The Nature Conservancy

SAVING THE LAST GREAT PLACES ON EARTH

Prioritizing Invasive Species

An Invasive Species Assessment Protocol: Evaluating Non-Native Plants for Their Impact on Biodiversity

Giant Reed (*Arundo donax*)

Doria Gordon

Outline

- Why use a Protocol?
- Description of NatureServe / TNC / NPS Protocol
- Implementation of the Protocol

Kudzu (*Pueraria montana*)
Kelly Briton photo USFS

Why use a Protocol?

To create objective, credible lists of the invasive plants most harmful to native biological diversity

Criteria:

- → transparent
- → objective
- → systematic

Uses

- Determine priorities for management and research on species most important to prevent and control
- Discourage use of ranked plants by industry, public
  - by gardeners, DOTs, sales by nurseries, etc.
- Determine species which should no longer be recommended by government, extension agents
- Promote government action, funding for prevention and control
- Designate species to be considered for regulation
  - e.g., listing as state or federal Noxious weeds
- Use for research
  - e.g., on common characteristics of the ‘most harmful’ species

Syringa vulgaris

Allows identification of where a species currently is along a continuum of invasiveness or impact

Bromus tectorum

Insig ⟷ High

Focus: **Species that negatively affect the native biodiversity within the region, generally by displacing native species, altering ecological communities, or changing ecosystem processes.**

Name of System	Purpose of System	Intended Scale of Application
PREDICTIVE SYSTEMS		
APHIS - USDA	Listing as noxious weed	National (USA)
Australian weed risk assessment (Pheloung, Williams, Halloy) 1999	Accept or reject for importation or introduction	National (Aust.)
Reichard and Hamilton, 1997	Accept or reject for importation or introduction	National (USA)
Rejmanek and Richardson 1996	Identify characteristics of invaders	undefined
Williams, Nicol, Newfield 2001	Accept or reject for importation	National (NZ)
PRIORITIZATION SYSTEMS		
Hiebert and Stubbendieck 1993	Prioritization for site management	Local, site
Wainger and King, 2001	Cost/Benefit analysis of response	Local, site
Orr et al 1993 Aquatic Nuisance Species Task Force	Rank by need for mitigation efforts	Nat, reg (USA)
Timmons and Owen 2001	Prioritization of control programs; Weed-led and/or Site-led	National, reg or site (NZ)
Champion and Clayton 2001 (aquatic weeds)	Rank current and potential aquatic weeds by category	National (NZ)
Virtue, Groves, Panetta 2001	Rank all (agro, forestry, environ) weeds for national significance	National (Aust.)
UF IFAS Fox et al 2001	Identify invaders in natural areas	State (FL)
NatureServe/TNC/NPS 2003	**Draw management, $, to species threatening biodiversity**	**National, reg, state, area**

Description of Protocol

Invasive Species Assessment Protocol: Evaluating Non-Native Plants for Their Impact on Biodiversity

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1 NatureServe

2 The Nature Conservancy
SAVING THE LAST GREAT PLACES ON EARTH

3 National Park Service
Department of the Interior

The Four Sections of the Protocol

Ecological Impact

Current Distribution & Abundance

Trend in Distribution & Abundance

Management Difficulty

THE PROTOCOL SECTIONS

I. **Ecological Impact (5 Qs, 50%)**

II. **Current Distribution and Abundance (4 Qs, 25%)**

III. **Trend in Distribution and Abundance (7 Qs, 15%)**

IV. **Management Difficulty (4 Qs, 10%)**

National, *Regional, State* List

Subrank I
Subrank II
Subrank III
Subrank IV

I-Rank →

Prioritized List

I-Rank = Invasive Species Impact Rank

High	a severe threat to native species and ecological communities
Medium	a moderate threat to native species and ecological communities
Low	a significant but relatively low threat to native species and ecological communities
Insignificant	an insignificant threat to native species and ecological communities
Unknown	insufficient information available
Not Applicable	not established outside cultivation as a non-native species anywhere in region of interest

Protocol Questions

Lygodium microphyllum

Screening Questions

S-1. Establishment in region of interest

Is this a non-native species that is currently established outside cultivation within the region of interest?

If NO, I-Rank = **Not Applicable** ***STOP***

If YES:

S-2. Occurrence in native species habitat

Does this species occur in conservation areas or other native species habitats within the region of interest, or is it probable that it will do so?

If NO, I-Rank = **Insignificant** ***STOP***

If YES, proceed to the 20 protocol questions

Section I. Ecological Impacts

Impact on Ecosystem Processes and System-Wide Parameters

A. Major, perhaps irreversible alteration of ecosystem processes
   - fire occurrence, frequency and intensity
   - geomorphological changes (e.g., erosion and sedimentation rates)
   - hydrological regimes (including soil water table)
   - nutrient and mineral dynamics

   or system-wide parameters
   - system-wide reductions in light availability (e.g., when an aquatic invader covers an entire water body which would otherwise be open)
   - changes in salinity, alkalinity, or pH

B. Significant alteration to processes or parameters

C. Influences processes or parameters

D. No perceivable impact on processes or parameters

U. Unknown

Impact on Ecological Community Structure

A. Major alteration of ecological community structure *(e.g., covers canopy, changing or eliminating most or all layers of vegetation below)*

B. Changes number of layers, or significantly alters structure of at least one layer of the vegetation *(e.g., creation of a new layer, elimination of an existing layer, substantial change in density or total cover of an existing layer)*

