To Plant, or Not to Plant?
Regulation of Invasive Plants in the Mid-Atlantic States

Johnson, Lea R., 2016. *Social-Ecological System Case Study: To Plant, or Not to Plant? Regulation of Invasive Plants of the Mid-Atlantic States.*

Photo: Forest & Kim Starr CC 3.0

To Plant, or Not to Plant?
Regulation of Invasive Plants in the Mid-Atlantic States

PART 3:
Risk and Regulation

Quick Questions

Think about an important decision you have had to make.

- Did you have all of the information you needed at the time?

- Were there things you found out later that you wished you'd known?

- Did you rely on your past experience, or the advice or experience of others, to inform your decision? If so, how useful was this?

Discuss

- How does uncertainty affect decision-making?

- How much uncertainty is acceptable when making decisions that affect only you? Is there a difference when your decisions affect others?

- How does past experience influence current decisions?
  How useful is it for predicting the future?

Uncertainty and Decision-Making
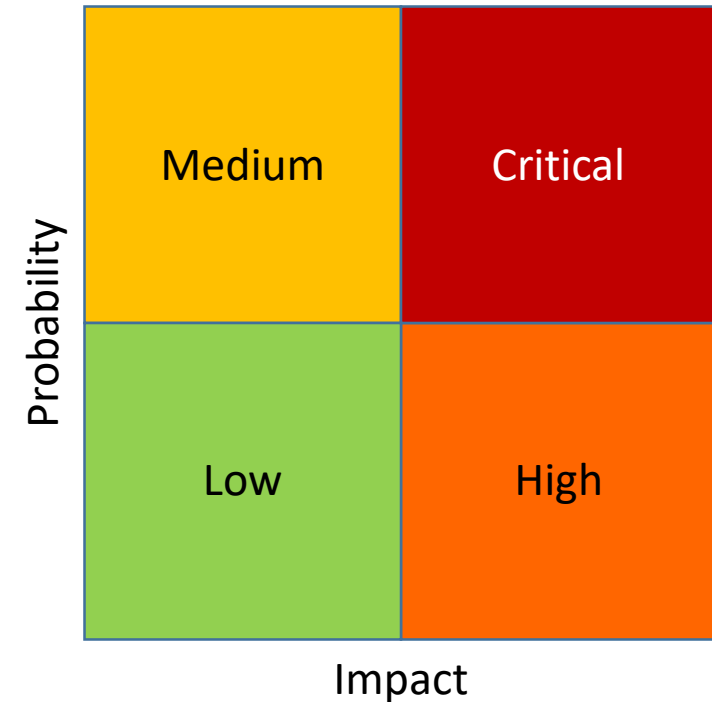
Strategies for managing risk:

- Avoid

- Reduce

- Examine
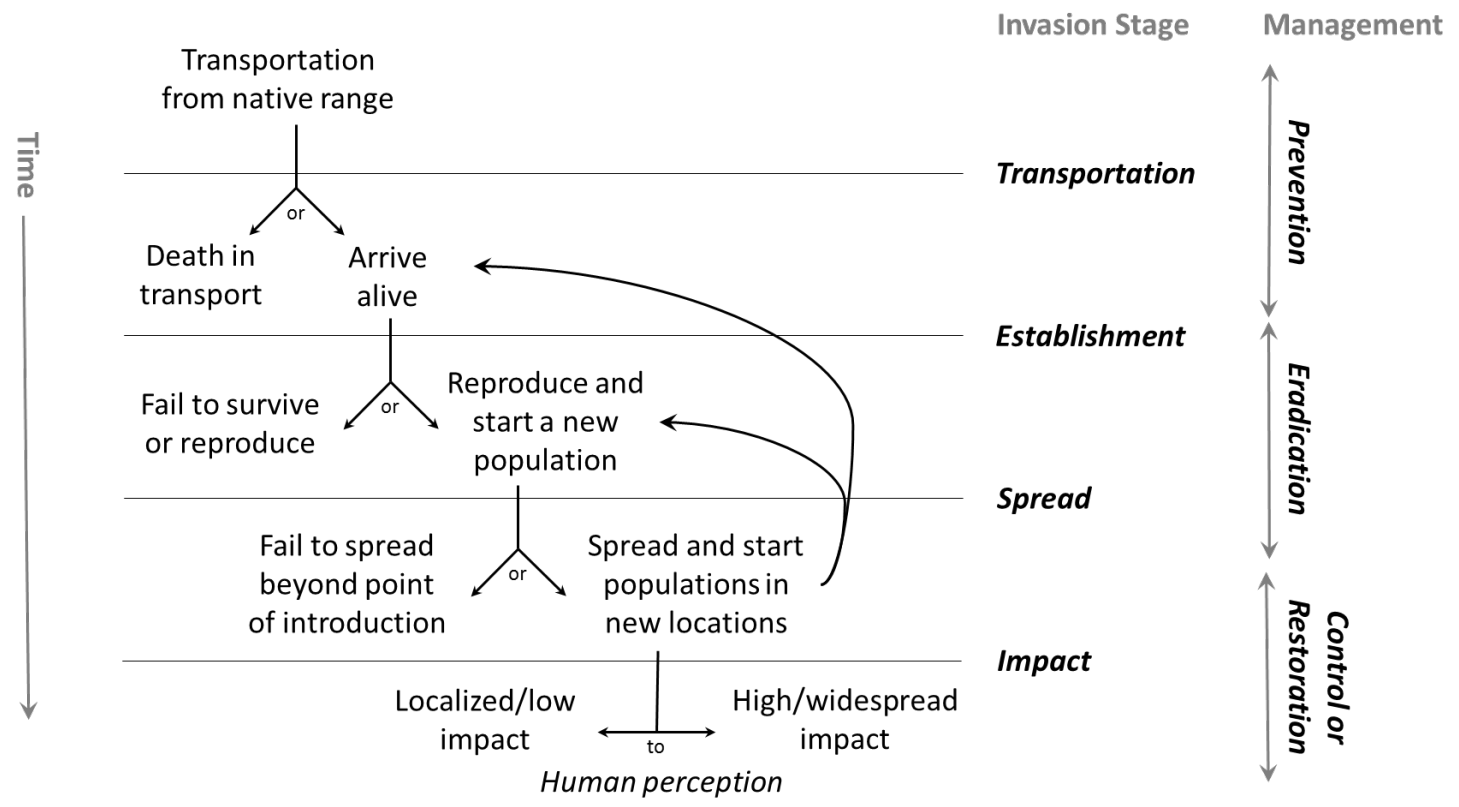
- Delay

- Delegate

- Get more information

Risk Assessment

- What are the likely impacts of an action (or no action)?

