Guidelines for the Development of an Aquatic Invasive Species Rapid Response Plan

Aquatic Nuisance Species Task Force

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Submitted to the Aquatic Nuisance Species Task Force

Prepared by the Rapid Response Template Task Team of the EDRR Subcommittee

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Executive Summary

Early detection and rapid response to new introductions of aquatic invasive species are essential to preventing their long-term establishment and impact. The Aquatic Nuisance Species Task Force's rapid response template offers a user-friendly outline of all necessary components for developing an effective response plan. This document breaks down key elements of a rapid response plan, including team building, funding, risk assessment, feasibility analysis, and other critical considerations. Designed as a step-by-step guide, the template helps users navigate the response planning process while incorporating relevant external resources. Our goal is to provide land and wildlife managers with a practical, accessible tool for creating effective rapid response plans.

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List of Acronyms

- Animal and Plant Health Inspection Service (APHIS)
- Aquatic Invasive Species (AIS)
- Aquatic Plant Control (APC)
- Aquatic Species Invasiveness Screening Kit (AS-ISK)
- Bipartisan Infrastructure Law (BIL)
- Canadian Marine Invasive Screening Tool (CMIST)
- Clean Water Act (CWA)
- Environmental DNA (eDNA)
- Endangered Species Act (ESA)
- Environmental Protection Agency (EPA)
- Categorical exclusion (CATEX)
- Federal Energy Regulatory Commission (FERC)
- Federal Emergency Management Agency (FEMA)
- Federal Insecticide Fungicide, and Rodenticide Act (FIFRA)
- Fish Invasiveness Screening Kit (FISK)
- Florida Fish and Wildlife Conservation Commission (FWC)
- Forest Service (FS)
- Incident action plan (IAP)
- Incident Command System (ICS)
- Incident Commander (IC)
- Marine Mammal Protection Act (MMPA)
- National Disaster Preparedness Training Center (NDPTC)
- National Environmental Policy Act (NEPA)
- National Historic Preservation Act (NHPA)
- National Incident Management System (NIMS)
- National Oceanic and Atmospheric Administration (NOAA)
- National Park Service (NPS)
- National Pollutant Discharge Elimination System (NPDES)
- Nonindigenous Aquatic Species Database (NAS)
- Notice of Funding Opportunity (NOFO)
- Point of contact (POC)
- Self-Contained Underwater Breathing Apparatus (SCUBA)
- Southern California Caulerpa Action Team (SCCAT)
- United States Army Corps of Engineers (USACE)
- United Sates Department of Agriculture (USDA)
- United States Fish and Wildlife Service (USFWS)
- United States Geological Survey (USGS)

Introduction

Preventing the introduction of aquatic invasive species (AIS) is the most efficient and cost-effective method to avoid their establishment, spread, and impacts. In addition to prevention measures, early detection, and rapid response (EDRR) strategies are needed to help identify and react to AIS introductions when prevention fails. Early detection involves monitoring for, reporting, and verifying the presence of an invasive species. Rapid response is employed to stop the spread of and eradicate or attempt to eradicate the founding AIS population in a specific location before it begins to reproduce and spread making eradication no longer feasible. Taken as a whole, EDRR is a coordinated process to find and eradicate potential invasive species in a specific location before they spread and cause harm (Figure 1).

The purpose of this document is to provide an overview of rapid response planning and a template for assembling a rapid response plan. Although this template was created for a response to AIS, it may be used as a model for terrestrial or disease rapid response. This document is intended for federal, state, regional, Tribal, territorial, county, and local agency staff responsible for preparing for and responding to new detections of AIS. All entities that have a role in responding to an invasive species detection within the area or for the species covered by the plan should be involved in drafting or reviewing the response plan. This document provides a template for each aspect of a rapid response plan, highlighting the needed elements. A response plan can be written to focus on a particular invasive species or a group of species (e.g., an entire genus). Species can be prioritized based on a horizon-scanning or a risk analysis process to identify high-risk species or prioritization can be based on the presence of invasive species in nearby jurisdictions. Alternatively, a response plan can focus on a particular waterbody or geographic area (for example, waters of a particular state or park unit) and consider multiple potential invasive species that are likely to survive in the waterbody or area. No matter the plan focus, the same plan structure is used.

Ideally, a response plan should be developed before the invasive species has been detected. An EDRR Plan helps to elucidate Roles and Responsibilities for efficient and consistent communication and response. Having an effective plan that includes designated responders, and available resources in advance of an incident allows for quick response to new detections, minimizing the likelihood that the species will spread and cause harm. The detection of an invasion is essentially considered an “incident” which may or may not, require a response. The type and level of risk greatly affects the scope, scale, complexity, and temporal aspects of the response to a detected invasion. Previously developed site-based risk assessments, including pathway and vector risks and species-based risk assessments, can help support the decision process that defines who, when, how, and if to respond to a new invasion. Response to an invasion “incident” may be formal or informal, and managed at different scales and complexities. The scope, scale, and complexity of the incident will affect how the response is structured and managed. Whether the incident is simple or complex, formal, or informal, low- or high-risk, the response approach can be addressed using the incident command system or other structured response approaches.

While some response actions may be linear, others may reflect a more iterative process. A response plan will have the most utility if it has been tested for its applicability under actual or scenario-based situations and reviewed to accommodate new information or changes. As new information is obtained

on the distribution and abundance of the newly detected species, the response plan may need to be adapted to maximize effectiveness and ensure regulatory compliance. The plan should be reviewed every 2-3 years to make sure the information is still correct.

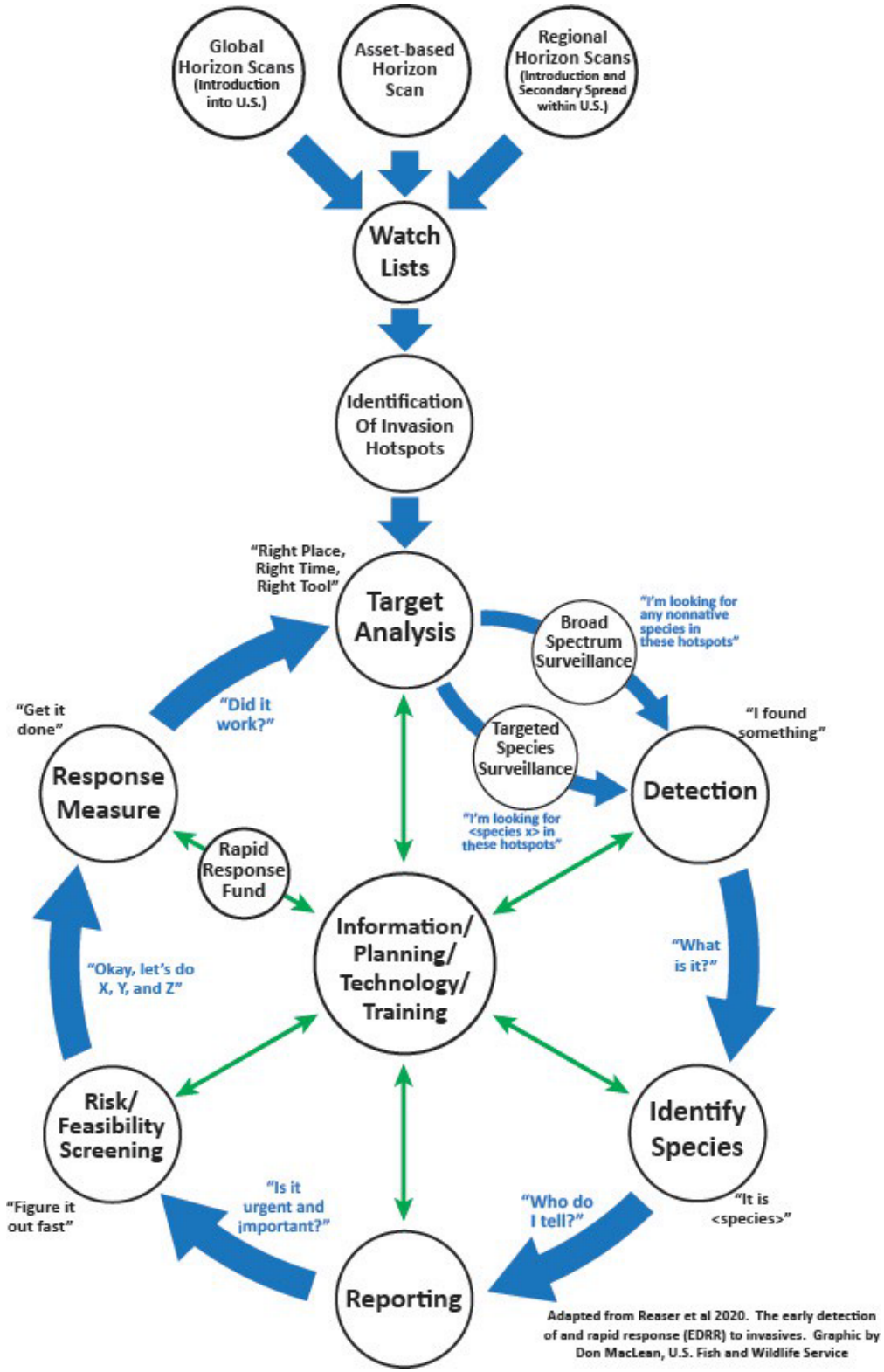

Figure 1 National Early Detection and Rapid Response (EDRR) Framework.

The figure provides guidance on the steps to EDRR process. The figure has been adapted from Reaser et al. 2020.

Plan Scope

The scope of a plan should state the geographic area and/or species covered by the plan. If the plan's scope includes multiple species or large or multiple areas, grouping them may make the plan more concise and easier to follow. For example, species could be grouped based on treatment or control options, biology of the organisms, or habitat type. Waterbodies with similar characteristics affecting response or in which introduced species may be able to survive and reproduce could be grouped. Additionally, the scope could include the whole jurisdiction.

Species covered by the plan should be ones known to have significant negative impacts and/or are new to the area covered by the plan. Identification of priority species during the planning stage will improve the decision-making process on whether a new detection requires a response. Priority species lists (sometimes called "watch lists") can come from numerous sources and be helpful in development of the plan. Sources include:

- Global horizon scans of species that can be introduced to the jurisdiction through importation, hitchhiking on commodities, or other human-mediated or natural pathways. (see Daniel et al. 2025)
- Regional horizon scans of non-native species that are established in nearby regions and could move into the jurisdiction through natural or human-mediated pathways. (see Lieurance et al. 2023, O'Shaughnessy et al. 2023, Wyman-Grothem, et al. 2024)
- Asset-based horizon scans to assess which non-native or invasive species could impact resources within the target area (hatchery, refuge, park, waterbody, etc.).

A species-specific plan should include information about the species' natural history and control. This will aid in potential management decisions on the best approach for the rapid response. Different species or taxa will require different responses. Relevant types of information to include about each invasive species are identifying characteristics, habitat requirements, life cycle, reproduction, local and global distribution, potential pathways and vectors, known methods of control, invasion history, and documented impacts of invasion.