C. Influences structure of at least one layer *(e.g., moderately changes density or total cover of a layer)*

D. No impact; establishes within existing layers without influencing their structure

U. Unknown

Impact on Community Composition

A. Causes major alteration in ecological community composition. For example, results in:
   - **the extirpation or sharp reduction in abundance of several common native plant, animal, or fungal species, or**
   - **the extirpation of one or more native species thereby reducing biodiversity, or**
   - **significant increases in the proportion of non-native species in the community**

B. Significantly alters ecological community composition (e.g., produces a significant reduction in the population size of one or more common native species in the ecological community)

C. Influences ecological community composition (e.g., reduces recruitment of one or more common native species which will likely result in significant reduction in the abundance of these species in the long-term)

D. No impact; causes no perceivable change in common native populations

U. Unknown

Impact on Individual Native Plant or Animal Species

A. High significance: impacts on >50% of individuals of 1+ species
B. Moderate significance: impacts on 20-50% of individuals
C. Low significance: Impacts on 5-20% or occasional
D. Insignificant
U. Unknown

Focus on disproportionate individual impacts on particular native species:

- Strongly out-competes a native species
- Hybridizes with a native species
- Parasitizes a native species
- Poisons a native species
- Hosts a non-native disease which damages a native species
- Distracts pollinators from a native species

Conservation Significance of the Communities and Native Species Threatened

Many non-native plants occur primarily in disturbed, low quality habitats that are dominated by other non-native species. Non-native plants have a greater impact if they:

i. directly or indirectly threaten native species or ecological communities that are considered rare or vulnerable (e.g., legally protected in the region (such as federally listed in the U.S.) or designated G1-G3 by NatureServe), or

ii. threaten outstanding, high quality occurrences of common ecological communities (e.g., NatureServe Element Occurrence Ranks A & B).

A. High significance
B. Moderate significance
C. Low significance
D. Insignificant
U. Unknown

Section II. Current Distribution and Abundance

Current Range Size in Region

A. High significance: > 1,000,000 mi^2
B. Moderate significance: >300,000 – 1,000,000 mi^2
C. Low significance: >3,000 – 300,000 mi^2
D. Insignificant: < 3,000 mi^2
U. Unknown

Note:
1,000,000 mi^2 is ~ one-third of the contiguous United States
300,000 mi^2 is ~ the size of TX, or of CA and NV combined
3,000 mi^2 is ~ the size of a few Midwestern U.S. counties

Proportion of Current Range Where The Species Is Negatively Impacting Biodiversity

Within what proportion of the species' generalized range (from the previous question) is the species causing negative impacts on biodiversity?

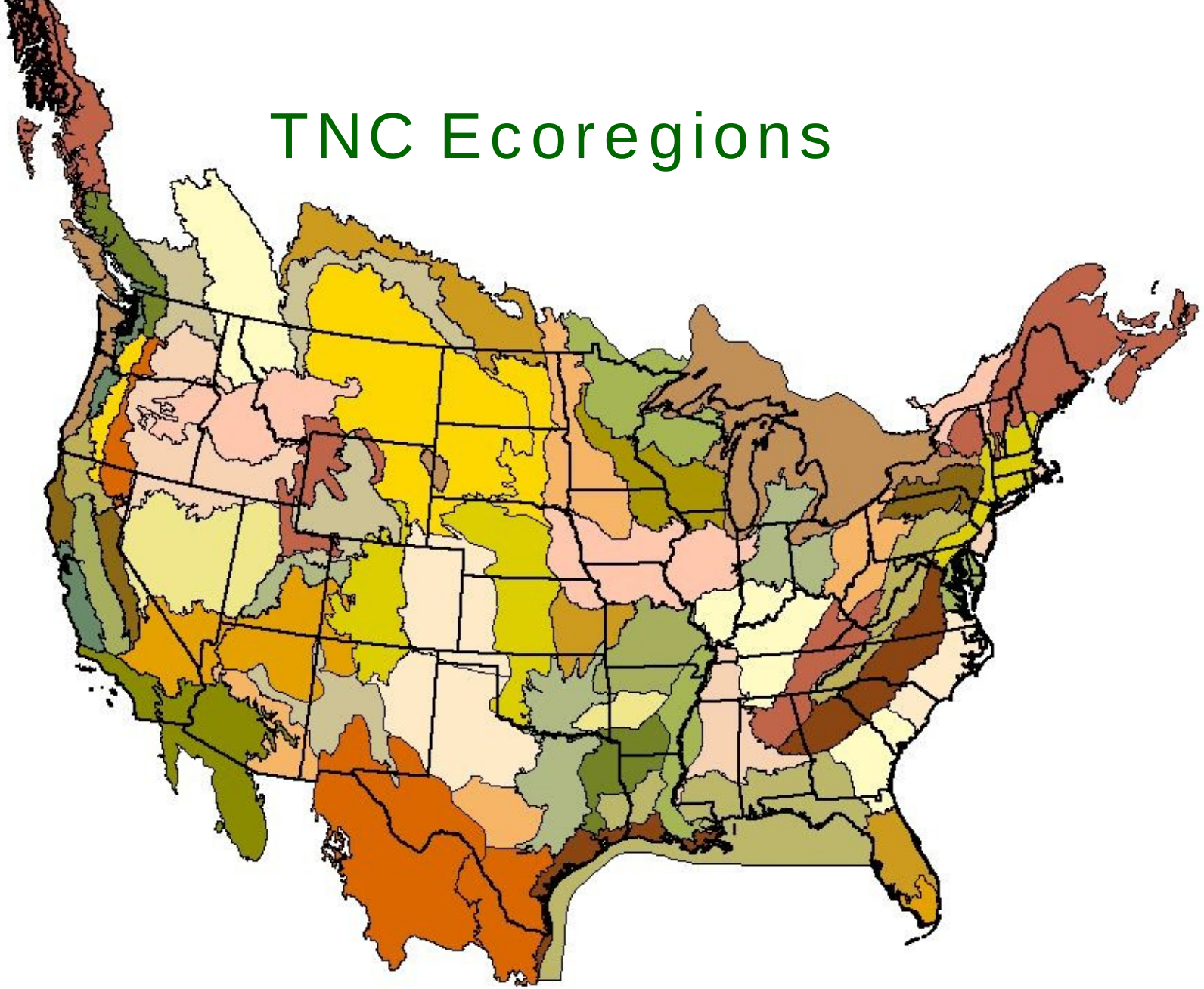
A. Impacts occur in >50% of the species' current generalized range in the region of interest
B. 20-50%
C. 5-20%
D. <5%
U. Unknown