- How likely are these impacts?

- To make these assessments, you need information.

- Information is never complete.

	Medium	Critical
Probability	Low	High
		Impact

Risk Assessment

The Invasion Process

Action to prevent spread and impact is more likely to be successful in early stages of invasion
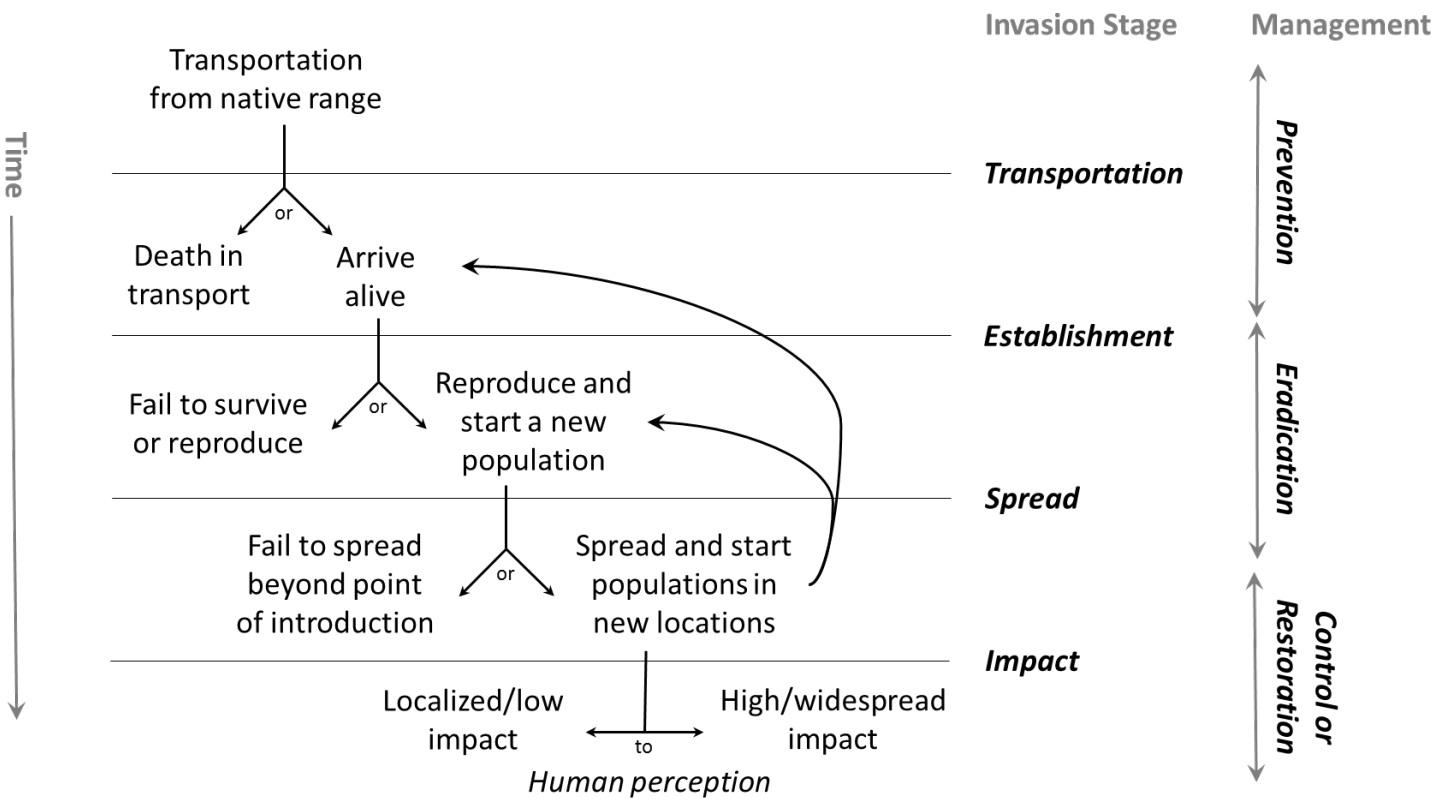
Time

Transportation from native range

— Transportation

Death in transport or Arrive alive

— Establishment

Fail to survive or reproduce or Reproduce and start a new population

— Spread

Fail to spread beyond point of introduction or Spread and start populations in new locations

— Impact

Localized/low impact to High/widespread impact

Human perception

Invasion Stage | Management

Prevention

Eradication

Control or Restoration

LR Johnson, after figures in *Invasion* Ecology by Lockwood, Hoopes and Marchetti (2007)

Risk Assessment

The Invasion Process

More information is available at later stages of invasion
- Widespread
- Familiar
- Documented impacts
- Management experience

LR Johnson, after figures in *Invasion* Ecology by Lockwood, Hoopes and Marchetti (2007)

APHIS Weed Risk Assessment

- Predicting risk of invasiveness for individual species

- High or low risk

- Major or minor invader

- Built on information about species that are already invasive

USDA

United States
Department of
Agriculture

Animal and Plant
Health Inspection
Service

Plant Protection and
Quarantine

June 3, 2016

Version 2

Guidelines for the USDA-APHIS-PPQ Weed Risk Assessment Process

Biol Invasions (2012) 14:273–294
DOI 10.1007/s10530-011-0061-4

ORIGINAL PAPER

Development and validation of a weed screening tool for the United States

Anthony L. Koop · Larry Fowler ·
Leslie P. Newton · Barney P. Caton

APHIS Weed Risk Assessment

- Multiple information sources
  - Peer-reviewed science
  - Government reports
  - Expert opinion

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APHIS Weed Risk Assessment

- Establishment/Spread Potential
  - 23 questions
- Impact Potential
  - 18 questions
- Geographic Potential
  - 3 variables with 36 questions total
- Entry Potential
  - 12 questions

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APHIS Weed Risk Assessment

- Questions are weighted
  - Importance to invasion
  - Uncertainty
    - Negligible, moderate, maximum
- Scores combined: risk potential
  - High risk
  - Low risk
  - Evaluate further

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APHIS Weed Risk Assessment

Question ID	Question	Answer	Uncertainty	Score	Notes (and references)
Establishment / Spread Potential					
ES-1	Select one: (A) Introduced elsewhere long ago (>75 years) but not escaped; (B) Introduced recently (<75 years) but not escaped; (C) Never introduced elsewhere; (D) Escaped/Casual; (E) Naturalized; (F) Invader.			???	Naturalized and spreading in Australia ({Parsons, 2001 #1220}).
ES-2	Is the species highly domesticated (y, n, or ?).	n	low	0	This species is cultivated ({Page, 2006 #5119}), but we found no evidence of domestication.
ES-3	Congeneric weed (y, n, or ?).			???	
ES-4	Shade tolerant at some stage of life cycle (y, n, or ?).	?	max		Unknown
ES-5	Climbing or smothering growth habit (y, n, or ?).	y	negl	1	Species is an herbaceous vine ({NRCS, 2013 #11020}).
ES-6	Forms dense thickets (y, n, or ?).	y	negl	2	Forms dense thickets of up to an acre in size in natural and disturbed environments ({Bossard, 2000 #9400;Weber, 2003 #394}).