Geographically specific plans should include a map of the area covered by the plan. The following types of information may be included in geographic plans: recreational access points, human uses in the area, relevant infrastructure (such as fish hatcheries, hydroelectric facilities, water purveyors, etc.), land management and ownership, location of AIS already present in the area, existing monitoring stations and their ownership, existing AIS control programs (including locations of boat and boot wash stations), special status species (e.g., federally endangered species), historic or cultural resources, habitat types, and relevant climatic and landscape features.

Regularly reviewing your rapid response plan every 2-3 years is essential to ensure its continued relevance and effectiveness. As circumstances, goals, and points of contact change, a previously well-crafted plan may become outdated or misaligned with current needs. A periodic review allows for adjustments based on team members or organizations, technological advancements, or regulatory changes. It also helps identify areas for improvement and ensures that resources are being allocated efficiently. By proactively assessing and refining the plan, individuals or organizations can stay adaptable and better positioned for long-term success with their rapid response.

Each section of the template includes worksheets, tables, or other interactive features available on Siren (the National Early Detection and Rapid Response Information System) to assist in developing a rapid response plan. It is recommended that you complete each section to develop a comprehensive response plan. Throughout the document we provide examples of information to include in the section, along with important external resources from various federal and state agencies. Please consider looking through some of these resources to see if any existing rapid response plans have been made that you could review.

Worksheet 1. Scope

Created by:

Jurisdiction:

Date:

Scope of plan *(species and/or location):*

Optional text to explain the significance or reason for the plan:

1. **Possible species-specific information:**
    a. Status of the species in the area of concern and neighboring jurisdictions (e.g., established in the wild, not in the wild, unknown)
    b. Spread Potential
        i. Distribution potential based on biology of species (e.g., large home range, spreads quickly, only passive movement, etc.)
        ii. Pathways or vectors of spread – how might this species be transported to a new area (e.g., in trade, fisheries stocking, vessel traffic, research, etc.)?
        iii. Hitchhiking potential – how likely is it that this species could be transported as a hitchhiker or contaminant? (List any transportation and materials that could be used)
    c. Human uses (e.g., ornamental, pet, game species, etc.)
    d. Information on known life history
        i. Habitat of the species (e.g., lakes, rivers, thermal or salinity requirements, etc.)
            1. Known limiting factors or tolerances.
            2. Habitat specificity (generalist, specialist, unknown)
        ii. Reproduction
            1. Timing (seasonal, multiple times year, over-winter, etc.
            2. Number of offspring per reproductive cycle
            3. Is asexual reproduction possible?
            4. For plants – how are pollen and seeds dispersed?
            5. Possible seed bank and also other forms of in soil reproduction
        iii. For Animals - Feeding preference (e.g., piscivore, herbivore, detritivore, etc.)
    e. Does the species have a special protected status (CITES, Endangered, etc.)? See section on Compliance with federal, state, Tribal, territorial, and local environmental rules.
    f. Impacts
        i. Disease and parasite host (list the diseases and/or parasites the species is known to host and any known native species that could be at risk)
        ii. History of invasiveness (include any special designations, for example, injurious or noxious weed)

iii. Known negative impacts to the environment?
iv. Known economic impacts?
v. Known threats to humans?
vi. Known impacts to cultural resources?

2. **Possible location-specific information:**
    a. Jurisdiction (e.g., state, territory, Tribal lands, county, park, etc.)
    b. Location description (e.g., wildlife refuge, lake, reservoir, bay, etc.)
    c. Geo-coordinates
    d. Access to the location (roads, boat ramps, etc.)
    e. Waterbody and surrounding land management and ownership
    f. Waterbody information
        i. Waterbody and surrounding land uses (e.g., recreational, water source, irrigation, etc.)
        ii. Waterbody characteristics (e.g., temperature range, depth, salinity, turbidity, etc.)
        iii. Waterbody connectivity (inflow, outflow streams and rivers or via aqueducts or diversions)
        iv. Known AIS already in the water body?
    g. Species of special concern found in that location (e.g., endangered, threatened, species of greatest conservation of need, etc.)
    h. Maps of the geographic scope of the plan

Roles and Responsibilities

Identification of entities with jurisdictional responsibility or authority prior to any detection of AIS will facilitate a coordinated response in the event of an actual discovery. After the geographic scope of the plan is determined, relevant federal, state, regional, Tribal, territorial, and local entities with jurisdiction for response activities should be identified. Multiple entities may contribute to a response; typically, the entity with the ultimate decision-making and legal authority will serve as the lead, with other entities in a supporting role. A lead agency should be agreed upon and clearly designated by all involved agencies. For responses occurring within federal waters, federal agency roles are determined by agency authorities. For example, the National Park Service (NPS) would be lead for response activities occurring on NPS managed properties.

Once the relevant entities with jurisdiction are identified, obtain and record the lead contact and contact information from each entity to ensure efficient and consistent communication. (See Table 1.) Contact information should be reviewed and updated every two to three years. Consider recording the role of each agency or department, along with specific individual contacts.

Identify relevant permitting processes for agencies that may be involved in a response and typical amount of time needed to complete the permitting process for response actions. It may be possible to secure general permits for response actions under various scenarios prior to an actual incident (See Compliance with federal, state, Tribal, territorial, and local environmental rules section.)

Coordination

Depending on the response scenario, multiple entities may have a role in decision-making and financing the response. Determining how decisions will be made and communicated prior to the response will

enable the response team to act without delay. The response plan can provide a process for integration of decision-making capabilities and is discussed in the Response section.

Development of mutual aid agreements prior to the incident can establish norms for resource sharing when multiple entities are involved in the response by defining criteria and processes for sharing resources such as personnel, equipment, facilities, and funding. Specific guidance on establishing mutual aid agreements can be found in the National Incident Management System Guideline for Mutual Aid.

Roles and Responsibilities Table

Identify the organizations that have jurisdiction and authority over the management of invasive species within the specified geographic area specified in the scope worksheet. Additionally, include other organizations that may assist in the response or whose actions, roles, and responsibilities could impact it. Examples of organizations to consider: federal, state, territorial, municipal, regional, and local resource agencies, water management authorities, Tribal Nations, private landowners.

Questions for consideration:

- Who manages the property and water in the area?
- Who controls public access?
- Who has regulatory authority over movement of the invasive species?
- Who has authority to manage, treat or remove the invasive species?
- Who has authority to restrict pathways?
- Who has jurisdiction over disposal methods, if needed?
- Who has authority over non-target species that may be impacted by the response?
- What municipal, county, Tribal, territorial, state, or federal entities have authorities to take response actions on private property?
- What are the response authorities (including any rules, regulations, or ordinances) for each of the entities listed above?

Example Roles and Responsibilities Table. See below for full fillable table.

Entity	**Role/Responsibility**	**Jurisdiction**
Tribal Nation Agency	Lead agency, access to waterbody, removal of the species, funding	Landowner/ wildlife management
State Agency	Support agency	State authority
State University	Support agency	None

Table 1. Roles and Responsibilities Table - For organizations whose actions, roles, and responsibilities may impact the response.

Entity	Role/Responsibility	Jurisdiction

Internal Communication

Effective communication is critical to create a timely exchange of information among those involved in the response. A list of lead contacts from all entities involved in the response should be developed and updated every two to three years. (see Example Communication Table 2). Consider creating tiers of notification, so important communications reach essential groups first. Composition of the tiers will depend on the specifics of the area covered by the plan. For example, tier 1 are individuals or entities that should be notified immediately when a new detection is suspected, but not confirmed. This could include those with legal authority over a water body (e.g., Tribal, territorial, state, federal authorities) or others who need situational awareness (e.g., agency heads, governors, mayors, etc.). Once a new detection is confirmed, all pertinent information should be provided to the tier 2 individuals in the Internal Communication Table (e.g., utility groups, landowners, etc.). This will aid in maintaining a coordinated response and keeping decision-makers informed of the situation, enabling them to make informed choices on possible next steps. Coordinated internal communication provides an opportunity for those leading the response to develop appropriate messaging for external groups (e.g., method for reporting additional sightings, recommended actions to prevent further spread, etc.).

Example Internal Communication Table- See below for full fillable table.

Notification Tier	Agencies/ Organizations	Name and Title	Email	Phone
1	*State*	Person	@email	#######
1	*Tribal*	Person	@email	#######
2	*Utilities*	Person	@email	#######

Table 2. Communication – Internal to Response

Fill out the table for all groups needed for a response. Primary and secondary contacts are recommended, as appropriate.

Notification Tier	Agencies/ Organizations	Name and Title	Email	Phone

External Communication and Outreach

It is important to have coordinated external communication to minimize confusion, streamline efforts, and ensure delivery of a consistent external message. Effective external communication is most easily accomplished by having a designated public communication officer for the response (e.g., a staff member from the lead entity's' communication department) to oversee all communications (see National Incident Management System Basic Guidance for Public Information Officers for more detailed information). The public communication officer will use agreed upon objective terminology to refer to the detection and level of infestation or response strategies to help bring greater understanding of the situation, garner public support for response actions, and gain support for recommended actions to limit spread (e.g., temporarily restricting access to a waterbody). Developing draft press releases or templates before an incident can speed the release of information and provide consistent messaging. Specific duties of the public information officer may include:

- Support the internal and external communications needs of the participating entities.
- Gather and disseminate incident information to ensure all relevant audiences are kept informed about the response efforts.
- Inform public, rightsholders, and stakeholders about the response.
    - Convey information to the public on the rapid response in an objective way, using neutral analytical language, avoiding politically or emotionally charged descriptions.
- Assist in establishing and implementing communications protocols such as for holding press conferences, disseminating press releases, and answering media queries.
- Ensure that the entities are kept informed on the overall response efforts.
- Develop an Outreach Plan with contacts, key messages, and distribution tools.
    - Revisit the Outreach Plan to keep contacts up to date.

When communicating with external partners, stakeholders, and rightsholders, it is vital to utilize dialogue that describes the problems associated with the invasion and the benefits of rapid response management. Sharing information about the species, the general location (unless poaching is a concern), and possible spread pathways, along with the known impacts on the local ecosystem, economy, and human health. Informing the public about the jurisdictional authority's official actions and any required calls to action, such as surveillance for the species. The message should be clear, concise, and accessible, using various media (websites, social media, press releases, and community meetings) to reach diverse audiences. Deliberate, well planned public outreach regarding the response can aid in informing, engaging, and partnering with the public (see Example Communication Table 3). There are numerous entities that can be informed of the effort, including:

- Neighboring and other potentially at-risk jurisdictions and agencies
- Relevant user groups (e.g., recreation, industry)
- Special interest groups (e.g., conservation organizations)
- Media

Example External Communication Table (Table 3). See below for full fillable table.

Agencies/ Organizations	Name and Title	Email	Phone
Neighboring jurisdictions	Person	@email	#######
User groups (e.g., recreation)	Person	@email	#######
Special interest groups (e.g., conservation orgs)	Person	@email	#######
Media	Person	@email	#######

Table 3. Communication – External to the Response

Fill out the table with all groups and their point of contact for outreach communication.

