysotus* is classified as Data Deficient due to the lack of information demonstrating negative impacts of nonnative populations. The climate matching analysis for the contiguous United States indicates establishment concern for this species outside its native range. The highest climate matches were found in the Southeast bordering the native range of *F. chrysotus*. The Certainty of Assessment for this ERSS is classified as Low since the History of Invasiveness of this species is Data Deficient. The Overall Risk Assessment Category for *F. chrysotus* in the contiguous United States is Uncertain.

Assessment Elements

- **History of Invasiveness (see Section 4): Data Deficient**
- **Establishment Concern (see Section 7): Yes**
- **Certainty of Assessment (see Section 8): Low**
- **Remarks, Important additional information: None**
- **Overall Risk Assessment Category: Uncertain**

10 Literature Cited

Note: The following references were accessed for this ERSS. References cited within quoted text but not accessed are included below in section 11.

Edwards CR, Thiels SE, Sullivan KT, Guajardo J, Littrell BM, Bonner TH. 2021. Occurrence of golden topminnow, *Fundulus chrysotus*, in the San Marcos River, Texas. Southeastern Naturalist Notes 20(3):N83–N87.

Fricke R, Eschmeyer WN, van der Laan R, editors. 2022. Eschmeyer's catalog of fishes: genera, species, references. California Academy of Science. Available: https://researcharchive.calacademy.org/research/ichthyology/catalog/fishcatmain.asp (December 2022).

…

[References abbreviated for this document.]

11 Literature Cited in Quoted Material

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.

Anonymous. 1997. Rare and endangered species checklist of Missouri. Jefferson City: Missouri Department of Conservation.

Buchanan TM. 2005. Small fish species of Arkansas reservoirs. Journal of the Arkansas Academy of Science 59:26–42.

Buchanan TM, Wilson D, Claybrook LG, Layher WG. 2003. Fishes of the Red River in Arkansas. Journal of the Arkansas Academy of Science 57:18–26.

…

[References abbreviated for this document.]

Appendix

Summary of Future Climate Matching Analysis

Future climate projections represent two Shared Socioeconomic Pathways (SSP) developed by the Intergovernmental Panel on Climate Change (IPCC 2021): SSP5, in which emissions triple by the end of the century; and SSP3, in which emissions double by the end of the century. Future climate matches were based on source locations reported by GBIF Secretariat (2022).

Under the future climate scenarios (figure A1), the highest climate match for *Fundulus chrysotus* is projected to occur in the Southeast (where this species is native; 2055 time step) into the southern Midwest (2085 time step). There was also a somewhat isolated area of high match remaining in western Texas at the 2085 time step. Under all scenarios, the climate match was projected to remain low along the Pacific coast, in the Great Basin, and in the North Central region of the United States, with a mix of climate matches in the Rocky Mountain region. The Climate 6 scores for the individual future scenario models (figure A2) ranged from a low of 0.521 (model: MPI-ESM1-2-HR, SSP5, 2085) to a high of 0.685 (model: UKESM1-0-LL, SSP5, 2085). Future scenario Climate 6 scores were above the Establishment Concern threshold, indicating that Yes, there is establishment concern for this species under future climate scenarios. The Climate 6 score for the current climate match (0.463, figure 4) falls below the range of scores for future projections. Compared to the current climate match, future scenarios suggest the greatest increases in climate match will occur in the Northeast, Upper Midwest, and the Rocky Mountains (figure A3). Climate match is projected to decrease the most in the Southeast (including the species native range), especially by the end of the 21st century.

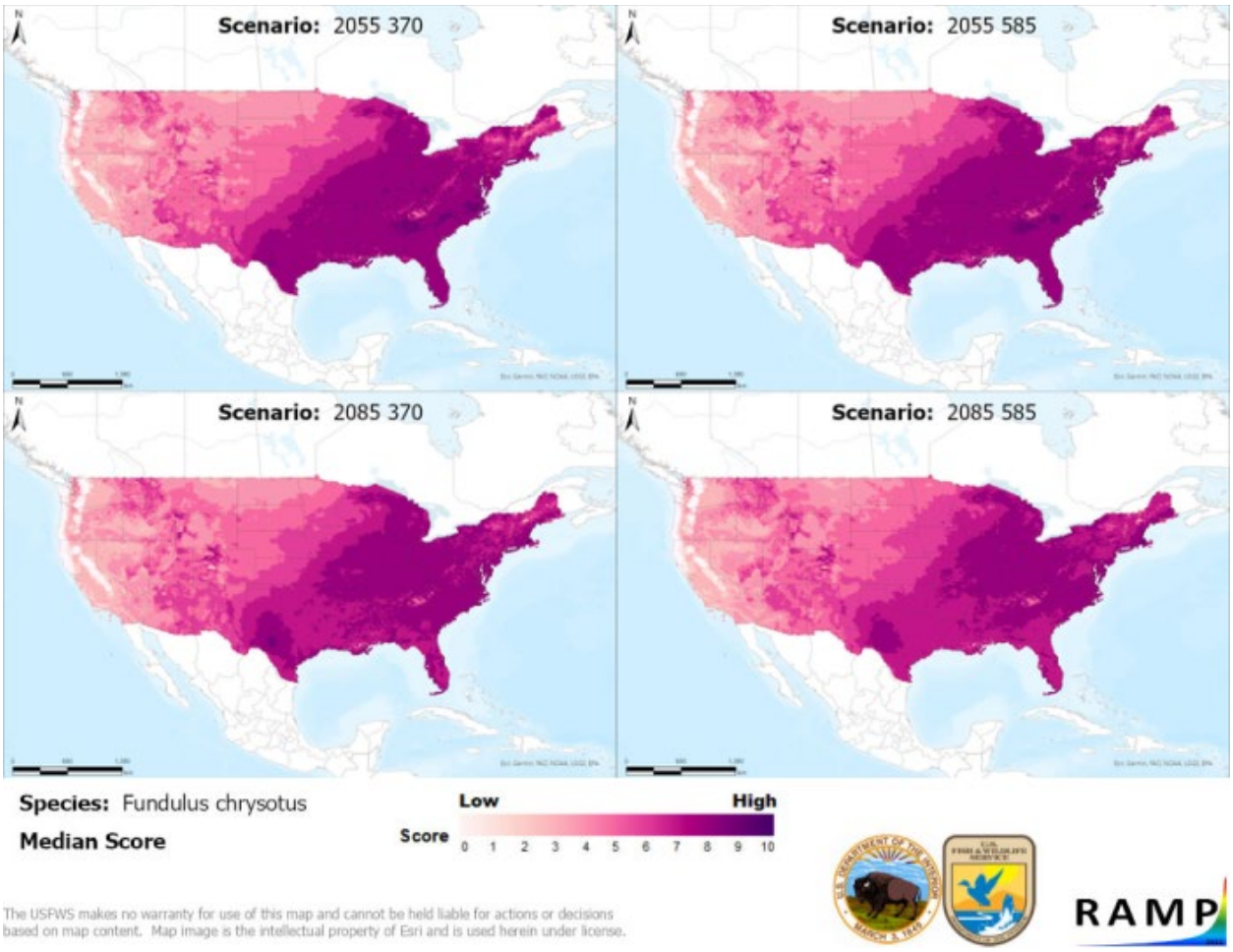


Figure A1. Maps of median RAMP (Sanders et al. 2023) climate matches projected under potential future climate conditions using five global climate models for *Fundulus chrysotus* in the contiguous United States. Climate matching is based on source locations reported by GBIF Secretariat (2022). Shared Socioeconomic Pathways (SSPs) used (from left to right): SSP3, SSP5 (IPCC 2021). Time steps: 2055 (top row) and 2085 (bottom row). Climate source data from CHELSA (Karger et al. 2017, 2018); global climate models used: GFDL-ESM4, UKESM1-0-LL, MPI-ESM1-2-HR, IPSL-CM6A-LR, and MRI-ESM2-0. 0/Pale Pink = Lowest match, 10/Dark Purple = Highest match.

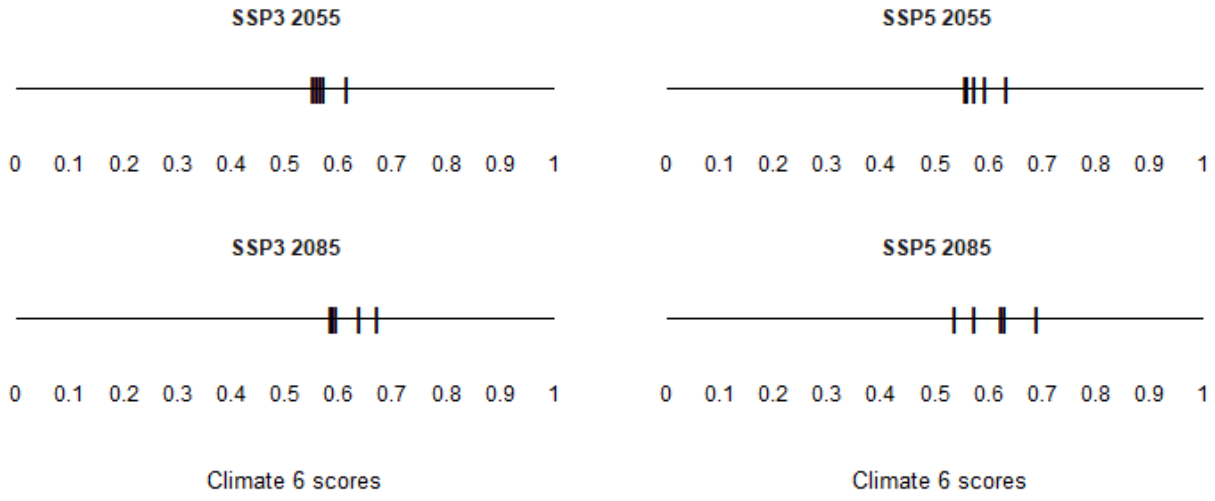


Figure A2. Comparison of projected future Climate 6 scores for *Fundulus chrysotus* in the contiguous United States for each of five global models under four combinations of Shared Socioeconomic Pathway (SSP) and time step. SSPs used (from left to right): SSP3, SSP5 (Karger et al. 2017, 2018; IPCC 2021). Time steps: 2055 (top row) and 2085 (bottom row). Climate source data from CHELSA (Karger et al. 2017, 2018); global climate models used: GFDL-ESM4, UKESM1-0-LL, MPI-ESM1-2-HR, IPSL-CM6A-LR, and MRI-ESM2-0.

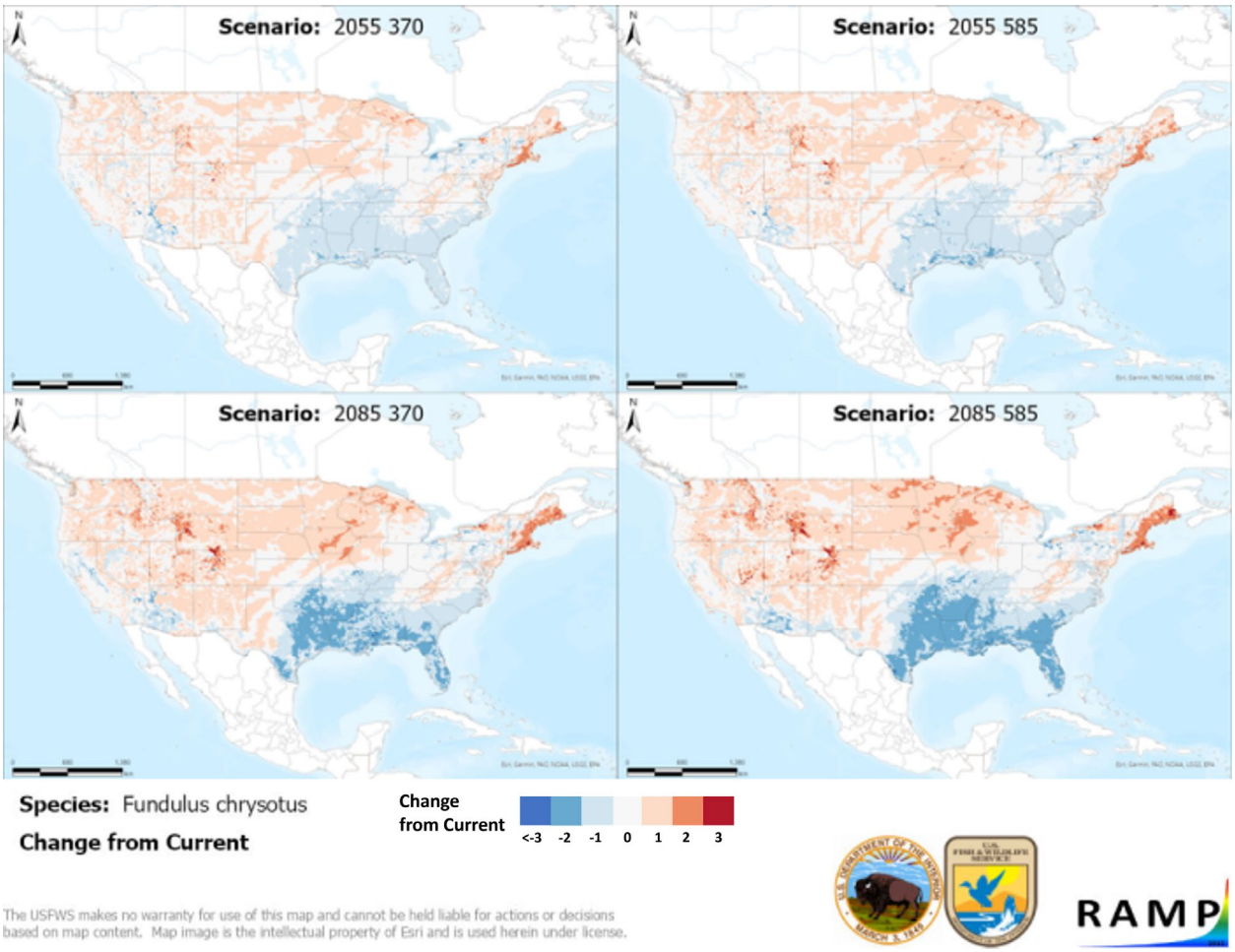


Figure A3. RAMP (Sanders et al. 2023) maps of the contiguous United States showing the difference between the current climate match target point score (figure 4) and the median target point score for future climate scenarios (figure A1) for *Fundulus chrysotus* based on source locations reported by GBIF Secretariat (2022). Shared Socioeconomic Pathways (SSPs) used (from left to right): SSP3, SSP5 (IPCC 2021). Time steps: 2055 (top row) and 2085 (bottom row). Climate source data from CHELSA (Karger et al. 2017, 2018); global models used: GFDL-ESM4, UKESM1-0-LL, MPI-ESM1-2-HR, IPSL-CM6A-LR, and MRI-ESM2-0. Shades of blue indicate a lower target point score under future scenarios than under current conditions. Shades of red indicate a higher target point score under future scenarios than under current conditions. Darker shades indicate greater change.

