THE NATIONAL INVASIVE SPECIES COUNCIL (NISC)

ANS Task Force — Dedicated to the prevention and control of aquatic nuisance species

Training and Implementation Guide for Pathway Definition, Risk Analysis and Risk Prioritization

This guide was developed to address issues pertaining to invasive species. Processes are also relevant to other pest risk management activities.

Developed jointly by the Aquatic Nuisance Species Task Force (ANSTF) and National Invasive Species Council (NISC) Prevention Committee via the Pathways Work Team

This Guide Only Applies to Unintentional, Man-Made Pathways

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A Note To Users

This training guide is still in draft stages - - -and is intended to be continually enhanced based upon user perspectives. As such, as you use this guide, please make note of any issues, unclear expectations or revisions you believe necessary to enable users to better develop pathway definitions, prioritization and analyses. Suggested changes may be forwarded to the following:

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Pathways Guide
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PATHWAY ASSESSMENT MANAGEMENT

1. THE PROGRAM

The purpose of pathway risk analysis is to provide scientific analyses and policy recommendations in support of U.S. National Invasive Species Council's Management Plan. These analyses and recommendations must comply with the Plan's mandates to:

- ensure Federal efforts are coordinated and effective
- promote action and partnership at local, State, tribal and ecosystem levels
- identify recommendations for international cooperation; and,
- facilitate networks to document, monitor and prioritize invasive species pathways

Though many definitions for invasive species and pathways may exist, we are defining these terms as they relate to Federal regulatory functions. Definitions are recounted, below:

Invasive species (IS) - - an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health.

Pathways - - the means by which species are transported from one location to another. Natural pathways include wind, currents, and other forms of dispersal in which a specific species has developed morphological and behavioral characteristics to employ. Man-made pathways are those pathways which are enhanced or created by human activity. These are characteristically of two types:

- Intentional pathways - - these result from deliberate actions to translocate an organism.

- Unintentional pathways - - these are man-made pathways that unintentionally move organisms. Examples of unintentional pathways are ballast water discharge (e.g. red-tide organisms), soil associated with the trade of nursery stock (e.g. fire ants), importation of fruits and vegetables (e.g. plant pests), and the international movement of people (e.g. pathogens). In these, the movement of species is an indirect byproduct of our activities.

This guide only addresses analysis of the second type of pathway: existing unintentional, man-made invasive species pathways; with a section devoted to policy synthesis. Though guide processes may be used for potential pathway analysis, such analysis must be based upon statistical predictive indicators of past trends - - which at this time is not feasible due to lack of consolidated data sources. For our purposes, analysis and policy synthesis are defined as:

Analysis-- the procedure by which we scientifically break down a 'whole' phenomena (i.e., unintentional IS incursions) into its parts or components.

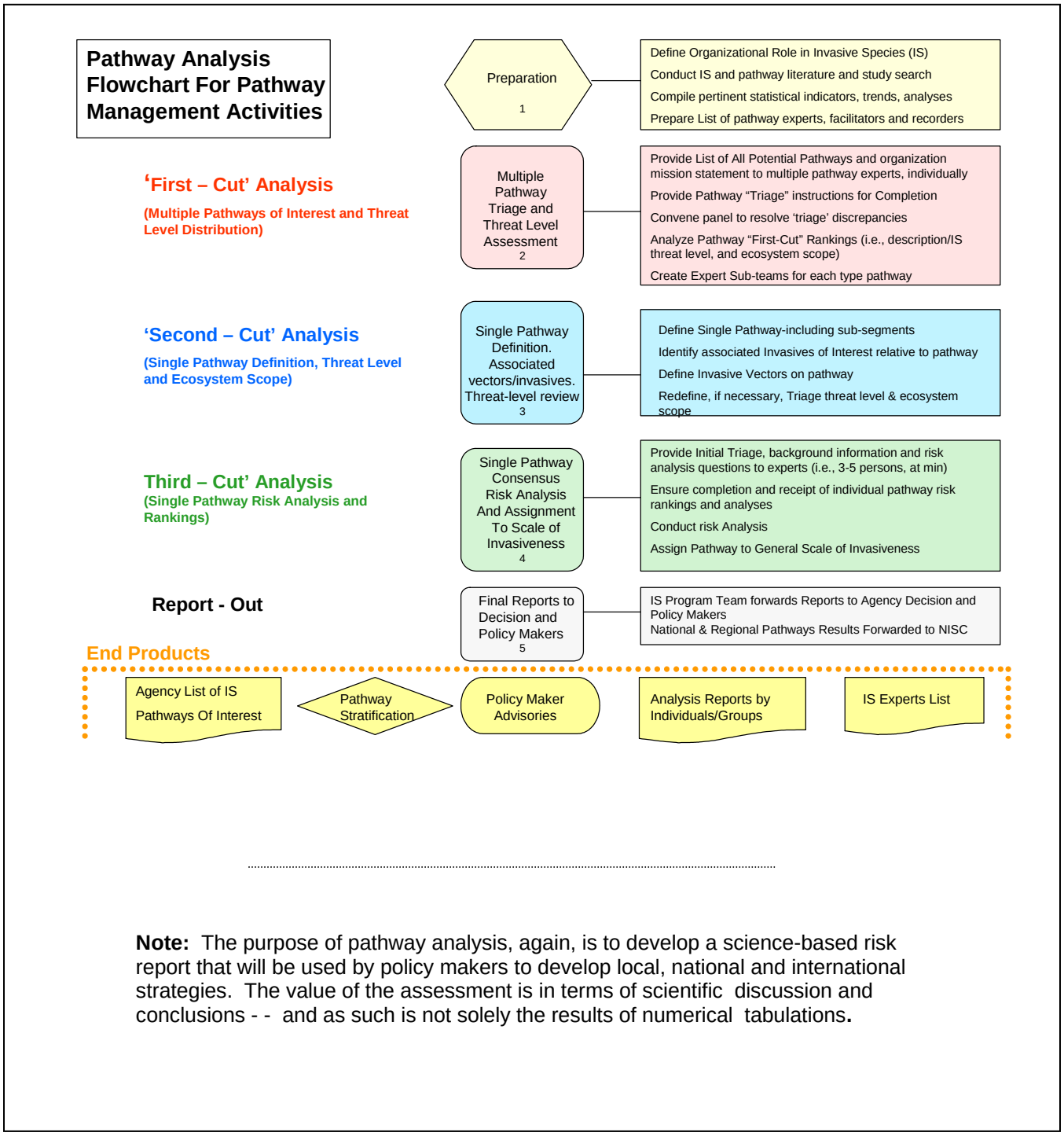
Policy Synthesis-- the process by which we combine the analysis components into a comprehensive perspective to devise copasetic IS policies and actions on the local, regional, national and international levels.

Invasive species definitions are posted at: http://www.invasivespeciesinfo.gov/plants/main.shtml

2. THE PROCESS OVERVIEW

The process for pathway analysis and prioritization has been 'broken down' into five basic steps. These steps are designed to ensure the matching of mission areas with pathways of interest; use of most recent literature and datasets relevant to the pathways; analysis based upon expert opinions; and science-based consensus advisories.

The schematic below provides a visual reference guide; with each step then described in detail.



Note: The purpose of pathway analysis, again, is to develop a science-based risk report that will be used by policy makers to develop local, national and international strategies. The value of the assessment is in terms of scientific discussion and conclusions - - and as such is not solely the results of numerical tabulations.

3. PREPARATION

Convene a Consensus Analysis Pathways Team (CAPT). It is recommended that each agency form an Invasive Species (IS) Consensus Analysis Pathways Team (CAPT) to manage the individual and group processes/documentation associated with pathway analyses. It is recommended the CAPT be a permanent standing committee and should be comprised of 3-5 persons (including a chair and recorder). CAPT should first perform the following functions prior to any pathway analyses:

A. Define organizational mission relative to invasive species (IS). The perspective and actions taken by an agency relative to invasive species is dependent upon the mission and its objectives. This definition is critical and serves as the foundation for all pathway activities. An example follows below:

Mission: USDA APHIS mission is to protect the health and value of American agriculture and natural resources. APHIS also addresses sanitary and phytosanitary trade barriers and certain issues related to the humane treatment of animals. Finally, APHIS ensures that biotechnology-derived agricultural products are safe for release into the environment.			
Strategic Goals	**Mission Areas**	**IS Functions**	**Defined IS Role**
Goal 1: Safeguard the health of animals, plants and ecosystems in the United States **Goal 2.** Facilitate safe agricultural trade **Goal 3.** Ensure the effective and efficient management of programs to achieve APHIS' mission	Animal Care (determines standards of humane care and treatment of animals).	**Not Applicable**	Not Applicable
	Biotechnology and Regulatory Services (Ensures safe dev. of genetically engineered organisms)	**Indirect**	Not Applicable
	International Services and Trade Support (Internat'l animal and plant health expertise to enhance safeguarding and trade).	**Indirect**	Not Applicable
	Plant Protection and Quarantine (safeguards agriculture and natural resources from the risks assoc with entry, establishment, or spread of animal and plant pests and noxious weeds)	**Direct**	**Safeguards agriculture and natural resources from the risks assoc with entry, establishment, or spread of animal and plant pests (inclusive of invasive species) and noxious weeds**
	Veterinary Services (protects and improves the health, quality, and marketability of nation's animals, animal products and veterinary biologics)	**Direct**	**Protects and improves the health, quality, and marketability of nation's animals, animal products and veterinary biologics (inclusive of prevention, detection or elimination of relevant invasive species)**
	Wildlife Services (resolve wildlife conflicts/creates balance)	Not Applicable	Not Applicable

(Note: this is only for example)

The remainder of activities during this phase center upon creating internal infrastructures to accomplish program tasks. As such they include:

B. Develop a general list of qualified group facilitators and recorders
C. Compile general collection of qualitative information sources on IS. Though pathway-specific quantitative benchmarks and datasets are to be researched to assist pathway prioritization, a significant lack of data history causes the use of additional qualitative methods for pathway assessment; specifically, document and scientific studies. Researched through such avenues as bibliographic literature searches, scientific journals, et. al., these pathway-specific documents are to be supplied to participants several weeks prior to the “Step 2” to create a common knowledge base for discussion and comparison.
D. Communicate the role of CAPT to appropriate organization personnel

"FIRST-CUT'- MULTIPLE PATHWAYS TRIAGE AND THREAT LEVEL ASSESSMENT

1. OVERARCHING PATHWAY DEFINITION

The next role of CAPT is to elicit from multiple (i.e., 5-8) individual experts, a 'first-cut' or general analysis of IS pathways. The 'first-cut' analysis is a preliminary 'triage' of pathways, wherein decisions are made as to what pathways are relevant to agency mission, what the traditional characteristics of the pathway(s) are; what invasives are traditionally transmitted via these pathways; and finally, what the threat level of invasives transmitted via those pathways represent. For this process, it is suggested the CAPT use the general definitions, lists and charts of pathways provided below. CAPT actions should include the following:

A. Develop list of agency invasive species/pathways experts
B. Provide a definition of agency mission - relative to invasive species - to 5 to 8 individual IS experts (see product from preparation phase).
C. Provide a copy of general pathway charts and listings to individual experts (as next provided in the following 5 graphics):

OVERVIEW OF DIAGRAMS

Categorization Of Pathways and Sub-Pathways (A continual 'Drill Down' of Pathways to the Lowest Levels)

Transportation Related Pathways

This category includes all the various pathways related to transportation of people and goods. Subcategories include:

1) Modes of Transportation
2) Military Travel and Transportation of Military Vehicles
3) Items Used in Shipping Process
4) Mail/Internet/Overnight Shipping Companies
5) Travel/Tourism, Recreation/Relocation

See Diagram 1 for more details

Living Industry Pathways

This category includes all the various pathways associated with living organisms and/or their by-products. Subcategories include:

1) Plant Pathways
2) Food Pathways (market ready or near market ready – transporting animals for consumption)
3) Non-Food Animal Pathways (transporting animals for reasons other than consumption)
4) Non-Living Animal and Plant Related Pathways (animal and plant products)

See Diagram 2 for more details

Miscellaneous Pathways

This category includes various pathways that did not fit into the other two categories. Subcategories include:

1) Biocontrol
2) Release of Animals for Religious, Cultural or Other Reasons
3) Other Aquatic Pathways
4) Natural Spread of Established Populations of Invasive Species
5) Ecosystem Disturbance (long and short term)

See Diagram 3 for more details

Diagram 1

Transportation Related Pathways

(Includes all the various pathways related to the transportation of people, commodities and goods, including military travel and transportation of military vehicles)