Agencies/ Organizations	Name and Title	Email	Phone

Invasive Species Detection and Confirmation

Detection

The plan should outline who will be designated as the point of contact (POC) and which agency will be responsible for receiving reports of invasive species detections and confirming their identification. Information about new invasive species may be gathered from intra-agency sampling or external sources (see list in Resources for Response section). Entities conducting surveillance should promptly communicate the results to the designated managing entity upon initial detection, prior to any follow-up confirmation sampling. The plan should specify the timeframe for reporting detections (e.g., within 24 hours) to the designated agency POC. Additionally, the selected POC agency should work to maintain connections with other natural resource agencies and potential reporting partners.

An initial detection may occur in a variety of ways including:

- Visual identification or collection of one or more specimens by:
    - Private individual
    - Community science group
    - Non-government organization
    - Academic institution
    - Industry
    - Local, state, Tribal, territorial, or federal agency
- Positive environmental DNA (eDNA) results from a water sample collected by:
    - Non-government organization
    - Academic institution
    - Local, state, Tribal, territorial, or federal agency

There are numerous regional and national invasive species databases (See Online Resources in Response Section) that provide information about new detections of invasive species. Three of the national databases, EDDMapS, iMapsInvasives, and United States Geological Survey (USGS) Nonindigenous Aquatic Species (NAS) Database, offer email alerts to subscribers about new detections.

For an example of a multijurisdictional surveillance plan see the Aquatic Invasive Species Interstate Surveillance Framework for the U.S. Waters of the Great Lakes (Chadderton et al. 2019).

Confirmation

Confirmation of invasive species identification is initiated when there is a report of a possible new species or a species in a new location. The plan should include how a reported detection will be confirmed and what would trigger a response based on samples collected by various methods. It is recommended that confirmation should include the use of multiple specimens and identification by two independent taxonomic experts. In some cases, additional sampling may be required to confirm identification. For some cryptic species, that are morphologically identical to native species, visual identification based on morphometrics might not suffice and that genetic confirmation might be required (for example Marmorkrebs crayfish (*Procambarus virginalis*) or New Zealand Mudsnails, *Potamopyrgus antipodarum*). To prevent a delay between identification and confirmation, a list of experts able to confirm identification, or conduct genetic testing can be included in the plan. The

Aquatic Nuisance Species Task Force Experts Database provides a source of taxonomic and genetic experts that could assist (*https://siren.fort.usgs.gov/findexperts*).

Experts familiar with eDNA should be consulted prior to collecting samples for eDNA analysis to ensure sampling design, quality control, and interpretation of results are robust. A single positive eDNA result would not be considered sufficient for confirmation but should lead to additional sampling to find and collect individuals in the subject waterbody. It also is suggested that the molecular lab processing the eDNA follow minimal requirements for eDNA analysis and sample handling such as those developed by USGS to be included in the NAS database (e.g., Ferrante et al. 2022), United States Fish and Wildlife Service (USFWS) (Environmental DNA (eDNA) Best Management Practices for Project Planning, Deployment, and Application | FWS.gov), or United Sates Department of Agriculture Forest Service (FS) eDNA Atlas (www.fs.usda.gov/research/rmrs/projects/ednatlas).

It is essential to preserve the initial specimen(s), eDNA samples, and any follow-up samples of the species for confirmation (positive identification). Preserved specimens should be housed in natural resource collections at a museum for perpetuity. Once confirmed, the occurrence should be reported by the entity with jurisdiction to one of the invasive species databases: the USGS NAS Database , EDDMapS, iMapInvasives.

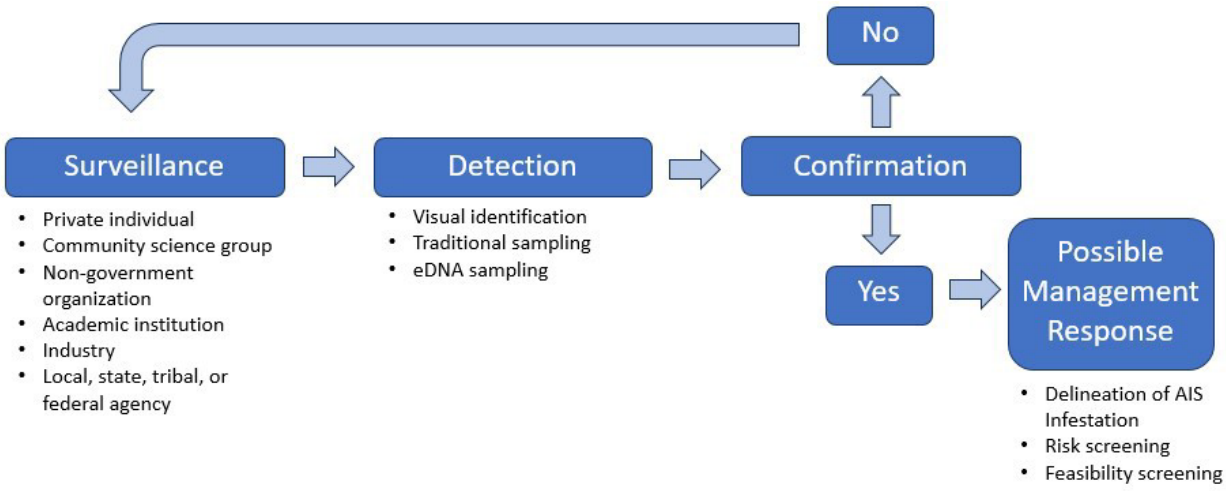

Figure 2. Example flow chart showing decision points and responses.

Delineation of AIS Infestation

It is essential to consider the spatial and temporal extent of the possible infestation and the environmental conditions before initiating a response. The plan needs to include information on how the spatial extent will be established through sampling (or checking data from long-term monitoring) in areas surrounding the discovery (see below for more methods for delineation). The plan should also include a protocol for establishing the timeline of the infestation. How long has it been there? Is the population already reproducing? It is possible that this type of data may not be available on discovery of a new species. Identification of known pathways and spread potential will aid in determining spread risk to surrounding systems and identifying additional areas to survey during delineation. The possibility of reintroduction from neighboring systems should also be considered.

Information about the spatial and temporal scale will help when screening for risk (see next section) and determining if a rapid response and eradication is a reasonable approach to the confirmed introduction. If it is determined that the species is widely distributed or already established nearby, a rapid response may not be appropriate, and eradication may not be feasible.

Important Factors to Consider:

- Connectivity of the waterbody
- Life history of the species
- Habitat requirements and tolerances (e.g., will it over-winter?)
- Sensitivity of different detection techniques
- Potential modes of spread (hitchhiking, poaching, etc.)
- Potential introduction pathways

See worksheet below for more examples and considerations. Case studies of actual AIS detections can be found following the Sampling Methods section and can be used as examples of delineation conducted by the primary jurisdiction.

There are various techniques to determine the extent of a species infestation, including traditional sampling methods, eDNA, dive operations, and canine detection (See Sampling Methods for more taxa specific examples). Sampling and surveys can be conducted by personnel from any of the governmental entities identified previously, contractors, or volunteer teams.

Using standardized terminology to refer to or characterize the detection, level of infestation or response strategies helps clarify the situation. For example, a single microscopic organism or fish confirmed detection may indicate an open pathway of introduction into a waterbody and requires further exploration, whereas multiple confirmed adult specimens may indicate a waterbody is infested with a reproducing population of an invasive species.

Sampling Methods

The methods required to determine the extent of the infestation are too numerous to list in this document and vary greatly depending on the taxa and life history. Consulting an expert in the species (See Experts Database) or someone who has responded to the same species may save time in designing a sampling strategy. If eDNA sampling is involved, refer to Morisette et al. 2021. Other nontraditional methods such as canine inspection teams could also be considered. Below is a list of references that identifies sampling methods for various species and habitats.

Taxonomic specific

- **Mammals** –
  - Hoffmann, A., Decher, J., Rovero, F., Schaer, J., Voigt, C., and Wibbelt, G. (2010). Field methods and techniques for monitoring mammals. *Manual on field recording techniques and protocols for all taxa biodiversity inventories*, *8* (part 2), 482-529.
- **Reptiles** –
  - Hutchens, S. J., and DePerno, C. S. (2009). Efficacy of sampling techniques for determining species richness estimates of reptiles and amphibians. *Wildlife Biology*, *15*(2), 113-122.
  - McDiarmid, R. (2012). Reptile biodiversity: standard methods for inventory and monitoring, 77-88.
- **Amphibians** –
  - Olson, D. H., Leonard, W. P., and Bury, R. B. (eds.). (1997). *Sampling amphibians in lentic habitats: methods and approaches for the Pacific Northwest*. Society for Northwestern Vertebrate Biology.
  - Gunzburger, M. S. (2007). Evaluation of seven aquatic sampling methods for amphibians and other aquatic fauna. *Applied Herpetology*, *4*(1), 47.
- **Birds**
  - Sutherland, W. J., Newton, I., and Green, R. (2004). *Bird ecology and conservation: a handbook of techniques* (Vol. 1). OUP Oxford
- **Freshwater fishes** –
  - Bonar, S. A., Hubert, W. A., and Willis, D. W. (2009). Standard methods for sampling North American freshwater fishes.
  - Jackson, D. A., and Harvey, H. H. (1997). Qualitative and quantitative sampling of lake fish communities. *Canadian Journal of Fisheries and Aquatic Sciences*, *54*(12), 2807-2813.
  - Radinger, J., Britton, J.R., Carlson, S.M., Magurran, A.E., Alcaraz-Hernández, J.D., Almodóvar, A., Benejam, L., Fernández-Delgado, C., Nicola, G.G., Oliva-Paterna, F.J. and Torralva, M. (2019) Effective monitoring of freshwater fish. *Fish and Fisheries*, *20*(4), pp.729-747.
  - Schneider, J.C. (2000). *Manual of fisheries survey methods II: with periodic updates*. Ann Arbor: Michigan Dept. of Natural Resources, Fisheries Division.
- **Brackish/estuarine fishes**
  - Franco, A., Elliott, M., Franzoi, P., Nunn, A., Hänfling, B., Colclough, S., and Young, M. (2022). Appendix A: *Study Methods: Field Equipment, Sampling and Methods. Fish and Fisheries in Estuaries: A Global Perspective*, 874-940.
- **Marine fishes**
  - Bakus, G. J. (2007). Quantitative analysis of marine biological communities: field biology and environment. John Wiley & Sons.
  - Caldwell, Z. R., Zgliczynski, B. J., Williams, G. J., and Sandin, S. A. (2016). Reef fish survey techniques: assessing the potential for standardizing methodologies. *PloS ONE*, 11(4), e0153066.
  - Murphy, H. M., and Jenkins, G. P. (2010). Observational methods used in marine spatial monitoring of fishes and associated habitats: a review. Marine and Freshwater Research, 61(2), 236-252.

- **Marine invertebrates**
    - Costello, M.J., Basher, Z., McLeod, L., Asaad, I., Claus, S., Vandepitte, L., Yasuhara, M., Gislason, H., Edwards, M., Appeltans, W. and Enevoldsen, H., 2017. Methods for the study of marine biodiversity. *The GEO handbook on biodiversity observation networks*, pp.129-163.
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Worksheet 2. Current Extent of the Invasion

Answer the following questions to determine the extent of the current infestation. This information will be used to help determine whether and how to respond.