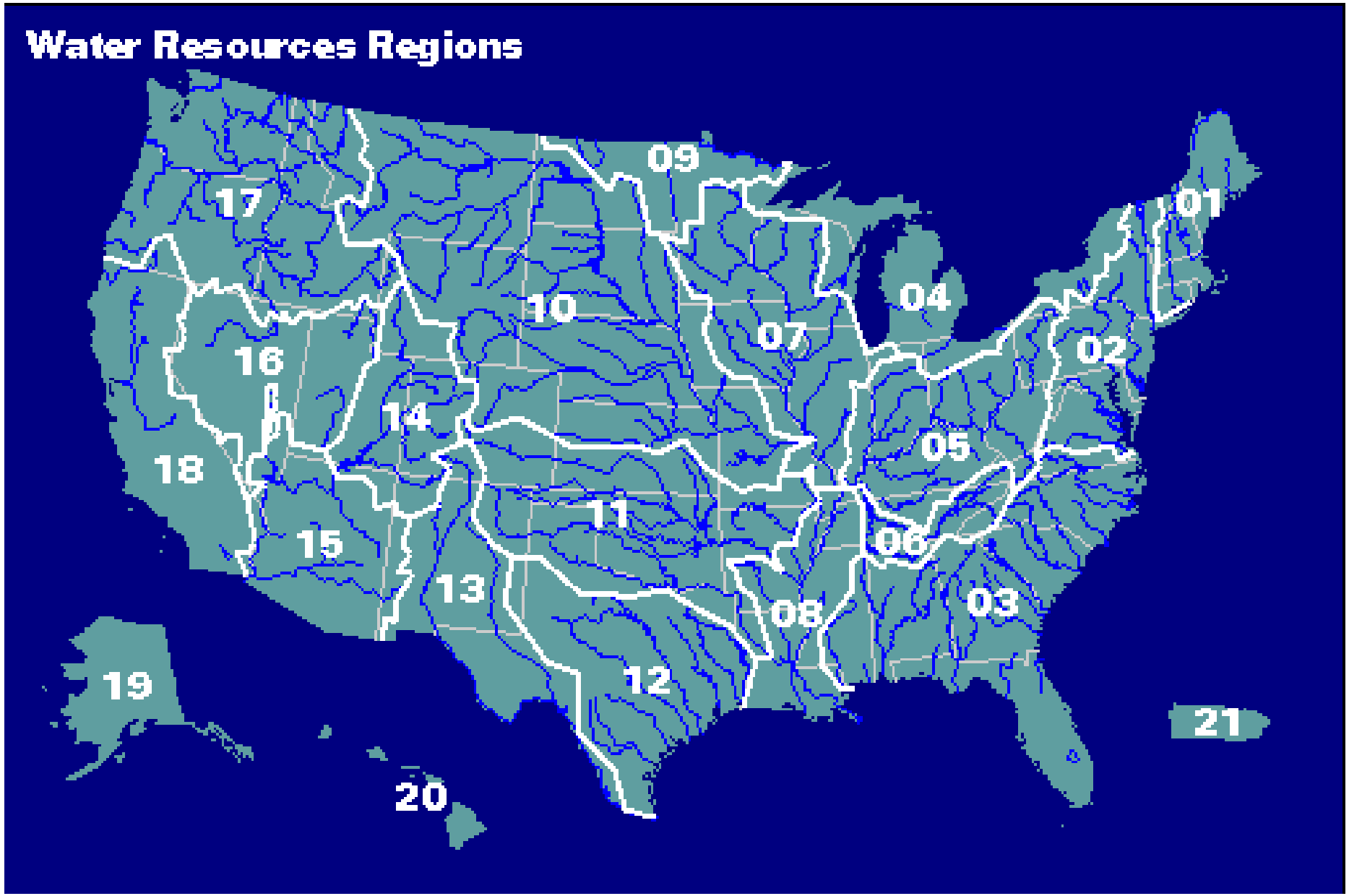
Proportion of Region's Biogeographic Units Invaded

A. ≥ 33 ecoregions
B. 13-32 ecoregions
C. 2-12 ecoregions or any one "major" ecoregion
D. Only one "minor" ecoregion
U. Unknown

Example of a minor ecoregion is the watershed of a tributary of a major river.