Literature Cited

GBIF Secretariat. 2022. GBIF backbone taxonomy: *Fundulus chrysotus* (Günther, 1866). Copenhagen: Global Biodiversity Information Facility. Available: https://www.gbif.org/species/5203617 (December 2022).

…

[References abbreviated for this document.]

Appendix E. ERSS Supplements for the Noncontiguous United States

Using the Risk Assessment Mapping Program (RAMP), Ecological Risk Screening Summary (ERSS) supplements can be prepared for any of the following noncontiguous U.S. States, Commonwealths, and territories: Alaska, American Samoa, Guam, Hawaii, Northern Mariana Islands, Puerto Rico, and U.S. Virgin Islands. Each supplement includes a climate matching analysis, certainty of assessment, and overall risk assessment category specific to one noncontiguous region. **An ERSS must be completed before a supplement can be written.** Below are directions and a template for writing an ERSS supplement.

A. Specific Instructions

1) Run the current and future climate matches for the target noncontiguous region (part 3K of the RAMP SOP, linked in appendix G).

    - Make sure that, wherever the RAMP files are stored on your computer, the Species folder contains the climate matching folder for the species of interest (named following the format "Genus_species"). This folder was created as part of RAMP Step 1 for the ERSS. **Do not repeat RAMP Step 1.**

    - For Step 2, select the option to "Use Previous Selection". This option selects the same climate stations as those used in the ERSS to conduct climate matching with the contiguous United States.

    - In Step 3, select "Individual State" as the "Region" and then select the postal code abbreviation of the target noncontiguous region under "State."

    - In Step 4, make sure to select a CSV file with the appropriate postal code abbreviation in the file name (in addition to the correct date and run number, if the match was run multiple times).

2) Insert the source map and current climate results map into the climate supplement template.

    - The source map and results map can be imported into Microsoft Word from the RAMP species folder. For the results map, look in the species folder and "Current" subfolder for the postal code abbreviation of the noncontiguous region and the correct date. For example, the results map for *Faxonella clypeata* in Alaska would have a title similar to this (possibly also with a date in the file name): "Faxonella_clypeata_**AK**_Current_results.jpg".

    - Write a **caption** and **alt text** for each map.

        - Copy the caption for the source map from the ERSS (section 7) then **add information to the source map caption on outlier locations used or not used** (from ERSS sections 5 and 6).

- Copy the alt text for the source map from the ERSS (section 7).

- Recommended format for the results map caption: "Map of RAMP (Sanders et al. 2023) climate matches for *scientific name* in *noncontiguous region* based on source locations reported by *citation*. Counts of climate match scores are tabulated on the left. 0/Pale Pink = Lowest match, 10/Dark Purple = Highest match."

- Recommended format for the results map alt text: "Map of *noncontiguous region* showing results of climate matching for *scientific name*. A text description of the results was provided at the beginning of this section."

3) Write a Summary of Climate Matching Analysis for the target noncontiguous region. See part 3I ("ERSS Section 7 — Climate Matching") of this SOP for details on how to write the summary.

4) Copy the Certainty of Assessment summary paragraph from the ERSS (section 8) into the Certainty of Assessment section of the supplement. **Revise the text as needed** to be applicable to the noncontiguous region.

   - Refer to part 3J of this SOP for definitions of the Certainty of Assessment categories.

   - With the exception of Puerto Rico, **downgrade the certainty relative to the ERSS** for Commonwealths and territories due to the small number of target points (and therefore the small sample size for the Climate 6 score calculation).

5) Copy the Summary of Risk paragraph from the ERSS (section 9) into the Risk Assessment section of the supplement**, then revise the text as needed** to be applicable to the target noncontiguous region.

   - Replace the information on climate match for the contiguous United States with information on climate match for the target noncontiguous region.

   - If you downgraded the Certainty of Assessment for the target Commonwealth or territory, give "uncertainty in the interpretation of the Climate 6 score" as a reason for the chosen level of certainty.

   - Determine the ORAC for the target noncontiguous region based on the HOI category (table E-1; same as the ERSS) and the Establishment Concern category (unique to the noncontiguous region).

Table E-1. Overall Risk Assessment Categories determined by combining the Establishment Concern category (Yes or Doubtful) with the History of Invasiveness category (High, Low, Data Deficient, or No Known Nonnative Population).

History of Invasiveness	Establishment Concern: Yes	Establishment Concern: Doubtful
High	**High**	*Uncertain*
Low	*Uncertain*	**Low**
Data Deficient	*Uncertain*	*Uncertain*
No Known Nonnative Population	*Uncertain*	*Uncertain*

6) Fill in the Assessment Elements list for the target noncontiguous region.

7) In the Literature Cited section of the supplement, provide full citations for the data sources used to select source points. Copy these citations from the ERSS.

8) Complete the future climate matching appendix following the instructions for the ERSS (part 3M), substituting the target noncontiguous region for the contiguous United States.

B. Template for ERSS Supplements

On the next page, there is a template that should be used in conjunction with the ERSS SOP and this appendix to complete an ERSS supplement for a noncontiguous region of the United States.

Please note that for the purposes of navigation within this document, heading text is not tagged as it should be for a published ERSS supplement. See part 3A of the ERSS SOP for instructions on setting text styles for document accessibility.

U.S. Fish & Wildlife Service

Common Name (*Scientific Name*)

ERSS Supplement for *Noncontiguous U.S. Region*

Author Name, affiliation only if not USFWS, Month Year

Climate Matching

Summary of Climate Matching Analysis

Describe areas of the map that have high, medium, and low matches. The overall Climate 6 score (Sanders et al. 2023; 16 climate variables; Euclidean distance) for *noncontiguous region* was *Climate 6 score*, indicating that *Yes, there is establishment concern/establishment is Doubtful* for this species [*if the species is native to part of the noncontiguous region, add:* outside its native range]. The Climate 6 score is calculated as: (count of target points with scores ≥ 6)/(count of all target points). Establishment concern is warranted for Climate 6 scores greater than or equal to 0.002 based on an analysis of the establishment success of 356 nonnative aquatic species introduced to the United States (USFWS 2024).

Projected climate matches in *noncontiguous region* under future climate scenarios are available for *scientific name* (see Appendix). These projected climate matches are provided as additional context for the reader; future climate scenarios are not factored into the Overall Risk Assessment Category for *noncontiguous region*.

Insert RAMP source map here. Alt text: Source map of *region* showing selected source locations for *scientific name* climate match to *noncontiguous region*. *Describe locations of source points.*
Figure 1. RAMP (Sanders et al. 2023) source map showing weather stations in *general geographic area* selected as source locations (red; *list countries containing selected source points*) and non-source locations (gray) for *scientific name* climate matching. Source locations from *citation*. Selected source locations are within 100 km of one or more species occurrences, and do not necessarily represent the locations of occurrences themselves. *Add text explaining any added or deleted source points, copying from sections 5 and 6 of the ERSS.*

Insert RAMP climate match results map here. Alt text: Map of *noncontiguous region* showing results of climate matching for *scientific name*. A text description of the results was provided at the beginning of this section.
Figure 2. Map of RAMP (Sanders et al. 2023) climate matches for *scientific name* in *noncontiguous region* based on source locations reported by *citation*. Counts of climate match scores are tabulated on the left. 0/Pale Pink = Lowest match, 10/Dark Purple = Highest match.

Certainty of Assessment

Copy from ERSS except where information is not applicable to the noncontiguous region: The Certainty of Assessment for *scientific name* is classified as *High/Medium/Low* for *noncontiguous region*. *Provide justification*.

Risk Assessment

Summary of Risk to *Noncontiguous Region*

Copy beginning of ERSS Summary of Risk including species name, distribution, biology, ecology, uses, regulations, introductions, impacts, threats, and HOI. The climate matching analysis for *noncontiguous region* indicates *establishment concern/doubtful establishment* for this species [*if the species is native to part of the noncontiguous region, add:* outside its native range]. *Summarize notable features of the climate match e.g., location with highest match (aside from native range, if applicable)*. The Certainty of Assessment for *noncontiguous region* is classified as *High/Medium/Low* due to *justification*. The Overall Risk Assessment Category for *scientific name* in *noncontiguous region* is *High/Low/Uncertain*.

Assessment Elements

- **History of Invasiveness: *High/Low/Data Deficient/No Known Nonnative Population***
- **Establishment Concern: *Yes/Doubtful***
- **Certainty of Assessment: *High/Medium/Low***
- **Overall Risk Assessment Category: *High/Low/Uncertain***

Literature Cited

Add references used as source points or to evaluate the source points used in the climate match; can be copied from the ERSS.

Sanders S, Castiglione C, Hoff M. 2023. Risk Assessment Mapping Program: RAMP. Version 5.0. U.S. Fish and Wildlife Service.

U.S. Fish and Wildlife Service. 2024. Standard operating procedure: how to prepare an "Ecological Risk Screening Summary." Version 3.

Appendix

Summary of Future Climate Matching Analysis

Future climate projections represent two Shared Socioeconomic Pathways (SSP) developed by the Intergovernmental Panel on Climate Change (IPCC 2021): SSP5, in which emissions triple by the end of the century; and SSP3, in which emissions double by the end of the century. Future climate matches were based on source locations reported by *citation(s) for sources used for climate match in section 7 of the ERSS.*

Under the future climate scenarios (figure A1), the highest climate match for *scientific name* was projected to occur in *location(s)*. *Describe other notable similarities and differences between the four future scenarios.* The Climate 6 scores for the individual future scenario models (figure A2) ranged from a low of *value* (model: *model, SSP, and time step that yielded the lowest Climate 6 score*) to a high of *value* (model: *model, SSP, and time step that yielded the highest Climate 6 score*). All future scenario Climate 6 scores were *above/below* the Establishment Concern threshold, indicating that *Yes, there is establishment concern/establishment is Doubtful* for this species under future scenarios. The Climate 6 score for the current climate match (*value*, figure 4) falls *within/above/below* the range of scores for future scenarios. *Describe areas with large increases or decreases in climate match in comparison to the current match, referencing figure A3.*

Insert four-image panel of RAMP future climate match results maps, two across and two down. Top row is time step 2055, SSP3 on the left, SSP5 on the right. Bottom row is time step 2085 with SSPs in same order. Alt text: Maps of *noncontiguous region* showing median climate matches for *scientific name* under future scenarios SSP3 and SSP5 in 2055 and 2085 from five global climate models. Description of results can be found at the beginning of this appendix.
Figure A1. Maps of median RAMP (Sanders et al. 2023) climate matches projected under potential future climate conditions using five global climate models for *scientific name* in *noncontiguous region*. Climate matching is based on source locations reported by *citation(s)*. Shared Socioeconomic Pathways (SSPs) used (from left to right): SSP3, SSP5 (IPCC 2021). Time steps: 2055 (top row) and 2085 (bottom row). Climate source data from CHELSA (Karger et al. 2017, 2018); global climate models used: GFDL-ESM4, UKESM1-0-LL, MPI-ESM1-2-HR, IPSL-CM6A-LR, and MRI-ESM2-0. 0/Pale Pink = Lowest match, 10/Dark Purple = Highest match.

Insert four-panel image of Climate 6 scores displayed on number lines. Alt text: Four-panel image of number lines representing the range of possible Climate 6 scores (0-1). In each panel, hatch marks represent the Climate 6 score calculated for *scientific name* from each of five global climate models for one of four SSP-time step combinations. Details on the range of Climate 6 scores can be found at the beginning of the appendix.
Figure A2. Comparison of projected future Climate 6 scores for *scientific name* in *noncontiguous region* for each of five global models under four combinations of Shared Socioeconomic Pathway (SSP) and time step. SSPs used (from left to right): SSP3, SSP5 (Karger et al. 2017, 2018; IPCC 2021). Time steps: 2055 (top row) and 2085 (bottom row). Climate source data from CHELSA (Karger et al. 2017, 2018); global climate models used: GFDL-ESM4, UKESM1-0-LL, MPI-ESM1-2-HR, IPSL-CM6A-LR, and MRI-ESM2-0.

Insert four-image panel of RAMP climate match difference maps, two across and two down. Top row is time step 2055, SSP3 on the left, SSP5 on the right. Bottom row is time step 2085 with SSPs in same order. Alt text: Maps of *noncontiguous region* showing the difference in climate matching results between current climate and medians of future scenarios for *scientific name*. Future scenarios are SSP3 and SSP5 in 2055 and 2085. Description of results can be found at the beginning of this appendix.
Figure A3. RAMP (Sanders et al. 2023) maps of *noncontiguous region* showing the difference between the current climate match target point score (figure 4) and the median target point score

for future climate scenarios (figure A1) for *scientific name* based on source locations reported by *citation(s)*. Shared Socioeconomic Pathways (SSPs) used (from left to right): SSP3, SSP5 (IPCC 2021). Time steps: 2055 (top row) and 2085 (bottom row). Climate source data from CHELSA (Karger et al. 2017, 2018); global models used: GFDL-ESM4, UKESM1-0-LL, MPI-ESM1-2-HR, IPSL-CM6A-LR, and MRI-ESM2-0. Shades of blue indicate a lower target point score under future scenarios than under current conditions. Shades of red indicate a higher target point score under future scenarios than under current conditions. Darker shades indicate greater change.

Literature Cited

Copy references used for climate match source points or to evaluate the source points from the ERSS.

[IPCC] Intergovernmental Panel on Climate Change. 2021. Climate change 2021: the physical science basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press.

Karger DN, Conrad O, Böhner J, Kawohl T, Kreft H, Soria-Auza RW, Zimmermann NE, Linder P, Kessler M. 2017. Climatologies at high resolution for the Earth land surface areas. Scientific Data 4:170122.

Karger DN, Conrad O, Böhner J, Kawohl T, Kreft H, Soria-Auza RW, Zimmermann NE, Linder HP, Kessler M. 2018. Data from: Climatologies at high resolution for the earth's land surface areas. EnviDat. Available: https://doi.org/10.16904/envidat.228.v2.1.

Sanders S, Castiglione C, Hoff M. 2023. Risk Assessment Mapping Program: RAMP. Version 5.0. U.S. Fish and Wildlife Service.

C. Example ERSS Supplement

The following pages provide an example of a completed ERSS supplement.