Questions for consideration:

1. Have you consulted with experts in designing your sampling strategy? If so, what feedback did the experts provide on your sampling strategy design?
2. What is the known distribution of the species within the waterbody?
3. Is the verified detection isolated to a single location or over multiple areas (multiple waterbodies or multiple areas within a large waterbody)?
4. What life stage are you sampling for in the current season?
5. Are there indicators that the species is reproducing? Have you found multiple life stages?
6. Are potential mechanisms of dispersal known for the species? If no, what is the most probable dispersal mechanism?
7. How can the species move within the waterbody or drainage?
    a. Active (for example, swimming)
    b. Passive (for example, drift of larvae or transport by currents or flow)
    c. Hitchhike on other species?
    d. Human mediated (for example, watercraft, fishing tackle, etc.)
8. Can the species move outside the waterbody or drainage?
    a. Overland movement (on its own)
    b. Movement in flooding
    c. Bird or other wildlife-vectored movement
    d. Human mediated (for example, sporting equipment, watercraft, fishing tackle, etc.)
    e. Movement on other equipment and infrastructure (for example, barges, water trucks, etc.)
    f. Movement associated with water management (for example, diversions, canals, pumps, etc.)

Case Studies

Red Swamp Crayfish (Procambarus clarkii) near Jacksonville, Florida

In August 2022, an EDDMapS report of red swamp crayfish (*Procambarus clarkii*) was received from a location in northeast Florida near Jacksonville. Florida Fish and Wildlife Conservation Commission (FWC) staff confirmed the report and positively identified a specimen as red swamp crayfish. The site has a series of drain lines connected to a retention pond. The red swamp crayfish were first spotted in one of the access wells of the drainage system and were also collected in a trap from the retention pond. Small numbers of red swamp crayfish were also trapped from a shallow pothole in an almost completely dry drainage ditch just north of the site. Trapping and surveying in waterbodies near the site were rapidly initiated to define the geographic range of the red swamp crayfish and a team was established to formulate an early detection rapid response plan to address this novel Florida invasion. The plan was executed over a two-year period with minor adjustments in control tools applied to the area. It was determined that the red swamp crayfish could not be eradicated with current control tools, but regular control treatments could contain the population to the infested area. (M. Spencer, FWC, personal communication, February 2024).

Zebra mussels (Dreissena polymorpha) in Christmas Lake, Minnesota

The Minnehaha Creek Watershed District detected zebra mussels (*Dreissena polymorpha*) in Christmas Lake using settlement plates at a high use access point in August of 2014. This prompted immediate

further visual inspection, and many mussels were found on the rocks near the access point. Minnesota Department of Natural Resources began a lake-wide assessment starting with snorkel surveys that resulted in no additional zebra mussels detected outside of the access point area. Snorkel surveys were followed by plankton tows taken at sites across the lake and analyzed microscopically resulting in no veligers (larvae) detected. In the weeks following, a systematic assessment using a combination of SCUBA, snorkel and wading in the immediate area of initial detection resulted in many adult mussels detected (5500 individuals). All of the information was used to inform the treatment area for an attempted eradication (Lund et al., 2018).

Caulerpa prolifera in Newport Bay, California

In April 2021, *Caulerpa prolifera* was found and confirmed growing in the China Cove area of Newport Bay, California in soft-bottomed habitats. Concern was high because of environmental impacts from previous introductions of Caulerpa species in California and elsewhere. The Southern California Caulerpa Action Team (SCCAT), which was initially convened to respond to a *Caulerpa taxifolia* infestation along the Southern California coast in 2000, was re-assembled to develop a strategy for responding to the *C. prolifera* discovery. The SCCAT arranged for preliminary surveys in late April 2021 to delineate the current extent of the infestation. Areas to be surveyed were identified based on the known location of the *C. prolifera* discovery near the mouth of Newport Bay and models of potential spread. During the initial delineation survey, the extent of infestation appeared to be limited to 200 square meters (over 1.2 hectares). During the survey divers noted the alga's growth form (rooted, attached to substrate, or mobile clumps) because this was important to understand potential spread. Based on the results of the initial surveys and potential economic, recreational, and biological impacts, a decision was made to attempt eradication. (SCCAT, July 2021; Merkel & Associates, March 2023; Merkel, K, personal communication.; Miller, W.B., personal communication).

Risk/Feasibility Screening

Confirmed detection of an AIS does not necessarily prompt a rapid response. Therefore, advance consideration of risk and response feasibility for specific species or locations are recommended to further inform potential actions. For each species included in the rapid response plan, it is important to determine the need for a response based on: 1) risk screening, which assesses the risk the species poses to ecological, economic, and human health of the area, including an assessment of the potential negative impacts of the new introduction; and 2) feasibility screening, which assesses the ability of the jurisdiction or agency to conduct a rapid response or if the actions will result in eradication of the species. The combination of Risk Screening and Feasibility Screening will determine whether to deploy a rapid response (Figure 3).

Consideration of the following elements can help determine the feasibility of response. These elements should be explored in an expedited, but thoughtful way. See the decision tree created by the Pennsylvania Invasive Species Council (page 6, 2019).

Risk Screening - Invasiveness of the species

What is the known or potential negative impact of introduction and establishment of the species to the ecological function of the watershed and economy of the area? What characteristics of the species would affect invasiveness? Considerations:

- Known or suspected ecological, economic, and human health impacts to:
    - Species of conservation concern
    - Important natural assets
    - Game species
    - Agriculture
    - Infrastructure
    - Recreational resources
    - Other
- Natural dispersal potential
- Human mediated dispersal potential
- Life history, life stage and reproductive traits
    - Will it survive and reproduce long-term?
    - Will predation or herbivory control the species?

Risk Assessments

There are several sources of existing information about the potential risk of a species. Dean and others (2023) cataloged all publicly available fish risk assessments. Additional lists of risk assessments of plants and invertebrates are being made available on Siren, as well as links to publicly accessible risk databases.

- National Oceanic and Atmospheric Administration's (NOAA) Great Lakes Aquatic Nonindigenous Species Information System (GLANSIS; https://www.glerl.noaa.gov/glansis/) has a Risk Assessment Clearinghouse. It contains information on risk assessments on all taxa related to the Great Lakes.
- U.S. Fish and Wildlife Service's (USFWS) Ecological Risk Screening Summaries (ERSS; https://www.fws.gov/story/ecological-risk-screening-summaries) offers rapid risk screenings of a species' potential to become invasive. These evaluations identify which species are likely to be high risk (more likely to cause damage if they spread beyond their natural range), low risk (less likely to cause harm), or uncertain risk (insufficient information available to make a determination).
- U.S. Department of Agriculture's (USDA) Animal and Plant Health Inspection Service (APHIS) conducts weed risk assessments (WRA; https://www.aphis.usda.gov/plant-pests-diseases/noxious-weeds/noxious-weeds-program-risk-assessments) as part of its process for safeguarding U.S. agriculture and natural resources from weeds and invasive plants. A weed risk assessment for terrestrial and aquatic plants is a science-based evaluation of the potential of a plant species to establish, spread, and cause harm in the United States.

Screening Tools

If the risk information for your species does not exist or if the lead agency wants to conduct their own risk assessment, there are several risk screening tools publicly available for use. Invasion risk screening tools are frameworks or models used to assess the likelihood of non-native species becoming invasive (spreading and causing negative impacts) in a given environment. They typically evaluate factors such as the species' biological traits, environmental suitability, and potential impacts on ecosystems. These tools support decision-making in biosecurity and conservation efforts by identifying high-risk species before they cause harm. There are many different risk screening tools, a few examples include:

- The Aquatic Species Invasiveness Screening Kit (AS-ISK; Copp et al. 2016) can be applied to all aquatic plants and animals from any type of aquatic system (marine, brackish/estuarine, freshwater), with the exception of infectious agents (parasites and pathogens).
- Fish Invasiveness Screening Kit (FISK; Vilizzi et al. 2019) – Focuses specifically on assessing the invasiveness of freshwater and brackish water fish.
- Canadian Marine Invasive Screening Tool (CMIST; Kingsburyet al. 2024) – Assesses freshwater and marine species' invasion risks in Canadian waters by evaluating their ecological and socio-economic impacts. https://www.bio.gc.ca/science/monitoring-monitorage/cmist/index-en.php

Worksheet 3. Feasibility

1. **Life history characteristics-** The life history of the species will influence the feasibility of management response as well as the risk of the species. Things to consider:
    a. Can management actions be taken based on known life history?
    b. Which stage is most feasible to eradicate?
    c. Will the species reproduce and spread before a response can be implemented?
    d. Is the minimum viable population known for the species?
    e. Climate suitability of the species:
        i. Will it survive and reproduce long-term?
        ii. Will predation or herbivory affect the species?

2. **Extent of the invasion-** The current range of the invasion and potential for the species spread can influence a management response. Things to consider:
    a. Is the introduction at a stage that a response can still be beneficial?
    b. Can the source of the introduction be identified? If no, what is the most probable source?
    c. What is the current extent of the infestation?
    d. Is a response possible based on the extent of the species spread?
    e. Is the species likely to move beyond its current location and spread rapidly and/or widely? Can the species be readily transported (self or human/animal-assisted)?
    f. Is there a source population outside the jurisdiction that reintroduces the species into the new area?

3. **Availability of management options-** The potential for a management response can be determined by the availability of options for control or eradication. Things to consider:
    a. Is technology available for a response?
    b. Is an eradication or control technology (for example, chemical, biological, physical) available?
    c. Will the proposed response mitigate the risk of establishment or spread of the species?
    d. Have alternatives to eradication (containment, monitoring, or no action) been considered?

4. **Cost and capacity-** The cost of a management response and the available capacity of the jurisdictional agency can impact the effectiveness and potential for a rapid response. Things to consider:
    a. Can the agency or partners take on the financial responsibilities of the response?
    b. Are internal and/or external funds available for initial and ongoing response?

c. Does the jurisdiction have the necessary resources, and can it afford to implement the response, including access to skilled personnel and equipment to execute the response and follow-up, as needed?
d. Is there an opportunity to partner to obtain the necessary resources?
e. Are there interested partners (for example, current and future impacted jurisdictions) that can be contacted if a multijurisdictional or regional response is needed?
f. Do agency decision-makers support starting and maintaining response actions?
g. Is access to the site physically difficult and/or cost-prohibitive?
h. Can the entity conducting the response obtain authority to access the site?

5. **Timeframe-** The timing of when the rapid response can be started can influence the effectiveness of the effort. Things to consider:
    a. How quickly is response required to address the invasion and risk?
    b. If establishment was not considered in the risk assessment, it should be here.
    c. Timing of the response:
        i. Is a method of eradication/control available?
        ii. Can the eradication/control method be used in the timeframe available (consider associated climate /seasonal factors/financial resources/staffing)?