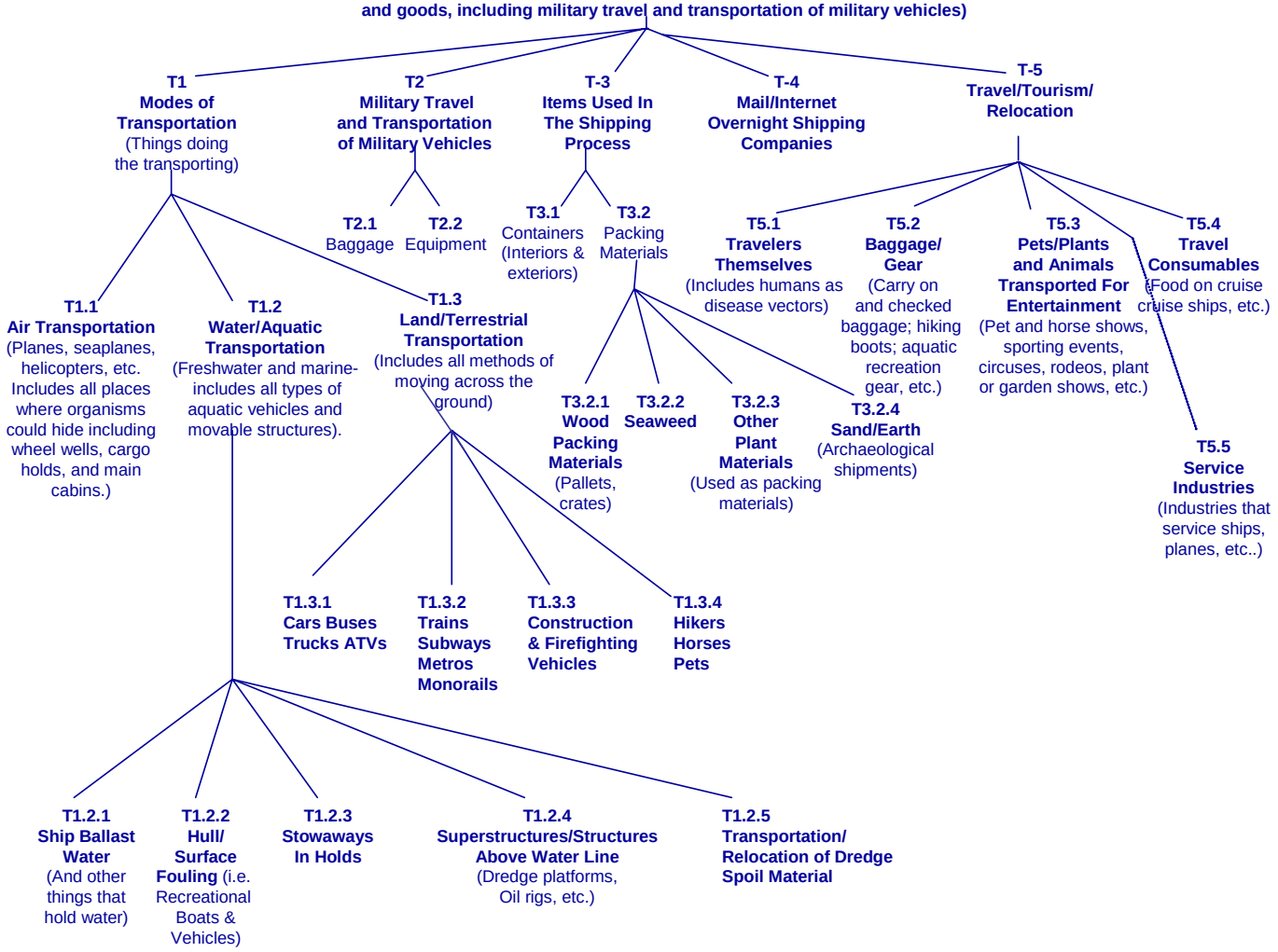


Diagram 2

Living Industry Pathways

(includes all pathways associated with living organisms and/or their by-products)

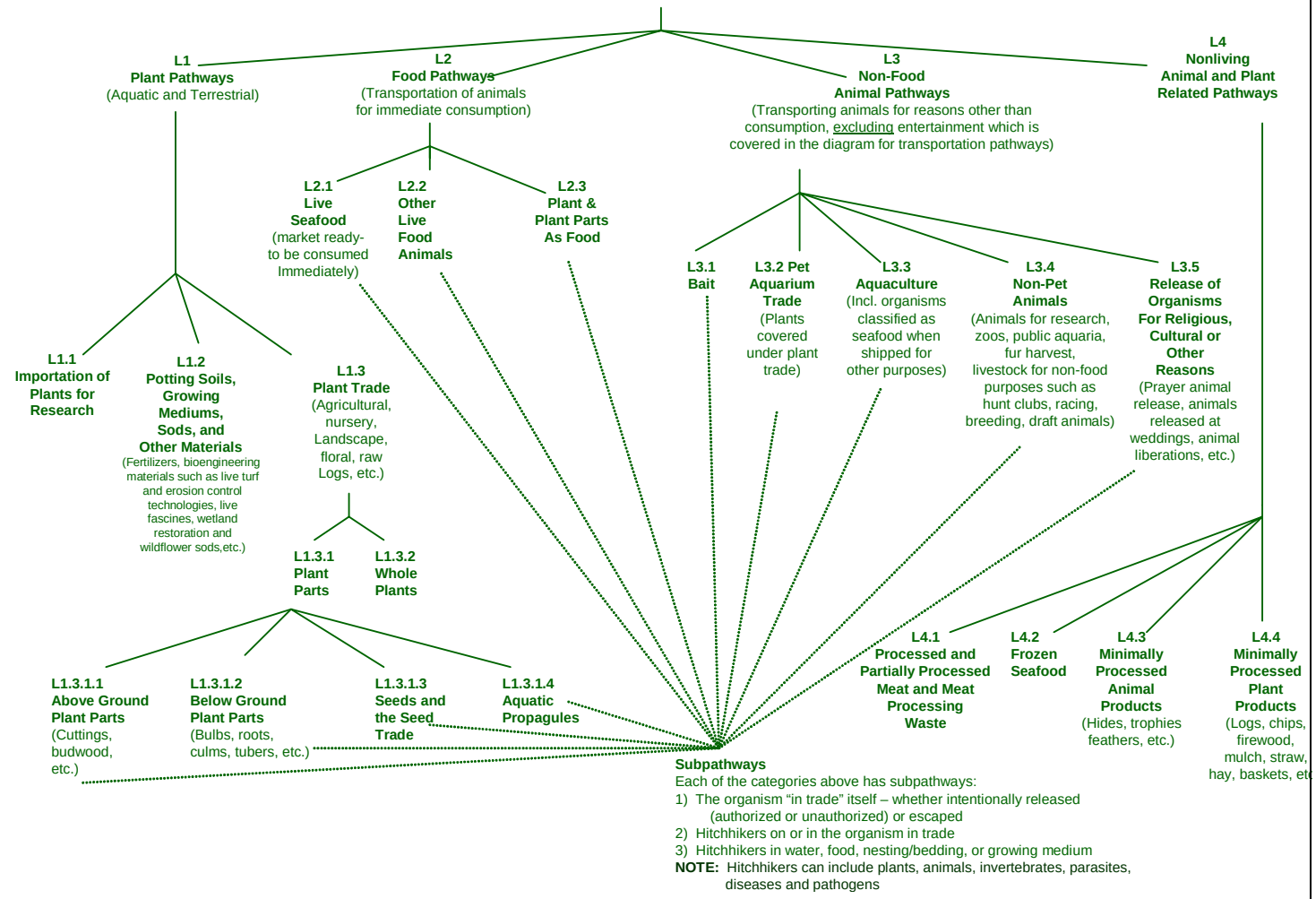
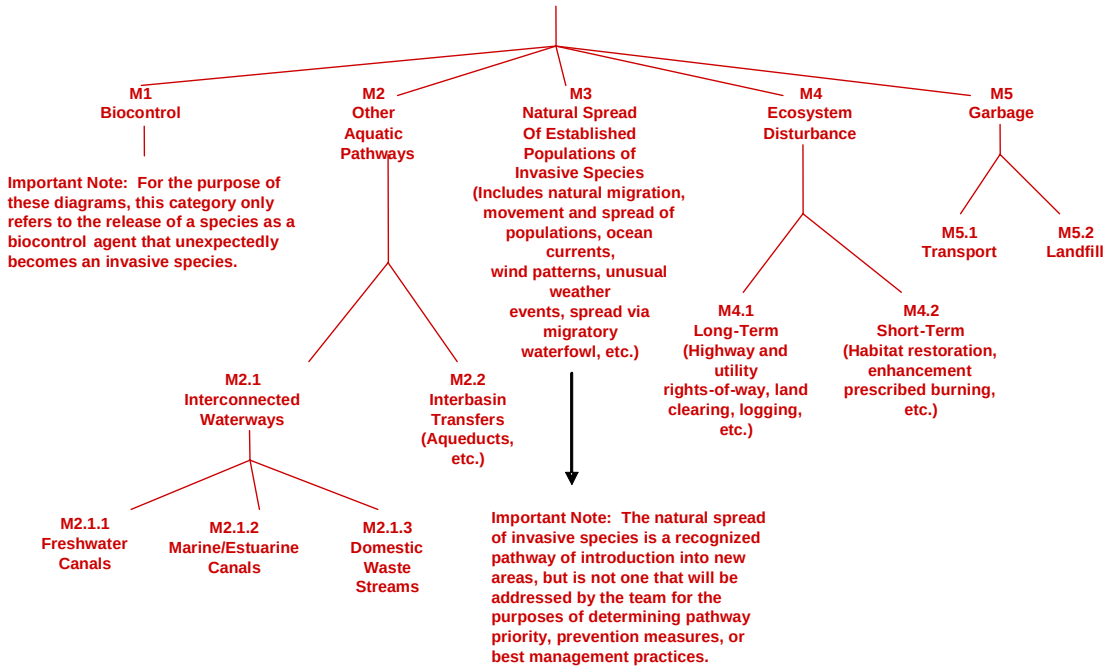


Diagram 3

Miscellaneous Pathways

(Includes various pathways that did not fit into the Transportation or Living Industry Pathway Categories)



Pathways Lists and Sub-Pathways
(Color-Coded to Match Prior Charts)

(T) Transportation

T 1 Modes of Transportation
- T1.1 Air
- T1.2 Water/Aquatic
  - T1.2.1 Ship Ballast Water
  - T1.2.2 Hull/Surface Fouling (i.e., Recreational Boats and Vessels)
  - T1.2.3 Stowaways in Holds
  - T1.2.4 Superstructures/Structures Above Water Line
  - T1.2.5 Transportation/Relocation of Dredge Spoil Material
- T1.3 Land Terrestrial
  - T1.3.1 Cars, Buses, Trucks, ATVs. Trailers for recreational boats
  - T1.3.2 Trains, Subways, Metros, Monorails
  - T1.3.3 Construction/Firefighting Vehicles
  - T1.3.4 Hikers, Horses Pets

T2 Military Travel and Transportation of Military Vehicles
- T2.1 Baggage/Gear
- T2.2 Equipment

T3 Items used in the Shipping Process
- T3.1 Containers
- T3.2 Packing Materials
  - T3.2.1 Wood Packing Materials
  - T3.2.2 Seaweed
  - T3.2.3 Other Plant Materials
  - T3.2.4 Sand/Earth

T4 Mail/Internet Overnight shipping

T5 Travel Tourism/Relocation
- T5.1 Travelers Themselves
- T5.2 Baggage/Gear
- T5.3 Pets/Plants and Animals Transported for Entertainment
- T5.4 Travel Consumables
- T5.5 Service Industries

(L) Living Industry

L1 Plant Pathways
- L1.1 Importation of Plants for Research
- L1.2 Potting Soils, Growing Mediums, Sods and Other Materials
- L1.3 Plant Trade (agricultural nursery, landscape, floral, raw logs)
  - L1.3.1 Plant Parts
    - L1.3.1.1 Above-Ground Plant Parts
    - L1.3.1.2 Below Ground Plant Parts
    - L1.3.1.3 Seeds and the Seed Trade
    - L1.3.1.4 Aquatic Propagules
  - L1.3.2 Whole Plants

L2 Food Pathways
- L2.1 Live Seafood
- L2.2 Other Live Food Animals
- L2.3 Plants and Plant Parts as Food

L3 Non-Food Animal Pathways
- L3.1 Bait
- L3.2 Pet/Aquarium Trade
- L3.3 Aquaculture
- L3.4 Non-Pet Animals
- L3.5 Release of Organisms for Religious, Cultural or Other Reasons

L4 Nonliving Animal and Plant Related Pathways
- L4.1 Processed and Partially Processed Meat and Meat Processing Waste
- L4.2 Frozen Seafood
- L4.3 Minimally Processed Animal Products
- L4.4 Minimally Processed Plant Products

(M) Miscellaneous

M1 Biocontrol

M2 Other Aquatic Pathways
- M2.1 Interconnected Waterways
  - M2.1.1 Freshwater Canals
  - M2.1.2 Marine/Estuarine Canals
  - M2.1.3 Domestic Waste Streams
- M2.2 Interbasin Transfers

M3 Natural Spread of Established Populations

M4 Ecosystem Disturbance

M4.1 Long-Term (highway and utility rights-of-way, clearing, logging)

M4.2 Short Term (habitat restoration, enhancement, prescribed burning)

M5 Garbage
- M5.1 Garbage Transport
- M5.2 Garbage Landfill

2. DEFINING MULTIPLE PATHWAYS OF INTERESTS

The CAPT ensures general definition of multiple pathways of interest- -based on agency mission. Processes are delineated, below:

A. **The Mission**. Define agency mission, functions, responsibilities and strategic initiatives relative to IS pathways.
B. **The 'Universe' of Pathways.** Review the general inventory list and diagrams of all invasive species pathways; adding any pathways that may not yet be listed (see prior pages 23-28). As part of this exercise it is advisable to briefly define pathway particulars (i.e., start point, mid and endpoints) for clarification.
C. **List Pathways.** Select and list all pathways that are pertinent to the mission.
D. **List Invasives.** Indicate, briefly, what particular invasives are associated with each pathway. Potential invasive species categories include:

1. All hitchhiking organisms
2. All aquatic organisms
3. Fouling organisms (e.g., organisms that attach to boats, pilings, platforms, etc.)
4. Arthropods (e.g., insects, arachnids, crustaceans, etc.)
5. Mollusks (e.g., giant African snails, zebra mussels, etc.)
6. Plants and plant propagules (e.g., water hyacinth, Russian knapweed, etc.)
7. Plant pathogens (e.g., sudden oak death, etc.)
8. Phytoplankton (e.g., Amphidinium, dinoflagellates, etc.)
9. Vertebrates (e.g., snakeheads, gavials, rats, brown tree snakes, etc.)
10. Human and animal parasites (e.g., liver flukes, etc.)
11. Human and animal pathogens (e.g.,salmonella, West Nile virus, foot and mouth disease, SARS, etc.)

3. PRELIMINARY MULTI-PATHWAY DESCRIPTIONS

Once the mission, the "universe' of all potential pathways, and the 'narrowed-down' list of pathways of agency-interest are complete, the CAPT should then prepare a preliminary or general description for each pathway of agency interest.