Figure 1. Sample excerpt from the workbook of an in-progress WRA. Evidence is organized under the "Notes (and references)" column for each of the questions. Once enough evidence has accumulated for any given question, the risk analyst enters an answer and uncertainty level ("Answer" and "Uncertainty" columns, respectively).
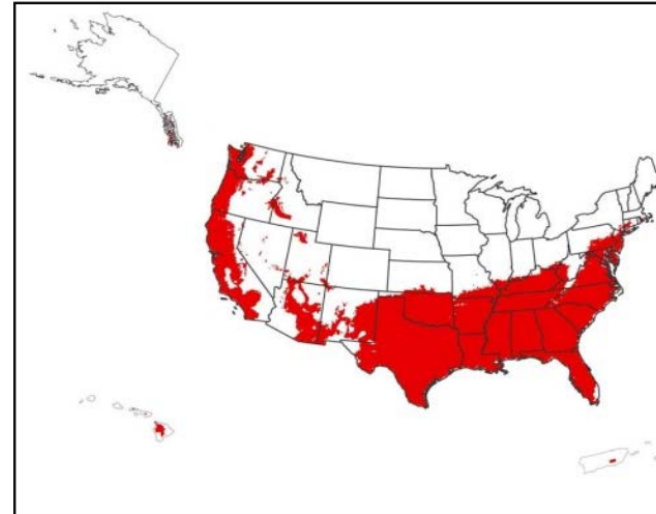
APHIS Weed Risk Assessment
Geographic Potential

- Climate of plant's native range

- Hardiness zones (minimum winter temperatures)

- Köppen-Geiger climate classes

Geographic Potential. Geographic potential is determined from the plant taxon's distribution in the world, and is based on three climatic variables: plant hardiness to minimum winter temperatures, Köppen-Geiger climate classes, and mean annual precipitation bands. The area shown in red represents the U.S. area where all three climatic variables are suitable for the taxon. This is typically a conservative estimate, as the actual U.S. area suitable is likely to be smaller when other limiting variables are considered. Furthermore, the area where a species is likely to become invasive is likely to be even smaller.

Figure 3. Map of the United States, including Alaska, Puerto Rico, and Hawaii, showing the areas estimated as suitable for establishment for the plant taxon under assessment. Map insets for Alaska, Hawaii, and Puerto Rico are not to scale.

World Map of Köppen−Geiger Climate Classification

updated with CRU TS 2.1 temperature and VASClimO v1.1 precipitation data 1951 to 2000

Af Am As Aw BWk BWh BSk BSh Cfa Cfb Cfc Csa Csb Csc Cwa

Cwb Cwc Dfa Dfb Dfc Dfd Dsa Dsb Dsc Dsd Dwa Dwb Dwc Dwd EF ET
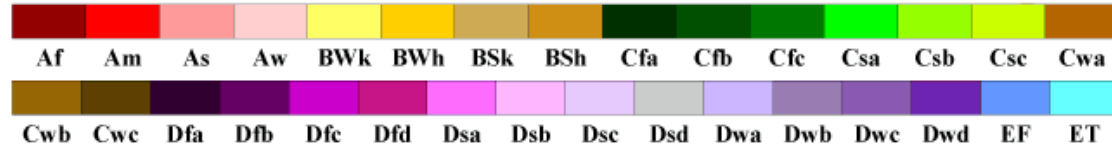
Main climates
A: equatorial
B: arid
C: warm temperate
D: snow
E: polar

Precipitation
W: desert
S: steppe
f: fully humid
s: summer dry
w: winter dry
m: monsoonal

Temperature
h: hot arid
k: cold arid
a: hot summer
b: warm summer
c: cool summer
d: extremely continental
F: polar frost
T: polar tundra

Resolution: 0.5 deg lat/lon

Version of April 2006

http://gpcc.dwd.de
http://koeppen-geiger.vu-wien.ac.at
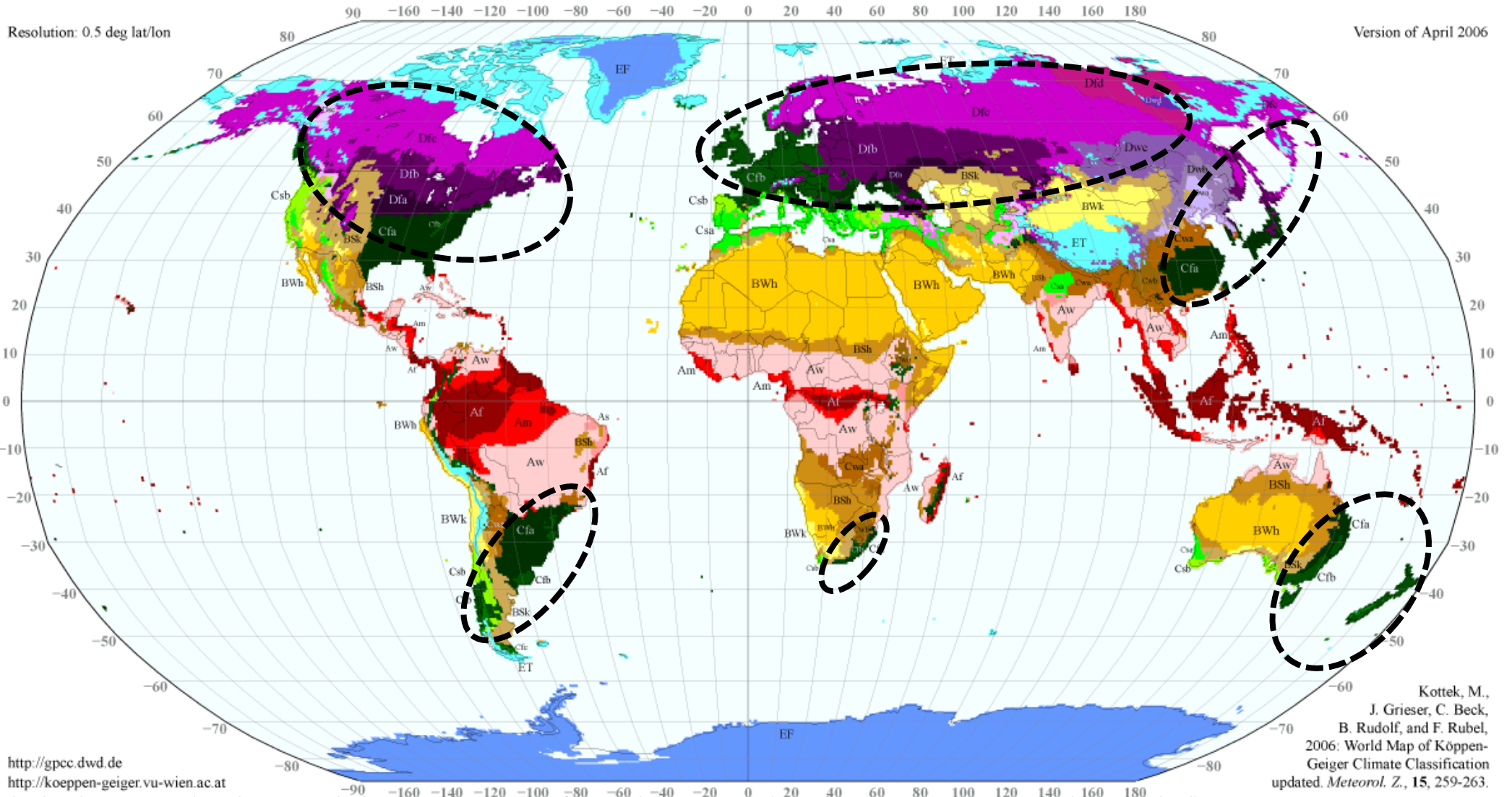
Kottek, M.,
J. Grieser, C. Beck,
B. Rudolf, and F. Rubel,
2006: World Map of Köppen-
Geiger Climate Classification
updated. *Meteorol. Z.*, **15**, 259-263.