Please note that for the purposes of navigation within this SOP, heading text is not tagged as it should be for a published ERSS supplement. See part 3A of this SOP for instructions on setting text styles for document accessibility.

U.S. Fish & Wildlife Service

Climbing Seedbox (*Ludwigia prostrata*)

ERSS Supplement for Alaska

U.S. Fish and Wildlife Service, February 2024

Climate Matching

Summary of Climate Matching Analysis

The climate match to Alaska for *Ludwigia prostrata* was high along the northeastern shore of Cook Inlet, in the Interior along the northern edge of the Alaska Range, and in a small area at the northern end of the Alaska Peninsula. Most of the State showed a medium climate match, while low climate matches were found in southeastern Alaska, on Kodiak Island, the western shore of Cook Inlet, much of the Alaska Peninsula and Aleutian Islands, and along the Arctic Ocean coastline. The overall Climate 6 score (Sanders et al. 2023; 16 climate variables; Euclidean distance) for Alaska was 0.322, indicating that Yes, there is establishment concern for this species. The Climate 6 score is calculated as: (count of target points with scores ≥ 6)/(count of all target points). Establishment concern is warranted for Climate 6 scores greater than or equal to 0.002 based on an analysis of the establishment success of 356 nonnative aquatic species introduced to the United States (USFWS 2024).

Projected climate matches in Alaska under future climate scenarios are available for *Ludwigia prostrata* (see Appendix). These projected climate matches are provided as additional context for the reader; future climate scenarios are not factored into the Overall Risk Assessment Category for Alaska.

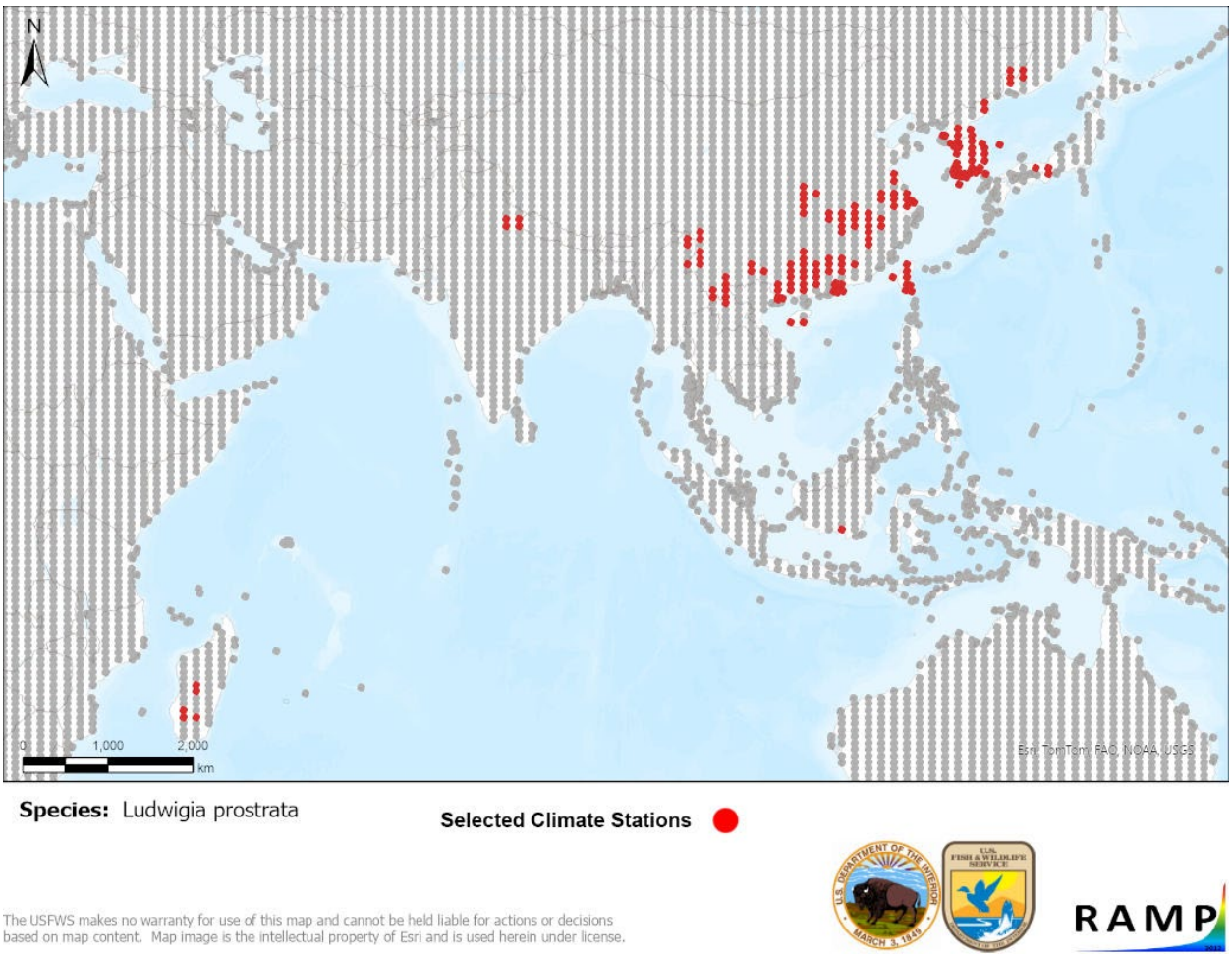


Figure 1. RAMP (Sanders et al. 2023) source map showing weather stations in Asia and Africa selected as source locations (red; China, India, Indonesia, Japan, Laos, Madagascar, Myanmar, North Korea, Russia, South Korea, Taiwan, Vietnam) and non-source locations (gray) for *Ludwigia prostrata* climate matching. Source locations from GBIF Secretariat (2021). Selected source locations are within 100 km of one or more species occurrences, and do not necessarily represent the locations of occurrences themselves.

There were no georeferenced occurrences available for parts of the native range in Bangladesh, Bhutan, Cambodia, Malaysia, Nepal, Philippines, Sri Lanka, Thailand, or Vietnam.

A reported occurrence in Mexico was excluded from the above map and from the climate matching analysis because of issues with the record. A reported occurrence in the Netherlands was excluded from the above map and from the climate matching analysis because it represented a preserved specimen in a bonsai center. Reported occurrences in several provinces of China outside the native range (Fujian, Hunan, Sichuan, Shaanxi, Anhui, Liaoning, and Jilin Provinces) were excluded from the climate matching analysis because no information was available to confirm establishment of the species (GBIF Secretariat 2021).

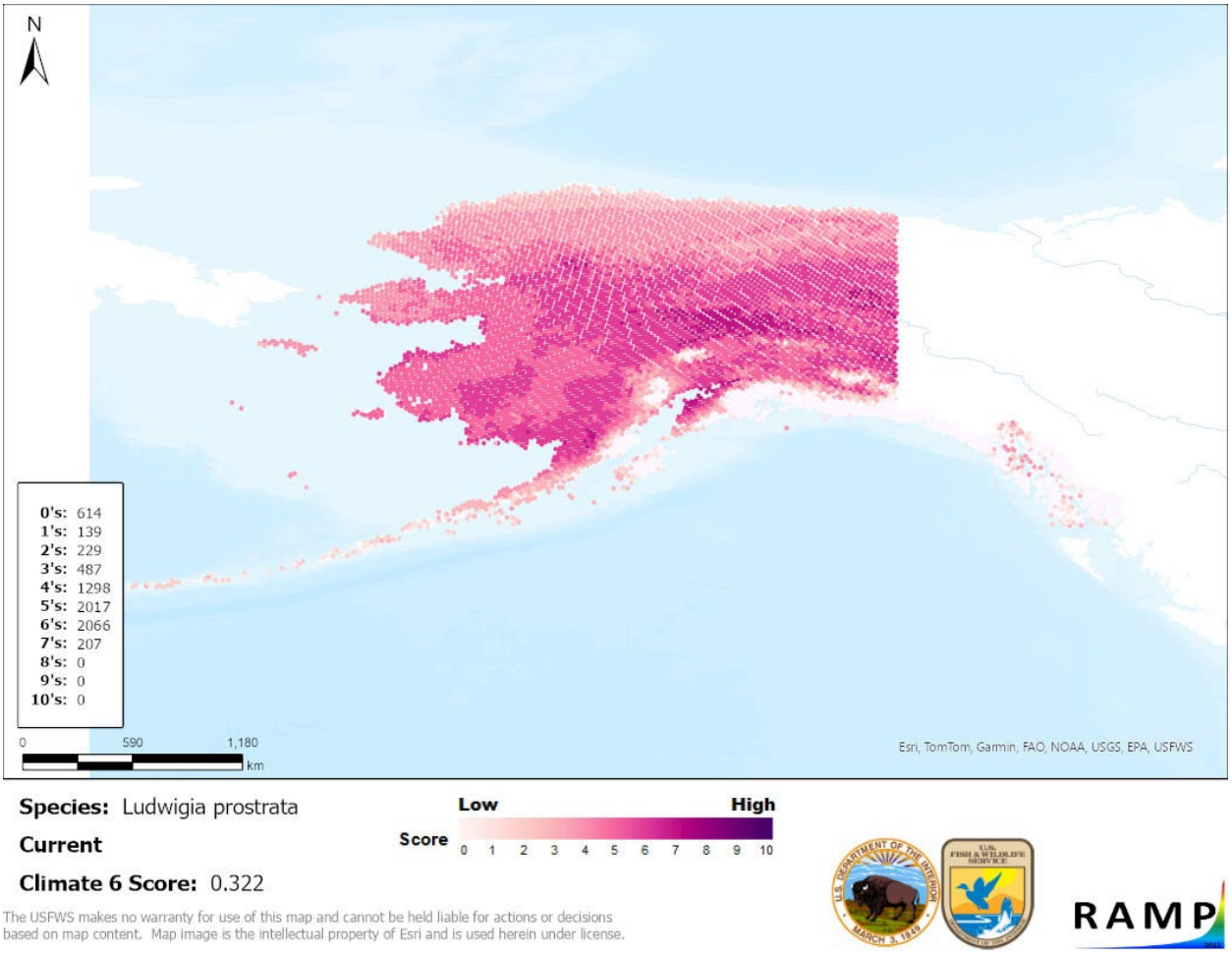


Figure 2. Map of RAMP (Sanders et al. 2023) climate matches for *Ludwigia prostrata* in Alaska based on source locations reported by GBIF Secretariat (2021). Counts of climate match scores are tabulated on the left. 0/Pale Pink = Lowest match, 10/Dark Purple = Highest match.

Certainty of Assessment

Information is available on the biology, ecology, and distribution of *Ludwigia prostrata*, and introductions and harm to agriculture outside its native range have been documented. However, limited information about the harm caused by *L. prostrata* is available in the English-language scientific literature; much of the literature on the numerous introduced *L. prostrata* populations in China is available only in Chinese. Furthermore, georeferenced occurrence data were not available for substantial portions of the species native range in South Asia and Southeast Asia, so these portions of the range could not be represented among the source locations used in climate matching. The Certainty of Assessment for *Ludwigia prostrata* is classified as Low for Alaska.

Risk Assessment

Summary of Risk to *Noncontiguous Region*

Ludwigia prostrata is a semi-aquatic annual plant native to southern and eastern Asia. It is not present in trade in the United States, but it is used in China as medicine, fodder for animals, and is a candidate for bioremediation uses. This species has been introduced outside its native range in China and Madagascar, and its native status in Singapore is uncertain. Established nonnative populations in China are reported to seriously diminish rice production, so the history of invasiveness is classified as High. The climate matching analysis for Alaska indicates establishment concern for this species. The highest climate matches occurred along the northeastern shore of Cook Inlet, in the Interior along the northern edge of the Alaska Range, and in a small area at the northern end of the Alaska Peninsula. The Certainty of Assessment for Alaska is classified as Low due to limited information on impacts of introduction in the English-language literature and a lack of georeferenced occurrence data for portions of the species range. The Overall Risk Assessment Category for *Ludwigia prostrata* in Alaska is High.

Assessment Elements

- **History of Invasiveness: High**
- **Establishment Concern: Yes**
- **Certainty of Assessment: Low**
- **Overall Risk Assessment Category: High**

Literature Cited

GBIF Secretariat. 2021. GBIF backbone taxonomy: *Ludwigia prostrata* Roxb. Copenhagen: Global Biodiversity Information System. Available: https://www.gbif.org/species/5545149 (July 2022).

Sanders S, Castiglione C, Hoff M. 2023. Risk Assessment Mapping Program: RAMP. Version 5.0. U.S. Fish and Wildlife Service.

U.S. Fish and Wildlife Service. 2024. Standard operating procedure: how to prepare an "Ecological Risk Screening Summary." Version 3.

Appendix

Summary of Future Climate Matching Analysis

Future climate projections represent two Shared Socioeconomic Pathways (SSP) developed by the Intergovernmental Panel on Climate Change (IPCC 2021): SSP5, in which emissions triple by the end of the century; and SSP3, in which emissions double by the end of the century. Future climate matches were based on source locations reported by GBIF Secretariat (2021).

Under the future climate scenarios (figure A1), high climate match for *Ludwigia prostrata* was projected to occur in the Interior as well as along the Kuskokwim River, Norton Sound, and onto the Seward Peninsula under most scenarios. The climate match was projected to be low along the

southern shoreline of the State from Ketchikan to the Aleutian Islands, except for the northwestern Kenai Peninsula. The Climate 6 scores for the individual future scenario models (figure A2) ranged from a low of 0.467 (model: MRI-ESM2-0, SSP3, 2055) to a high of 0.811 (model: UKESM1-0-LL, SSP3, 2085). All future scenario Climate 6 scores were above the Establishment Concern threshold, indicating that Yes, there is establishment concern for this species under future scenarios. The Climate 6 score for the current climate match (0.322, figure 4) fell below the range of scores for future scenarios. As compared to the current climate match, future climate matches were projected to increase the most in northwest Alaska and along the northern coast (figure A3). There were no areas projected to have substantial declines in climate match under the future scenarios as compared to the current climate match.