A matrix example of these processes is provided on the next page:

Agency IS Mission	The "Universe" of ALL Potential Pathways	From the "Universe" of Pathways, Only Those Mission-Related Pathways	Mission Related Preliminary Pathway(s) Description	Invasives Transmitted via Pathway
U.S. Coast Guard protects the public, environment & U.S. economic interests in ports, waterways, along the coast, on international waters, or in any maritime region. Invasive Species strategic priorities includes ballast water, hull/surface, superstructure dredge	T 1 Transportation T1.1 Air T1.2 Water/Aquatic T1.2.1 Ballast Water	T1.2.1 Ballast Water	T1.2.1 Ship Ballast Water-Cargo ship that begins voyage in Kusadasi, with endpoint NYC.	Amphidinium Cholera
	T1.2.2 Hull/Surface T1/2.3 Stowaways T1.2.4 Superstructures	T1.2.2 Hull/Surface	T1.2.2 Hull/Surface Fouling. Cruise ship start point Miami, to Jamaica and Return	Zebra Mussels
	T1.2.5 Transportation/ Relocation of Dredge **(L) Living Industry** L1 Plant Pathways L1.1 Importation Plants L1.2 Potting Soils (M) Miscellaneous M1 Biocontrol M2 Other Aquatic M2.1 Interconnected Waterways M2.1.1 Freshwater Canals M2.1.2 Estuarine Canals M2.1.3 Domestic Waste Streams M2.2 Interbasin Transfr	T1.2.5 Dredge Relocation	T1.2.5 Dredge Relocation Barge traveling from Hawaii to Oregon	Water hyacinth

4. PATHWAY THREAT LEVEL DETERMINATION

CAPT next ensures the team assigns an invasive species threat level to each pathway. As determined by National Invasive Species Plan priorities, those pathways which present a threat to human health take priority over those presenting threats to the economy and then ecology. As a frame of reference, ballast water carrying cholera that dumps directly into drinking water would be a threat level of A. Whereas that same water, if dumped into a stream that is not used for any human or business purposes (i.e., where cholera contamination would not impact health or economics), then the threat level could be C.

Further definition of ;method of assigning IS threat level follows below as:

> **Threat Level A** - - **Human Health**. The pathway currently transmits an invasive species that poses a direct threat to human health. This threat is typified by such emerging infectious diseases

as monkeypox, pandemic influenza, bovine spongiform encephalitis, etc., that may be transmitted to human population from any nonindigenous invasive source such as plants, animals, prions, et al. An underlying assumption to this category is that if human health is affected, then economic ecological factors will be impacted as well. As such, designation at the "A" level, is inclusive of lower level threat risk levels.

Define the impact on Human Health (i.e., rationale for category determination)
_____
_____
_____

Threat Level B - - Economic Health. The pathway currently transmits an invasive species that, via history or current consequences, demonstrates a direct negative impact to U.S. economic health (i.e., diminishes gross domestic product quotient; lowers market value of goods and/or services). An underlying assumption to this category is that if economic health of industries is affected, then ecosystem factors will be impacted as well.

Define the impact on Economic Health (i.e., rationale for category determination)
_____
_____
_____

Threat Level C - - Ecosystem Health. The pathway currently transmits an invasive species that pose a threat to ecosystem health via impeding biological integrity, diversity, sustainability, quality or physical/biological functioning of ecosystems. An underlying assumption to this category is the invasive does not have a direct impact on human or economic systems.

Define the impact on Ecosystem Health (i.e., rationale for category determination)
_____
_____
_____

What is the final threat level assigned? _____
Select only A, B or C

Note: Why only one level? By definition, for our purposes, an invasive species must be harmful and as such will 'fall' within one of the above three categories. Though new exotics may be continually entering the country via these selfsame pathways - - if they do not pose a harmful threat, they do not meet our definition of invasiveness. In addition, these threat levels are hierarchical in basis. The intent is for a determination of threat level 'A' to be inclusive of 'B' and 'C' levels of harm. Threat level 'B' means level 'C' of harm is included. Threat level 'C' is a 'stand-alone'. So, though an invasive may pose a threat on one or more levels, it is the 'top inclusive' or most pernicious category that is assigned.

5. FINALIZING THE "FIRST-CUT" ANALYSIS

Triage, again, is to provide the first prioritization factors or 'cut' of which pathway(s) an agency or organization should assess. In that the pathways for IS are complex and numerous, the CAPT should then convene a panel of the 5 to 8 agency IS experts. The purpose of the meeting is to, via consensus, finalize the "first cut" analysis of invasive species (otherwise known as triage). To accomplish the final triage, the CAPT team should:

A. Convene individual IS experts into a PANEL OF EXPERTS for consensus 'first-cut' analysis of IS pathways – requiring group to discuss opinions and decisions
B. Facilitate a consensus "first-cut" analysis
C. Document the "First-Cut" analysis consensus results, incorporating the individual responses as background documentation.
D. Create a hierarchy or ordered list of IS pathways, based on posed threat determined by 'First-Cut', for 'Second and Third cut' analysis processes.
E. Establish an analysis timeline for each individual IS pathway deemed relevant to agency mission - - with associated lists of experts, group facilitators and recorders.

A matrix-sample of the finalized 'first-cut analysis follows on the next page:

FIRST CUT ANALYSIS

1. Agency IS Mission, Strategic Priority	**2. All Potential Pathways**	**3. All Mission-Related Pathways for Risk Analysis**	**3. Mission Related Pathway(s) Description**	**4. Invasives Transmitted via Pathway**	**5. Threat Level**
U.S. Coast Guard protects the public, environment & U.S. economic interests in ports, waterways, along the coast, on international waters, or in any maritime region. Invasive Species strategic priorities includes ballast water, hull/surface, superstructure dredge	T 1 Transportation T1.1 Air T1.2 Water/Aquatic T1.2.1 Ballast Water T1.2.2 Hull/Surface T1/2.3 Stowaways T1.2.4 Superstructures T1.2.5 Transportation/ Relocation of Dredge **(L) Living Industry** L1 Plant Pathways L1.1 Importation Plants L1.2 Potting Soils (M) Miscellaneous M1 Biocontrol M2 Other Aquatic M2.1 Interconnected Waterways M2.1.1 Freshwater Canals M2.1.2 Estuarine Canals M2.1.3 Domestic Waste Streams M2.2 Interbasin Transfr	T1.2.1 Ballast Water	T1.2.1 Ship Ballast Water- Cargo ship that begins voyage in Kusadasi, with endpoint NYC.	Amphidinium Cholera	**A Human Health** **First Priority**
		T1.2.2 Hull/Surface	T1.2.2 Hull/Surface Fouling. Cruise ship start point Miami, to Jamaica and Return	Zebra Mussels	**B Economy** **Second Priority**
		T1.2.5 Dredge Relocation	T1.2.5 Dredge Relocation Barge traveling from Hawaii to Oregon	Water hyacinth	**C Ecology** **Third Priority**

The result of this triage is a prioritized list for pathways risk assessment. In this case, Ship Ballast Water is first, followed by Hull Fouling, then Dredge relocation.

"SECOND-CUT'" ANALYSIS – SINGLE PATHWAY DEFINITION, COUPLING WITH INCLUSIVE IS LISTING AND ECOSYSTEM SCOPE

1. DETAILED SINGLE PATHWAY DESCRIPTION

Based on the 'first-cut' analysis, agencies now have a roughly prioritized list of pathways upon which to work. Second-cut analysis is the process for the analysis of individual, single pathways. In that pathways can be simple or complex, it is essential to further define the single pathway being analyzed. Examples follow:

> Example A. This is a single segment pathway, wherein a rail car carries oranges from Jacksonville, Florida to Atlanta Georgia rail station. The rail station then transmits boxed, fumigated fruit directly to city markets. There is currently a fruit fly quarantine in place in Florida. Related invasives include fruit fly and citrus canker. However, due to endpoint destination ecosystem, no threat occurs UNLESS there is co-mingling of product with shipments destined for California citrus growing regions. For Department of Agriculture, the first-cut analysis indicates it is an invasive pathway of agency concern, the related invasives impact would be on economy.
>
> Example B. This is a three-segment pathway that begins with table grapes from Paris that are cold-treated during cargo shipment. The shipment is then unloaded in the Port of New York, into two rail cars that will unload the product in Chicago, and Los Angeles. Associated invasives are fruit flies. The rail shipments will go from rail car, to market and then human consup0tion in both cities.
>
> Example C: This is a two segment pathway where pink hibiscus, plants for planting are harvested from Puerto Rico growers, transmitted via airplane to Miami Airport; transferred to outbound plane for Indianapolis; then disseminated to retail nurseries. Associated invasive is pink hibiscus mealybug.

What is important to realize, is that based upon the pathway segment under discussion, the pathway may be local, regional or national in perspective or impact. Pathway definition includes factors such as the pathway beginning/mid/end points; receiving, transiting and ending ecoregions; pathway segments; pathway vectoring agents (sometimes called sub-pathways) that may harbor pests/diseases; and all associated invasives. A matrix of further examples follows:

Nbr #	Pathway Name	Threat Level	Pathway Start Point	Pathway Mid Point(s)	Pathway End Point	Dissemination Points	Related Invasives
T3.2.1	Wood Packing Materials	B	Ciudad Juarez, MX. Via Railcar transport of heavy equipment	Transits through El Paso but by-passes inspection points	Tillamook Oregon	A. Commercial lumber operations in forest B. City hardware store-retail	Asian Long Horn Beetle
			Ecoregion Type(s) Great Plains	Ecoregion Type(s) Great Plains	Ecoregion Type(s) NW Forested Mtns	Ecoregion Type(s) A. NW Forested Mtns B. NW Forested Mtns-confined non-ag area	Preferred Ecoregion Type(s) A. Forest Areas-Receptive B.City –low receptivity
T1.2.1	Ship Ballast Water	A	Naples -Cargo Ship (Cholera	Lisbon, Portugal	Bar Harbor Maine	City Harbor	zebra mussels cholera

			Outbreak)				
			Ecoregion Type(s) Mediterranean Sea	Ecoregion Type(s) Mediterranean Sea	Ecoregion Type(s) Grand Banks	Ecoregion Type(s) Grand Banks	Preferred Ecoregion Type(s) Marine-salt water
L1.1	Import Plants for Research Perth, Australia Marsh Grasses in soil. Soil is a vectoring agent or sub-pathway for other invasives	C	Perth Botanical Society-passenger hand-carry	None	Raleigh, NC airport	NC State Botany lab	Marsh grasses are pathway for invasive water hyacinth Soil is a vectoring or sub-pathway agent for snails
			Ecoregion Type(s) Mangroves	Ecoregion Type(s) N/A	Ecoregion Type(s) Temperate Coniferous Forest	Ecoregion Type(s) Temperate Coniferous Forest – Controlled lab	Preferred Ecoregion Type(s) Marine Ecosystem Temperate grasslands – controlled lab low receptivity

2. DETAILED INVASIVE DEFINITIONS

It is critical to 'marry-up' the specific invasive(s) and its (their) threat to the related pathway. It is at this point that the 'science' of the individual invasive(s) becomes important. Though abbreviated in the exemplar chart s, it is also imperative to specifically define the taxonomy and biological invasive characteristics that should be considered for this specific pathway. Examples include:

- **Description:** ***Caulerpa taxifolia:*** Green algae with feather-like branches, leaf is 5-65 cm in length, tropical in origin, found in Caribbean Sea and Indian Ocean, hybrid form found in Mediterranean Sea is much larger (plants up to 10 ft.), and can survive out of water for up to 10 days. It can survive in a wide variety of habitats, including sandy bottoms, rocky outcroppings, mud, and natural meadows.

- **Description:** ***Agrilus planipennis. (Emerald Ash Borer)*** The beetle appears to have a one year life cycle in North America. Mating occurs during the first 7-10 days after emergence. Each female lays an average of 77 eggs in bark crevices from late May through July, and these hatch in 7 to 9 days. Larvae tunnel in the cambial layer, feeding on the phloem and outer sapwood, and move into the sapwood as they increase in size. Larva feed aggressively until cooler fall temperatures arrive, and then over winter in the tree. Pupation occurs in late April to June.

Detailed invasive definitions are contained on www.invasivespeciesinfo.gov

3. PATHWAY ECOSYSTEM THREAT/SCOPE LEVEL DETERMINATION

As noted above, ecosystem consideration is an important aspect of pathway analysis. As such, it is essential to review and, if necessary, revise the first general assessment of pathway threat level and

ecosystem scope determination made in the 'First-Cut' analysis that may result from redefinition. Exemplar ecosystem charts and listings are provided below (sources: Commission for Environmental Cooperation and World Wildlife Federation). Please note, the above pathway ecosystem designations and ecoregion charts are just examples. Ecoregion charts may be modified, developed anew by the teams, etc. What is required, however, is documentation of ecoregion determinations.

The next step is to define the scope of the pathway using one of the categories, below. The underlying assumption to this step is: the broader the pathway (i.e., in terms of distance and ecosystems potentially contaminated), the greater the threat the pathway may pose. These devised categories are not absolutes but represent a general framework for assignment of scope complexities. Expertise, knowledge and discretion should be used in assigning scope level as there may be nuances regarding a particular invasive species or pathway that will warrant varying the scope category as defined. Ecosystem definitions, ultimately, are the responsibility of the assessing team - - though a general map to assist in these definitions is provided. Specific pathways and associated invasive species may even call for redefinition of ecosystems. Any redefinition should be documented as part of the assessment process to provide basis for transparency in decision making. As such, the CAPT must ensure the assignment of ecosystem threat or scope for each pathway using one of the following categories:

Level 0- - Single Event. This is a single invasive species outbreak in a state, territory or tribal land within a single ecosystem with no movement of the invasive via a pathway. It may also represent more than one type of invasive species outbreak, but again, with no movement outside of a single ecosystem that is contained within a single state, territory or tribal land boundary.

Level I - - **Multiple Event**. This is a multiple event where one or more outbreaks of a single invasive species crosses two ecosystems within a single state, territory or tribal boundary or where the single invasive species crosses one or more ecosystems that crosses boundaries between two different states, territories or tribal land boundaries. It may also represent more than one type of invasive species outbreak, but again, with movement only between two distinct ecosystems within a single boundary land area; or movement between two different state, territory or tribal land boundaries.