USDA
Agricultural Research Service
United States Department of Agriculture
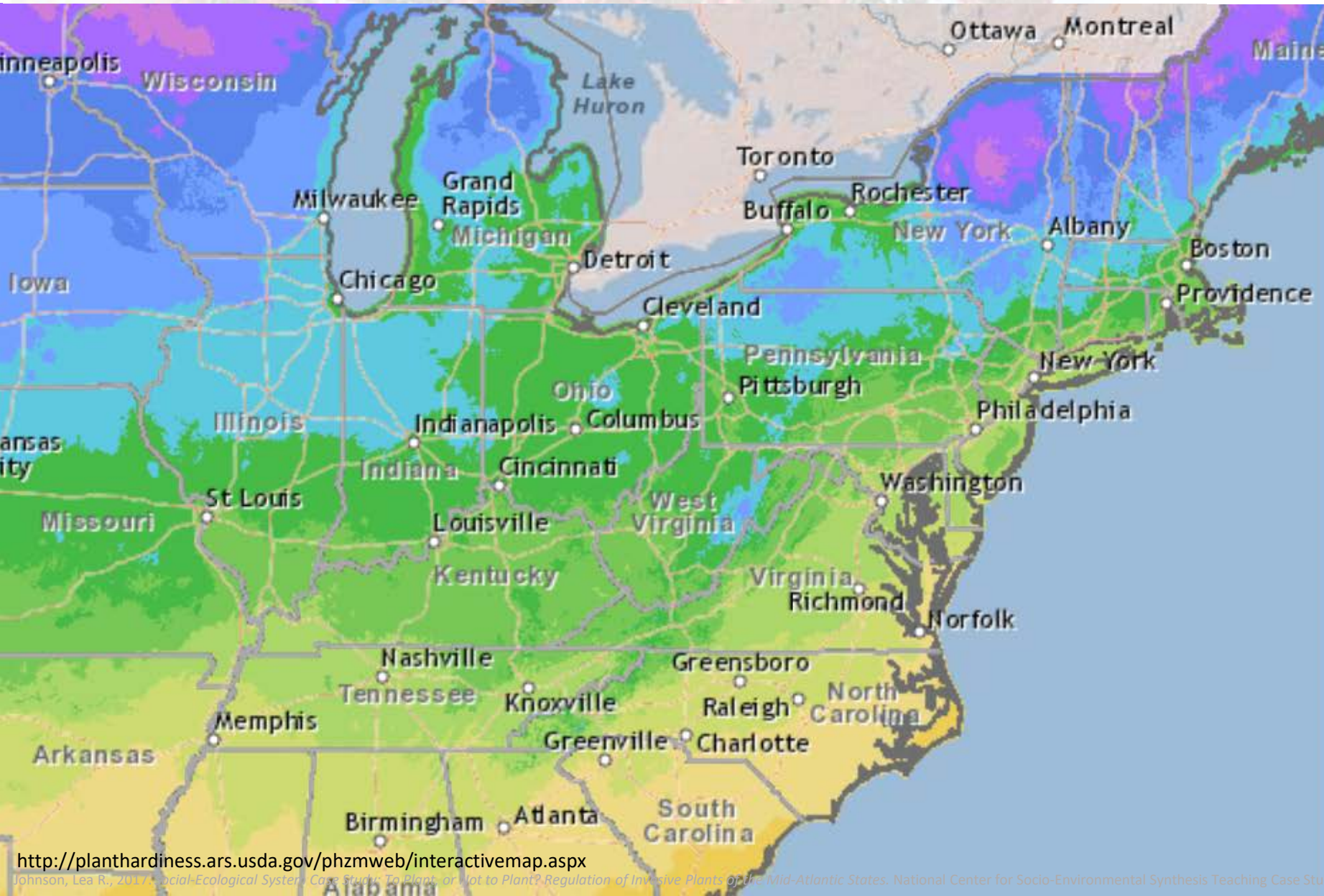
Average Annual Extreme Minimum Temperature 1976-2005