6. **Impact on at-risk species, human use and public access-** Responding to an invasive species in a waterbody could lead to temporary restrictions on public access or use to ensure effective management. Things to consider:
    a. Will the response disrupt normal operations in the waterbody (recreation, harvest, etc.) and if so, can the agency manage the disruption?
    b. Will the response have potential impacts on non-target species or ecosystem services?
    c. What activities need to be suspended to implement the response (human use of the watershed for example: recreation, drinking water, irrigation)?
    d. Is there the presence or proximity of endangered, threatened, or other rare/at-risk species that could be affected by response actions?
    e. Are there the potential non-target species impacts of response?

7. **Compliance and consultation-** Compliance in consultation is critical before enacting a rapid response to a new invasive species to ensure legal, ethical, and ecological considerations are addressed. Things to consider:
    a. Does the response align with legal and regulatory requirements (primary jurisdiction, Tribal, state or federal requirements) as well as best practices?
    b. Does the primary jurisdiction have the authority for the response action?
    c. Have potential indigenous, cultural, and historical impacts been considered (see section on Compliance with federal, state, Tribal, territorial, and local environmental rules)?

8. **Acceptability-** Public and political support is important for the success of a rapid response effort. Things to consider:
    a. Is the response acceptable to rightsholders and stakeholders, including landowners, agency leadership, and partners?
    b. Is there likely public support for response?
    c. Will the types of control available and the possible impacts on resources and public uses of those resources be acceptable?
    d. Have cultural (for example, historic, indigenous) considerations been considered?

e. Have the human uses of the species been considered?
f. How will the rapid response influence human use of the waterbody (shipping, fishing, recreational boating)?

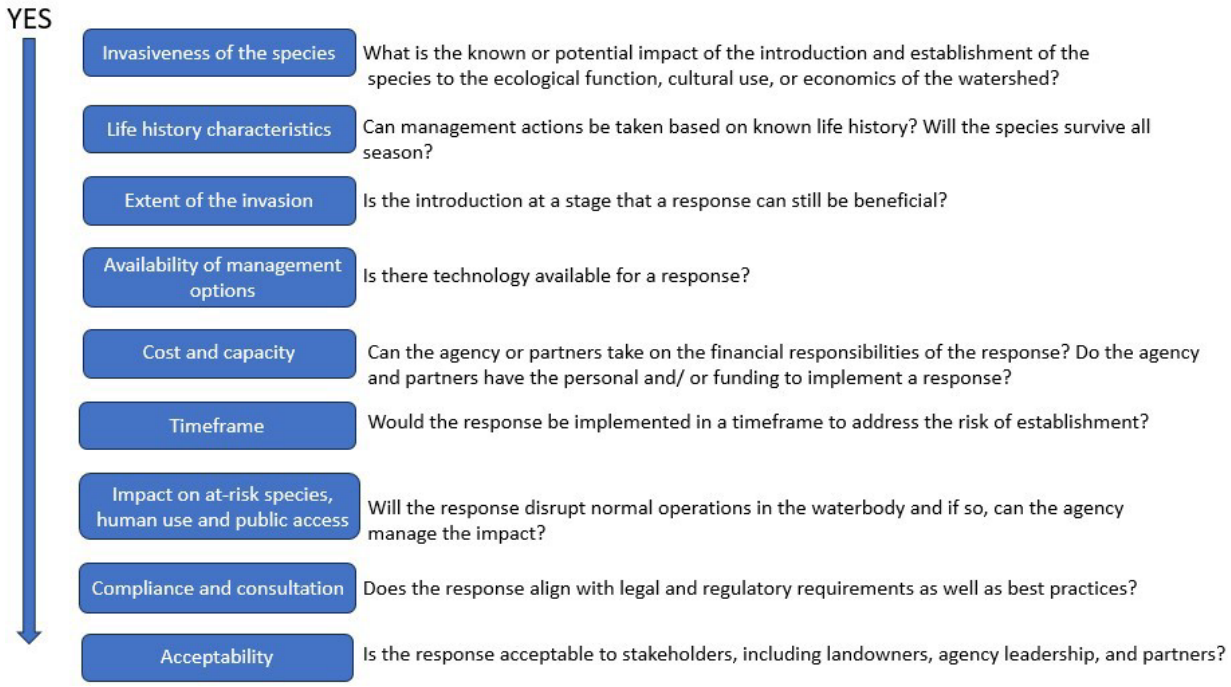

Figure 3. A flow diagram of considerations to determine the feasibility of response.

The flow moves from top to bottom addressing elements about the species, location, jurisdiction/agency internal considerations, and external considerations. A single "no" could suggest a response is not feasible, but the final decision will be determined by the primary jurisdiction.

Response

Once the initial discovery of an invasive species is confirmed and the decision is made to respond, the next step is to consider the elements needed to successfully proceed and what type of an organizational response structure is needed.

Organizing the Response

An effective response to a confirmed invasive species discovery should include the following critical elements: designated decision makers, surveillance and delineation, containment, eradication and control, monitoring, and communication. The extent of resources and staff needed to implement these critical elements depends on the size and nature of the response. Required staff size may range from a single person fulfilling numerous roles (small response) to multiple-person teams dedicated to each critical element (large response). An effective response requires agencies and jurisdictions to consider critical elements prior to an invasive species detection and identify available resources and staff who will respond to a detection. Resources and staff will be organized into teams; each team will be responsible for responding to one or more of the critical elements. The information provided here is intended to

help agencies and entities identify critical elements and determine which resources and staff are necessary to implement an effective response.

Surveillance and Delineation

Understanding the scope of an invasive species infestation is essential to determining the containment and eradication/control measures as well as the necessary resources for response.

Actions and recommendations for surveillance and delineation include:

- Surveillance methods to delineate the infestation (e.g., physical, molecular etc.).
- Surveillance plan for confident detection of invasive species.
- Source of supplies and equipment needed for identified surveillance method.
- Identification of staff and resources necessary for surveillance plan.
- Identification of labs for processing genetic samples (if collected) and timeline for results.

Containment

An effective response is more likely if the invasive species is contained to a limited geographic area. What authorities are available to prevent movement of the invasive species or limit access to infested areas? The response plan should clearly articulate if there are local, county, state, Tribal, territorial or federal authorities that can be used to contain the invasive species through waterbody closure, road closure, in-water booms, etc.

Actions and recommendations for containment include:

- Process to implement authorities for containment.
- Timeline to implement a regulatory containment (set of rules and standards that govern the containment).
- Personnel available to enforce containment measures.
- Outreach to the public about containment measures (see communication section).
- Methods for containment.
- Staff, equipment, and materials for containment measures.
- Methods for implementing voluntary containment measures with the public if no regulatory authorities are available.

Eradication and Control

The plan should state what eradication and control methods are available for the species of interest. This section of the response plan should identify different actions based on the extent of the infestation and available resources. Additionally, the plan should clarify when the management objective would transition from eradication to long-term control. There are situations when eradication of a species or rapid response is not possible, and managers will need to commit to long-term management of the established species to minimize impacts.

When implementing control efforts for aquatic invasive species, it is essential to consider potential non-target impacts to minimize unintended harm. Chemical treatments or mechanical removal can affect native species, disrupting food webs and water quality. A thorough National Environmental Policy Act

(NEPA) review and risk assessment can helps mitigate these risks, ensuring that control measures effectively manage the invasive species while preserving overall ecosystem health.

Actions and recommendations for eradication and control include:

- Methods to eliminate, remove, limit reproduction, and/or decrease population of invasive species.
- Supplies and equipment needed to apply control measures and timeline to acquire the supplies.
- Personnel resources needed to apply control measures or use of professionals for control (e.g. certified pesticide applicators).
- Disposal method for invasive species (if applicable).
- Limiting non-target impacts of control efforts.
- Safety procedures and precautionary measures necessary for treatment.

Case Study: Rapid Response to address *Caulerpa prolifera*

A response to the April 2021 detection was seen as necessary to prevent potentially serious biological, economic and recreational impacts. The previous infestations of *C. taxifolia* discovered in Huntington Harbor and Agua Hedionda lagoon took 8 years and over $7 million to eradicate (Merkel & Associates, March 2023). For the occurrence of *C. prolifera* in the China Cove area of Newport Bay, a decision was made to use hand removal and suction dredging for eradication. While these methods have the potential to fragment the alga during removal and cause further spread from fragments floating away, this was considered the only feasible method for removal in this location due to the strong currents at the mouth of Newport Bay. After the initial eradication survey in 2021 and the hand removal of floating C. prolifera, the suction-assisted removal of rooted Caulerpa was conducted by divers. Subsequently, the area where the Caulerpa was removed was resurveyed by divers to look for areas of regrowth and remove by hand any remaining Caulerpa found (SCCAT, July 2021; Merkel & Associates, March 2023; Merkel, K, personal communication). Follow-up surveys were initially performed and completed until September of 2023 due to intermittent discoveries of Caulerpa in the infestation area, either from regrowth or movement of large amounts of sediment through the survey area that would bury and then expose rooted Caulerpa.

In March 2022, a second patch of Caulerpa was discovered at Collins Isle in Newport Bay, 2.5 km from the China Cove occurrence. A dock dredging project had been proposed in the area, which triggered a survey requirement for Caulerpa. The 2022 occurrence was in an area of the Bay with weaker currents, so a decision was made to eradicate the Caulerpa near Collins Island by placing a sealed benthic barrier over the patch for an extended period. The barrier deprived the Caulerpa of oxygen and light and reduced the chance of fragments breaking free. The Collins Isle patch was treated in May 2022. Surveys were conducted in the surrounding area in May prior to installing the barrier; in early June prior to removal of the barrier, and then in late June after removal of the barrier. No additional Caulerpa was found during any of the May or June surveys. After the surveys confirmed the eradication of the Caulerpa, the dredging project was authorized to proceed, but it had to be resurveyed in compliance with the Caulerpa Control Protocol. (Merkel & Associates, March 2023; Memorandum from Robert Mooney to SCCAT Regulatory Committee, August 2, 2022; Miller, WB, personal communication, Mooney, R, personal communication).

Monitoring

The plan should include a process for monitoring the effectiveness of containment, control and eradication measures that informs the continuation or modification of the chosen methods. Regular systematic surveys are needed to assess the population of the invasive species. There should be an iterative process where containment, eradication and/or control methods are implemented followed by monitoring. Using a combination of techniques (see section on Sampling Methods), such as visual inspections, trapping, and eDNA sampling, can help determine the efficacy of the treatment. If treatment methods are not successful or less successful than anticipated, methods should be modified and monitored for effectiveness (see adaptive management). Additionally, for some methods, it may also be necessary to monitor impact of the response on native species. The *Caulerpa prolifera* case study shows how different eradication methods may be used on the same species depending on the situation.

Adaptive management can be utilized as a structured, iterative approach to invasive species management that emphasizes learning and flexibility in decision-making. It recognizes that there is uncertainty in complex ecological systems and invasive species management and seeks to improve the desired outcomes by continuously monitoring, evaluating, and adjusting management strategies based on new information. This approach involves setting clear objectives (eradication, control, or containment), implementing management actions, monitoring results, and using feedback to refine future management actions. By incorporating scientific research, stakeholder input, and real-world data, adaptive management allows for more effective responses to invasive species (see Foxcroft and McGeoch 2011; Rist et al. 2013).