Level II- - **Regional Event**. This is a regional event where two or more outbreaks of a single invasive species invades three or more ecosystems within a single state, territory or tribal land boundary or where the single invasive species invades three or more ecosystems that cross boundaries between three or more different state, territory or tribal lands. It may also represent more than one type of invasive species outbreak, but again, with movement only between three distinct ecosystems within three boundary land areas; or movement between three different state, territory or tribal land boundaries.

Level III - - **Multiregional** - - This level represents multi-regional, multiple events where three or more outbreaks of a single invasive species invades four or more ecosystems within multiple state, territory or tribal land boundaries or where the single invasive species invades four or more ecosystems that cross boundaries between four or more different state, territory or tribal lands. It may also represent more than one type of invasive species outbreak, but again, with movement only between four distinct ecosystems within four boundary land areas; or movement between four different state, territory or tribal land boundaries.

Level IV - - **National** - - This is a national level event where invasion impacts national resources and priorities. It is characterized by four or more outbreaks of a single invasive species that invades five or more ecosystems within multiple state, territory or tribal land boundaries or where the single invasive species invades five or more ecosystems that cross boundaries between five or more different state, territory or tribal lands. It may also represent more than one type of invasive species outbreak, but again, with movement between five distinct ecosystems within five boundary land areas; or movement between five different state, territory or tribal land boundaries.

Level V - - **International** - - An international level event is characterized by pathway movement of a single or multiple invasive species between the continental United States (CONUS) boundaries (for these purposes, Hawaii would be considered international; tribal lands considered CONUS), its territories and

foreign countries. This pathway may range from single start and endpoint, to multiple 'intermediary stop points' of an invasive species pathway from initial to final destination.

Assigned Pathway Scope Level: _____. Please indicate rational for scope decision and attach map/schematic of eco-regions assigned to pathway:

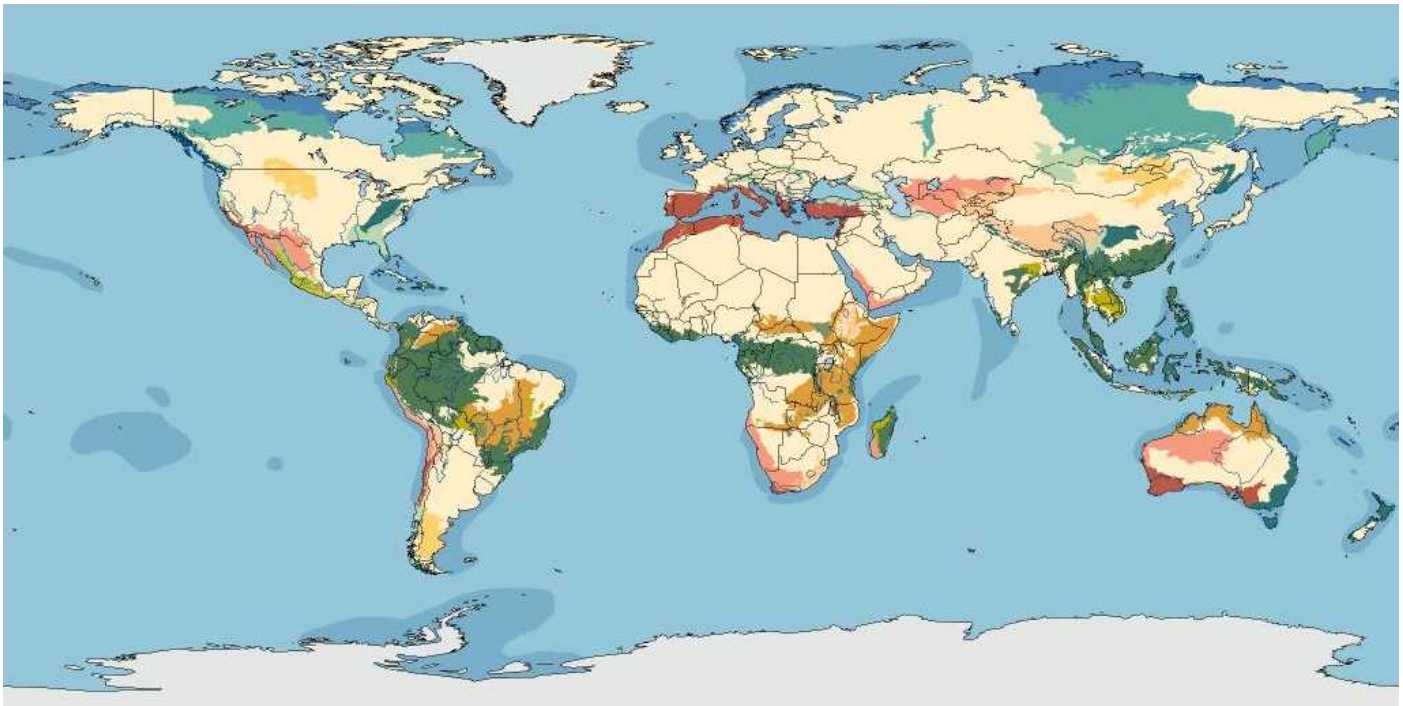
_____
_____
_____
_____

4. EXEMPLAR ECOSYSTEM CHARTS.

The following are exemplar ecosystem charts and listings for reference. However, different ones may be used, based upon the preferences of expert opinions.

North American Ecoregion Map

World Ecoregion Map



Terrestrial Major Habitat Types

- Tropical & Subtropical Moist Broadleaf Forests
- Tropical & Subtropical Dry Broadleaf Forests
- Tropical & Suptropical Coniferous Forests
- Temperate Broadleaf & Mixed Forests
- Temperate Coniferous Forests
- Boreal Forests / Taiga
- Tropical & Subtropical Grasslands, Savannas & Shrublands
- Temperate Grasslands, Savannas & Shrublands
- Flooded Grasslands & Savannas
- Montane Grasslands & Shrublands
- Tundra
- Mediterranean Forests, Woodlands & Scrub
- Deserts & Xeric Shrublands
- Mangroves

- Marine Ecoregions
- Freshwater Ecoregions
- No Data
- International Boundaries
- Disputed Boundaries, Lines of Control, or alignment uncofirmed [Boundaries based on UN sources]

TERRESTRIAL ECOREGIONS

Tropical and Subtropical Moist Broadleaf Forests

Afrotropical

(1) Guinean Moist Forests - Benin, Côte d'Ivoire, Ghana, Guinea, Liberia, Sierra Leone, Togo

(2) Congolian Coastal Forests - Angola, Cameroon, Democratic Republic of Congo, Equatorial Guinea, Gabon, Nigeria, São Tomé & Príncipe, Republic of Congo

(3) Cameroon Highlands Forests - Cameroon, Equatorial Guinea, Nigeria

(4) Northeastern Congo Basin Moist Forests - Central African Republic, Democratic Republic of Congo

(5) Central Congo Basin Moist Forests - Democratic Republic of Congo

(6) Western Congo Basin Moist Forests - Cameroon, Central African Republic, Democratic Republic of Congo, Gabon, Republic of Congo

(7) Albertine Rift Montane Forests - Burundi, Democratic Republic of Congo, Rwanda, Tanzania, Uganda

(8) East African Coastal Forests - Kenya, Somalia, Tanzania

(9) Eastern Arc Montane Forests - Kenya, Tanzania

(10) Madagascar Forests and Shrublands - Madagascar

(11) Seychelles and Mascarenes Moist Forests - Mauritius, Reunion (France), Seychelles

Australasia

(12) Sulawesi Moist Forests - Indonesia

(13) Moluccas Moist Forests - Indonesia

(14) Southern New Guinea Lowland Forests - Indonesia, Papua New Guinea

(15) New Guinea Montane Forests - Indonesia, Papua New Guinea

(16) Solomons-Vanuatu-Bismarck Moist Forests - Papua New Guinea, Solomon Islands, Vanuatu

(17) Queensland Tropical Forests - Australia

(18) New Caledonia Moist Forests - New Caledonia (France)

(19) Lord Howe-Norfolk Islands Forests - Australia

Indo-Malayan

(20) Southwestern Ghats Moist Forests - India

(21) Sri Lankan Moist Forests - Sri Lanka

(22) Northern Indochina Subtropical Moist Forests - China, Laos, Myanmar, Thailand, Vietnam

(23) Southeast China-Hainan Moist Forests - China, Vietnam

(24) Taiwan Montane Forests - China

(25) Annamite Range Moist Forests - Cambodia, Laos, Vietnam

(26) Sumatran Islands Lowland and Montane Forests - Indonesia

(27) Philippines Moist Forests - Philippines

(28) Palawan Moist Forests - Philippines

(29) Kayah-Karen / Tenasserim Moist Forests - Malaysia, Myanmar, Thailand

(30) Peninsular Malaysian Lowland and Mountain Forests - Indonesia, Malaysia, Singapore, Thailand

(31) Borneo Lowland and Montane Forests - Brunei, Indonesia, Malaysia

(32) Nansei Shoto Archipelago Forests - Japan

(33) Eastern Deccan Plateau Moist Forests - India

(34) Naga-Manupuri-Chin Hills Moist Forests - Bangladesh, India, Myanmar

(35) Cardamom Mountains Moist Forests - Cambodia, Thailand

(36) Western Java Mountain Forests - Indonesia

Neotropical

(37) Greater Antillean Moist Forests - Cuba, Dominican Republic, Haiti, Jamaica, Puerto Rico (United States)

(38) Talamancan and Isthmian Pacific Forests - Costa Rica, Panama
(39) Chocó-Darién Moist Forests - Colombia, Ecuador, Panama
(40) Northern Andean Montane Forests - Colombia, Ecuador, Venezuela, Peru
(41) Coastal Venezuela Montane Forests - Venezuela
(42) Guianan Moist Forests - Brazil, French Guiana (France), Guyana, Suriname, Venezuela
(43) Napo Moist Forests - Colombia, Ecuador, Peru
(44) Río Negro-Juruá Moist Forests - Brazil, Colombia, Peru, Venezuela
(45) Guayanan Highlands Forests - Brazil, Colombia, Guayana, Suriname, Venezuela
(46) Central Andean Yungas - Argentina, Bolivia, Peru
(47) Southwestern Amazonian Moist Forests - Bolivia, Brazil, Peru
(48) Atlantic Forests - Argentina, Brazil, Paraguay
Oceania
(49) South Pacific Islands Forests - American Samoa (United States), Cook Islands (New Zealand), Fiji, French Polynesia (France), Niue (New Zealand), Samoa, Tonga, Wallis and Futuna Islands (France)
(50) Hawaii Moist Foresst - Hawaii (United States)
Tropical and Subtropical Dry Broadleaf Forests
Afrotropical
(51) Madagascar Dry Forests - Madagascar
Australasia
(52) Nusu Tenggara Dry Forests - Indonesia
(53) New Caledonia Dry Forests - New Caledonia (France)
Indo-Malayan
(54) Indochina Dry Forests - Cambodia, Laos, Thailand, Vietnam
(55) Chhota-Nagpur Dry Forests - India
Neotropical
(56) Mexican Dry Forests - Guatemala, Mexico
(57) Tumbesian-Andean Valleys Dry Forests - Colombia, Ecuador, Peru
(58) Chiquitano Dry Forests - Bolivia, Brazil
(59) Atlantic Dry Forests - Brazil
Oceania
(60) Hawaii's Dry Forests - Hawaii (United States)
Tropical and Suptropical Coniferous Forests
Nearctic
(61) Sierra Madre Oriental and Occidental Pine-Oak Forests - Mexico, United States
Neotropical
(62) Greater Antillean Pine Forests - Cuba, Dominican Republic, Haiti
(63) Mesoamerican Pine-Oak Forests - El Salvador, Guatemala, Honduras, Mexico, Nicaragua
Temperate Broadleaf and Mixed Forests
Australasia
(64) Eastern Australia Temperate Forests - Australia
(65) Tasmanian Temperate Rain Forests - Australia
(66) New Zealand Temperate Forests - New Zealand

Indo-Malayan
(67) Eastern Himalayan Broadleaf and Conifer Forests - Bhutan, China, India, Myanmar, Nepal
(68) Western Himalayan Temperate Forests - Afghanistan, India, Nepal, Pakistan
Nearctic
(69) Appalachian and Mixed Mesophytic Forests - United States
Palearctic
(70) Southwest China Temperate Forests - China
(71) Russian Far East Temperate Forests - Russia
Temperate Coniferous Forests
Nearctic
(72) Pacific Temperate Rainforests - Canada, United States
(73) Klamath-Siskiyou Coniferous Forests - United States
(74) Sierra Nevada Coniferous Forests - United States
(75) Southeastern Coniferous and Broadleaf Forests - United States
Neotropical
(76) Valdivian

Temperate Rainforests / Juan Fernandez Islands - Argentina, Chile

Palearctic

(77) European-Mediterranean Montane Mixed Forests - Albania, Algeria, Andorra, Austria, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, France, Germany, Greece, Italy, Liechtenstein, Macedonia, Morocco, Poland, Romania, Russia, Slovakia, Slovenia

(78) Caucasus-Anatolian-Hyrcanian Temperate Forests - Armenia, Azerbaijan, Bulgaria, Georgia, Iran, Russia, Turkey, Turkmenistan

(79) Altai-Sayan Montane Forests - China, Kazakstan, Mongolia, Russia

(80) Hengduan Shan Coniferous Forests - China

Boreal Forests / Taiga

Nearctic

(81) Muskwa / Slave Lake Boreal Forests - Canada

(82) Canadian Boreal Forests - Canada

Palearctic

(83) Ural Mountains Taiga - Russia

(84) Eastern Siberian Taiga - Russia

(85) Kamchatka Taiga and Grasslands - Russia

Tropical and Subtropical Grasslands, Savannas and Shrublands

Afrotropical

(86) Horn of Africa Acacia Savannas - Eritrea, Ethiopia, Kenya, Somalia, Sudan

(87) East African Acacia Savannas - Ethiopia, Kenya, Sudan, Tanzania, Uganda

(88) Central and Eastern Miombo Woodlands - Angola, Botswana, Burundi, Democratic Republic of Congo, Malawi, Mozambique, Namibia, Tanzania, Zambia, Zimbabwe