Temp (F)	Zone	Temp (F)	Zone
-60 to -55	1a	10 to 15	8a
-55 to -50	1b	15 to 20	8b
-50 to -45	2a	20 to 25	9a
-45 to -40	2b	25 to 30	9b
-40 to -35	3a	30 to 35	10a
-35 to -30	3b	35 to 40	10b
-30 to -25	4a	40 to 45	11a
-25 to -20	4b	45 to 50	11b
-20 to -15	5a	50 to 55	12a
-15 to -10	5b	55 to 60	12b
-10 to -5	6a	60 to 65	13a
-5 to 0	6b	65 to 70	13b
0 to 5	7a		
5 to 10	7b		

http://planthardiness.ars.usda.gov/phzmweb/interactivemap.aspx

APHIS Weed Risk Assessment

- Risk potential
  - All data combined
  - Major and minor invaders
  - Model built on known species
    - Known invasive species
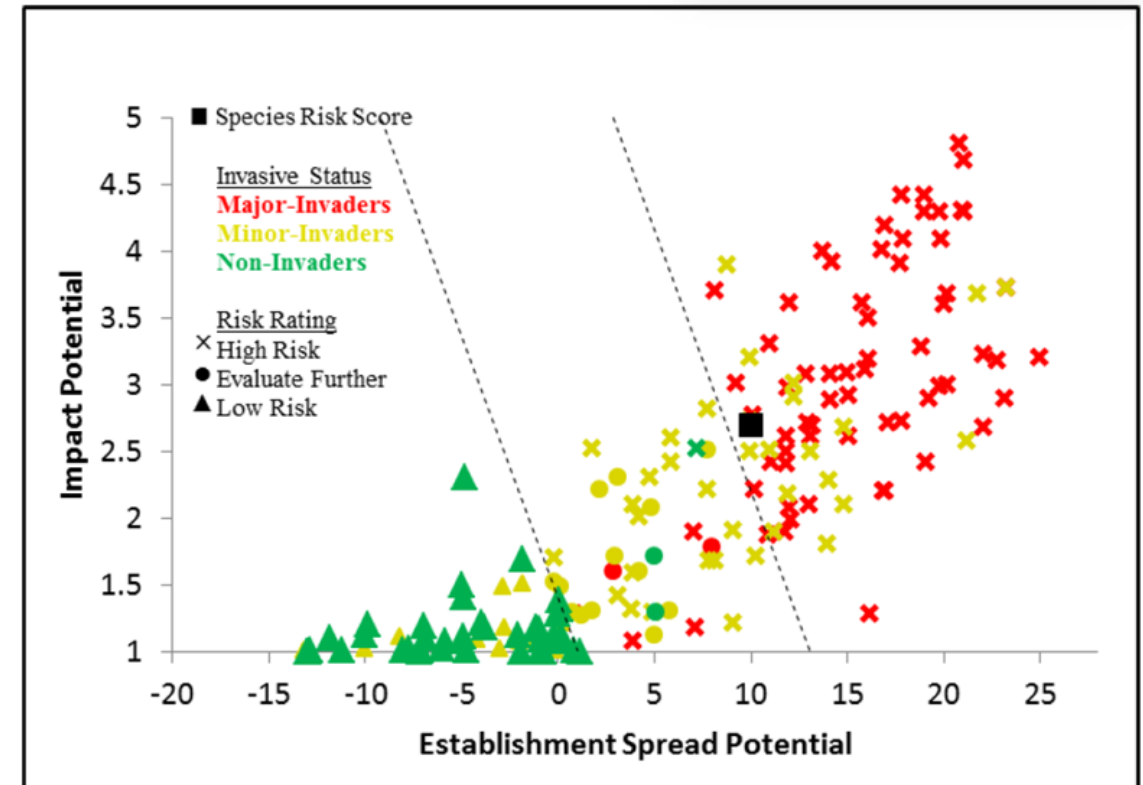   - Known non-invasive species

Figure 2. *Euonymus alatus* risk score (black box) relative to the risk scores of species used to develop and validate the PPQ WRA model (other symbols). See Appendix A for the complete assessment.

US Laws and Regulations
Executive Order (EO) 13112

What is required by EO 13112?

What important terms are defined?

Presidential Documents

Executive Order 13112 of February 3, 1999

Invasive Species

By the authority vested in me as President by the Constitution and the laws of the United States of America, including the National Environmental Policy Act of 1969, as amended (42 U.S.C. 4321 *et seq.*), Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990, as amended (16 U.S.C. 4701 *et seq.*), Lacey Act, as amended (18 U.S.C. 42), Federal Plant Pest Act (7 U.S.C. 150aa *et seq.*), Federal Noxious Weed Act of 1974, as amended (7 U.S.C. 2801 *et seq.*), Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*), and other pertinent statutes, to prevent the introduction of invasive species and provide for their control and to minimize the economic, ecological, and human health impacts that invasive species cause, it is ordered as follows:

US Laws and Regulations
Executive Order (EO) 13112: Five Year Review (2006)

What phases of invasion are prioritized for action?

Fiscal Year 2006 President's Budget
General Category Summary by Department ($1,000)

	DOT	USDA	USACE	DOI	STATE	EPA	DOC	DHS	TOTAL
Prevention	0	128,373	700	3,775	0	0	300	4,000	137,148
EDRR	0	247,259	700	8,065	0	0	1,000	0	257,024
Control	0	365,836	59,000	27,606	12,119	345	1,000	0	465,906
Research	500	208,611	3,750	10,012	0	1,230	3,000	0	227,103
Restoration	0	22,326	10,000	10,642	0	0	0	0	42,968
Education and Public Awareness	0	59,227	300	12	0	0	700	0	60,239
Leadership/ International Coordination	0	63,920	0	511	88	0	500	0	65,019
TOTAL	**500**	**1,095,552**	**74,450**	**60,623**	**12,207**	**1,575**	**6,500**	**4,000**	**1,255,407**

The Invasion Process

Transportation from native range

or

Death in transport — Arrive alive

Fail to survive or reproduce

or

Reproduce and start a new population

Fail to spread beyond point of introduction

or

Spread and start populations in new locations

Localized/low impact

to

High/widespread impact

Human perception

Time

Invasion Stage
- *Transportation*
- *Establishment*
- *Spread*
- *Impact*

Management
- *Prevention*
- *Eradication*
- *Control or Restoration*

LR Johnson, after figures in *Invasion* Ecology by Lockwood, Hoopes and Marchetti (2007)

US Laws and Regulations
Executive Order (EO) 13112: Five Year Review (2006)