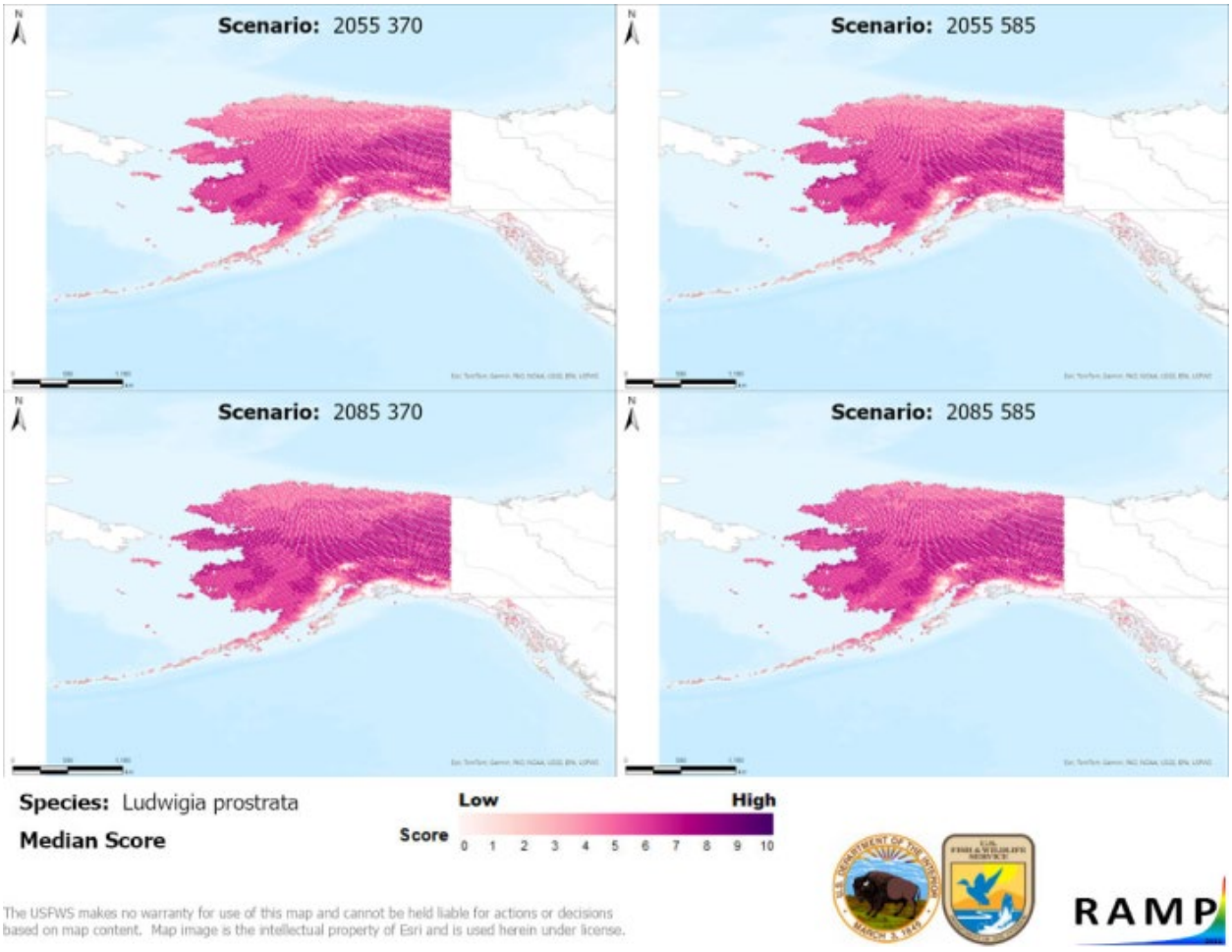


Figure A1. Maps of median RAMP (Sanders et al. 2023) climate matches projected under potential future climate conditions using five global climate models for *Ludwigia prostrata* in Alaska. Climate matching is based on source locations reported by GBIF Secretariat (2021). Shared Socioeconomic Pathways (SSPs) used (from left to right): SSP3, SSP5 (IPCC 2021). Time steps: 2055 (top row) and 2085 (bottom row). Climate source data from CHELSA (Karger et al. 2017, 2018); global climate models used: GFDL-ESM4, UKESM1-0-LL, MPI-ESM1-2-HR, IPSL-CM6A-LR, and MRI-ESM2-0. 0/Pale Pink = Lowest match, 10/Dark Purple = Highest match.

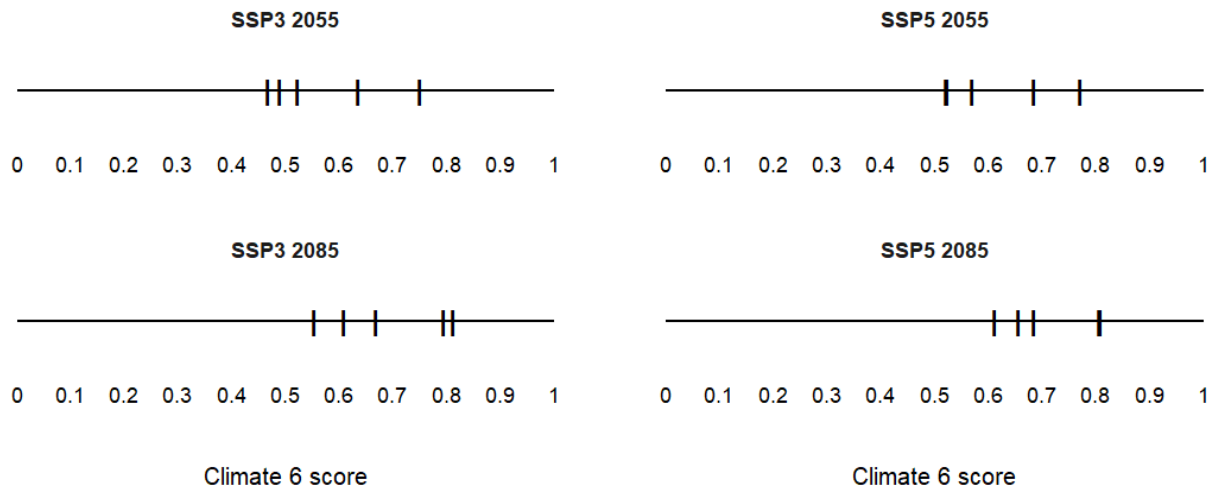


Figure A2. Comparison of projected future Climate 6 scores for *Ludwigia prostrata* in Alaska for each of five global models under four combinations of Shared Socioeconomic Pathway (SSP) and time step. SSPs used (from left to right): SSP3, SSP5 (Karger et al. 2017, 2018; IPCC 2021). Time steps: 2055 (top row) and 2085 (bottom row). Climate source data from CHELSA (Karger et al. 2017, 2018); global climate models used: GFDL-ESM4, UKESM1-0-LL, MPI-ESM1-2-HR, IPSL-CM6A-LR, and MRI-ESM2-0.

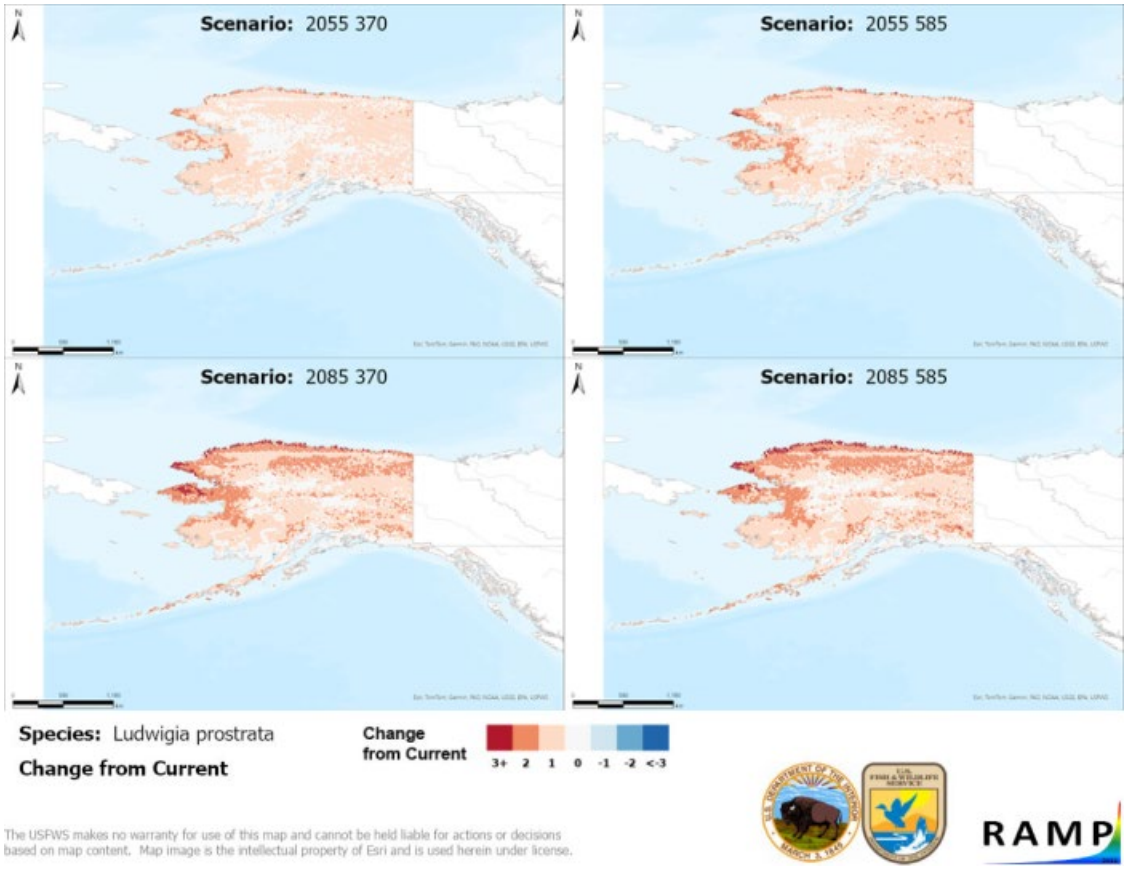


Figure A3. RAMP (Sanders et al. 2023) maps of Alaska showing the difference between the current climate match target point score (figure 4) and the median target point score for future climate scenarios (figure A1) for *Ludwigia prostrata* based on source locations reported by GBIF Secretariat (2021). Shared Socioeconomic Pathways (SSPs) used (from left to right): SSP3, SSP5 (IPCC 2021). Time steps: 2055 (top row) and 2085 (bottom row). Climate source data from CHELSA (Karger et al. 2017, 2018); global models used: GFDL-ESM4, UKESM1-0-LL, MPI-ESM1-2-HR, IPSL-CM6A-LR, and MRI-ESM2-0. Shades of blue indicate a lower target point score under future scenarios than under current conditions. Shades of red indicate a higher target point score under future scenarios than under current conditions. Darker shades indicate greater change.

Literature Cited

GBIF Secretariat. 2021. GBIF backbone taxonomy: *Ludwigia prostrata* Roxb. Copenhagen: Global Biodiversity Information System. Available: https://www.gbif.org/species/5545149 (July 2022).

[IPCC] Intergovernmental Panel on Climate Change. 2021. Climate change 2021: the physical science basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press.

Karger DN, Conrad O, Böhner J, Kawohl T, Kreft H, Soria-Auza RW, Zimmermann NE, Linder P, Kessler M. 2017. Climatologies at high resolution for the Earth land surface areas. Scientific Data 4:170122.

Karger DN, Conrad O, Böhner J, Kawohl T, Kreft H, Soria-Auza RW, Zimmermann NE, Linder HP, Kessler M. 2018. Data from: Climatologies at high resolution for the earth's land surface areas. EnviDat. Available: https://doi.org/10.16904/envidat.228.v2.1.

Sanders S, Castiglione C, Hoff M. 2023. Risk Assessment Mapping Program: RAMP. Version 5.0. U.S. Fish and Wildlife Service.

Appendix F. ERSS Writing for Aquatic Species Not Restricted to Freshwater

For aquatic organisms, source locations for climate matching should include only those located in freshwater and brackish water environments to minimize the influence of salinity-dependent temperature tolerances (Todd and Dehnel 1960; Kinne and Kinne 1962).

A. Specific Instructions

Add the following line to map captions in sections 5 and 6 if marine occurrences were excluded from the source locations for climate matching: "Because the climate matching analysis (section 7) is not valid for marine waters, no marine occurrences were used in the climate matching analysis."

Use the following key to determine whether and how to assess a species based on its salinity tolerance:

1. Can the species survive in freshwater (<0.5 parts per thousand [ppt] salinity) during any part of its lifecycle?

    a. YES. Go to 2.

    b. NO. Go to 4.

2. Can the species reproduce in freshwater (<0.5 ppt salinity)?

    a. YES. Go to 3.

    b. NO. The ERSS (especially section 3 and beyond) should focus on the freshwater parts of the lifecycle:

        i. The assessor should state in the climate matching summary in section 7 that the climate match refers only to where the species can survive and not necessarily to where it can reproduce.

        ii. The assessor should restate the limitations of the climate match in sections 8 and 9, and downgrade the Certainty of Assessment accordingly.

        iii. The ORAC should be characterized as Uncertain.

3. Does the species require a higher salinity environment (>0.5 ppt) for a non-reproductive part of its lifecycle?

    a. REQUIRES MARINE. The ERSS (especially section 3 and beyond) should focus on the freshwater parts of the lifecycle.

        i. In section 7, state: "The climate match presented here refers only to nonmarine environments where the species can survive."

        ii. In sections 8 and 9, state: "This species migrates between marine and freshwater environments. Because not all locations in the United States are conducive to such migration, inland establishment of this species may be limited according to habitat connectivity."

    b. REQUIRES BRACKISH. The Certainty of Assessment should be Low because brackish water habitats are not widely available in many areas covered by the climate matching analysis.

        i. In section 7, state: "This species migrates between fresh and brackish water environments. Because not all locations in the United States are conducive to such migration, establishment of this species may be limited according to habitat connectivity."

        ii.

    c. NO. No modifications to the ERSS are necessary other than what is outlined in the general note, above.

4. Can the species survive in brackish water (<35 ppt salinity)?

    a. YES. Go to 5.

    b. NO. An ERSS should not be written or reviewed. Choose an alternate tool for assessing the risk posed by marine species.

5. Can the species reproduce in brackish water (<35 ppt salinity)?

    a. YES. The Certainty of Assessment should be Low because brackish water habitats are not widely available in many areas covered by the climate matching analysis.

        i. In section 7, state: "The climate match does not account for salinity tolerance. Species establishment will require both a suitable climate and the availability of aquatic habitat with appropriate salinity (see Environment, above)."

        ii. The assessor should restate the limitations of the climate match in sections 8 and 9.

    b. NO. The ERSS (especially section 3 and beyond) should focus on the brackish water parts of the lifecycle:

i. In section 7, state: "The climate match refers only to climates where the species can survive and not necessarily to where it can reproduce. Additionally, the climate match does not account for salinity tolerance. Species establishment will require both a suitable climate and the availability of aquatic habitat with appropriate salinity (see Environment, above)."

ii. The assessor should restate the limitations of the climate match in sections 8 and 9 and downgrade the Certainty of Assessment category accordingly.

iii. The ORAC should be characterized as Uncertain.