(89) Sudanian Savannas - Cameroon, Central African Republic, Chad, Nigeria, Democratic Republic of Congo, Eritrea, Ethiopia, Kenya, Nigeria, Sudan, Uganda

Australasia

(90) Northern Australia and Trans-Fly Savannas - Australia, Indonesia, Papua New Guinea

Indo-Malayan

(91) Terai-Duar Savannas and Grasslands - Bangladesh, Bhutan, India, Nepal

Neotropical

(92) Llanos Savannas - Colombia, Venezuela

(93) Cerrado Woodlands and Savannas - Bolivia, Brazil, Paraguay

Temperate Grasslands, Savannas and Shrublands

Nearctic

(94) Northern Prairie - Canada, United States

Neotropical

(95) Patagonian Steppe - Argentina, Chile

Palearctic

(96) Daurian Steppe - China, Mongolia, Russia

Flooded Grasslands and Savannas

Afrotropical

(97) Sudd-Sahelian Flooded Grasslands and Savannas - Cameroon, Chad, Ethiopia, Mali, Niger, Nigeria, Sudan, Uganda

(98) Zambezian Flooded Savannas - Angola, Botswana, Democratic Republic of Congo, Malawi, Mozambique, Namibia, Tanzania, Zambia

Indo-Malayan

(99) Rann of Kutch Flooded Grasslands - India, Pakistan

Neotropical

(100) Everglades Flooded Grasslands - United States

(101) Pantanal Flooded Savannas - Bolivia, Brazil, Paraguay

Montane Grasslands and Shrublands

Afrotropical

(102) Ethiopian Highlands - Eritrea, Ethiopia, Sudan

(103) Southern Rift Montane Woodlands - Malawi, Mozambique, Tanzania, Zambia

(104) East African Moorlands - Democratic Republic of Congo, Kenya, Rwanda, Tanzania, Uganda

(105) Drakensberg Montane Shrublands and Woodlands - Lesotho, South Africa, Swaziland

Australasia

(106) Central Range

Subalpine Grasslands - Indonesia, Papua New Guinea

Indo-Malayan

(107) Kinabalu Montane Scrub - Malaysia

Neotropical

(108) Northern Andean Paramo - Colombia, Ecuador, Peru, Venezuela

(109) Central Andean Dry Puna - Argentina, Bolivia, Chile, Peru

Palearctic

(110) Tibetan Plateau Steppe - Afghanistan, China, India, Pakistan, Tajikistan

(111) Middle Asian Montane Steppe and Woodlands - Afghanistan, China, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan

(112) Eastern Himalayan Alpine Meadows - Bhutan, China, India, Myanmar, Nepal

Tundra

Nearctic

(113) Alaskan North Slope Coastal Tundra - Canada, United States

(114) Canadian Low Arctic Tundra - Canada

Palearctic

(115) Fenno-Scandia Alpine Tundra and Taiga - Finland, Norway, Russia, Sweden

(116) Taimyr and Siberian Coastal Tundra - Russia

(117) Chukote Coastal Tundra - Russia

Mediterranean Forests, Woodlands and Scrub

Afrotropical

(118) Fynbos - South Africa

Australasia

(119) Southwestern Australia Forests and Scrub - Australia

(120) Southern Australia Mallee and Woodlands - Australia

Nearctic

(121) California Chaparral and Woodlands - Mexico, United States

Neotropical

(122) Chilean Matorral - Chile

Palearctic

(123) Mediterranean Forests, Woodlands and Scrub - Albania, Algeria, Bosnia and Herzegovina, Bulgaria, Canary Islands (Spain), Croatia, Cyprus, Egypt, France, Gibraltar (United Kingdom), Greece, Iraq, Israel, Italy, Jordan, Lebanon, Libya, Macedonia, Madeira Islands (Portugal), Malta, Monaco, Morocco, Portugal, San Marino, Slovenia, Spain, Syria, Tunisia, Turkey, Western Sahara (Morocco), Yugoslavia

Deserts and Xeric Shrublands

Afrotropical

(124) Namib-Karoo-Kaokeveld Deserts - Angola, Namibia, South Africa

(125) Madagascar Spiny Thicket - Madagascar

(126) Socotra Island Desert - Yemen

(127) Arabian Highland Woodlands and Shrublands - Oman, Saudi Arabia, United Arab Emirates, Yemen

Australasia

(128) Carnavon Xeric Scrub - Australia

(129) Great Sandy-Tanami Deserts - Australia

Nearctic

(130) Sonoran-Baja Deserts - Mexico, United States

(131) Chihuahuan-Tehuacán Deserts - Mexico, United States

Neotropical

(132) Galápagos Islands Scrub - Ecuador

(133) Atacama-Sechura Deserts - Chile, Peru

Palearctic

(134) Central Asian Deserts - Kazakstan, Kyrgyzstan, Uzbekistan, Turkmenistan

Mangroves

Afrotropical

(135) Gulf of Guinea Mangroves - Angola, Cameroon, Democratic Republic of Congo, Equatorial Guinea, Gabon, Ghana, Nigeria

(136) East African Mangroves - Kenya, Mozambique, Somalia, Tanzania

(137) Madagascar Mangroves - Madagascar

Australasia

(138) New Guinea Mangroves - Indonesia, Papua New Guinea

Indo-Malayan

(139) Sundarbans Mangroves - Bangladesh, India

(140) Greater Sundas Mangroves - Brunei, Indonesia, Malaysia

Neotropical

(141) Guianan-Amazon

Mangroves - Brazil, French Guiana (France), Suriname, Trinidad and Tobago, Venezuela
(142) Panama Bight Mangroves - Colombia, Ecuador, Panama, Peru

FRESHWATER ECOREGIONS
Large Rivers
Afrotropical
(143) Congo River and Flooded Forests - Angola, Democratic Republic of Congo, Republic of Congo
Indo-Malayan
(144) Mekong River - Cambodia, China, Laos, Myanmar, Thailand, Vietnam
Nearctic
(145) Colorado River - Mexico, United States
(146) Lower Mississippi River - United States
Neotropical
(147) Amazon River and Flooded Forests - Brazil, Colombia, Peru
(148) Orinoco River and Flooded Forests - Brazil, Colombia, Venezuela
Palearctic
(149) Yangtze River and Lakes - China
Large River Headwaters
Afrotropical
(150) Congo Basin Piedmont Rivers and Streams - Angola, Cameroon, Central African Republic, Democratic Republic of Congo, Gabon, Republic of Congo, Sudan
Nearctic
(151) Mississippi Piedmont Rivers and Streams - United States
Neotropical
(152) Upper Amazon Rivers and Streams - Bolivia, Brazil, Colombia, Ecuador, French Guiana (France), Guyana, Peru, Suriname, Venezuela
(153) Upper Paraná Rivers and Streams - Argentina, Brazil, Paraguay
(154) Brazilian Shield Amazonian Rivers and Streams - Bolivia, Brazil, Paraguay
Large River Deltas
Afrotropical
(155) Niger River Delta - Nigeria
Indo-Malayan
(156) Indus River Delta - India, Pakistan
Palearctic
(157) Volga River Delta - Kazakhstan, Russia
(158) Mesopotamian Delta and Marshes - Iran, Iraq, Kuwait
(159) Danube River Delta - Bulgaria, Moldova, Romania, Ukraine, Yugoslavia
(160) Lena River Delta - Russia
Small Rivers
Afrotropical
(161) Upper Guinea Rivers and Streams - Côte D'Ivoire, Guinea, Liberia, Sierra Leone
(162) Madagascar Freshwater - Madagascar
(163) Gulf of Guinea Rivers and Streams - Angola, Cameroon, Democratic Republic of Congo, Equatorial Guinea, Gabon, Nigeria, Republic of Congo
(164) Cape Rivers and Streams - South Africa
Australasia
(165) New Guinea Rivers and Streams - Indonesia, Papua New Guinea
(166) New Caledonia Rivers and Streams - New Caledonia (France)
(167) Kimberley Rivers and Streams - Australia
(168) Southwest Australia Rivers and Streams - Australia
(169) Eastern Australia Rivers and Streams - Australia
Indo-Malayan
(170) Xi Jiang Rivers and Streams - China, Vietnam
(171) Western Ghats Rivers and Streams - India
(172) Southwestern Sri Lanka Rivers and Streams - Sri Lanka
(173) Salween River - China, Myanmar, Thailand
(174) Sundaland Rivers and Swamps - Brunei, Malaysia, Indonesia, Singapore
Nearctic
(175) Southeastern Rivers and Streams - United States
(176) Pacific Northwest Coastal Rivers and Streams - United States
(177) Gulf of Alaska Coastal Rivers and Streams - Canada, United States
Neotropical
(178) Guianan Freshwater - Brazil, French Guiana (France), Guyana, Suriname, Venezuela
(179) Greater Antillean Freshwater - Cuba,

Dominican Republic, Haiti, Puerto Rico (United States)

Palearctic

(180) Balkan Rivers and Streams - Albania, Bosnia and Herzogovina, Bulgaria, Croatia, Greece, Macedonia, Turkey, Yugoslavia

(181) Russian Far East Rivers and Wetlands - China, Mongolia, Russia

Large Lakes

Afrotropical

(182) Rift Valley Lakes - Burundi, Democratic Republic of Congo, Ethiopia, Kenya, Malawi, Mozambique, Rwanda, Tanzania, Uganda, Zambia

Neotropical

(183) High Andean Lakes - Argentina, Bolivia, Chile, Peru

Palearctic

(184) Lake Baikal - Russia

(185) Lake Biwa - Japan

Small Lakes

Afrotropical

(186) Cameroon Crater Lakes - Cameroon

Australasia

(187) Lakes Kutubu and Sentani - Indonesia, Papua New Guinea

(188) Central Sulawesi Lakes - Indonesia

Indo-Malayan

(189) Philippines Freshwater - Philippines

(190) Lake Inle - Myanmar

(191) Yunnan Lakes and Streams - China

Neotropical

(192) Mexican Highland Lakes - Mexico

Xeric Basins

Australasia

(193) Central Australian Freshwater - Australia

Nearctic

(194) Chihuahuan Freshwater - Mexico, United States

Palearctic

(195) Anatolian Freshwater - Syria, Turkey

MARINE ECOREGIONS

Polar Seas

Antarctic

(196) Antarctic Peninsula & Weddell Sea - Antarctic Peninsula & Weddell Sea

Arctic

(197) Bering Sea - Canada, Russia, United States

(198) Barents-Kara Sea - Norway, Russia

Temperate Shelfs and Seas

Mediterranean

(199) Mediterranean Sea - Albania, Algeria, Bosnia and Herzegovina, Croatia, Cyprus, Egypt, France, Gibraltar (United Kingdom), Greece, Israel, Italy, Lebanon, Libya, Malta, Monaco, Morocco, Slovenia, Spain, Syria, Tunisia, Turkey, Yugoslavia

North Temperate Atlantic

(200) Northeast Atlantic Shelf Marine - Belgium, Denmark, Estonia, Finland, France, Germany, Ireland, Latvia, Lithuania, Netherlands, Norway, Poland, Russia, Sweden, United Kingdom

(201) Grand Banks - Canada, St. Pierre and Miquelon (France), United States

(202) Chesapeake Bay - United States

North Temperate Indo-Pacific

(203) Yellow Sea - China, North Korea, South Korea

(204) Okhotsk Sea - Japan, Russia

Southern Ocean

(205) Patagonian Southwest Atlantic - Argentina, Brazil, Chile, Uruguay

(206) Southern Australian Marine - Australia

(207) New Zealand Marine - New Zealand

Temperate Upwelling

North Temperate Indo-Pacific

(208) Californian Current - Canada, Mexico, United States

South Temperate Atlantic

(209) Benguela Current - Namibia, South Africa

South Temperate Indo-Pacific

(210) Humboldt Current - Chile, Ecuador, Peru

(211) Agulhas Current - Mozambique, South Africa

Tropical Upwelling

Central Indo-Pacific

(212) Western Australian Marine - Australia

Eastern Indo-Pacific

(213) Panama Bight - Colombia, Ecuador, Panama

(214) Gulf of California - Mexico

(215) Galápagos Marine - Ecuador

Eastern Tropical Atlantic

(216) Canary Current - Canary Islands (Spain), Gambia, Guinea-Bissau, Mauritania, Morocco, Senegal, Western Sahara (Morocco)

Tropical Coral

Central Indo-Pacific

(217) Nansei Shoto - Japan

(218) Sulu-Sulawesi Seas - Indonesia, Malaysia, Philippines

(219) Bismarck-Solomon Seas - Indonesia, Papua New Guinea, Solomon Islands

(220) Banda-Flores Sea - Indonesia

(221) New Caledonia Barrier Reef - New Caledonia (France)

(222) Great Barrier Reef - Australia

(223) Lord Howe-Norfolk Islands Marine - Australia

(224) Palau Marine - Palau

(225) Andaman Sea - Andaman and Nicobar Islands (India), Indonesia, Malasia, Myanmar, Thailand

Eastern Indo-Pacific

(226) Tahitian Marine - Cook Islands (New Zealand), French Polynesia (France)

(227) Hawaiian Marine - Hawaii (United States)

(228) Rapa Nui - Chile

(229) Fiji Barrier Reef - Fiji

Western Indo-Pacific

(230) Maldives, Chagos, Lakshadweep Atolls - Chagos Archipelago (United Kingdom), India, Maldives, Sri Lanka

(231) Red Sea - Djibouti, Egypt, Eritrea, Israel, Jordan, Saudi Arabia, Sudan, Yemen

(232) Arabian Sea - Djibouti, Iran, Oman, Pakistan, Qatar, Saudi Arabia, Somalia, United Arab Emirates, Yemen

(233) East African Marine - Kenya, Mozambique, Somalia, Tanzania

Western Tropical Atlantic

(235) Mesoamerican Reef - Belize, Guatemala, Honduras, Mexico

(236) Greater Antillean Marine - Bahamas, Cayman Islands (United Kingdom), Cuba, Dominican Republic, Haiti, Jamaica, Puerto Rico (United States), Turks and Caicos Islands (United Kingdom), United States

(237) Southern Caribbean Sea - Aruba (Netherlands), Columbia, Netherlands Antilles (Netherlands), Panama, Trinidad and Tobago, Venezuela

(238) Northeast Brazil Shelf Marine - Brazil

5. FINALIZING THE 'SECOND-CUT' ANALYSIS.

The second-cut analysis, should therefore have provided detailed, pathway description, full listing and defined properties of all invasive species associated with the specific pathway; and, most importantly, definition of the scope of the pathway.