FY 2006 INTERAGENCY PERFORMANCE BUDGET SUMMARY

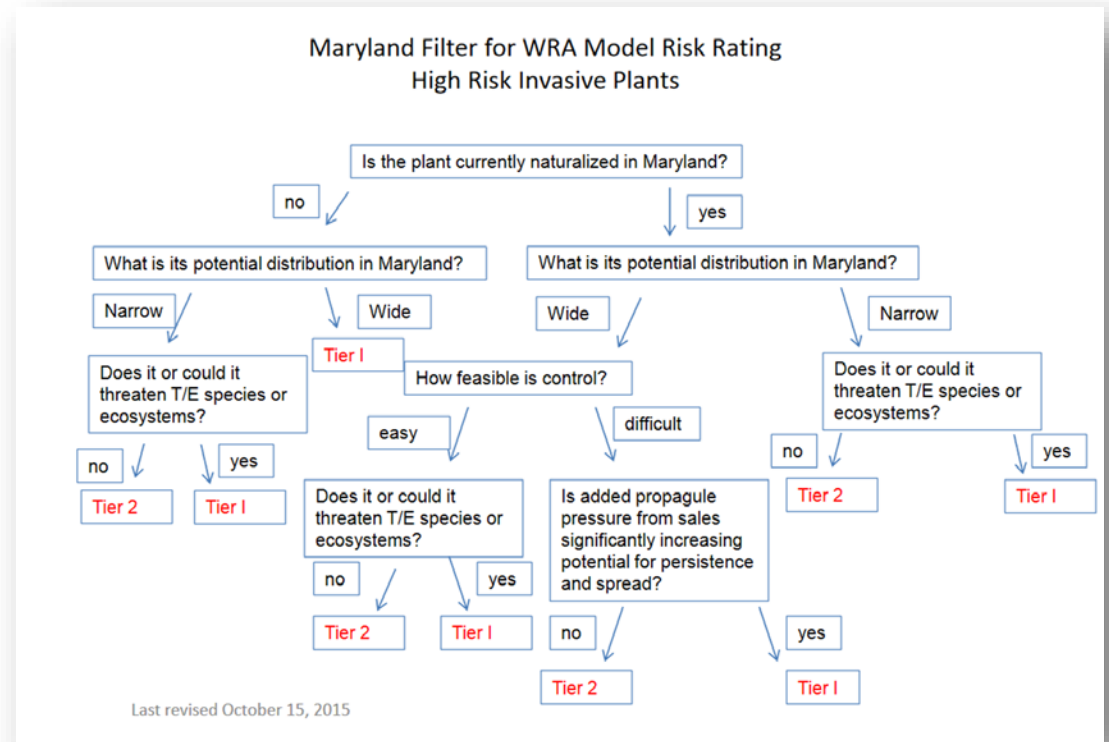| INITIATIVE	Funding for FY 2006 ($1000)
Brown Treesnake	4,745
Tamarisk	9,831
Emerald Ash Borer	35,235
Leafy Spurge/Yellow Star Thistle	6,031
Sudden Oak Death	5,109
Asian Carp	2,972
Ballast Water	920
Prevention Through Education	949
Aquatic Area Monitoring	2,832
Early Detection/Rapid Response	49,573
Innovative Control Technologies	18,919
TOTAL	**137,116**

What kinds of organisms were given highest priority, as indicated by funding?

What kinds of harm do prioritized organisms cause?

Regulation of Invasive Plants in the Mid-Atlantic
Maryland Laws and Regulations

- APHIS WRA

- Maryland Filter for high-risk invasive plants

Maryland Filter for WRA Model Risk Rating
High Risk Invasive Plants

Is the plant currently naturalized in Maryland?

no / yes

What is its potential distribution in Maryland? — Narrow / Wide

What is its potential distribution in Maryland? — Wide / Narrow

Tier I

Does it or could it threaten T/E species or ecosystems? — no → Tier 2 / yes → Tier I

How feasible is control? — easy / difficult

Does it or could it threaten T/E species or ecosystems? — no → Tier 2 / yes → Tier I

Does it or could it threaten T/E species or ecosystems? — no → Tier 2 / yes → Tier I

Is added propagule pressure from sales significantly increasing potential for persistence and spread? — no → Tier 2 / yes → Tier I

Last revised October 15, 2015

Regulation of Invasive Plants in the Mid-Atlantic
Maryland Laws and Regulations

- APHIS WRA

- Maryland Filter for high-risk invasive plants
  - Tier 1
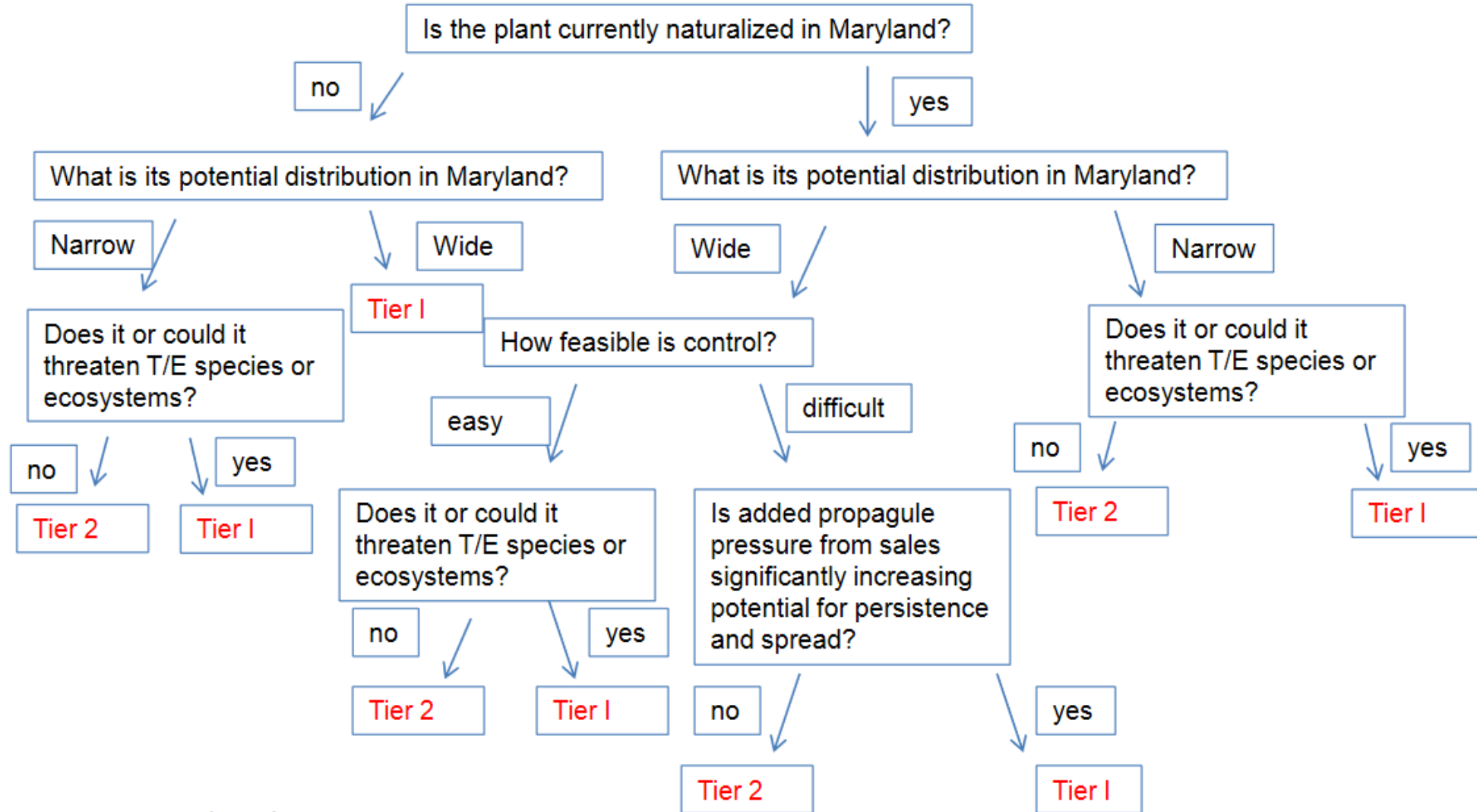   - Can't be sold or transported