TNC Ecoregions




Water Resources Regions
09
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20

Diversity of Habitats Invaded

Examples of natural habitats or ecological systems:

- lake
- river
- coastal dune
- bottomland hardwood forest
- salt marsh
- savanna
- upland conifer forest

A. 6 or more habitats
B. 4-5 habitats
C. 2-3 habitats
D. 1 habitat
U. Unknown

Section III. Trend in Distribution and Abundance

Current Trend in Region

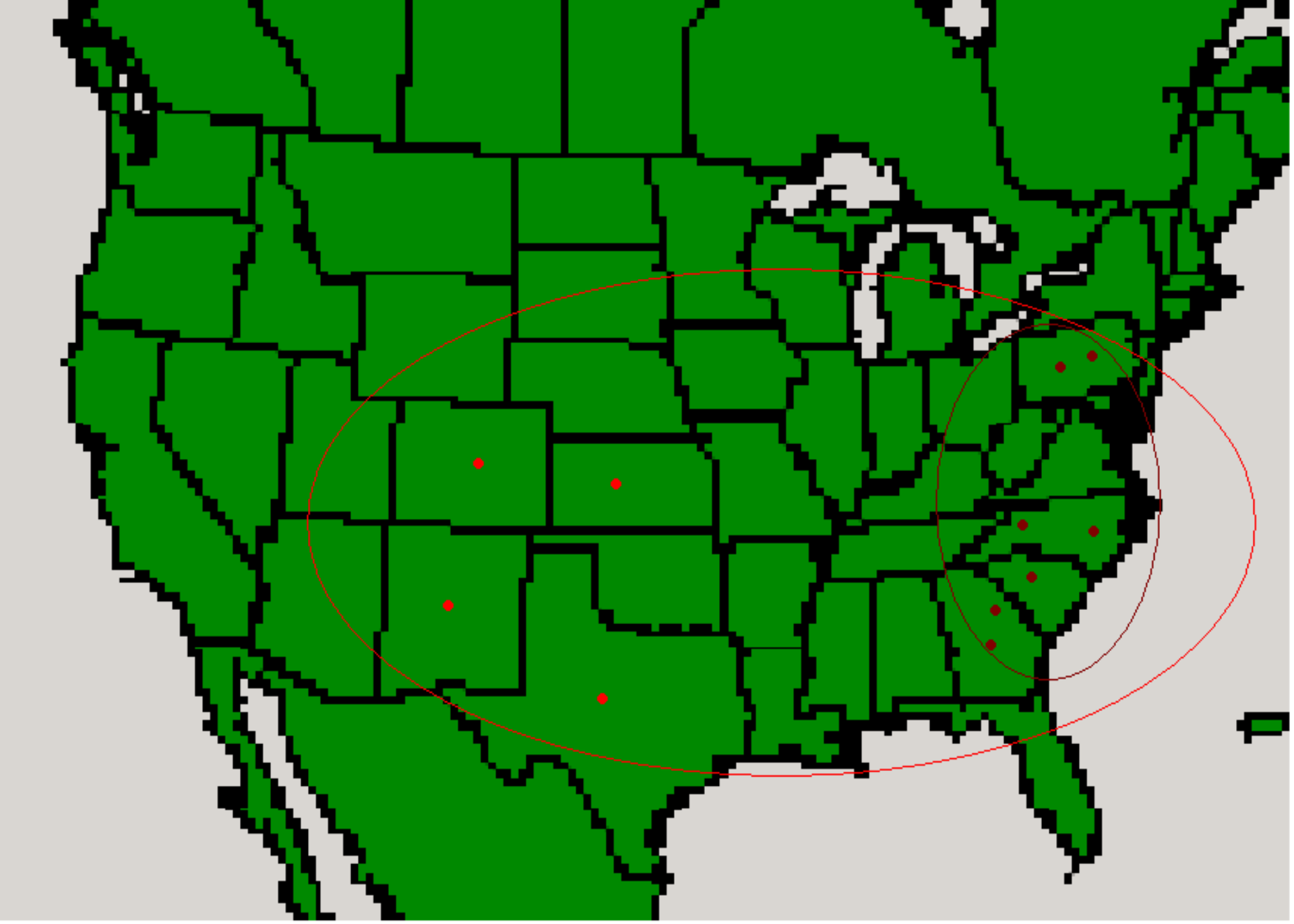
A. Range expanding in most or all directions, and/or spreading into new portions of the region