After completion of 'second cut' analysis, CAPT is to forward results and expert lists to:

National Invasive Species Council
Prevention Committee
ATTN: Richard Orr
Assistant Director for International Policy and Prevention
U.S. Department of Interior (OS/SIO//NISC)
1849 C Street, NW
Washington, DC 20240

"THIRD-CUT' ANALYSIS - - SINGLE PATHWAY RISK ANALYSIS VIA EXPERT CONSENSUS

1. INDIVIDUAL TO FOCUS GROUP - - EXPERT ANALYSIS

Similar in process to the 'First-Cut' analysis, the CAPT is to oversee the risk evaluation of a single pathway, first, by individual experts, then via a consensus meeting. In step 5, using products developed in steps 1-4, the CAPT completes the following:

A. Selects 5 to 8 IS risk evaluators, with experience pertinent to the single, defined pathway to be analyzed. Pathway analysis and prioritization is a challenge to be met by scientific program experts. It is important to gather together a team of individuals whom can appropriately accomplish all quantitative analyses and also be able to provide qualitative opinions. At a minimum, a pathway assessment expert team list should be compiled that includes information as to the expert(s)' name, organization/association, areas of specialty, published papers, academic background, related work history and contact information. The following process is recommended for the selection of individual or team members for pathway analyses:

   A. Define academic and experience expertise essential for analysis
   B. Compile a list of all pertinent agencies, organizations, industries and stakeholders
   C. Forward letters for IS evaluator participation solicitation to various groups (complying with any Federal Advisory Committee Act provisions). The solicitation should clearly state the pathway and expertise areas being sought.
   D. Designate evaluators; matching credential and pathways to be assessed
   E. Designated participants are to provide curricula vita, resumes, any relevant published articles, areas of specialty, academic background, related work history and contact information.

B. Forwards information packages to individual risk evaluators that includes pathway definition, pathway threat level determination and rationale, pathway ecosystem scope determination and rationale, related literature and study searches, related quantitative datasets/databases, risk questionnaire contained later in this guide. Specific risk factors for quantitative assessment included such factors as the following

   - Prevalence of a pest or disease agent in the exporting area;
   - Geographic and environmental characteristics;
   - Sanitary and phytosanitary status of the adjoining or neighboring areas;
   - Trading partners and practices;
   - Regulatory infrastructure of the exporting country;
   - Invasive species surveillance and monitoring system(s);
   - Pest or disease agent survival rate in transit;
   - Interception data;

- Invasive species destination risk factors such as likelihood and consequences of a particular pest or disease agent surviving, multiplying, establishing and spreading in the territory of the importing country;
- Uncertainty about the organisms, the human error factor, or methods used;
- Distribution of the commodity or vectoring agents; and,
- Availability of susceptible hosts and/or competent vectors.

The relevant economic factors include:

- The potential damage due to loss of production or sales in the event of the entry, establishment or spread of a pest or disease;
- The cost of control and eradication;
- The relative cost-effectiveness of risk mitigation strategies; and.
- Cost-benefit analysis of mitigation versus consequence of introduction.

C. CAPT, finally, receives completed risk assessments from individual IS experts.

2. PROCESSES FOR RISK ANALYSIS

Though pathway analysis can be accomplished by a single expert, it is advised that focus group procedures be used for more complex pathways and for any pathway that is being assessed at the regional level and above. The risk questions, that later follow, provide a consistent structured protocol for individual assessment that can later be used for consensus analysis and policy synthesis.

CAPT, during focus group processes, must ensure the following:

A. Provides information packages to focus group risk evaluators that includes pathway definition, pathway threat level determination and rationale, pathway ecosystem scope determination and rationale, related literature and study searches, related quantitative datasets/databases, AND all individual expert risk questionnaire assessments.
B. Construct focus groups. In that pathways are to be succinctly defined and assessed, a single focus group per pathways is deemed sufficient. This is not to say once evaluated, a pathway is always evaluated. In fact, it is expected that pathways will be re-assessed, as needed, due to changing conditions
C. Facilitate Focus Groups. Focus group participants are to be asked to reflect on the questions asked by the moderator; are permitted to hear one another's individual responses and then make additional comments beyond their own original responses. The facilitator(s)' role in these discussions will be to seek consensus between participants on pathway risk prioritization.
D. Record Focus Group Data. The focus group facilitator should assign a non-expert person as the recorder to take notes on all comments and assessments. A major advantage to this is the recorder focuses on observing and taking notes, while the facilitator concentrates on asking questions, facilitating group interaction, following up on ideas, and making smooth transition from issue to issue. These results are then codified in a final overarching assessment by the recorder but without individual names or organizations attributed to specific comments. ***The risk analysis assessment tool must be completed by each***

individual experts for each pathway assessments; regardless if they are the sole evaluator or a co-evaluator for focus group assessment. The recorder is responsible for ensuring individual evaluators 'turn-in' their individual assessments and for compiling overarching consolidated pathway assessment based on group discussion. The analysis process requires record-keeping of comments and opinions to ensure transparency and for review of decision rationale.

E. Ensure access to database sources for quantitative assessment. The goal of developing quantitative datasets is to give statistical indicators to aid in assessing the likelihood of invasive species entry or occurrence, establishment or spread of a pest or disease within the territory, phytosanitary measures which might be applied, and the associated potential biological and economic consequences or the evaluation of the potential for adverse effects on human or animal health. Assessment should first be rooted in the unmitigated (unmanaged) pest or disease risk but then modified to address mitigation/management practices. Biological, economic or ecosystem consequences should also be addressed, but in terms of merging risk 'science' with policy decisions. Database sources for pathway assessment are numerous. Therefore, prior to any group discussion, individual expert should first compile and document quantitative data sources used for forming expert perspectives.

F. Ensure consensus completion of pathway risk analysis. This portion of pathway assessment requires risk experts perform science-based risk analysis of invasive species via common criterion. Expert opinions are to be supported by quantitative datasets, expert literature and scientific expertise. Pathway complexities and characteristics are in constant change and flux - -motivated by shifting trade and market patterns. As such, though future pathway risk assessments will strive for greater quantifiable or formulaic assessments, expert opinion will remain a key source of pathway risk determinations. Risk decisions are guided by response to the following set of pre-determined analysis questions.

3. RISK ANALYSIS VIA SURVEY QUESTIONNAIRE

CAPT is to ensure each question is answered (again, a single/consensus response in whole numbers). The questions are geared to address such issues as probability of introduction, probability of establishment, history of invasiveness, available mitigation methods and invasive impacts. Issues regarding action planning, policy and political implications for the invasives are not part of this scientific risk assessment phase but rather will be covered in the last portion, Invasive Species response, action planning and communication.

Critical to these processes, also, is the documentation of decision uncertainties. During this process, evaluators <u>must</u> accept the existence of varying degrees of uncertainty. It is expected for all reviewers, even in light of the uncertainty, to come to a single/consensus whole number score for each question. If uncertainty exists, the basis for that uncertainty must be defined. Pathway analysts must give character to the uncertainty, using such rationale as flaws in methodology, lack of expertise, coherence or error on part of risk assessor, biological unknowns of the invasive organisms/pathways, insufficient information (i.e., lack of accurate or precise knowledge of the input values), or political impediments.

Completing the Risk Questions. The following section contains the risk assessment portion of pathways prioritization. Expert(s) are to review the questions, determine the level of risk posed by the pathway and assign a single, whole number between 1-10 to each question.

Question 1: What is the level of risk of this pathway introducing invasive species on a frequent basis? (*Frame of Reference: Extremely high frequency ranking is defined, in relative terms, as introducing numerous invasives (i.e., 10 or more) that have had either human health pandemic implications resulting in deaths; moderate is 5 or more that have caused serious economic impacts on (i.e., failure of) major industries; low is 2 or more introduced invasives that negatively impacted 2 or more ecological niches).*

Level Nbr	**Level Descriptor**	**Level Determination (i.e., 0,1,2,3,4,5,6,7,8,9 or 10) (Assign a whole number):**
Level 0	No Risk	**Rationale**
Level 1-2	Extremely Low Level of Risk	
Level 3-4	Moderately Low Level of Risk	
Level 5-6	Medium Level of Risk	
Level 7-8	Moderately High Level of Risk	
Level 9-10	Extremely High Level of Risk	

Is there uncertainty regarding this rating? If so, please complete the chart below:

Basis of Uncertainty	**Check All Relevant**	**Uncertainty level (Assign whole nbr from 0-5 where 1= slightly uncertain; 5= highly uncertain)**
Flaws in methodology		**Rationale**
Lack of expertise		
Lack of issue coherence		
Biological unknowns		
Insufficient information		
Political impediments		
Other-Define		

Question 2: What is the level (0-5) of risk of this pathway transmitting a large number of different viable invasive species? *(Frame of Reference: Extremely High (i.e., ranking of 5) infers a pathway capable of transferring 100 or more viable invasives species in a single event).*

Level Nbr	**Level Descriptor**	**Level Determination (i.e., 0,1,2,3,4,5,6,7,8,9 or 10) (Assign a whole number):**
Level 0	No Risk	**Rationale**
Level 1-2	Extremely Low Level of Risk	
Level 3-4	Moderately Low Level of Risk	
Level 5-6	Medium Level of Risk	
Level 7-8	Moderately High Level of Risk	
Level 9-10	Extremely High Level of Risk	

Is there uncertainty regarding this rating? If so, please complete the chart below:

Basis of Uncertainty	**Check All Relevant**	**Uncertainty level (Assign whole nbr from 0-5 where 1= slightly uncertain; 5= highly uncertain)**
Flaws in methodology		**Rationale**
Lack of expertise		
Lack of issue coherence		
Biological unknowns		
Insufficient information		
Political impediments		
Other-Define		

Question 3: What is the level of risk (0-5) of this pathway transmitting a large number of viable individuals per invasive species? *(Frame of Reference: Extremely High infers the pathway transmits numerous [i.e. 100 plus) viable populations that can readily be established. Extremely low infers that only 1-2 specimens capable of establishment/reproduction are transmitted. Zero is 'no risk' infers no specimen survival.*

Level Nbr	**Level Descriptor**	**Level Determination (i.e., 0,1,2,3,4,5,6,7,8,9 or 10) (Assign a whole number):**
Level 0	No Risk	**Rationale**
Level 1-2	Extremely Low Level of Risk	
Level 3-4	Moderately Low Level of Risk	
Level 5-6	Medium Level of Risk	
Level 7-8	Moderately High Level of Risk	
Level 9-10	Extremely High Level of Risk	

Is there uncertainty regarding this rating? If so, please complete the chart below:

Basis of Uncertainty	**Check All Relevant**	**Uncertainty level (Assign whole nbr from 0-5 where 1= slightly uncertain; 5= highly uncertain)**
Flaws in methodology		**Rationale**
Lack of expertise		
Lack of issue coherence		
Biological unknowns		
Insufficient information		
Political impediments		
Other-Define		

Question 4: Based on the specific invasive species transmitted via this pathway, what is the relative level of risk (0-5) of this pathway introducing invasive species into hospitable ecosystems or habitats? *Frame of Reference: Level 5 = exact ecosystem match with IS' natural habitat; plentiful food sources, no predators or ecosystem controls. Zero (0) risk is when environmental factors preclude IS establishment.*

Level Nbr	**Level Descriptor**	**Level Determination (i.e., 0,1,2,3,4,5,6,7,8,9 or 10) (Assign a whole number):**	
Level 0	No Risk	**Rationale**	
Level 1-2	Extremely Low Level of Risk		
Level 3-4	Moderately Low Level of Risk		
Level 5-6	Medium Level of Risk		
Level 7-8	Moderately High Level of Risk		
Level 9-10	Extremely High Level of Risk		

Is there uncertainty regarding this rating? If so, please complete the chart below:

Basis of Uncertainty	**Check All Relevant**	**Uncertainty level (Assign whole nbr from 0-5 where 1= slightly uncertain; 5= highly uncertain)**	
Flaws in methodology		**Rationale**	
Lack of expertise			
Lack of issue coherence			
Biological unknowns			
Insufficient information			
Political impediments			
Other-Define			

Question 5: To what degree does the pathway's own ecosystem enhance the viability of and opportunity for transmission of invasive species? *(Frame of Reference: Level 5 equals 100% likelihood of invasive species survival due to hospitable pathway ecosystem. Level 1 equates to pathway that by nature (i.e., travel through arctic climes) will result in invasive mitigation.*

Level Nbr	**Level Descriptor**	**Level Determination (i.e., 0,1,2,3,4,5,6,7,8,9 or 10) (Assign a whole number):**
Level 0	No Risk	**Rationale**
Level 1-2	Extremely Low Level of Risk	
Level 3-4	Moderately Low Level of Risk	
Level 5-6	Medium Level of Risk	
Level 7-8	Moderately High Level of Risk	
Level 9-10	Extremely High Level of Risk	

Is there uncertainty regarding this rating? If so, please complete the chart below:

Basis of Uncertainty	**Check All Relevant**	**Uncertainty level (Assign whole nbr from 0-5 where 1= slightly uncertain; 5= highly uncertain)**
Flaws in methodology		**Rationale**
Lack of expertise		
Lack of issue coherence		
Biological unknowns		
Insufficient information		
Political impediments		
Other-Define		

Question 6: What is the level of risk (0-5) of this pathway introducing invasive species at multiple entry points? *(Frame of Reference: Level 5 infers multiple entry points (4 or more) that expand across CONUS; Level 1 infers single, localized entry point.)*

Level Nbr	Level Descriptor	Level Determination (i.e., 0,1,2,3,4,5,6,7,8,9 or 10) (Assign a whole number):
Level 0	No Risk	**Rationale**
Level 1-2	Extremely Low Level of Risk	
Level 3-4	Moderately Low Level of Risk	
Level 5-6	Medium Level of Risk	
Level 7-8	Moderately High Level of Risk	
Level 9-10	Extremely High Level of Risk	