B. Literature Cited

Kinne O, Kinne EM. 1962. Rates of development in embryos of a cyprinodont fish exposed to different temperature-salinity-oxygen combinations. Canadian Journal of Zoology 40(2):231–253.

Todd ME, Dehnel PA. 1960. Effect of temperature and salinity on heat tolerance in two grapsoid crabs, *Hemigrapsus nudus* and *Hemigrapsus oregonensis*. Biological Bulletin 118:150–172.

Appendix G. Use of Climatch in ERSS Development

Although RAMP is recommended for climate matching as part of ERSS development, Climatch is an acceptable alternative for current climate matching if ArcGIS software is not available to run RAMP. The user manual for Climatch is linked here: https://climatch.cp1.agriculture.gov.au/climatch.jsp. For users of Climatch, recommended modifications to the climate matching process (detailed in part 3I of this SOP and in the RAMP SOP) are described below.

A. Current Climate Matching (ERSS Section 7)

Climatch does not automatically calculate the Climate 6 score required for the ERSS. Instead, the Climate 6 score can be calculated manually as:

$$\text{Climate 6 Score} = \frac{\text{Count of target points with climate scores} \geq 6}{\text{Count of all target points}}$$

The ERSS author should create a table of the target point scores (similar to table G-1) within section 7 of the ERSS report with the following caption: "Table *X*. Climatch (ABARES 2020) target point scores for *scientific name* for *region of the United States*. Climate 6 Score = Count of Climate Scores 6-10 / Count of Total Climate Scores = *insert Climate 6 score*."

Table G-1. Example of a table of target point scores 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

B. Future Climate Matching (ERSS Appendix)

Climatch only allows future climate matching to Australia, so it cannot be used for future climate matching to the United States. If Climatch is used in place of RAMP, remove the future climate matching appendix from the ERSS and remove the statement referencing the appendix that appears below the Summary of Climate Matching Analysis in the ERSS drafting template (appendix C).

C. Citing Climatch

The citation for Climatch is:

[ABARES] Australian Bureau of Agricultural and Resource Economics and Sciences. 2020. Climatch. Version 2.0. Available: https://climatch.cp1.agriculture.gov.au/ (*insert month and year accessed*).

Appendix H. Detecting Outlier Data Points

As you inspect georeferenced occurrence data for a species with the intent to create a climate match map, sometimes there will be occurrences that seem out of place. Perhaps they fall outside the described range or outside the type of habitat expected for the species, or maybe they seem inaccurate for other reasons. These points are called "outliers" and they need to be carefully examined so you can decide whether to include or exclude them from the climate matching analysis. One erroneous point in a climate matching scenario can drastically change the outcome! This appendix is meant to be a starting guide to seeking out and identifying outliers when performing a climate match. The outliers in the example below are immediately recognizable because they are located far outside of the described range for this species. However, outliers can occur for many reasons, some of which may not be so obvious. In the end, whether to include a point or not may come down to risk assessor discretion, and this appendix will help you make that decision.

> Note: Use of GBIF and the Google Chrome internet browser are assumed in this appendix, although a similar approach can be used for identifying outliers in other systems with georeferenced occurrence data.

A. Assumptions

1) Only ESTABLISHED population records are to be used in climate matching.

2) Points on GBIF maps within the known range of the species are assumed to accurately represent established populations.

B. Specific Instructions

Follow these steps to evaluate georeferenced observations for use in selecting source points for the climate match.

1) Open GBIF and enter the species name in the search area (for this example, *Perca flavescens* will be used; figure H-1). Click the magnifying glass icon to search.

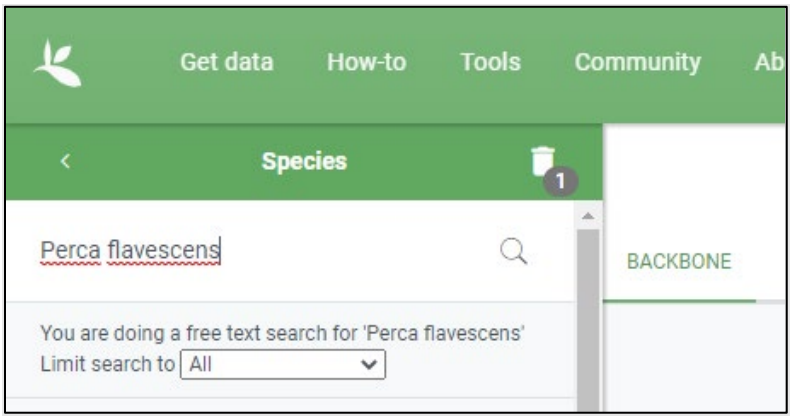


Figure H-1. Image of the GBIF species data search box.

2) The search results appear as a list of scientific names (figure H-2). Select the option that is labeled as the "Accepted" species. In this case, it is the first result listed.

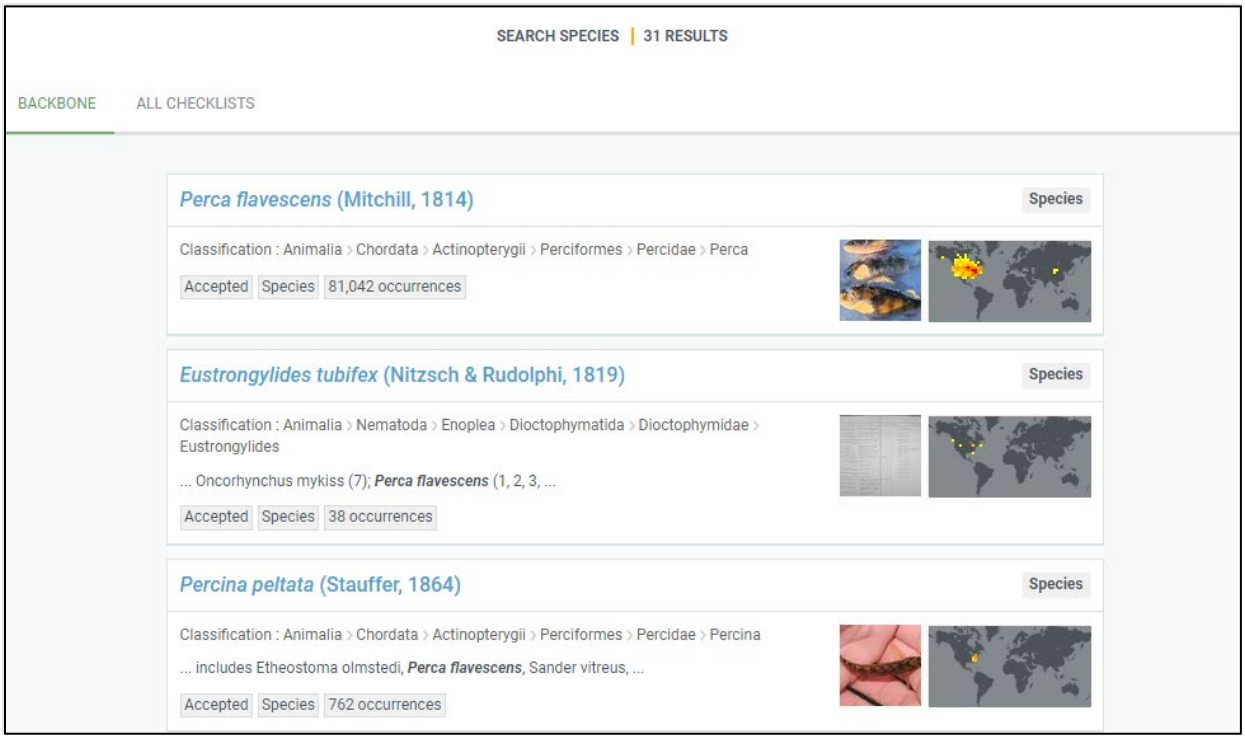


Figure H-2. Screenshot of GBIF search results.

3) Click on the species name in the results list to view the species page and global distribution map (figure H-3). On the map for *P. flavescens*, there are a few locations in China and Mongolia that lie far outside most of the data points.

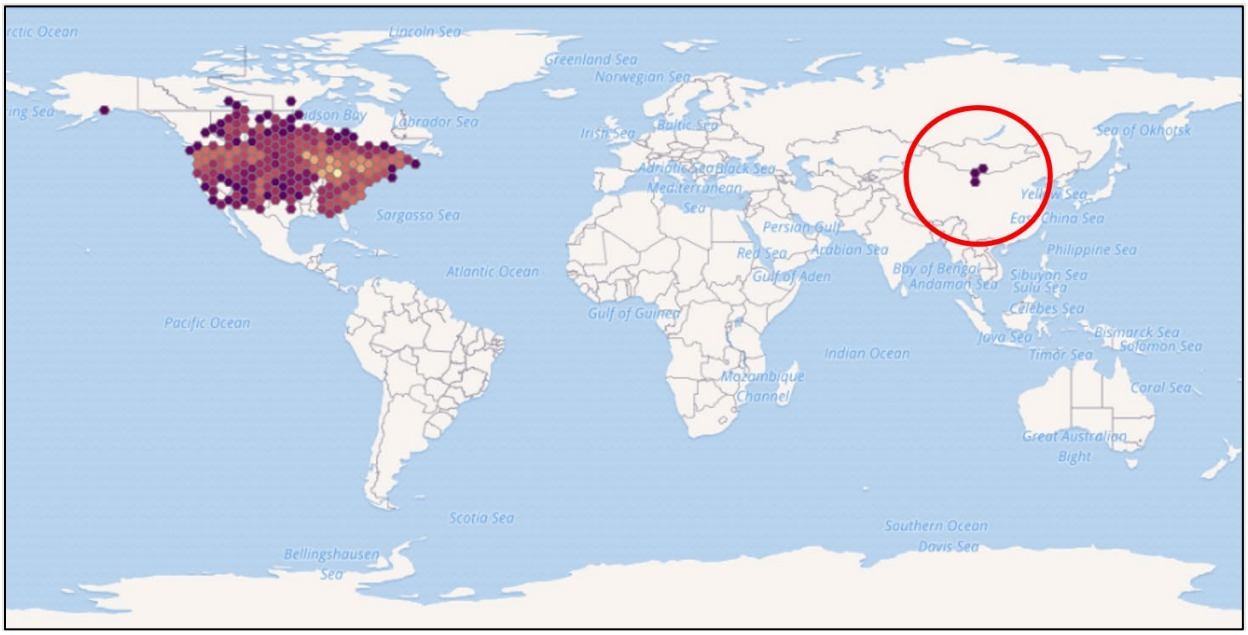


Figure H-3. Map of the global distribution of *Perca flavescens* from GBIF showing potential outlier points (circled).

4) Refer to a reputable source that describes the known distribution of this species. For example, FishBase lists the following distribution for *P. flavescens*: "North America: Atlantic, Arctic, Great Lakes, and Mississippi River basins from Nova Scotia to Mackenzie River drainage, Northwest Territories in Canada, and south to Ohio, Illinois and Nebraska in the USA; south in Atlantic drainages to Savannah River in Georgia, USA." Fishbase also lists the following countries as having populations of this species: United States and Canada. For this species, all points on the global distribution map (figure H-3) fall within that described range with the exception of the few points located in China and Mongolia. These points should be further investigated as potential outliers.

5) Zoom in on the map until the only points visible on the map are the potential outliers (figure H-4) and then click on the gray 'EXPLORE AREA' button in the lower right corner of the map.

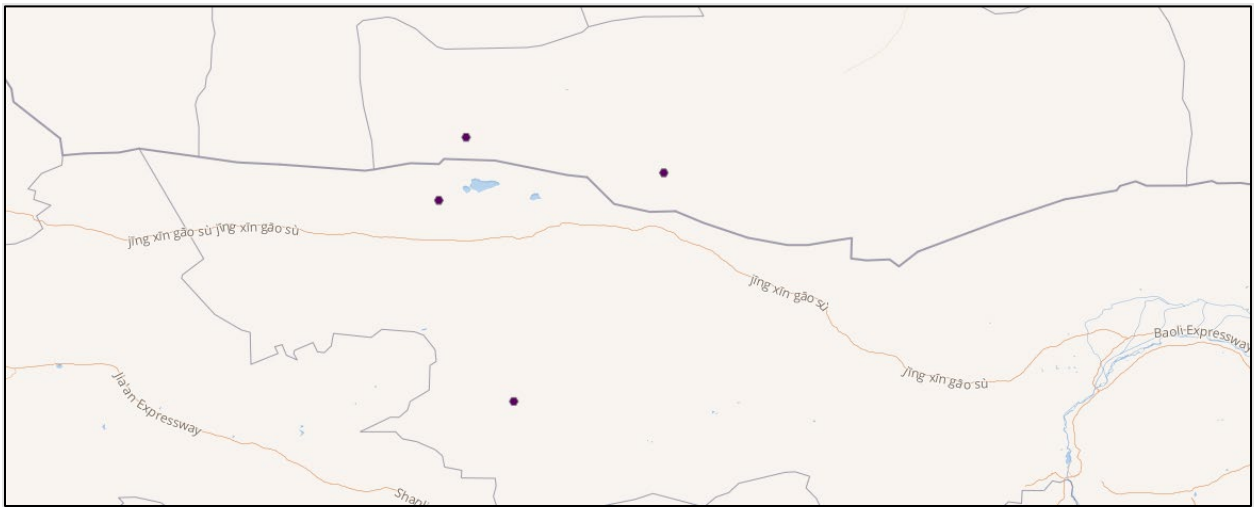


Figure H-4. A map focused in on the potential outlier points in Mongolia and China.

6) The button will take you to a records page (figure H-5). Sometimes there can be many records at a single location which would suggest that the point in question may not be an outlier; many records at a single location are a good indicator of establishment. Often, however, there is only one record at a single location. While the number of records is not a definitive indication that this data point is an outlier that should be excluded, it is the first clue that points towards exclusion.

SEARCH OCCURRENCES | 5 RESULTS

TABLE GALLERY MAP TAXONOMY METRICS DOWNLOAD

Scientific name	Country or area	Coordinates	Month & year	Occurrence status	Ba
Perca flavescens (Mitchill, 1814)	Mongolia	42.9N, 100.5E	2008 July	Present	Pre
Perca flavescens (Mitchill, 1814)	Mongolia	42.5N, 102.6E	2008 July	Present	Pre
Perca flavescens (Mitchill, 1814)	China	42.2N, 100.3E	2008 August	Present	Pre
Perca flavescens (Mitchill, 1814)	China	40.2N, 101.0E	1997 August	Present	Pre
Perca flavescens (Mitchill, 1814)	China	40.2N, 101.1E	1997 August	Present	Pre

Figure H-5. Image of the list of records shown after clicking on the 'EXPLORE AREA' button under the GBIF map.