Response Organizational Structure – Incident Command System (ICS)

The critical response elements previously identified must be organized for effective implementation. If the incident is small and localized, only a few resources may be required to address the issue and a scalable incident response structure may not be needed. However, if the incident is large, multijurisdictional, or otherwise complex, choosing to use a scalable incident response framework is wise. Determining the response framework to be used may be influenced by several factors including, but not limited to, urgency (time) to respond, jurisdictions involved, number of responding entities, funding, nature of the detection and other factors. Regardless of the scale or the approach chosen, the critical response elements described above should be addressed.

A common way to organize resources and decision-making authorities when multiple jurisdictions are involved, or the rapid response is large or complex, is the Incident Command System (ICS) used by the Federal Emergency Management Agency (FEMA) and many other agencies to respond to natural disasters and other emergency incidents. ICS has been used for response to many types of incidents (e.g., oil spills, wildland fires, disease outbreaks, Sars-COV2 vaccination). ICS provides a scalable structure with a clear decision-making process, and a set of common terminology for the response. ICS is especially useful when multiple entities are involved in the response as it provide a concise communication of objectives, priorities, and strategies. It can be used regardless of the number of entities involved. In 2003, Homeland Security Presidential Directive 5 established the National Incident Management System (NIMS) to coordinate emergency response across all federal agencies and uses ICS as the response framework. As a result of NIMS, many federal, and now state, agencies use ICS for their incident responses. ICS has been used to coordinate responses from large national responses to small

local responses for a wide variety of situations. The Columbia River Basin Dreissenid Incident Response Toolkit (www.crbdirt.com) serves as an example of the use of ICS to organize an invasive species response.

Basic tenets of ICS include:

- Unified command that allows (supports) a command structure which can include multiple jurisdictions.
- Span of control that maintains a reasonable supervisor to staff ratio.
- Unity of command that ensures that everyone on the response reports to only one supervisor.
- Scalability that allows the response to fit specific incident needs (from very small to very large).
- Operational and planning meetings that support management of the response by objectives.
- Minimizes differences between agency cultures.
- Personnel resources can come from any agency participating in the response.

This section provides a brief overview of the components of an ICS response (Figure 4), but there are numerous resources available to help further inform how to use ICS to manage a response (see ICS Training).

To effectively utilize ICS:

- All response entities must agree to participate in the ICS framework.
- A critical mass of personnel from response agencies must be trained in basic ICS principles and ideally there should be a core set of response personnel with additional training to serve in the command and general staff positions.

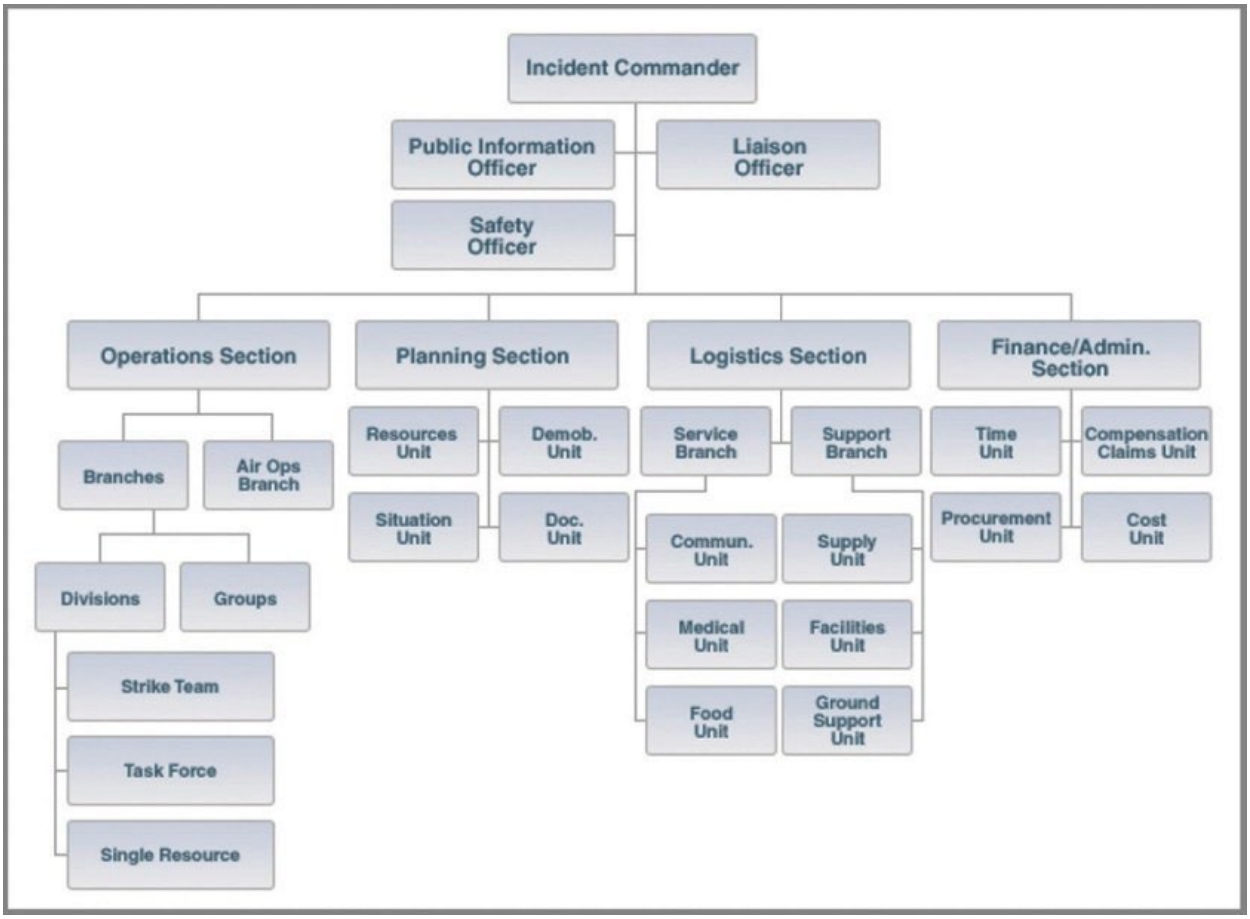

Figure 4. Incident Command System (ICS) Organizational Structure and Elements
Source: (FEMA 2018) image from Wildfire Today.

The ICS system has an Incident Commander and their command staff: Liaison Officer, Safety Officer and Public Information Officer. The general staff is all else in the structure. Each incident may consider the roles identified in Figure 4, and in some cases one or more roles may not be needed. Not every response will require every position, and a single person can fill multiple roles in the organization structure, especially for small, less complex responses See FEMA Form ICS 207 for a fillable version of this chart.

Incident Commander

Incident Commander (IC)- The Incident Commander oversees the organization of the response and has overall responsibility for the incident (See Figure 4). The IC is responsible for establishing the organization needed for the response, coordinating the activities of command and general staff, and approving resource requests. When an incident involves multiple jurisdictions, a unified command can be established allowing for multiple incident commanders representing different jurisdictions to develop a common set of incident objectives and strategies for the incident. The IC is responsible for all positions that are not filled (i.e., in a very small response you may only have an IC and Operations

Section Chief). In that situation, the IC would cover the responsibilities of the other command and general staff positions. FEMA form ICS 203 is available to track personnel involved in the response.

Command Staff

Command Staff- The command staff carry out functions that support the IC. The typical roles are interagency liaison officer, incident safety officer, and public information officer. Additional command staff personnel can be added depending on the scale and needs of the incident. Other potential positions include legal counsel or medical advisor.

The **Liaison Officer** is responsible for acting as a point of contact for agency representatives, maintaining a contact list for involved entities, coordinating with interagency contacts, and participating in planning meetings.

The **Safety Officer** is responsible for identifying potentially hazardous situations in the operational plan, briefing response personnel on safety, providing safety information in the incident action plan (IAP, see below) to address safety concerns, and participating in tactics and planning meetings.

The **Public Information Officer** determines, with direction from the IC, what information can be shared, interfaces with the media, creates press releases and other briefings, and makes information available to incident personnel.

General Staff

The general staff are the functional sections of the response. The typical sections are operations, planning, logistics, and finance/administration. Each general staff section will have one leader. Deputies can be established if the scale of the incident requires additional leadership personnel or if more than one agency wants to have leadership over a particular section.

In ICS, an IAP is developed for each operational period and includes incident objectives and strategies and assigns the work to complete them. The IAP ensures that everyone maintains a coordinated approach. Specific meetings are held within the operational period to support the IAP, and command and general staff contribute information included in the IAP (Figure 5).

The **Operations Section Chief** is responsible for tactical operations and supervises the operations portion of the IAP.

The **Planning Section Chief** oversees planning during the incident by staying informed about the current situation and future needs to develop appropriate action plans, including the IAP. The Planning Section Chief facilitates planning meetings, gathers information, and reports on anticipated challenges to the incident.

The **Logistics Section Chief** provides all incident support needs such as facilities, supplies, equipment, transportation, etc.

The **Finance/Administration Section Chief** is responsible for managing all the financial aspects of the response, including providing cost analysis, and maintaining personnel time records.

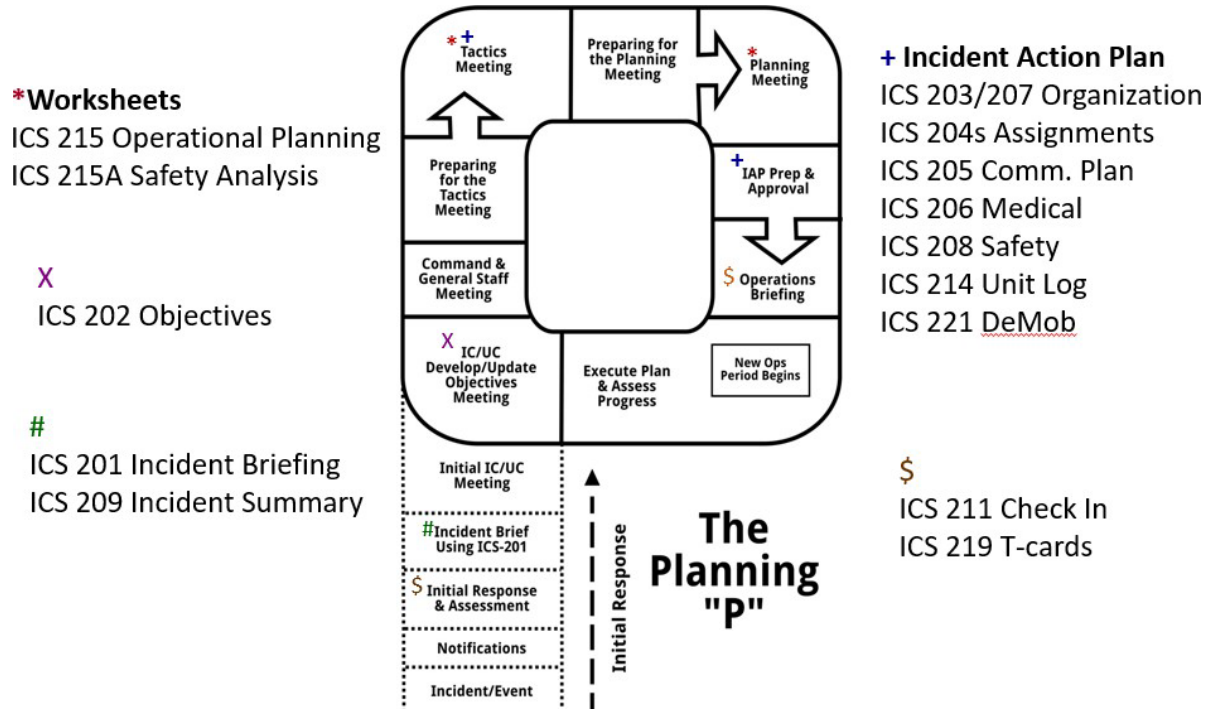

Figure 5. The Planning P

The Planning P provides the functional flow within an ICS response. The associated ICS form number is indicated at each stage in the planning P to aid in the response and marked by the symbol (*, x, #, +, $). Adapted from Smits, J. and Moser, F. 2009.