Is there uncertainty regarding this rating? If so, please complete the chart below:

Basis of Uncertainty	Check All Relevant	Uncertainty level (Assign whole nbr from 0-5 where 1= slightly uncertain; 5= highly uncertain)
Flaws in methodology		**Rationale**
Lack of expertise		
Lack of issue coherence		
Biological unknowns		
Insufficient information		
Political impediments		
Other-Define		

Question 7: What is the level of risk (0-5) of this pathway for transmitting invasives, based on standard treatment measures? *(Frame of Reference: Zero (0) level indicates all IS are dead upon arrival; 3 = most (60%) of the IS are still reproductively viable; 5 = 100% IS are alive, have expanded populations, colonies or enhanced invasiveness capabilities).*

Level Nbr	**Level Descriptor**	**Level Determination (i.e., 0,1,2,3,4,5,6,7,8,9 or 10) (Assign a whole number):**
Level 0	No Risk	**Rationale**
Level 1-2	Extremely Low Level of Risk	
Level 3-4	Moderately Low Level of Risk	
Level 5-6	Medium Level of Risk	
Level 7-8	Moderately High Level of Risk	
Level 9-10	Extremely High Level of Risk	

Is there uncertainty regarding this rating? If so, please complete the chart below:

Basis of Uncertainty	**Check All Relevant**	**Uncertainty level (Assign whole nbr from 0-5 where 1= slightly uncertain; 5= highly uncertain)**
Flaws in methodology		**Rationale**
Lack of expertise		
Lack of issue coherence		
Biological unknowns		
Insufficient information		
Political impediments		
Other-Define		

Question 8: What is the level of risk of this pathway to assist spread of invasive species to uncontaminated shipments during transport or storage? *(Frame of Reference: High reflects a pathway that commingles multi-source vectoring agents with multiple dissemination points (i.e., multi-source, co-mingled wood packing materials in cargo hold with multiple dissemination points. Low equates to no cross-contamination or spread)*

Level Nbr	**Level Descriptor**	**Level Determination (i.e., 0,1,2,3,4,5,6,7,8,9 or 10) (Assign a whole number):**
Level 0	No Risk	**Rationale**
Level 1-2	Extremely Low Level of Risk	
Level 3-4	Moderately Low Level of Risk	
Level 5-6	Medium Level of Risk	
Level 7-8	Moderately High Level of Risk	
Level 9-10	Extremely High Level of Risk	

Is there uncertainty regarding this rating? If so, please complete the chart below:

Basis of Uncertainty	**Check All Relevant**	**Uncertainty level (Assign whole nbr from 0-5 where 1= slightly uncertain; 5= highly uncertain)**
Flaws in methodology		**Rationale**
Lack of expertise		
Lack of issue coherence		
Biological unknowns		
Insufficient information		
Political impediments		
Other-Define		

Question 9: What is the level of risk (0-5) of this pathway for transmitting invasives, based on current screening techniques? *(Frame of Reference: A rating of zero (0) indicates that virtually all invasives are detected prior to or during transit. A rating of 5 indicates that there are no detection methods for the invasives prior to or during transit)*

Level Nbr	**Level Descriptor**	**Level Determination (i.e., 0,1,2,3,4,5,6,7,8,9 or 10) (Assign a whole number):**
Level 0	No Risk	**Rationale**
Level 1-2	Extremely Low Level of Risk	
Level 3-4	Moderately Low Level of Risk	
Level 5-6	Medium Level of Risk	
Level 7-8	Moderately High Level of Risk	
Level 9-10	Extremely High Level of Risk	

Is there uncertainty regarding this rating? If so, please complete the chart below:

Basis of Uncertainty	**Check All Relevant**	**Uncertainty level (Assign whole nbr from 0-5 where 1= slightly uncertain; 5= highly uncertain)**
Flaws in methodology		**Rationale**
Lack of expertise		
Lack of issue coherence		
Biological unknowns		
Insufficient information		
Political impediments		
Other-Define		

Question 10: What is the level of risk of the pathway transporting an invasive species that is difficult to detect once in the 'receiving point' ecosystem? *(Frame of reference: Zero (0) indicates that all invasives are detected immediately at the pathway endpoint. A rating of 5 indicates the species is/are so difficult to detect, there is a 100% likelihood they will be disseminated without detection)*

Level Nbr	**Level Descriptor**	**Level Determination (i.e., 0,1,2,3,4,5,6,7,8,9 or 10) (Assign a whole number):**
Level 0	No Risk	**Rationale**
Level 1-2	Extremely Low Level of Risk	
Level 3-4	Moderately Low Level of Risk	
Level 5-6	Medium Level of Risk	
Level 7-8	Moderately High Level of Risk	
Level 9-10	Extremely High Level of Risk	

Is there uncertainty regarding this rating? If so, please complete the chart below:

Basis of Uncertainty	**Check All Relevant**	**Uncertainty level (Assign whole nbr from 0-5 where 1= slightly uncertain; 5= highly uncertain)**
Flaws in methodology		**Rationale**
Lack of expertise		
Lack of issue coherence		
Biological unknowns		
Insufficient information		
Political impediments		
Other-Define		

Question 11: What is the level of risk of this pathway transmitting invasive species that are capable of surviving in multiple habitats (i.e., are generalists)? *(Frame of Reference: An assessment of zero (0) indicates the pathway does not transmit any generalists. An assessment of 5 indicates the majority of invasives transmitted by this pathway are generalists with at least 3 or more populations capable of surviving in any of the pathway endpoints.)*

Level Nbr	**Level Descriptor**	**Level Determination (i.e., 0,1,2,3,4,5,6,7,8,9 or 10) (Assign a whole number):**
Level 0	No Risk	**Rationale**
Level 1-2	Extremely Low Level of Risk	
Level 3-4	Moderately Low Level of Risk	
Level 5-6	Medium Level of Risk	
Level 7-8	Moderately High Level of Risk	
Level 9-10	Extremely High Level of Risk	

Is there uncertainty regarding this rating? If so, please complete the chart below:

Basis of Uncertainty	**Check All Relevant**	**Uncertainty level (Assign whole nbr from 0-5 where 1= slightly uncertain; 5= highly uncertain)**
Flaws in methodology		**Rationale**
Lack of expertise		
Lack of issue coherence		
Biological unknowns		
Insufficient information		
Political impediments		
Other-Define		

Question 12: What is the level of risk of this pathway transmitting invasive species into ecosystems conducive to natural spread? *(Frame of Reference: A rating of zero (0) indicates the pathway transmits invasives with low reproductive rates or one that are fragile in any ecosystem other than that of origination. A ranking of 5 indicates the pathway transmits multiple (i.e. 10 or more)invasives that are highly mobile; spread by wind, water; have/high reproductive rates in multiple ecosystems)*

Level Nbr	**Level Descriptor**	**Level Determination (i.e., 0,1,2,3,4,5,6,7,8,9 or 10) (Assign a whole number):**
Level 0	No Risk	**Rationale**
Level 1-2	Extremely Low Level of Risk	
Level 3-4	Moderately Low Level of Risk	
Level 5-6	Medium Level of Risk	
Level 7-8	Moderately High Level of Risk	
Level 9-10	Extremely High Level of Risk	

Is there uncertainty regarding this rating? If so, please complete the chart below:

Basis of Uncertainty	**Check All Relevant**	**Uncertainty level (Assign whole nbr from 0-5 where 1= slightly uncertain; 5= highly uncertain)**
Flaws in methodology		**Rationale**
Lack of expertise		
Lack of issue coherence		
Biological unknowns		
Insufficient information		
Political impediments		
Other-Define		

Question 13: What is the level of risk of this pathway transmitting invasive species that are further spread by human activities? *(Frame of Reference: A rating of zero (0) indicates that humans or human activities do not spread the invasive species. A rating of 5 indicates humans or human activities are the primary agent for the rapid spread of pandemic IS.)*

Level Nbr	**Level Descriptor**	**Level Determination (i.e., 0,1,2,3,4,5,6,7,8,9 or 10) (Assign a whole number):**
Level 0	No Risk	**Rationale**
Level 1-2	Extremely Low Level of Risk	
Level 3-4	Moderately Low Level of Risk	
Level 5-6	Medium Level of Risk	
Level 7-8	Moderately High Level of Risk	
Level 9-10	Extremely High Level of Risk	

Is there uncertainty regarding this rating? If so, please complete the chart below:

Basis of Uncertainty	**Check All Relevant**	**Uncertainty level (Assign whole nbr from 0-5 where 1= slightly uncertain; 5= highly uncertain)**
Flaws in methodology		**Rationale**
Lack of expertise		
Lack of issue coherence		
Biological unknowns		
Insufficient information		
Political impediments		
Other-Define		

Question 14: What is the level of risk (0-5) of the pathway introducing invasive species that are known to be invasive in similar ecosystems but are not yet in the U.S.? *(Frame of Reference: Zero (0) =the pathway transmits no compatible IS; 3 rating = transmits invasives that are in some, not all, U.S ecoregions, but are not yet present in the pathway endpoint ecosystem. Level 5 infers the pathway transmits viable IS into pristine ecosystems).*

Level Nbr	**Level Descriptor**	**Level Determination (i.e., 0,1,2,3,4,5,6,7,8,9 or 10) (Assign a whole number):**
Level 0	No Risk	**Rationale**
Level 1-2	Extremely Low Level of Risk	
Level 3-4	Moderately Low Level of Risk	
Level 5-6	Medium Level of Risk	
Level 7-8	Moderately High Level of Risk	
Level 9-10	Extremely High Level of Risk	

Is there uncertainty regarding this rating? If so, please complete the chart below:

Basis of Uncertainty	**Check All Relevant**	**Uncertainty level (Assign whole nbr from 0-5 where 1= slightly uncertain; 5= highly uncertain)**
Flaws in methodology		**Rationale**
Lack of expertise		
Lack of issue coherence		
Biological unknowns		
Insufficient information		
Political impediments		
Other-Define		

Question 15: What is the level of risk of this pathway transmitting invasive species that are novel and have limited scientific data upon which to develop control methods?
(Frame of Reference: Zero (0) indicates there are comprehensive control options to mitigate all invasives transmitted. Level 5 indicates there are no existing control options.)

Level Nbr	**Level Descriptor**	**Level Determination (i.e., 0,1,2,3,4,5,6,7,8,9 or 10) (Assign a whole number):**
Level 0	No Risk	**Rationale**
Level 1-2	Extremely Low Level of Risk	
Level 3-4	Moderately Low Level of Risk	
Level 5-6	Medium Level of Risk	
Level 7-8	Moderately High Level of Risk	
Level 9-10	Extremely High Level of Risk	

Is there uncertainty regarding this rating? If so, please complete the chart below:

Basis of Uncertainty	**Check All Relevant**	**Uncertainty level (Assign whole nbr from 0-5 where 1= slightly uncertain; 5= highly uncertain)**
Flaws in methodology		**Rationale**
Lack of expertise		
Lack of issue coherence		
Biological unknowns		
Insufficient information		
Political impediments		
Other-Define		

Question 16: What is the level of risk of this pathway transmitting an invasive species in which existing control options are too expensive to implement? *(Frame of Reference: A rating of zero (0) indicates control options are a part of routine operations and therefore no additional funding is required. A rating of 5 indicates control options are so expensive, it requires the petitioning of external agency/multi-source emergency funding mechanisms)*

Level Nbr	**Level Descriptor**	**Level Determination (i.e., 0,1,2,3,4,5,6,7,8,9 or 10) (Assign a whole number):**
Level 0	No Risk	**Rationale**
Level 1-2	Extremely Low Level of Risk	
Level 3-4	Moderately Low Level of Risk	
Level 5-6	Medium Level of Risk	
Level 7-8	Moderately High Level of Risk	
Level 9-10	Extremely High Level of Risk	

Is there uncertainty regarding this rating? If so, please complete the chart below:

Basis of Uncertainty	**Check All Relevant**	**Uncertainty level (Assign whole nbr from 0-5 where 1= slightly uncertain; 5= highly uncertain)**
Flaws in methodology		**Rationale**
Lack of expertise		
Lack of issue coherence		
Biological unknowns		
Insufficient information		
Political impediments		
Other-Define		

Calculating Risk Individual/Consensus Score

After each single question is provided a score, this portion of pathway assessment requires the awarding of a final, overall assessment number (i.e., 0-5). No partial numbers are to be awarded. The process for awarding the single risk score follows:

A.	Tally overall pathway risk rating (Is the average of all per question ratings)	
B.	Review uncertainty ratings	
C.	Assign Final Pathway Risk Rating. Usually this score should be the same as the rating in #A - -but not necessarily. Based on uncertainty ratings, it is expected that overall assessment number may change. This score is subjective in that it represents a compromise or adjusted rating reflective of the best determination after consideration of uncertainty. Again, it is a whole number	

Rationale for Final Risk Ratings should be codified in brief narrative format: (i.e., score was adjusted to a lower level due to new treatments capabilities that will ensure total eradication; the score was adjusted to a higher level due to the evolution or detection of new species variant that is immune to current mitigation methods or detection procedures).

Rationale is below for final risk rating: _____

_____

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4. PATHWAY ASSIGNMENT TO SCALE OF INVASIVENESS

Based on the prior analyses, there are now 3 major factors upon which to assign a pathway to a scale of invasiveness: impact category (i.e., human health, economy or ecosystem impact), pathway ecosystem scope (i.e., from local to international range); and pathway risk. Using the charts below as an example, you may next assign a risk prioritization (on scale of 1-200) for the pathway. Example of these determinations follow:

Example 1: Ballast Water

Impact Category	**Pathway Scope**	**Pathway Risk Level**
A Human	V	4

Example 2: Wood Packing Material

Impact Category	**Pathway Scope**	**Pathway Risk Level**
B Economy	V	8

Using the Scale of Invasiveness chart contained on the next page, after assigning an invasiveness scale number, the above pathways would be assessed as below. (This scale assists in further stratifying and prioritizing invasive pathways and will serve greater purpose for cumulative assessments on invasiveness.)