Regulation of Invasive Plants in the Mid-Atlantic
Maryland Laws and Regulations

- APHIS WRA

- Maryland Filter for high-risk invasive plants
  - Tier 1
    - Can't be sold or transported
  - Tier 2
    - Must be labeled when sold

TIER 2 INVASIVE PLANT
MAY CAUSE ENVIRONMENTAL HARM

PLANT WITH CAUTION!

Ask About Alternatives

mda.maryland.gov/invasiveplants

Maryland Filter for WRA Model Risk Rating
High Risk Invasive Plants

Is the plant currently naturalized in Maryland?

no

yes

What is its potential distribution in Maryland?

What is its potential distribution in Maryland?

Narrow

Wide

Wide

Narrow

Tier I

Does it or could it threaten T/E species or ecosystems?

How feasible is control?

Does it or could it threaten T/E species or ecosystems?

no

yes

easy

difficult

no

yes

Tier 2

Tier I

Does it or could it threaten T/E species or ecosystems?

Is added propagule pressure from sales significantly increasing potential for persistence and spread?

Tier 2

Tier I

no

yes

Tier 2

Tier I

no

yes

Tier 2

Tier I

Last revised October 15, 2015

Johnson, Lea R., 2017. *Social-Ecological System Case Study: To Plant, or Not to Plant? Regulation of Invasive Plants of the Mid-Atlantic States.* National Center for Socio-Environmental Synthesis Teaching Case Study Collection.

Quick Questions

- What does this map mean?

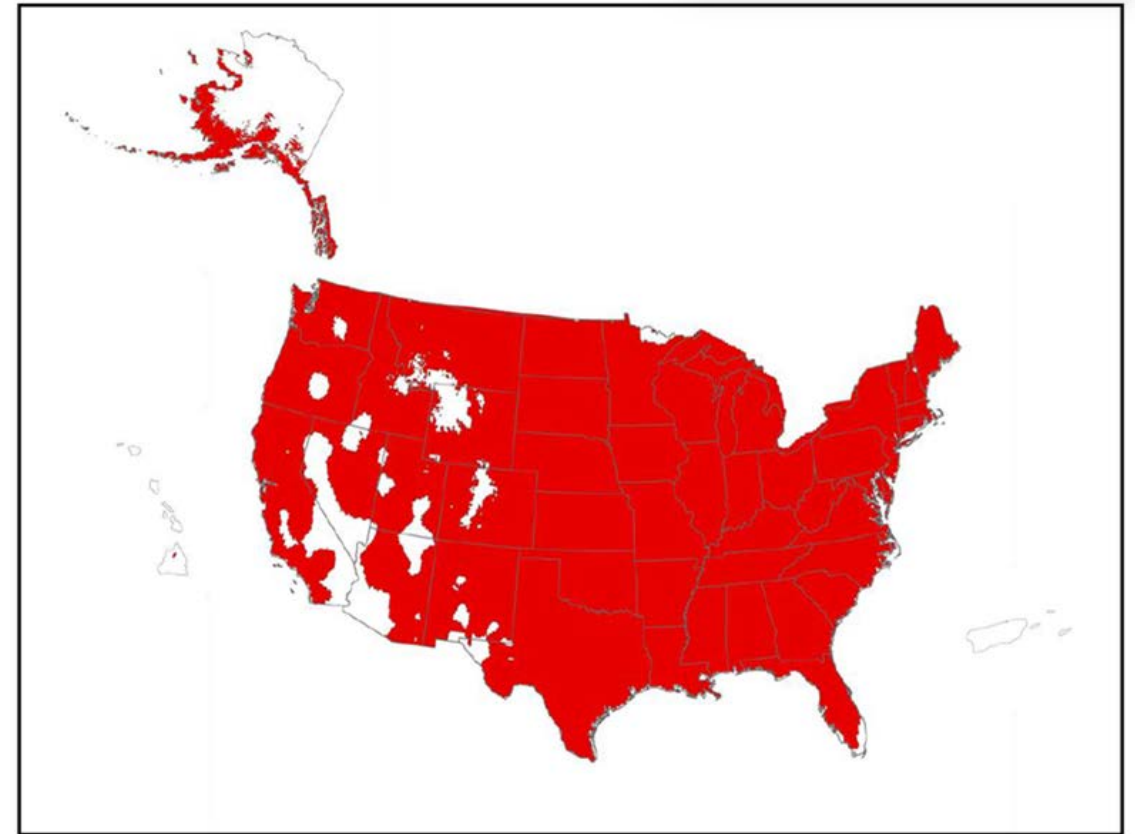- What kinds of information are used to make this kind of map?

Figure 1. Predicted distribution of *Euonymus alatus* in the United States. Map insets for Alaska, Hawaii, and Puerto Rico are not to scale.

Quick Questions

- What does this figure mean?

- What kinds of information are used to make this kind of figure?