B. Range increasing in some directions but not all

C. Range stable, or areas of range contraction balancing areas of expansion

D. Range decreasing

U. Unknown



Proportion Of Potential Range Occupied

A. Less than 10% of potential range currently occupied

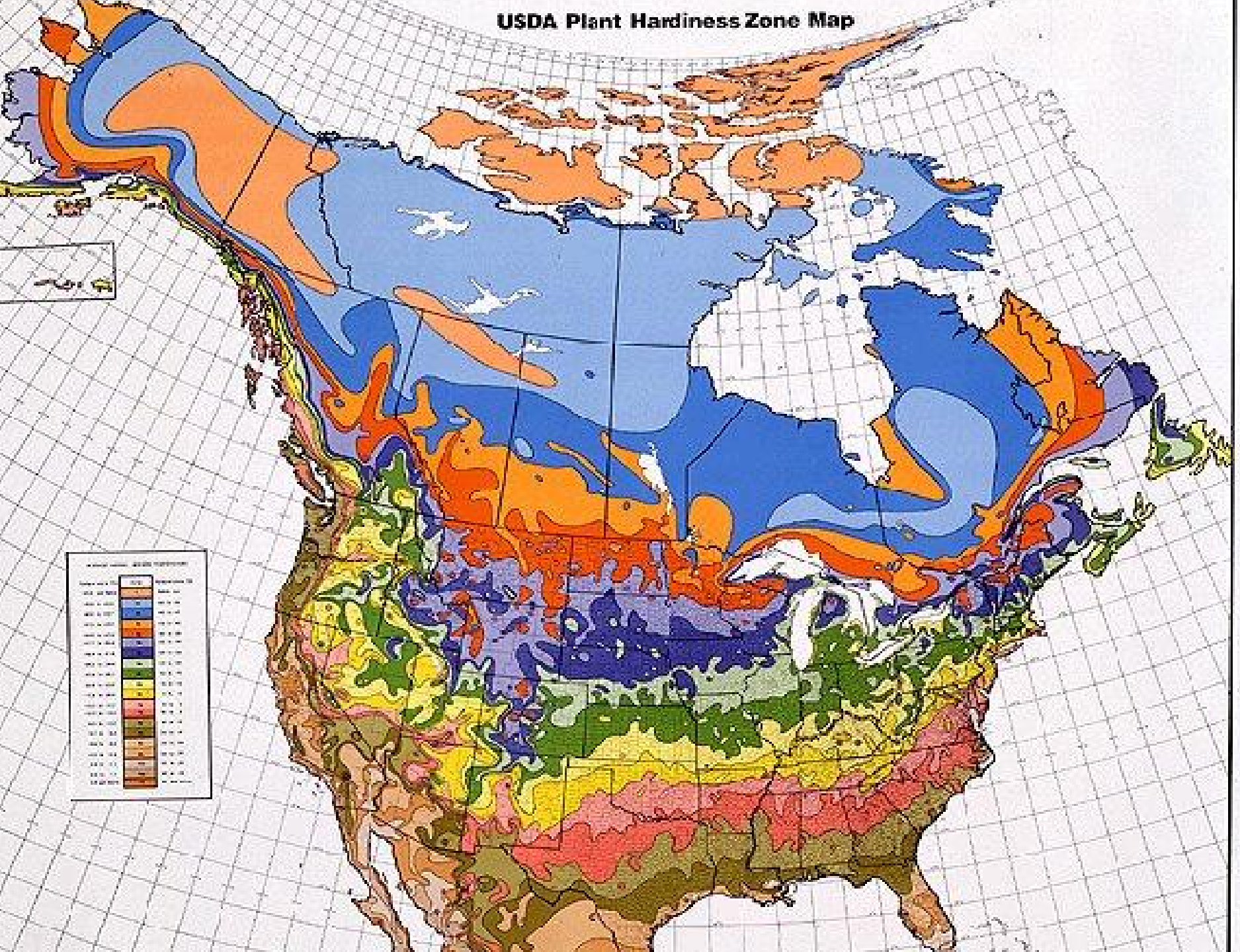
B. 10-30% of potential range currently occupied

C. 31-90% of potential range currently occupied

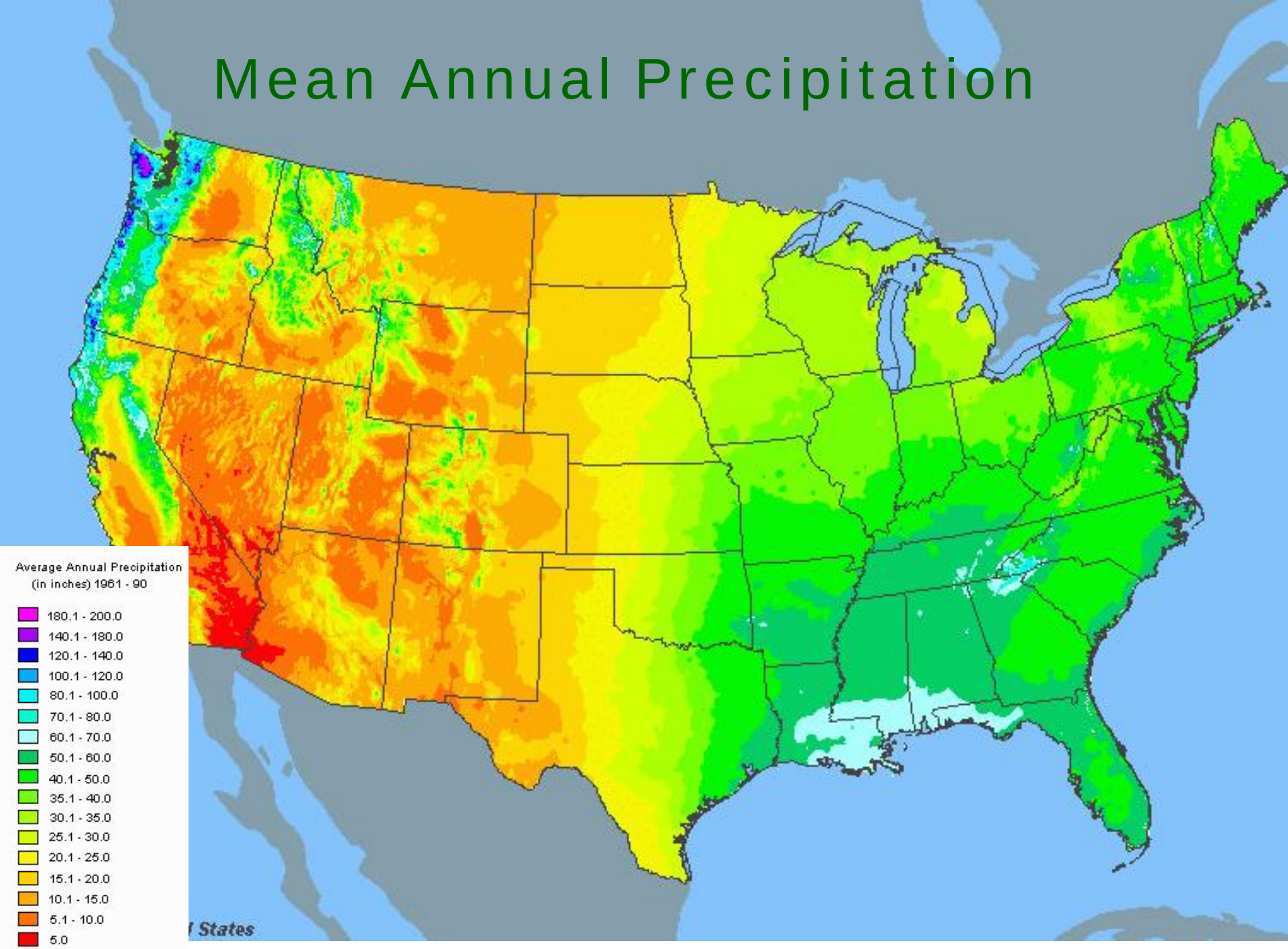
D. Greater than 90% of potential range currently occupied