7) Click on the first *Perca flavescens* (Mitchill, 1814) to view more information on this record.

8) 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 (figure H-6) 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 georeferenced record. In this case there does not seem to be a body of water nearby; this is another clue that the record may not be valid.

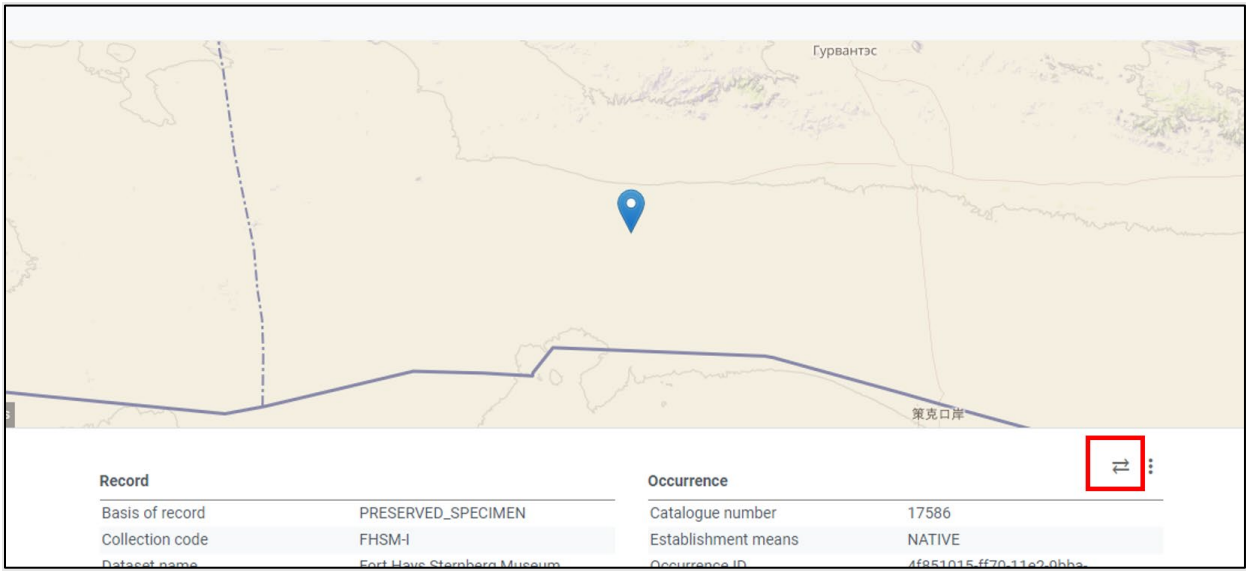
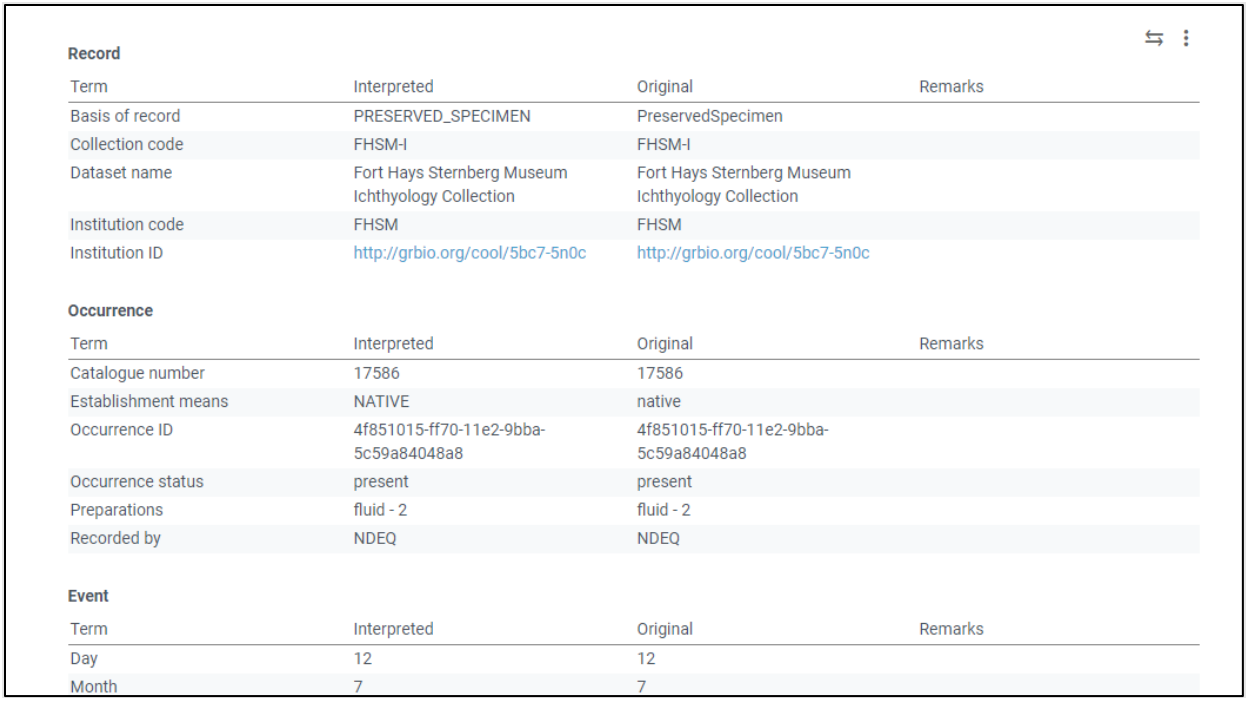


Figure H-6. Topographic map of the specimen location. Red box highlights the button that will display the original record information beside the GBIF interpretation of that information.

9) Scroll down the page to look at the original record information and the GBIF interpretation of the information side by side (figure H-7). (You may need to turn on the record comparison by toggling the button with two arrows pointing in opposite directions; figure H-6.)
   - In this case it is somewhat suspicious that the data set is from a United States military base for a location in China. Again, this is not a definitive indication of an occurrence that should be excluded, but it is suspicious.
   - Additionally, the details list the basis of record as “PRESERVED_SPECIMEN” which does not indicate whether or not this record should be excluded. However, a record based on a live specimen would be more suggestive of an established population (although even a live specimen is not definitive evidence of establishment).



Record

Term	Interpreted	Original	Remarks
Basis of record	PRESERVED_SPECIMEN	PreservedSpecimen	
Collection code	FHSM-I	FHSM-I	
Dataset name	Fort Hays Sternberg Museum Ichthyology Collection	Fort Hays Sternberg Museum Ichthyology Collection	
Institution code	FHSM	FHSM	
Institution ID	http://grbio.org/cool/5bc7-5n0c	http://grbio.org/cool/5bc7-5n0c	

Occurrence

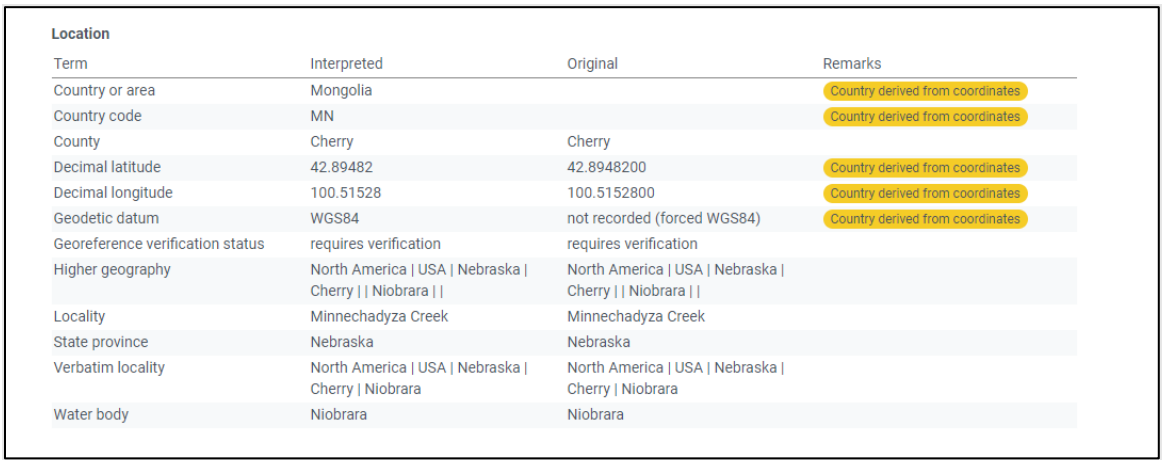
Term	Interpreted	Original	Remarks
Catalogue number	17586	17586	
Establishment means	NATIVE	native	
Occurrence ID	4f851015-ff70-11e2-9bba-5c59a84048a8	4f851015-ff70-11e2-9bba-5c59a84048a8	
Occurrence status	present	present	
Preparations	fluid - 2	fluid - 2	
Recorded by	NDEQ	NDEQ	

Event

Term	Interpreted	Original	Remarks
Day	12	12	
Month	7	7	

Figure H-7. The detailed record information for a potential outlier data point.

10) Scroll further down the page to see the original and interpreted location information. Significantly, the collection location given in the original record location is Nebraska (figure H-8). The country is not given in the original information but was derived from the coordinates by GBIF. The discrepancy is due to inaccurate recording and transmittal of the coordinates; the longitude is missing the "-" sign indicating the western hemisphere. It can sometimes be helpful to check the coordinates and change the signs to see if adding or removing a "-" from one coordinate then puts the point in the corresponding collection location.



Location

Term	Interpreted	Original	Remarks
Country or area	Mongolia		Country derived from coordinates
Country code	MN		Country derived from coordinates
County	Cherry	Cherry	
Decimal latitude	42.89482	42.8948200	Country derived from coordinates
Decimal longitude	100.51528	100.5152800	Country derived from coordinates
Geodetic datum	WGS84	not recorded (forced WGS84)	Country derived from coordinates
Georeference verification status	requires verification	requires verification	
Higher geography	North America | USA | Nebraska | Cherry | | Niobrara | |	North America | USA | Nebraska | Cherry | | Niobrara | |	
Locality	Minnechadyza Creek	Minnechadyza Creek	
State province	Nebraska	Nebraska	
Verbatim locality	North America | USA | Nebraska | Cherry | Niobrara	North America | USA | Nebraska | Cherry | Niobrara	
Water body	Niobrara	Niobrara	

Figure H-8. The location section of the record detail for a potential outlier data point.

11) The original version of the record is as descriptive as the record is going to get. At this point, use your best judgment on including or excluding a point and write your justification into the ERSS. 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 does not seem to be located near a body of water,
- The record is a single record, and
- The collection location is listed as Nebraska while the coordinates are for a location in Mongolia.

Based on the above points, the risk assessor concluded that this record should be excluded from the climate matching process. (The other outlier points indicated at the beginning of the example were also collected in Nebraska.)

> Note: Experienced users of GBIF note that outlier data are particularly common from locations in Germany and near Oslo, Norway, as well as among occurrences shared from the iNaturalist database. The German and Norwegian occurrence data seem to have been entered by museums or botanical gardens and do not represent wild, established populations. Data in these locations should be examined with extra care. iNaturalist has a relatively low threshold for verification of species identification, and live occurrences may also be reported from botanical gardens or other similarly managed environments. From the detailed record in GBIF, follow the link to the original iNaturalist record to obtain more information with which to evaluate the reported occurrence.

Appendix I. Derivation of Establishment Concern Categories

In an ERSS, the results of the climate matching analysis can be summarized with a Climate 6 score (Bomford 2008; Baker and Bomford 2009), which is calculated as the number of target points with target point scores[7] of at least 6, divided by the total number of target points. The ERSS process classifies Climate 6 score into one of two Establishment Concern categories, "Doubtful" or "Yes," based on the relationship between Climate 6 score and probability of species establishment. This appendix describes the dataset developed to characterize the relationship between Climate 6 score and probability of establishment, as well as the derivation of the two Establishment Concern categories.

A. Dataset Development

A positive relationship between climate match and establishment success of nonnative species is well known in the literature (e.g., Thuiller et al. 2005; Hayes and Barry 2008; Bomford et al. 2009, 2010; Howeth et al. 2016; Liu et al. 2020). For application to the ERSS process, a dataset was constructed of species from any freshwater taxon that had been recorded as introduced to the contiguous United States. A list of 375 exotic freshwater species (no hybrid taxa or taxa above the species level) with a recorded establishment status ("failed" or "established") was obtained from the USGS Nonindigenous Aquatic Species (NAS) database (USGS 2023) in April 2023. NAS reports establishment status for each occurrence individually; for the purpose of this analysis, a species that was recorded as "established" at one or more locations within the contiguous United States was considered "established" in general. This generalized establishment status from NAS was compared to the species establishment status according to the United States Register of Introduced and Invasive Species (Simpson et al. 2022). When status differed between the two sources, these differences were resolved through further investigation of NAS species profiles and, occasionally, outside literature (references available on request).

A climate matching analysis was completed for each species on the list following the process described in this SOP and the SOP for RAMP version 4.0 (USFWS 2023) for identifying valid source locations and calculating the Climate 6 score. However, in contrast to a typical ERSS climate matching analysis, no source points within the contiguous United States were used, consistent with previous validation studies of the relationship between Climate 6 score and establishment probability (Bomford et al. 2009, 2010).

In the process of completing the climate matching analysis, a handful of additional introduced species were excluded from the analysis. Reasons for exclusion included identification of native populations within the contiguous United States, inability of the assessor to adequately distinguish between cultivated and wild occurrences of a species, and taxonomic uncertainty that inhibited the assessor from identifying source points accurately. The final dataset included 356 species, of which 226 had been reported as established within the contiguous United States. Approximately 43% of the species included were fish, followed by 31% aquatic plants, 7%

[7] The process used to calculate target point scores themselves can be found in the SOP for RAMP (USFWS 2024).

mollusks, and 7% crustaceans. The remaining species in the dataset included algae, amphibians, annelids, bryozoans, coelenterates, mammals, reptiles, and rotifers.

All subsequent data analysis was conducted in Program R (R Core Team 2023).

B. Establishment Concern Category Derivation

There was a highly significant positive relationship between Climate 6 score for the contiguous United States and probability of establishment in the contiguous United States (Wilcoxon rank sum test, $p < 2.2\times10^{-16}$). One of 15 species with a Climate 6 score of 0.0 successfully established in the contiguous United States, while 55 of 58 with a Climate 6 score greater than 0.9 successfully established.