Compliance with Federal, State, Tribal, Territorial, and Local Environmental Rules

Numerous local, state, Tribal, territorial, and federal environmental regulations may apply to response actions. Some relevant federal regulations are listed below. The response plan should detail which regulations pertain to suggested response actions and the process for complying with those regulations. Not all of these regulations will apply but should be considered in your plan. **This section only addresses federal laws**. Please make sure you know your state, Tribal, territorial, and local rules that apply. Rules for managed areas (parks, sanctuaries, refuges, etc.) may also apply. Contact your local natural resource agency for assistance with identifying environmental rules.

National Environmental Policy Act (NEPA)

The National Environmental Policy Act (NEPA) provides a process intended to facilitate decision making by identifying environmental consequences of potential courses of action and revealing those consequences to the public. NEPA is required for most federal actions and for activities that are funded, entirely or in part, by federal funds. If the actions proposed under a rapid response plan will be partially or fully funded by the federal government, NEPA likely applies to the actions. The disclosure of potential environmental consequences is accomplished through an Environmental Assessment (EA) or an Environmental Impact Statement (EIS). Before undertaking an EA or an EIS for proposed actions under the rapid response plan, check with federal agencies working in the vicinity of the plan. There may be

existing documentation that would cover actions under the plan. If a categorical exclusion applies, an EA or EIS may not be needed.

A Categorical Exclusion (CATEX) under the National Environmental Policy Act (NEPA) refers to a category of actions that a federal agency has determined do not individually or cumulatively have a significant effect on the environment. Because these actions are deemed to have minimal impact, they do not require the preparation of an Environmental Assessment or an Environmental Impact Statement. For example, small-scale species removal actions with minimal environmental impact or research activities that do not significantly alter the environment may be listed under CATEX.

Endangered Species Act (ESA)

The Endangered Species Act (ESA) prohibits take of federally listed endangered or threatened species. According to ESA Section 3, the term "take" means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. The response plan should consider any species listed federally as endangered or threatened that could potentially be affected by response actions, and not only those in the aquatic environment. This will include staging equipment areas, human activities or traffic associated with the incident. Depending on anticipated impacts and timeline, an informal or formal consultation with the U.S. Fish and Wildlife Service (USFWS) or National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service may be required. If the response action is funded in whole or in part by the Federal government, consultation with the USFWS or NOAA is required under Section 7. Emergency consultation can be considered when the consultation is needed more quickly than can be accommodated under the normal consultation timeline. If a non-federal entity believes that their otherwise lawful activities may result in take of listed species, they may choose to seek an incidental take permit under Section 10(a)(1)(B) of the ESA.

Users can utilize the web tool on Information for Planning and Consultation (IPaC) to identify designated critical habitat for ESA listed species, migratory birds or other natural resources under the jurisdiction of USFWS that may fall within the response area. The Species Directory can be used to find ESA-listed species under NOAA jurisdiction.

Marine Mammal Protection Act (MMPA)

Marine mammals, including species like whales, dolphins, porpoises, seals, sea lions, walruses, polar bears, sea otters, manatees, and dugongs play a critical role in maintaining the balance of marine ecosystems and act as indicators of ocean health. All marine mammals are safeguarded by the Marine Mammal Protection Act (MMPA), through NOAA; some species have additional protections under the Endangered Species Act and/or the Convention on International Trade in Endangered Species of Wild Fauna and Flora. Generally, the MMPA prohibits the “take” of marine mammals—meaning harassment, hunting, capturing, collecting, or killing—in U.S. waters. Marine responses may require a consultation with NOAA Fisheries depending on anticipated impacts.

Clean Water Act (CWA) and National Pollutant Discharge Elimination System (NPDES)

The Clean Water Act (CWA) is the primary Federal statute regulating the protection of the nation’s water. The CWA aims to prevent, reduce, and eliminate pollution in the nation's water in order to

"restore and maintain the chemical, physical, and biological integrity of the Nation's waters", as described in CWA section 101(a). A stated goal of the CWA is to eliminate discharge of pollutants into waters of the U.S. pollutant discharges would require obtaining a National Pollutant Discharge Elimination System (NPDES) permit and managing direct discharges in compliance with permit conditions. If a plan calls for the use of chemicals into or in close proximity to a water body or wetland, then obtaining a NPDES permit prior to the action will likely be required. Although the permit requirement stems from the Clean Water Act administered by the Environmental Protection Agency (EPA), most states and Tribes have an EPA authorized NPDES program and issue their own permits. More information can be found here: Pesticide Permitting | US EPA

The U.S. Army Corps of Engineers (USACE) administers Section 404 of the Clean Water Act. Any physical alteration of wetlands including dredging or filling, will require a permit through the local or regional office of the USACE Regulatory program. The permit is required regardless of use of the federal funding. https://www.usace.army.mil/Missions/Civil-Works/Regulatory-Program-and-Permits/

The Rivers and Harbors Act

The U.S. Army Corps of Engineers administers Section 10 of the Rivers and HUSACE)arbors Act. Any physical alteration of navigable waters of the United States, including permanent or temporary structures or modifications, requires a permit to ensure U.S. waters are protected for navigation of commerce. See form: ENG 4345 and consult your local or regional office of the USACE Regulatory program. The permit is required regardless of federal funding. More information can be found on USACE website (https://www.usace.army.mil/Missions/Civil-Works/Regulatory-Program-and-Permits/).

National Historic Preservation Act (NHPA)

If there are cultural and archeological resources in your response plan area, then impacts should be considered in response actions. Units considering rapid response should coordinate with rightsholders, stakeholders, local governments, state and Federal Tribal Liaisons to ensure that response plans are reviewed and approved by their local Tribal offices and State Historic Preservation Offices.

Federal Energy Regulatory Commission (FERC)

If the environmental impacts are associated with a dam, federal consultation can be required with the Federal Energy Regulatory Commission (FERC) to ensure that actions do not affect operation of the dam.

Federal Insecticide Fungicide, and Rodenticide Act (FIFRA)

FIFRA is the Federal statute concerning the registration, distribution, and use of pesticides in the United States. The response plan should ensure that any chemicals intended for use during the response are labeled for that use. Pesticide labels are legally enforceable. If there is no labeled chemical, the response entity may need to work with the Office of Pesticide Programs within the EPA to apply for an emergency use permit under section 18 of FIFRA to allow for use during the response. If restricted chemicals must be applied the response team will need to include a certified pesticide applicator. See EPA Pesticide Applicator Website (https://www.epa.gov/pesticide-worker-safety/how-get-certified-pesticide-applicator#Who).

ICS and Other Training

Proper training enhances rapid response capabilities and ensures entities are well prepared to respond to an AIS detection. Training in its variety of forms allows entities to see gaps in capabilities, make improvements, test skill sets, create new relationships, better understand roles and responsibilities, and explore response mechanisms. There are multiple types and opportunities for ICS training, including formal in-person courses, on-line courses, and joint exercises or drills with other responders. Although invasive species ICS training may not be available in all jurisdictions, the approach of ICS can be used for any type of response. Training can involve multiple persons from the different response teams within an agency or organization or from multiple agencies or organizations. Training helps teams familiarize themselves with possible responses and creates an opportunity for internal agency reflection and identification of gaps in planning or training. Opportunities to attend emergency response trainings on any invasive species, such as forest pests, and within other disciplines, would be helpful in developing a response for aquatic invasive species.

Below are suggested training courses that may be beneficial for rapid responders:

Online FEMA Courses

The FEMA hosts the National Incident Emergency Management training program of the ICS. The NIMS Training Program identifies courses critical to train personnel capable of implementing all functions of emergency management. The National Incident Emergency Management training program establishes the NIMS core curriculum to ensure it adequately trains emergency and incident response personnel in all concepts and principles.

FEMA ICS resource website: https://training.fema.gov/emiweb/is/icsresource/

Other Training

Additional training centers exist that can provide background and familiarity for responding to invasive species issues.

The National Disaster Preparedness Training Center (NDPTC)

The National Disaster Preparedness Training Center is authorized to develop and deliver training and educational programs related to homeland security and disaster management, with a specific focus on natural hazards, coastal communities, and the special needs and opportunities of islands and territories. The NDPTC actively engages internally with FEMA and the University of Hawai`i, as well as with external partners across the region to integrate the delivery of its trainings, products, and services.

NDPTC website: https://ndptc.hawaii.edu/

Local Training: federal, state, Tribal and county Training

Check with fire, police, and fish and wildlife agencies for training that may be available locally or through state emergency management agencies.

In short, take advantage of opportunities to improve capabilities for any level of engagement on emergency response. Beginning with the FEMA ICS courses can be a great way to introduce basic concepts into natural resource management response.

Interactive exercises, including tabletop exercises, mock responses

Once a rapid response plan is created, test the plan through interactive exercises or mock responses. By bringing together the anticipated team members, teams can explore potential scenarios and assess the integrity of plan components. Possible test points can be to examine roles within response teams, public communication, direct consultation with control experts, identifying equipment staging areas, and/or federal consultation under emergency action. Tabletop and mock exercises may reveal specialized skills or equipment that may be needed as part of a response (e.g., chemical treatment, netting, electrofishing, and SCUBA). For examples of exercises please see FEMA website, Individual and Community Preparedness Activities.

Funding to Support Rapid Response Needs

Funding for rapid response is needed to ensure timely and more effective responses to AIS and avoid costly long-term and widespread control efforts. Response plans should identify potential sources of funding. Some past response events secured funds using existing discretionary funding from federal, Tribal or state programs that conduct invasive species work. This ad hoc approach is not ideal, as it relies on decision-makers prioritizing the response to make the necessary resources available. There may not always be general agreement among decision-makers on what is considered an emergency that merits funding. Third party funding, such as from foundations, nongovernmental organizations, and industry, may also be a potential funding source.