U. Unknown

USDA Plant Hardiness Zone Map



Mean Annual Precipitation



Long-Distance Dispersal

A. Long-distance dispersal frequent (e.g., seed or other propagules frequently carried long distances, by humans, wide-ranging birds or mammals, wind [spores or small seeds], or river currents)

B. Long-distance dispersal infrequent (e.g., Seeds carried occasionally by unusually strong winds, more localized birds or mammals, or periodic floods)

C. Long-distance dispersal rare but known (e.g., major floods, hurricanes, or other unusual weather events)

D. Long-distance dispersal seldom or never

U. Unknown

Local Range Expansion or Change in Abundance

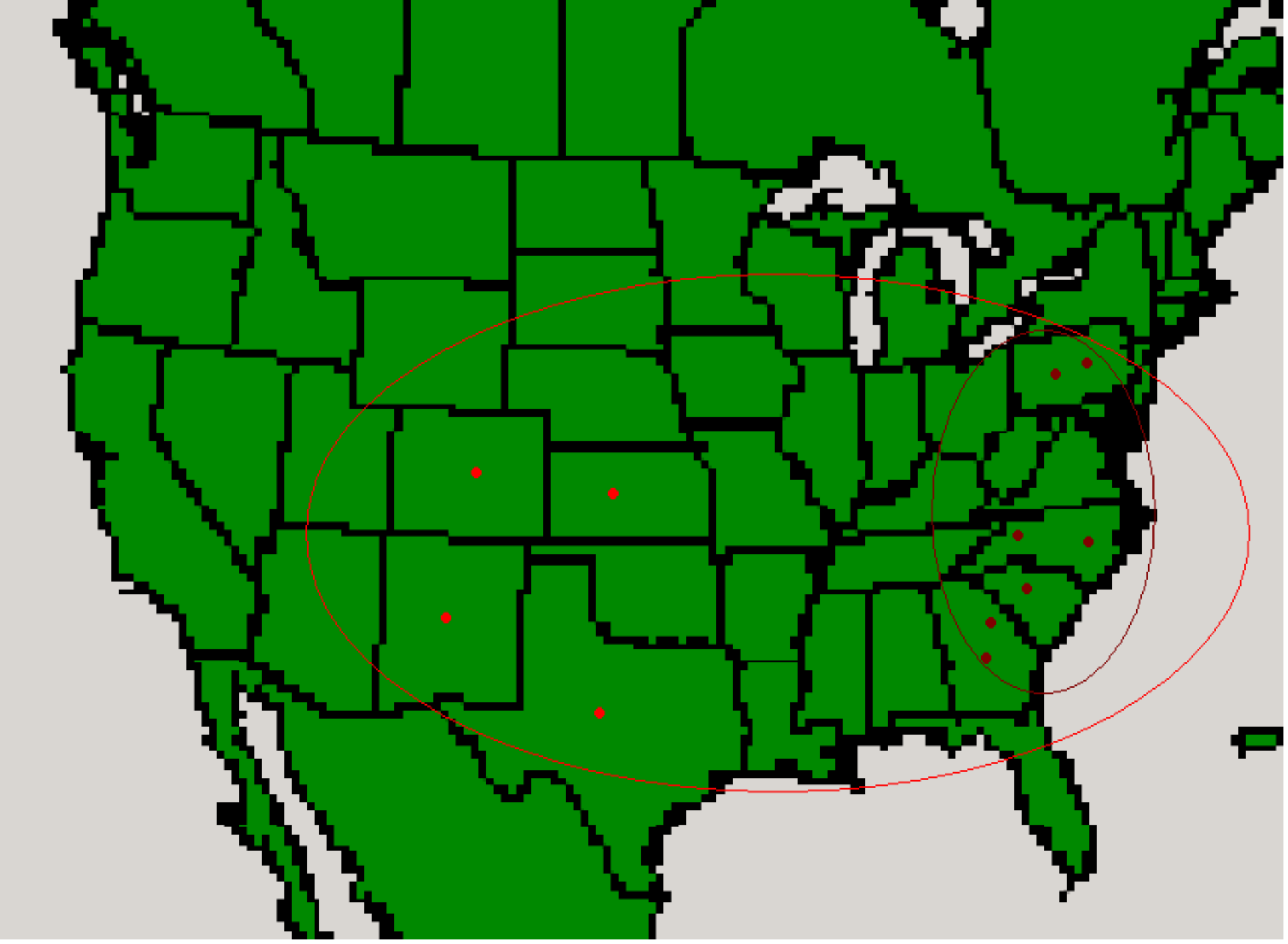
A. Local range and/or species abundance increasing rapidly (e.g., area occupied likely to double within 10 years in most areas where it doesn't already fully occupy its potential habitat, and/or abundance increasing by >25% in the area that it has already invaded)