Because there were no values of Climate 6 score at which the observed probability of establishment changed rapidly, the division of possible Climate 6 score values into categories was accomplished through optimal cutpoint estimation. The optimal cutpoint for this analysis was defined as the value that maximized the probability of a species failing to establish given that the Climate 6 score fell below that value. This probability, otherwise known as negative predictive value, was chosen as the metric for optimal cutpoint estimation because of the invasive species prevention context in which rapid risk screening is conducted. Policy based on an incorrect prediction that a species will fail to establish has greater potential negative consequences to ecological and human health than policy based on an incorrect prediction that a species will establish. In other words, a cutpoint based on maximizing negative predictive value helps reduce unexpected establishment and harm by nonnative species that were previously assumed to be unable to establish.

Optimal cutpoint estimation was conducted using the 'cutpointr' package (Thiele and Hirschfeld 2021). The optimal cutpoint was estimated to be a Climate 6 score of 0.002; scores below that threshold indicated lower probability of establishment while scores above that threshold indicated higher probability of establishment. For a Climate 6 score of 0.002, the negative predictive value is 0.89; in other words, about 90% of species with Climate 6 scores less than 0.002 are expected to fail to establish. One hundred bootstrap samples were used for validation. The bootstrap estimate of the optimal cutpoint was 0.002 ± 0.001 (mean ± sd), and categorization of species based on this cutpoint performed well in distinguishing between established and failed introductions (AUC for out-of-bag samples = 0.812 ± 0.030).

In ERSS reports, the optimal cutpoint determined through the above analysis is reflected in the designation of Establishment Concern category. Establishment Concern for a species with a Climate 6 score less than 0.002 is determined to be "Doubtful." However, a Climate 6 score of 0.002 and greater indicates that "Yes," there is Establishment Concern regarding the species.

C. A Note on Past Interpretation of Climate 6 Scores

ERSS reports published prior to 2024 used a different classification of Climate 6 scores, called Overall Climate Match Category, with categories of Low, Medium, and High. Establishment Concern now supersedes Overall Climate Match Category as the preferred method for Climate 6 score interpretation. Establishment Concern categories are simpler (two categories instead of

three), more transparent (explicitly connecting Climate 6 score with invasiveness via establishment), and intentionally developed to apply to all taxa and to the ERSS focal geographic region of the contiguous United States.

D. Literature Cited

Bomford M. 2008. Risk assessment models for establishment of exotic vertebrates in Australia and New Zealand. Canberra, Australia: Invasive Animals Cooperative Research Centre.

Bomford M, Barry SC, Lawrence E. 2010. Predicting establishment success for introduced freshwater fishes: a role for climate matching. Biological Invasions 12:2559–2571.

Bomford M, Kraus F, Barry SC, Lawrence E. 2009. Predicting establishment success for alien reptiles and amphibians: a role for climate matching. Biological Invasions 11:713–724.

Hayes KR, Barry SC. 2008. Are there any consistent predictors of invasion success? Biological Invasions 10:483–506.

Howeth JG, Gantz CA, Angermeier PL, Frimpong EA, Hoff MH, Keller RP, Mandrak NE, Marchetti MP, Olden JD, Romagosa CM, Lodge DM. 2016. Predicting invasiveness of species in trade: climate match, trophic guild and fecundity influence establishment and impact of non-native freshwater fishes. Diversity and Distributions 22:148–160.

Liu C, Wolter C, Xian W, Jeschke JM. 2020. Most invasive species largely conserve their climatic niche. Proceedings of the National Academy of Sciences 117:23643–23651.

R Core Team. 2023. R: a language and environment for statistical computing. Vienna: R Foundation for Statistical Computing. Available: https://www.R-project.org/ (September 2023).

Simpson A, Fuller P, Faccenda K, Evenhuis N, Matsunaga J, Bowser M. 2022. United States Register of Introduced and Invasive Species (US-RIIS). Version 2.0. U.S. Geological Survey data release. Available: https://doi.org/10.5066/P9KFFTOD (May 2023).

Thiele C, Hirschfeld G. 2021. cutpointr: improved estimation and validation of optimal cutpoints in R. Journal of Statistical Software 98(11):1-27.

Thuiller W, Richardson DM, Pyšek P, Midgley GF, Hughes GO, Rouget M. 2005. Niche-based modelling as a tool for predicting the risk of alien plant invasions at a global scale. Global Change Biology 11:2234–2250.

[USFWS] U.S. Fish and Wildlife Service. 2023. Standard operating procedures for the Risk Assessment Mapping Program (RAMP). Revised version.

Appendix J. Examples of Standard Formatting for References

The following information is from the Journal of Fish and Wildlife Management Guide for Authors.

A. In-text Citations

In-text citations use the name-year format and may take one of two forms:

"Johnson (1995), Jones and Smith (1996, 1998), Rice et al. (1997) and Berger (in press) found walleyes in Lake Pollock."

"Walleyes occur in Lake Pollock (Johnson 1995; Jones and Smith 1996, 1998; Rice et al. 1997; Berger, in press)"

Cite both authors if there are only two authors of the publication. If there are three or more authors, give the first author followed by "et al." Citations in text should be arranged chronologically.

If an institution is the author and the name is very long, the name may be abbreviated if also defined in the reference list.

"APHA et al. (1992)" in the text would then appear in the reference list as "[APHA] American Public Health Association, American Water Works Association, and Water Environment Federation. 1992."

B. Literature Cited

Journal Article

Author(s). Year. Article title. Journal title volume number (issue number only if each starts with page 1): inclusive pages.

Examples:

Crawshaw LI, Lemons DE, Palmer M, Messing JM. 1982. Behavioral and metabolic aspects of low-temperature dormancy in the brown bullhead, *Ictalurus nebulosus*. Journal of Comparative Physiology B 148:41–47.

Hochachka PW. 1990. Scope for survival: a conceptual "mirror" to Fry's scope for activity. Transactions of the American Fisheries Society 119:622–628.

Kennedy VS. 1990. Anticipated effects of climate change on estuarine and coastal fisheries. Fisheries 15(6):16–24.

Kent ML, Traxler GS, Kieser D, Richard J, Dawe SC, Shaw RW, Prosperi-Porta G, Ketcheson J, Evelyn TPT. 1998. Survey of salmonid pathogens in ocean-caught fishes in British Columbia, Canada. Journal of Aquatic Animal Health 10:211–219.

Petersen MR, Weir DN, Dick MH. 1991. Birds of the Kilbuck and Ahklun Mountain Region, Alaska. North American Fauna 76:1–158. doi: 10.3996/nafa.76.0001

Book

Author(s). Year. Title. Edition (other than 1st) or Volume (if part of a series). City, State, Province, or Country (only if needed to locate city): Publisher. Other identifying information. Omit the number of pages.

Examples:

[APHA] American Public Health Association, American Water Works Association, and Water Environment Federation. 1992. Standard methods for the examination of water and wastewater. 18th edition. Washington, D.C.: APHA.

Hoar WS, Randall DJ, editors. 1988. Fish physiology. Volume 11, part B. New York: Academic Press.

Rheinheimer G. 1985. Aquatic microbiology. 3rd edition. New York: Wiley.

Article in a Book

(including those in the AFS book series – Special Publications, Symposia, and Monographs, and conference proceedings)

Author(s). Year. Article title. Inclusive pages in editor(s). Book title. City, State, or Province, or Country (only if needed to locate city): Publisher. Other identifying information.

For conference proceedings, use year of publication (not year of meeting) for the date, and give publisher's name and location (not the location of the meeting).

Examples:

Adams SM, Breck JE. 1990. Bioenergetics. Pages 389–415 in Schreck CB, Moyle PB, editors. Methods for fish biology. Bethesda, Maryland: American Fisheries Society.

Campton DE. 1995. Genetic effects of hatchery fish on wild populations of Pacific salmon and steelhead: what do we really know? Pages 337–353 in Schramm HL Jr, Piper RG, editors. Uses and effects of cultured fishes in aquatic ecosystems. Bethesda, Maryland: American Fisheries Society. Symposium 15.

Livingstone AC, Rabeni CF. 1991. Food-habitat relations of underyearling smallmouth bass in an Ozark stream. Pages 76–83 in Jackson DC, editor. The first international smallmouth bass symposium. Bethesda, Maryland: American Fisheries Society.

Thesis or Dissertation

Author. Year. Title. Master's thesis or Doctoral dissertation. City, State, Province, or Country (only if needed to locate city): University. Omit State after city if included in the university name.

Examples:

Chitwood JB. 1976. The effects of threadfin shad as a forage species for largemouth bass in combination with bluegill, redear, and other forage species. Master's thesis. Auburn, Alabama: Auburn University.

Hartman KJ. 1993. Striped bass, bluefish, and weakfish in the Chesapeake Bay: energetics, trophic linkages, and bioenergetics model applications. Doctoral dissertation. College Park: University of Maryland.

Government Publication

Author(s) or agency. Year. Title. City, State, Province, or Country (only if needed to locate city): Agency. Type and number of publication. Omit State or province after city if included in the agency name.

Examples:

[EPA] U.S. Environmental Protection Agency. 1986. Quality criteria for water. Washington, D.C.: EPA. Report 440/5-86-001.

Gimbarzevsky P. 1988. Mass wasting on the Queen Charlotte Islands: a regional inventory. Victoria: British Columbia Ministry of Forests and Lands. Land Management Report 29.

Contract Report

Author(s). Year. Title. Organization that issued the report (if different from the author) to Organization that received the report, Receiver's city, State, province, or country (only if needed to locate city).

Examples:

Smith AB. 1986. Turbine-induced fish mortality at Highrise Dam, 1985. Report of Robertson Consultants to Prairie Utilities, Jonesville, Alberta.

Webpages

Author(s) or agency. Year [of last page revision]. Title. Publisher or Publication. [volume: page numbers]. Available: URL (month and year accessed). [doi:] Items in brackets are optional.

See appendix A for citations for online databases and websites commonly used in ERSSs.

Examples:

Baldwin NA, Saalfield RW, Dochoda MR, Buettner HJ, Eshenroder RL. 2000. Commercial fish production in the Great Lakes 1867–1996. Great Lakes Fishery Commission. Available: www.glfc.org/databases/commercial/commerc.php (September 2000).

Villeneuve DL, Wang RL, Bencic DC, Biales AD, Martinovic D, Lazorchak JM, Toth G, Ankley GT. 2009. Altered gene expression in the brain and ovaries of zebrafish (*Danio rerio*) exposed to the aromatase inhibitor fadrozole: microarray analysis and hypothesis generation. Environmental Toxicology and Chemistry 28:1767–1782. Available: www.setacjournals.org/perlserv/?request=get-abstract&doi=10.1897%2F08-653.1&ct=1 (October 2009). doi: 10.1897/08-653.1

Appendix K. Quality Assurance and Quality Control Checklists

This appendix includes checklists that 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. Checklists are provided to guide technical review and final review of the ERSS, as well as technical review and final review of a noncontiguous United States ERSS supplement. While not required as part of the administrative record, technical review checklists may be used at the drafting stage to support the drafter in producing a high-quality product.

ERSS Technical Review Checklist

Use this checklist in the drafting and review stages to determine if an ERSS is complete, follows the SOP, and meets data standards.

Subject Species Scientific Name:
Subject Species Common Name:

Name of Reviewer:
Date Reviewed:

General Questions
Has an administrative record for the ERSS been included? ☐ Yes ☐ No
Has the Record of Online Data Searches been completed? ☐ Yes ☐ No
Was a search done on all synonyms listed? If not, was justification given? ☐ Yes ☐ No
Has the format of the ERSS drafting template been followed? ☐ Yes ☐ No
Is the ERSS style template (.dotx) attached? ☐ Yes ☐ No
Are information sources cited under each subheading? ☐ Yes ☐ No
Is the document internally consistent? ☐ Yes ☐ No
Is there alt text for all images and maps? ☐ Yes ☐ No
Are tables formatted properly (i.e., no split cells, header rows repeat at top of page, alt text is available, rows do not break across pages)? ☐ Yes ☐ No
Comments:

Title Page Header
Was the scientific name obtained via a database appropriate for the taxon? ☐ Yes ☐ No Indicate where the info was obtained:
Was the common name obtained via a database appropriate for the taxon? ☐ Yes ☐ No Indicate where the info was obtained:
If no common name, was a familiar name for the taxonomic group provided? ☐ Yes ☐ No
Are the preparer and version details complete? ☐ Yes ☐ No
Are the organism type and Overall Risk Assessment Category filled in correctly? ☐ Yes ☐ No
Are any species photographs or artwork properly cited? ☐ Yes ☐ No
Have we verified reuse license information for any images used? ☐ Yes ☐ No
Comments:

Section 1 — Native Range and Status in the United States
Was information sought, from multiple sources in the list of online databases, for all 4 headings in section 1? - Native Range ☐ Yes ☐ No

- Status in the United States ☐ Yes ☐ No - Means of Introduction ☐ Yes ☐ No - Remarks ☐ Yes ☐ No
Is it clear what countries or States the species range encompasses? ☐ Yes ☐ No
Has trade status, volume, and duration been described? ☐ Yes ☐ No
Have State and Federal regulations been checked for this species? ☐ Yes ☐ No
Have copies of all sources consulted for this section been properly cited and referenced and saved as PDFs for the administrative record? ☐ Yes ☐ No
Comments:

Section 2 — Biology and Ecology
Was information sought, from multiple sources in the list on online databases, for all 11 headings in section 2? - Taxonomy Hierarchy and Standing ☐ Yes ☐ No - Size, Weight, Age Range ☐ Yes ☐ No - Environment ☐ Yes ☐ No - Climate ☐ Yes ☐ No - Distribution Outside the United States ☐ Yes ☐ No - Means of Introduction Outside the United States ☐ Yes ☐ No - Short Description ☐ Yes ☐ No - Biology ☐ Yes ☐ No - Human Uses ☐ Yes ☐ No - Diseases ☐ Yes ☐ No - Threats to Humans ☐ Yes ☐ No
Is it clear what countries or States the species range encompasses? ☐ Yes ☐ No
Are water temperatures discussed under Environment and air temperatures discussed under Climate? ☐ Yes ☐ No
If water temperatures refer to a captive environment, is this made clear? ☐ Yes ☐ No
Were any WOAH-listed diseases documented for the assessed species? If none were found, is this documented? ☐ Yes ☐ No ☐ N/A (plants only)
Have copies of all sources consulted for this section been properly cited and referenced and saved as PDFs for the administrative record? ☐ Yes ☐ No
Comments:

Section 3 — Impacts of Introduction
Was information sought from multiple sources for this section? ☐ Yes ☐ No
Are the impacts listed specific to areas where the species is nonnative? ☐ Yes ☐ No
Has the author clearly separated any impact information that does not inform the History of Invasiveness? (e.g., impacts to other nonnative species, potential impacts) ☐ Yes ☐ No

Is there a summary of State and Federal regulations applicable to the species (from section 1)? ☐ Yes ☐ No
Have copies of all sources consulted for this section been properly cited and referenced and saved as PDFs for the administrative record? ☐ Yes ☐ No
Comments:

Section 4 — History of Invasiveness
Has the History of Invasiveness been adequately explained, considering records of introductions, establishment, volume and duration of trade, and documented impacts? ☐ Yes ☐ No
Comments:

Section 5 — Global Distribution
Was GBIF consulted for global distribution? ☐ Yes ☐ No Indicate any additional sources where info was obtained:
Were the data for global distribution reviewed for outliers and anomalies? ☐ Yes ☐ No
Is an explanation provided for any differences in range between sections 1 and 2 and section 5? ☐ Yes ☐ No
Were all maps used for this section saved for the administrative record? ☐ Yes ☐ No
Have copies of all sources consulted for this section been properly cited and referenced and saved as PDFs for the administrative record? ☐ Yes ☐ No
Comments:

Section 6 — United States Distribution
Was the USGS NAS Database used for U.S. distribution? ☐ Yes ☐ No Indicate any additional sources where info was obtained:
Were the data for U.S. distribution reviewed for outliers and anomalies? ☐ Yes ☐ No
Is an explanation provided for any differences in range between sections 1 and 2 and section 6? ☐ Yes ☐ No
Were all maps used for this section saved for the administrative record? ☐ Yes ☐ No
Have copies of all sources consulted for this section been properly cited and referenced and saved as PDFs for the administrative record? ☐ Yes ☐ No
Comments:

Section 7 — Climate Matching
Was RAMP used for the climate match? ☐ Yes ☐ No - If so, was the species folder saved for the administrative record? ☐ Yes ☐ No - Indicate RAMP version:
Was Climatch used for the climate match? ☐ Yes ☐ No - If so, was the ".clm" file saved for the administrative record? ☐ Yes ☐ No - Has the Climate 6 score been double-checked for accuracy? ☐ Yes ☐ No

Was the U.S. climate match map saved for the administrative record? ☐ Yes ☐ No
Has the climate match been summarized accurately and completely? ☐ Yes ☐ No
If georeferenced locations were not available for a large portion of the range or the range of the species is uncertain, is this noted in the section 7 summary text as potentially causing uncertainty in the climate match? ☐ Yes ☐ No
Comments:

Section 8 — Certainty of Assessment
Has the Certainty of Assessment been adequately explained, considering amount and quality of data on introductions, impacts, range, and taxonomy? ☐ Yes ☐ No
Comments:

Section 9 — Risk Assessment
Does this section begin with a sentence characterizing the species and its native range? ☐ Yes ☐ No
Does the section summarize pertinent details from the risk assessment, including uses, listed diseases, introductions, impacts, and regulations? ☐ Yes ☐ No
Do any special conditions apply, and if so, has language regarding those conditions been inserted in Section 9 and elsewhere, as appropriate? ☐ Yes ☐ No - Native to United States (§1&§2-Native Range; §7-Climate Matching) - Species stocked in United States (§1-Remarks) - Portion of range is marine (§7-Climate Matching; §8-Certainty of Assessment) - No source points available (§7-Climate Matching; §8-Certainty of Assessment) - Species lives in hot springs (§7-Climate Matching; §8-Certainty of Assessment)
Have each of the elements of the risk assessment (i.e., History of Invasiveness, Establishment Concern, Certainty of Assessment) been adequately explained? ☐ Yes ☐ No
Comments:

Section 10 — Literature Cited
Has all the quoted material within the ERSS been properly cited in section 10 using Journal of Fish and Wildlife Management formatting guidelines? ☐ Yes ☐ No
Comments:

Section 11 — Literature Cited in Quoted Material
Have all the references in the ERSS within quoted material (and not accessed by the author) been properly cited in section 11 using Journal of Fish and Wildlife Management formatting guidelines? ☐ Yes ☐ No
Comments:

Appendix — Future Climate Matching
Does the summary paragraph describe significant trends in future climate matching results, without excess detail? ☐ Yes ☐ No
Have the Climate 6 scores in figure A2 been checked for accuracy? ☐ Yes ☐ No
Are the panels in all three figures (A1, A2, A3) arranged with increasing SSP number from left to right and increasing year from top to bottom? ☐ Yes ☐ No
Do the sources referenced in each figure caption match the sources referenced in the figure captions in section 7? ☐ Yes ☐ No
Do the figures (A1, A2, A3) have appropriate alt text? ☐ Yes ☐ No
Comments:

ERSS Final Review Checklist

Once the technical review is complete, and all edits have been made, an ERSS is ready for final review. The final review should take much less time than the technical review.

Subject Species Scientific Name:
Subject Species Common Name:

Name of Reviewer:
Date Reviewed:

Sections 1–4 — Status, Biology, Ecology, Impacts
Is there anything questionable about the scientific information? ☐ Yes ☐ No
Does the scientific literature on invasive impacts sufficiently support the History of Invasiveness characterization (i.e., is there one or more sources providing clear, convincing, and reliable documentation of negative impacts of introduction)? ☐ Yes ☐ No
Comments:

Sections 5–7 — Distribution, Climate Matching
Is an explanation provided for any differences in range between sections 1-2 and sections 5-6? ☐ Yes ☐ No
Are any outliers explained? ☐ Yes ☐ No
Is the current climate matching summary clear, complete, and succinct? ☐ Yes ☐ No
Is there anything obviously questionable about the climate matching? ☐ Yes ☐ No
Comments:

Sections 8–9 — Certainty and Risk Assessment
Does the assessment's certainty accurately portray the quantity and quality of information in the ERSS? ☐ Yes ☐ No
Is the characterization of risk supported by the data and analysis in the ERSS, and is it consistent with the SOP? ☐ Yes ☐ No
Does section 9, Summary of Risk to the Contiguous United States, have new information not explained and cited in previous sections? ☐ Yes ☐ No
Comments:

Appendix — Future Climate Matching
Are the four panels in each figure ordered correctly, according to the caption? ☐ Yes ☐ No
Is the future climate matching summary clear, complete, and succinct? ☐ Yes ☐ No
Comments:

General Questions — Content
Do any special conditions apply, and if so, has language regarding those conditions been inserted (see appropriate section of SOP for suggested language)? ☐ Yes ☐ No - Native to United States (§1&§2, Native Range; §7, Climate Matching; §9, Summary) - Species stocked in United States (§1, Remarks; §9, Summary) - Portion of range is marine (§7, Climate Matching; §8, Certainty; §9, Summary) - No source points available (§7, Climate Matching; §8, Certainty; §9, Summary) - Species lives in thermal springs or other thermally anomalous environments (§7, Climate Matching; §8, Certainty; §9, Summary)
Does the administrative record include the RODS, technical review checklist, climate matching files, and copies of all sources listed in section 10 of the ERSS? ☐ Yes ☐ No
Is the organism type and ORAC listed correctly under the title? ☐ Yes ☐ No
Are any issues identified in the technical review checklist fully addressed? ☐ Yes ☐ No
Is the document internally consistent? ☐ Yes ☐ No
Is there anything we do not feel comfortable with in what the ERSS communicates or how it is being communicated (including how sources are quoted or referenced)? ☐ Yes ☐ No - If so, why? Can we fix it?
Comments:

General Questions — Formatting
Are citations formatted properly in the text and in Sections 10 and 11? ☐ Yes ☐ No
Have any typographical or formatting issues been noted for correction? ☐ Yes ☐ No
Is the ERSS style template attached? ☐ Yes ☐ No
Does the document pass Word's accessibility check? ☐ Yes ☐ No
Are titles and headings in the ERSS marked with the appropriate Style (e.g., Heading 1, 2, and 3)? ☐ Yes ☐ No
Is there alt text for all images and maps? ☐ Yes ☐ No
Are any tables formatted properly (i.e., no split cells, header rows repeat at top of page, alt text is available, rows do not break across pages, reading order is correct)? ☐ Yes ☐ No ☐ N/A

Once a final review is complete, the final reviewer gives the Regional ERSS lead a copy of the ERSS with any edits, comments, and questions marked in Track Changes. The final reviewer should use the first comment in Track Changes to summarize the final review.

Review for Public Distribution or Posting on ERSS Web Page
Were final review edits and comments fully addressed? ☐ Yes ☐ No
Is the organism type and correct ORAC under the title? ☐ Yes ☐ No
Has the draft watermark been removed? ☐ Yes ☐ No
Is the ERSS indicated to be a "web version"? ☐ Yes ☐ No

Is the author listed as USFWS on title page and in File Properties? ☐ Yes ☐ No
Is the title complete in File Properties? ☐ Yes ☐ No
Does the document pass Word's accessibility check (File > Info > Check for Issues or Inspect [depending on version of Word] > Check Accessibility)? ☐ Yes ☐ No

ERSS Supplement Technical Review Checklist

Use this checklist in the drafting and review stages to determine if an ERSS supplement is complete, follows the SOP, and meets data standards.

Subject Species Scientific Name:
Subject Species Common Name:
Noncontiguous Region:

Name of Reviewer:
Date Reviewed:

General Questions
Has an administrative record for the ERSS supplement been included? ☐ Yes ☐ No
Does the administrative record contain a copy of the final ERSS on which the supplement is based? ☐ Yes ☐ No
Has the format of the ERSS supplement template been followed? ☐ Yes ☐ No
Is the ERSS style template (.dotx) attached? ☐ Yes ☐ No
Is the document internally consistent? ☐ Yes ☐ No
Is there alt text for all images and maps? ☐ Yes ☐ No
Comments:

Title Page Header
Do the scientific and common names match the ERSS on which the supplement is based? ☐ Yes ☐ No
Are the preparer and version details complete? ☐ Yes ☐ No
Comments:

Climate Matching
Was RAMP used for the climate match? ☐ Yes ☐ No - If so, was the species folder saved for the administrative record? ☐ Yes ☐ No - Indicate RAMP version:
Was Climatch used for the climate match? ☐ Yes ☐ No - If so, was the ".clm" file saved for the administrative record? ☐ Yes ☐ No - Has the Climate 6 score been double-checked for accuracy? ☐ Yes ☐ No
Was the climate match results map saved for the administrative record? ☐ Yes ☐ No
Has the climate match been summarized accurately and completely? ☐ Yes ☐ No
If georeferenced locations were not available for a large portion of the range or the range of the species is uncertain, is this noted in the summary text as potentially causing uncertainty in the climate match? ☐ Yes ☐ No

Comments:

Certainty of Assessment
Does the Certainty of Assessment text match the language used in the **final** ERSS (except if downgraded due to a small number of target points)? ☐ Yes ☐ No
Comments:

Risk Assessment
Has the risk summary from the finalized ERSS been edited for relevance to the noncontiguous region? ☐ Yes ☐ No
Have each of the elements of the risk assessment (i.e., History of Invasiveness, Establishment Concern, Certainty of Assessment) been filled in appropriately? ☐ Yes ☐ No
Comments:

Literature Cited
Have all the sources referenced within the ERSS supplement been properly cited using Journal of Fish and Wildlife Management formatting guidelines? ☐ Yes ☐ No
Comments:

Appendix — Future Climate Matching
Does the summary paragraph describe significant trends in future climate matching results, without excess detail? ☐ Yes ☐ No
Have the Climate 6 scores in figure A2 been checked for accuracy? ☐ Yes ☐ No
Are the panels in all three figures (A1, A2, A3) arranged with increasing SSP number from left to right and increasing year from top to bottom? ☐ Yes ☐ No
Do the sources referenced in each figure caption match the sources referenced in the figure captions in section 7? ☐ Yes ☐ No
Do the figures (A1, A2, A3) have appropriate alt text? ☐ Yes ☐ No
Comments:

ERSS Supplement Final Review Checklist

Once the technical review is complete, and all edits have been made, an ERSS supplement is ready for final review. The final review should take much less time than the technical review.

Subject Species Scientific Name:
Subject Species Common Name:
Noncontiguous Region:

Name of Reviewer:
Date Reviewed:

General Questions — Format
Does the administrative record include a finalized ERSS, complete set of climate matching files, and completed technical review checklist? ☐ Yes ☐ No
Are citations formatted properly in the text and in Sections 10 and 11? ☐ Yes ☐ No
Have any typographical or formatting issues been noted for correction? ☐ Yes ☐ No
Is the ERSS style template attached? ☐ Yes ☐ No
Does the document pass Word's accessibility check? ☐ Yes ☐ No
Are titles and headings in the ERSS marked with the appropriate Style (e.g., Heading 1, 2, and 3)? ☐ Yes ☐ No
Is there alt text for all images and maps? ☐ Yes ☐ No
Comments:

Climate Matching
Is the current climate matching summary clear, complete, and succinct? ☐ Yes ☐ No
Is there anything obviously questionable about the climate matching? ☐ Yes ☐ No
Is the source map the same as that used in the finalized ERSS? ☐ Yes ☐ No
If there were any notes made on the climate matching source points in sections 5-7 of the final ERSS (points added, removed or missing), are these notes repeated below the source map? ☐ Yes ☐ No
Comments:

Certainty and Risk Assessment
Does the text in these sections match the finalized ERSS except for modifications specific to the noncontiguous region (including downgraded certainty, if necessary)? ☐ Yes ☐ No
Comments:

Appendix — Future Climate Matching
Are the four panels in each figure ordered correctly, according to the caption? ☐ Yes ☐ No

Is the future climate matching summary clear, complete, and succinct? ☐ Yes ☐ No
Comments:

General Questions — Content
Are any issues identified in the technical review checklist fully addressed? ☐ Yes ☐ No
Is the document internally consistent? ☐ Yes ☐ No
Is there anything we do not feel comfortable with in what the supplement communicates or how it is being communicated (including how sources are quoted or referenced)? ☐ Yes ☐ No - If so, why? Can we fix it?
Comments:

Once a final review is complete, the final reviewer gives the Regional ERSS lead a copy of the ERSS supplement with any edits, comments, and questions marked in Track Changes. The final reviewer should use the first comment in Track Changes to summarize the final review.

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Is the title complete in File Properties? ☐ Yes ☐ No
Does the document pass Word's accessibility check (File > Info > Check for Issues or Inspect [depending on version of Word] > Check Accessibility)? ☐ Yes ☐ No