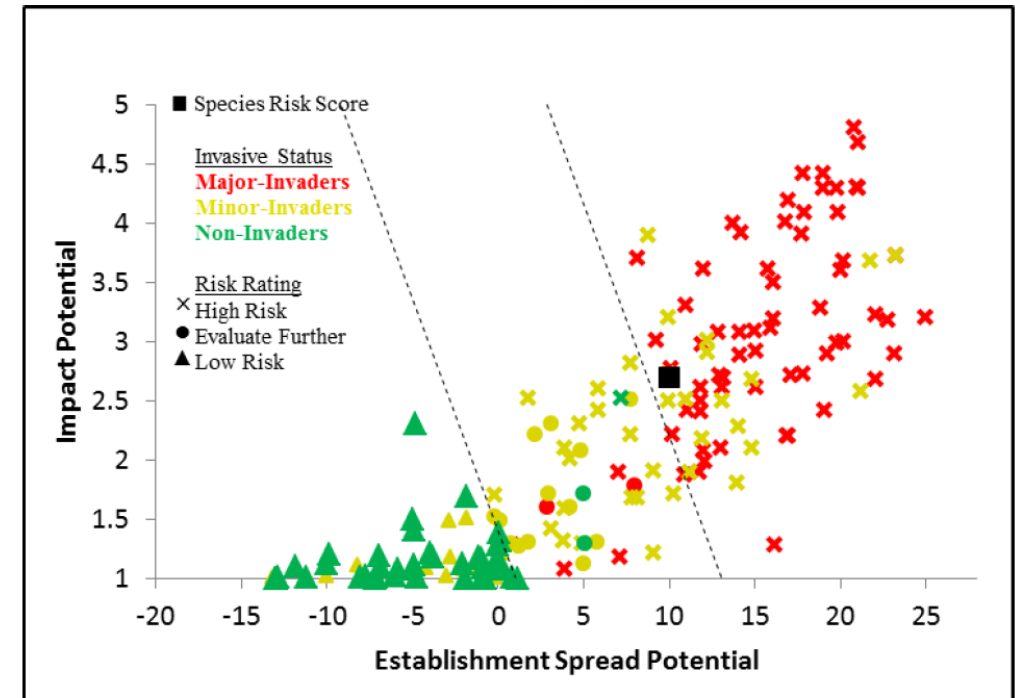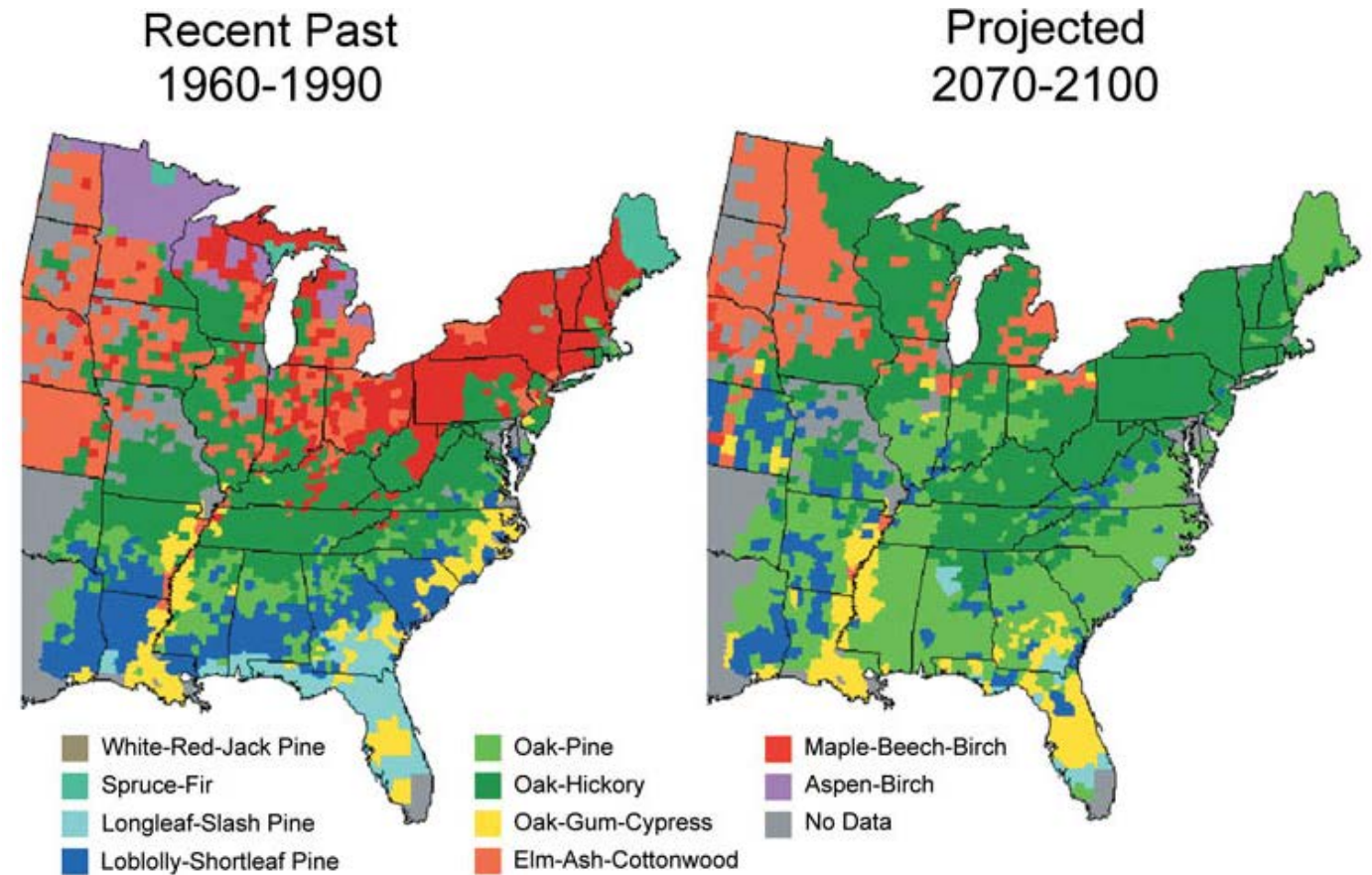- How does the process of making this figure incorporate uncertainty?

Figure 2. *Euonymus alatus* risk score (black box) relative to the risk scores of species used to develop and validate the PPQ WRA model (other symbols). See Appendix A for the complete assessment.

Discuss

USDA Hardiness Zones, based on observed minimum winter temperatures, shifted between 1990 and 2006.

This has led the US Forest Service to predict changes in the spatial distribution of future forests.

What effects could climate change have on predictions of invasive potential?

Recent Past 1960-1990

Projected 2070-2100

Legend:
- White-Red-Jack Pine
- Spruce-Fir
- Longleaf-Slash Pine
- Loblolly-Shortleaf Pine
- Oak-Pine
- Oak-Hickory
- Oak-Gum-Cypress
- Elm-Ash-Cottonwood
- Maple-Beech-Birch
- Aspen-Birch
- No Data

Projected shifts in forest types. The maps show current and projected forest types. Major changes are projected for many regions. For example, in the Northeast, under a mid-range warming scenario, the currently dominant maple-beech-birch forest type (red shading) is projected to be completely displaced by other forest types in a warmer future. Source: USGCRP (2009)

https://www3.epa.gov/climatechange/impacts/forests.html