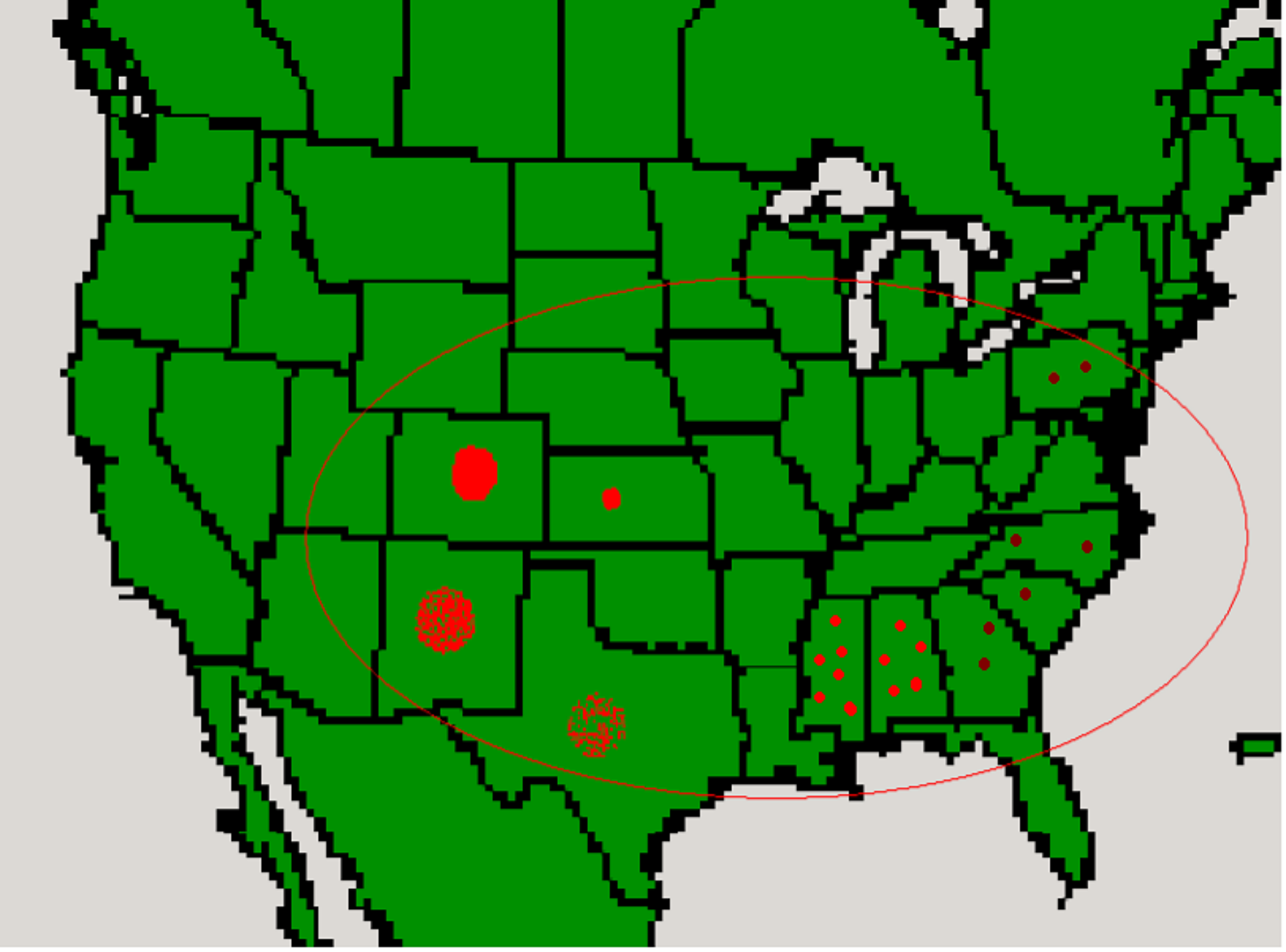
B. Local range expanding at a moderate rate (e.g., area occupied likely to increase by 50% in 10 years or to double within 50 years) and/or species abundance increasing significantly in 25%-75% of the area that it has already invaded

C. Local range expanding slowly (e.g., by >25% of current abundance in <25% of the area already invaded)

D. Species abundance and local range stable or decreasing across invaded area

U. Unknown





Inherent Ability to Invade

A. Often establishes in intact or otherwise healthy, late-successional or mature native vegetation

B. Often establishes in mid- to late-successional native vegetation where minor disturbances may occur (e.g., tree falls, hiking trails, streambank erosion), or in minor disturbances within otherwise mature vegetation, but not establishing in intact mature native vegetation