Ex 1: Ballast Water

Impact Category	**Pathway Scope**	**Pathway Risk Level**	**Risk Ranking**
A – Human	V	4	194

Ex 2: Wood Packing

Impact Category	**Pathway Scope**	**Pathway Risk Level**	**Risk Ranking**
B – Economy	V	8	148

See Next Page for Invasiveness Scale

Procedure for Scale Assignment

1. Assign Risk Impact Category (Row A, B, or C)
2. Assign Pathway Scope Level (Column Numeral V, IV, II, II or I)
3. Assign Pathway Risk Level (i.e., Risk Score of 1,2,3,4,5,6,7,8,9 OR 10)
4. Assign Corresponding Numerical Rank Order (i.e., integer between the numbers 50-200)

(This guide is not designed to assess any pathway receiving a score below 50)

A Level: Human Health Impact	200. V– 10 199. V – 9 198. V – 8 197. V – 7 196. V – 6 194. V – 5 194. V – 4 193. V – 3 192. V – 2 191. V - 1	190 IV–10 189. IV–9 188. IV–8 187. IV–7 186. IV–6 185. IV–5 184. IV–4 183. IV–3 182. IV–2 181. IV–1	180. III–10 179. III – 9 178. III – 8 177. III – 7 176. III – 6 175. III – 5 174. III – 4 173. III – 3 172. III – 2 171. III – 1	170. II–10 169. II – 9 168. II – 8 167. II – 7 166. II – 6 165. II – 5 164. II – 4 163. II – 3 162. II – 2 161. II – 1	160. I– 10 159. I – 9 158. I – 8 157. I – 7 156. I – 6 155. I – 5 154. I – 4 153. I – 3 152. I – 2 151. I – 1
B Level: Economic Impact	150. V –10 149. V – 9 148. V – 8 147. V – 7 146. V – 6 145. V – 5 144. V – 4 143. V – 3 142. V – 2 141. V - 1	140 IV–10 139. IV–9 138. IV–8 137. IV–7 136. IV–6 135. IV–5 134. IV–4 133. IV–3 132. IV–2 131. IV–1	130 III–10 129. III – 9 128. III – 8 127. III – 7 126. III – 6 125. III – 5 124. III – 4 123. III – 3 122. III – 2 121. III – 1	120. II -10 119. II – 9 118. II – 8 117. II – 7 116. II – 6 115. II – 5 114. II – 4 113. II – 3 112. II – 2 111. II – 1	110. I– 10 109. I – 9 108. I – 8 107. I – 7 106. I – 6 105. I – 5 104. I – 4 103. I – 3 102. I – 2 101. I – 1
C Level: Ecological Impact	100 V – 10 99. V – 9 98. V – 8 97. V – 7 96. V – 6 95. V – 5 94. V – 4 93. V – 3 92. V – 2 91. V - 1	90 IV–10 89. IV – 9 88. IV – 8 87. IV – 7 86. IV – 6 85. IV – 5 84. IV – 4 83. IV – 3 82. IV – 2 81. IV – 1	80. III– 10 79. III – 9 78. III – 8 77. III – 7 76. III – 6 75. III – 5 74. III – 4 73. III – 3 72. III – 2 71. III – 1	70. II – 10 69. II – 9 68. II – 8 67. II – 7 66. II – 6 65. II – 5 64. II – 4 63. II – 3 62. II – 2 61. II - 1	60. I – 10 59. I – 9 58. I – 8 57. I – 7 56. I – 6 55. I – 5 54. I – 4 53. I – 3 52. I – 2 51. I – 1
Outlier Range for Invasives with no harmful impact to human health, economy or ecology	50. X 49. X 48. X 47. X 46. X 45. X 44. X 43. X 42. X 41. X	40. X 39. X 38. X 37. X 36. X 35. X 34. X 33. X 32. X 31. X	30. X 29. X 28. X 27. X 26. X 25. X 24. X 23. X 22. X 21. X	20. X 19. X 18. X 17. X 16. X 15. X 14. X 13. X 12. X 11. X	10. X 9. X 8. X 7. X 6. X 5. X 4. X 3. X 2. X 1. X

NOTE

Scope values of X indicate either an event so small not to warrant a 'local' (i.e., category I) determination; or they represent the incursion of an invasive that does not harm human health, the economy or any ecosystems.

However, events in these areas are valid. They may provide indicators for IS observations or may be used to provide corollary, comparative data for invasive assessment.

5. FINALIZING THE 'THIRD-CUT' ANALYSIS

The end results of the definition and prioritization of the pathway(s) is not solely a number, but all of the research, expert insights, recommendations and comments that led up to final evaluation. As such, the main value of the assessment is not just a number, but the collective comments and perspectives of multiple experts from a myriad of organization and academic disciplines and perspectives. All of this information will be provided in consolidated format to assist policy makers with approaches and responses to issues regarding Invasive Species.

THE RISK ANALYSIS REPORT

1. REPORT COMPONENTS.

The 'bulk' of the report-out should have been accomplished via the previous steps. However, in review the components should be as follows:

- Agency-based multiple pathways list
- Multiple pathways threat list
- Experts List
- Single pathway(s) detailed consensus description
- Pathway consensus ecosystem scope determination
- Pathway-specific consensus invasives listings and definition
- Pathway Risk consensus survey questionnaire responses
- Pathway Risk scale consensus decision
- Specific recommendations or issues regarding uncertainty

As indicated, this report, in its entirety, will be provided to pathway decision/policy makers.

FROM SCIENCE TO PATHWAY POLICY

1. SITUATIONAL MODIFIERS

A critical of developing pathway prioritization is development of consensus scientific perspective to enable policy makers to effect quality decisions, networks, collaborations and allocations relative to invasive species management. Key factors include the following:

- Invasive Species prevention is inherently an international activity that impacts market competitiveness. As such, policy decisions are to be based on what the future should look like for particular groups; with consideration of current situations and trends. Policy makers must devise plans for pathway management, resource leveraging, policy development, budget decisions and technology transfer/development.

- Pathway ranking combines community, government and corporate interests. The process for evaluating pathway risks is as important as assessment tools and criteria. The outcome of process is the predictive characterization and control of pathway risks. Policy decides the direction to take, but science maintains the focus. [2]

- Are there non-risk situational issues relative to invasive species that policy makers must take into account in the decision process? Such issues include:

    - Does the pathway transport invasives that are known to cause impact to human infrastructures (i.e., plant that lowers property values)?
    - Does the pathway transport invasives known to cause impacts to biologic/primary productivity/living industries (i.e., ecotourism, birding, aquatic recreation)?
    - Does the Pathway transport invasives that are known to have political or public sensitivity beyond that scientifically associated with the pathway (i.e., sensationalism of 'killer bees', endangered species)?

[2] Source: Arizona State University Consortium for Science, Policy and Outcomes, College of Liberal Arts and Sciences

Often there are no clear-cut responses to issues. However, creating a foundation of sound science will help ensure the best possible decisions, based on current knowledge, can be effected.

2. NISC, ISAC AND PATHWAY ANALYSIS

NISC, responsible for the field or operating level implementation of IS programs, has the three following primary goals relative to pathways:

- **Assessment Collaboration.** Once each agency has gone through the first 'triage' of pathway prioritization, these results are to be shared with the National Invasive Species Council (NISC). NISC will then inform the various agencies as to which pathways they share similar priorities. This 'matching' will enable NISC to provide a framework for regional, national, and international strategic groupings of organizations and experts for matrixed, systemic pathway prioritization, analysis, and resource sharing. In that the matching is for collaborative purposes, only, it will not impede or infringe upon individual agency decisions or mission regarding IS activities. In this NISC role, will also define international implementation methods and collaboration points.

- **Data Clearinghouse.** A long term goal is for NISC to serve as the central clearinghouse for an online library of benchmarked pathway risk analyses and datasets.

- **Program Evaluator**. Finally, NISC will serve as evaluator of the efficacy IS pathway analysis and policy development, nationwide.

ISAC Facilitated International Pathway Analysis and Policy Consultations. The Invasive Species Advisory Council, through NISC, is currently proposing international resource management approaches for invasive species pathways. The ultimate goal is to provide a NAPPO regional standards or guidelines on pathway evaluation.

3. INTERNATIONAL RESOURCE MANAGEMENT PROPOSAL

Based on discussions of the Pathways work team and readings in S. Andresen, & W. Ostreng, ed, **International Resource Management**, Belhaven Press, New York, 1989; and Dickson, David, **The New Politics of Science**, University of Chicago Press, Chicago, 1997, the Pathway Work Team Chair provided a proposal to NISC for international resource management. It is hoped withis will enable the collaborative development of pathway analysis methods and procedures on a global basis. The proposal follows below:

White paper:[3]

A proposal to the North American Plant Protection Organization to enjoin with the U.S. National Invasive Species Council's development and implementation of an international resource management approach for invasive species pathway identification, prioritization, risk-based analysis and collaborative policy decision-making.

[3] Draft dated 5-6-06 pkriesch

The Proposal: The National Invasive Species Council (NISC), through its work with Aquatic Nuisance Species Task Force (ANSTF) and NISC Prevention Committee Pathways Work Team, has developed (and is further refining) a methodology for pathway identification, prioritization and risk-based analysis of unintentional invasive species introductions. The methodology combines the principles of scientific expertise and transparency with democratic policy development. The intent is to ultimately create a system using an international resource management approach (i.e., inter-agency and inter-governmental) for the definition, risk analysis and management of invasive species. We are requesting the North American Plant Protection Organization review current processes proposal and enjoin in the further development and implementation of this approach with all participant members.

Background Leading to Proposal. In June 2002, the U.S. Invasive Species Advisory Council to the President, through the National Invasive Species Council, established a discreet set of tasks for the prevention, interdiction and eradication of Invasive Species (IS) nationwide. This was put into effect via the National Invasive Species Management Plan. Comprehensive, the Plan addressed all aspects of IS challenges throughout the U.S. This proposal centers upon the tasks which called for U.S. Federal, state governments, private industry and academia to accomplish the following:

1. Devise a common methodology to interdict pathways that are recognized as significant sources for the unintentional introduction of invasive species;
2. Implement a process for identifying high priority invasive species that are likely to be introduced unintentionally and for which effective mitigation tools are needed;
3. Implement a system for evaluating invasive species pathways and ranking those pathways that it believes are the most significant; and
4. Define the most useful tools, methods, and monitoring systems for identifying pathways, including emerging or changing pathways, and for intervening and stopping introductions most efficiently.

The Proposal Specifics. The proposal blends qualitative expertise, academic research and quantitative data analysis via a democratic process to reach consensus analysis and decisions regarding pathway definition, risk levels and action planning.

1. Triage: Stage one requests participating entities respond (from their individual perspectives) to the basic question: "How do we prioritize resources dedicated to the mitigation of unintentional introduction of invasive species in light of multiple competing pathway interests and yet-to-be-determined pathway risk levels?" This is done via a two-fold process. First, participating entities are requested to review pathway schematics to determine the IS pathways for which they have a vested interest. Second, they are asked to prioritize those pathways based on existing academic knowledge of the threats the pathways pose to human health, economy and ecological threats

2. Scope: Stage two addresses the definition of the scope (i.e., breadth of potential contamination) of the pathway via definition of pathway characteristics, ecological clime contact points and invasiveness potential. Again, analysis is from the individual entity perspective and results in a 'rough cut' distribution of severity of all pertinent pathways.

3. Individual Entity to Consensus Risk Assessment. Individual entities are then asked to complete a risk assessment of the pathway, using a series of guide questions and available datasets, to support the determinations. These independent assessments are then used in

inter-agency/government/academia focus groups to create a single consensus risk decision for the pathway.

4. Situational Modifiers. Sound science was used for determining the IS risk analysis. But stage 4 permits the blending of science with situational (or socially-based) modifiers. These modifiers give opportunity to ensure the ultimate decision makers are aware of and given opportunity to address non-scientific, relevant social issues that may impact policy action. Such issues include the following:

- human infrastructures (property values);
- biologic/primary productivity/living industries (ecotourism);
- political/public sensitivities (sensationalism, i.e., 'killer bees')
- uncertainty factors (i.e., incomplete science affecting analysis, etc.)

Proposal's Visioned Outcomes. The outcome of the process is a common, global definition and perspective of particular IS pathways and they risks that they pose relative to specific invasives. The intent is for this to be a 'fluid, evolving' process wherein pathways will be continually re-evaluated due to changing risk. The analysis should serve as common ground for all entities to then decide on common areas of interest, areas of needed expertise, areas of potential collaboration and cooperation, gaps in existing regulatory oversight and sharing of research, datasets and ideas for IS management

NAPPO Involvement. NAPPO involvement is requested as this stage, prior to solidifying final methods, to devise, accommodate and incorporate aspects relevant to international collaboration that may not have been evident in domestic analyses. NAPPO participation would require the below:

1. Proposal Infrastructure: Designation of Pathways 'team captains' in Canada and Mexico to participate in IS Pathways analysis, prioritization and planning implementation
2. Expert Evaluation: Feedback and facilitation of user comments on current and future versions of the IS pathways guide, posted on www.invasivespeciesinfo.gov
3. Data Analysis: Participation in the development of methods and systems to used to create North American benchmark datasets relative to IS introductions/spread. This would include use of predictive statistical modeling for anticipatory response
4. Training: Cooperation in bilingual training delivery to vested stakeholders in IS pathways analysis and risk management
5. Policy: Development of international consensus for transparent, science-based NAPPO IS policies
6. Cadre: Establishment of international nodes of IS expertise
7. Quality: Establishment of uniform, quality standards for IS analysis
8. Communication: Creation of IS communication network

Future Vision: The vision of this proposal is to develop a method for continual interagency, inter-governmental, science-based collaboration and policy planning for predicting invasiveness and developing North American regional position and management plan. It is anticipated this would lead to better management of resources, the ability to create short and long term regional targets, action planning with consideration of political and situational elements. Ultimately, it could serve as a democratic strategy for furthering IS science and policies relevant to regional trade activities.

This training guide is in still in draft form.
Comments regarding this guide
may be forwarded to National Invasive Species Council
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