Collaborating with governmental agencies, research institutions, non-profit organizations, and local communities can provide valuable expertise, resources, and funding to support rapid response efforts. By forming partnerships, organizations can pool their resources, share knowledge and best practices, and coordinate response efforts more efficiently. Collaboration can also help leverage diverse perspectives and skills, leading to more innovative and effective solutions. Furthermore, partnerships can help distribute costs associated with response actions, making response more feasible and sustainable in the long term. By sharing financial responsibilities among multiple rightsholders or stakeholders, the burden on any single entity is reduced, allowing for broader participation and support. For example, there are dive teams within many federal agencies which could aid in a response needing those skills. Starting in 2022, using Bipartisan Infrastructure Law Funds, and as part of a core component of advancing a National EDRR Framework, the Department of the Interior established a four-year pilot Rapid Response Fund for AIS within the existing authorities of the USFWS's Fish and Aquatic Conservation program, to be coordinated though the Aquatic Nuisance Species Task Force (ANSTF). The USFWS posted a Notice of Funding Opportunity (NOFO) to Grants.gov, on behalf of the ANSTF to solicit proposals. Proposals are reviewed on a quarterly basis to allow for timely response to new species threats. Rapid Response funding may be used to respond to a new species introduction within freshwater, estuarine, wetland, or marine waters of the United States or U.S. territories. A full description of the Rapid Response Fund for AIS process can be found on the website A Rapid Response Fund for Aquatic Invasive Species | U.S. Fish & Wildlife Service (fws.gov).

Through the Aquatic Plant Control (APC) Program, the USACE has the ability to support EDRR activities through cost-share agreements with non-federal partners. The APC Program can support responses related to all aquatic invasive species. See the APC website (https://corpslakes.erdc.dren.mil/employees/invasive/program.cfm).

Sharing Partner Resources

Seeking partner resources that can be borrowed (equipment, staff with specific application training, staff that can help respond) to aid a rapid response effort, can help with the overall cost of the management actions. Proactive actions should be taken to identify organizations, agencies, and stakeholders with aligned missions and the capacity to provide immediate personnel or logistical support. This involves leveraging existing networks, such as government agencies, nonprofits, and professional groups, to secure agreements to use these resources. Establishing pre-vetted agreements and response frameworks with these partners can further accelerate deployment, minimizing delays and maximizing the effectiveness of the response effort.

The Department of the Interior (DOI) and USFWS developed the conceptual foundation for an Interjurisdictional Invasive Species Rapid Response Team (IInSRRT; https://siren.fort.usgs.gov/static-page/iinsrrt) in 2023 as part of the National EDRR Framework. Efforts are now underway to put that concept into action. IInSRRT is a program being designed to support or lead, as requested, rapid response actions across jurisdictions in support of lead management authorities, such as states, tribes, territories, and federal land management agencies. The program structure is envisioned to be composed of the IInSRRT Coordinator, an IInSRRT Advisory group, and deployment team members. The Advisory group will provide guidance and support as needed and assist with planning, communications, and overall program operations. The deployment team will be composed of DOI employees that have technical skills in rapid response and relevant ICS qualifications. Consideration of deployment will occur when the lead agency or agencies lack capacity and requests assistance. The request from a lead entity will require justification and be subject to approval by the IInSRRT Coordinator and IInSRRT Advisory Group. The criteria to determine what merits a response and the process to request the team will be developed by the IInSRRT Coordinator and Advisory Group. Details on how to request assistance are forthcoming.

Post-response Monitoring and Reporting

Post response involves careful monitoring of the ecosystem's recovery and the effectiveness of control measures implemented. Long-term monitoring will be different for various invasive species and should be based on known life history but is important to prevent reinvasion and mitigate future impacts. A plan for how long the post response monitoring should be developed and should include assessing population dynamics of target species, evaluating impacts on non-target species, and measuring changes in ecosystem functions. Planning for the post-response phase is crucial as it informs future management strategies, helps refine techniques, and ensures sustainable outcomes. By analyzing the results of species control efforts, management can adapt and improve approaches to mitigate invasive species' threats (see adaptive management). Some examples of post-response timelines:

Reed Canary grass (*Phalaris arundinacea*), can take multiple chemical applications and several years of post-treatment monitoring as resprouting from the seed bank can occur greater than two years (USACE 2006).

Signal crayfish (*Pacifastacus leniusculus*) treatment in the United Kingdom required a minimum of five years of post-treatment monitoring using extensive coverage of the site with baited crayfish traps (Peay et al. 2019).

Zebra mussels (*Dreissena polymorpha*) were removed through SCUBA in Lake George, NY and seven years of post-monitoring showed no new recruitment but did discover six separate colonizing populations (Wimbush et al. 2009).

Following a rapid response, it is recommended that all response actions and results of these efforts be evaluated to identify lessons learned and areas that can be improved to advance future response efforts. External communication will help to ensure accurate information reaches target audiences regarding response efforts, potential impacts, and information learned from the event. The key components below should be included in an after-action report are listed in worksheet 4.

Worksheet 4. After-action Report

An after-action report for a rapid response to a new invasive species should include the following key sections:

Incident Overview

a. Date, time, and location of detection
b. Description of the invasive species (scientific and common name, origin, impact potential)
c. How the species was identified and confirmed

2. Response Actions
    a. Timeline of key events and decisions
    b. Agencies, organizations, and stakeholders involved
    c. Contact list of key personnel and agencies
    d. Strategies and methods used for containment, eradication, or mitigation
3. Public communication and outreach efforts
    a. Challenges and Limitation
    b. Logistical or operational difficulties
    c. Resource constraints (e.g., personnel, funding, equipment)
    d. Gaps in coordination or information-sharing
4. Outcomes and Effectiveness
    a. Successes and positive impacts of the response
    b. Areas where response efforts fell short
    c. Data collected (e.g., species spread, environmental impact)
    d. Maps, photos, and data visualizations
5. Lessons Learned
    a. What worked well and should be repeated
    b. Areas needing improvement or further study
    c. Recommendations for future responses
6. Next Steps and Recommendations
    a. Monitoring and follow-up actions required
    b. Policy or regulatory changes needed
    c. Long-term management and prevention strategies

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Resources for Response

Resources for response can readily be found online. Below is a list of example guidelines, tools (e.g., species reporting and tracking websites, expert databases), and eradication methods that can aid in response development:

- Guidelines Pennsylvania Invasive Species Council. 2022. Rapid Response Plan and Procedures for Responding to Aquatic Invasive Species in Pennsylvania. https://www.pa.gov/content/dam/copapwp-

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- Great Lakes Environmental Center, et al. 2021. Draft Great Lakes Basin Aquatic Invasive Species Interstate Response Framework. https://www.glc.org/wp-content/uploads/AIS-Interstate-Surveillance-Framework_US-waters-Great-Lakes-2019.pdf
- Mississippi River Basin Panel on ANS. 2010. A Model Rapid Response Plan for AIS. https://mrbp.org/wp-content/uploads/2018/05/mrbp-model-rapid-response-plan-with-appendices.pdf
- Catalog of U.S. Federal EDRR Databases and Tools: Version 2.0 (https://www.sciencebase.gov/catalog/item/5bf87027e4b045bfcae2ece6)
- For sample terminology, see the Water Body Sampling and Monitoring section provided in *Building Consensus in the West* (https://westernregionalpanel.org/wp-content/uploads/2019/11/WRP-BC-Activity-Report-FINAL.pdf) beginning on page 11.

Reporting and Expert Tools

- Reporting and Tracking
    - Siren (Siren: The National Early Detection and Rapid Response Information System | U.S. Geological Survey)
    - EDDMapS (https://www.eddmaps.org/)
    - USGS Nonindigenous Aquatic Species Database (https://nas.er.usgs.gov/)
    - iMap Invasives (https://www.imapinvasives.org/)
    - National Exotic Marine and Estuarine Species Information System "NEMESIS" (https://invasions.si.edu/nemesis/)
    - iNaturalist (https://www.inaturalist.org/)
    - Global Biodiversity Information Facility (GBIF; https://www.gbif.org)
    - US Register of Invasive Species (https://www.sciencebase.gov/catalog/item/62d59ae5d34e87fffb2dda99)
    - CABI Invasive Species Compendium (https://www.cabi.org/isc/)
    - PestTracker (https://www.pesttracker.org/)
    - ForWarn II: Satellite-Based Change Recognition and Tracking (https://forwarn.forestthreats.org/)
    - The Aquatic eDNAtlas Project (https://www.fs.usda.gov/rm/boise/AWAE/projects/the-aquatic-eDNAtlas-project.html)
    - Wildlife Health Information Sharing Partnership - Event Reporting System (WHISPers; https://whispers.usgs.gov/home)
- Expert databases
    - USDA National Invasive Species Information Center (www.invasivespeciesinfo.gov/)

- Invasive Species Experts Database (https://www.invasivespeciesinfo.gov/subject/expertise-contacts)
- National Invasive Species Information Management System (NISIMS; Weeds and Invasives | Bureau of Land Managementhttps://www.blm.gov/programs/natural-resources/weeds-and-invasives/nisims-database)
- State Plant Health Directors Database (https://www.aphis.usda.gov/aphis/ourfocus/planthealth/ppq-program-overview/sphd)

Eradication Methods

- All taxa
  - Maintenance management and eradication of established aquatic invaders (https://link.springer.com/content/pdf/10.1007/s10750-020-04352-5.pdf);
  - Eradications of invasive alien species in Europe (https://link.springer.com/content/pdf/10.1007/s10530-004-9642-9.pdf);
  - Eradication of invasive species: progress and emerging issues in the 21st century (https://www.researchgate.net/profile/John-Parkes-4/publication/29660781_Eradication_of_invasive_species_progress_and_emerging_issues_in_the_21st_century/links/55a38f0008aea517405cf965/Eradication-of-invasive-species-progress-and-emerging-issues-in-the-21st-century.pdf);
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  - USDA Control Mechanisms

- Vertebrates
  - Aquatic invasive alien rodents in Western France: Where do we stand today after decades of control? (https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0249904)
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  - Eradication of Introduced Carnivorous Lizards from the Cape Coral Area (https://chnep.wateratlas.usf.edu/upload/documents/MonitorLizardEradication_CampbellUnivTampa.pdf)
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  - Successful eradication of invasive American bullfrogs leads to coextirpation of emerging pathogens (https://conbio.onlinelibrary.wiley.com/doi/pdfdirect/10.1111/conl.12970)
  - Biological control of fish (Bajer et al. 2019).
  - Carbon dioxide to eradicate amphibians and fish (https://afspubs.onlinelibrary.wiley.com/doi/pdf/10.1080/03632415.2017.1383903_)

- Invertebrates
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    - Control Methods - Plant Management in Florida Waters - An Integrated Approach - University of Florida, Institute of Food and Agricultural Sciences - UF/IFAS (ufl.edu)
    - USDA Biology and control of aquatic plants – a best management practices handbook
    - USDA APHIS website: Plant Pests and Diseases
    - USACE Aquatic Plant Control Research Program
    - Management and control methods of invasive alien freshwater aquatic plants: A review
    - Invasive Species Control/Management Plan (ISCP Guidance)

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