C. Establishes only in areas where major human-caused or natural disturbance has occurred in last 20 years (e.g., post-hurricane sites, landslides, highway corridors)

D. Not known to spread into conservation areas on its own (e.g., species may persist from former cultivation, or be present along edges)

U. Unknown

Similar Habitats Invaded Elsewhere (outside region of interest)

1. **Does this species invade elsewhere?**
2. **What habitats does it invade in elsewhere?**
3. **Are there any similar habitats in U.S.?**
4. **Have these similar habitats been invaded yet already by this species?**

A. Escaped in 3+ habitats in another region that are not invaded in this region

B. Escaped in 1-2 habitats in another region that are not invaded in this region

C. Escaped elsewhere but only in the same habitats as in this region

D. Not known to escape outside of this region

U. Unknown

Reproductive Characteristics

- Reproduces readily both vegetatively and by seed or spores
- Produces over 1,000 seeds or spores per plant annually
- Reproduces more than once per year
- Grows rapidly to reproductive maturity for its life form
- Has seeds (or spores) that remain viable in soil for three or more years
- Has quickly spreading rhizomes that may root at nodes
- Resprouts readily when cut, grazed, or burned
- Fragments easily, with fragments capable of becoming established elsewhere
- Has other comparable reproductive factors suggesting potential aggressiveness *(Explain in comments)*

A. Extremely aggressive – 3+ of characteristics
B. Moderately aggressive – 2 of characteristics
C. Somewhat aggressive – 1 of characteristics
D. Not aggressive – 0 characteristics
U. Unknown

Section IV. Management Difficulty

General Management Difficulty

A. Managing this species normally requires a major, long-term investment of human and/or financial resources or is not possible with available technology (e.g., >$1,500 per hectare per year for 5 years or more)

B. Management requires a major short-term investment of human and financial resources, or a moderate long-term investment (e.g., >$1,500 per hectare per year for less than 5 years OR $500 per hectare per year for 5 years or more)

C. Management is relatively easy and inexpensive; requires a minor investment in human and financial resources (e.g., <$100 per hectare per year for less than 5 years)

D. Managing this species is not necessary (e.g., species does not persist without repeated human disturbance and/or reintroduction)

U. Unknown

Minimum Time Commitment

A. Control requires at least 10 years
B. Control requires 5-10 years
C. Control requires 2-5 years
D. Control can normally be accomplished in 1-2 years
U. Unknown

Impacts of Management on Native Species

Do the effective methods for managing this species normally cause significant and persistent reductions in the abundance of native species (sometimes referred to as collateral or non-target damage)?

A. >75% of time have non-target damage
B. 25-75% of time have non-target damage
C. <25% of time have non-target damage
D. Any non-target damage lasts <2 yrs
U. Unknown

Accessibility of Invaded Areas

A. Accessibility problems high, with many invaded areas (hundreds of thousands of acres, or >30% of area it infests) not accessible for treatment (e.g., they are on very steep slopes or canyon walls, in roadless areas, or areas where permission to enter is difficult to obtain)

B. Accessibility problems medium, with a substantial percentage of the area invaded by this species inaccessible (tens of thousands of acres, or 5-30% of the area it infests)

C. Accessibility problems low, with a significant but relatively small percentage of the area invaded by this species inaccessible (thousands of acres or <5% of area it infests)

D. Accessibility problems insignificant or rare, with little or none of the area infested by this species inaccessible

U. Unknown

Guidance

- **Use the best, most recent information**
- **Include complete documentation of scoring decisions**
- **Critical to identify the native range of a species even though that's not a question in the Assessment.**
- **Only evaluating species, not var. or ssp. or forms. If a species occurs only in the region of interest as one variety, evaluate it at the full species level. (e.g., *Pueraria montana* var. *lobata*).**
- **Select the response that would be consistently repeated given the data in the comments field.**
- **Don't spend more than 1.5-3 hours on a species – no need for exhaustive information.**
- **Consider the species' behavior the entire region in you are evaluating (if whole U.S., don't just look at response in one area).**

Scoring:
How the answers to the 20 questions are used to rank the species:

- Each answer is assigned points (each question is weighted individually)
- The points for all answers in a section are summed to yield a subrank (subranks are calculated for each of the four sections)
- The subranks, which are weighted, are then summed to yield an overall I-Rank for each species

Example: Section I (Ecological Impact) subrank calculation for *Lonicera japonica*

SUBRANKS **Date Assessed:** **1/21/2003**

	A	B	C	D	Answer	Max Pts	Min Pts
I. ECOLOGICAL IMPACTS							
1.	**33**	**22**	**11**	**0**	**C**	**11**	**11**
2.	**18**	**12**	**6**	**0**	**A**	**18**	**18**
3.	**18**	**12**	**6**	**0**	**BC**	**12**	**6**
4.	**9**	**6**	**3**	**0**	**C**	**3**	**3**
5.	**24**	**16**	**8**	**0**	**B**	**16**	**16**
						60	**54**

SUBRANK I **Medium**

78-102	**A = High**
52-77	**B = Medium**
27-51	**C = Low**
0-26	**D = Insignificant**

Max Subrank	B	B	Min Subrank

Example: I-Rank calculation for *Lonicera japonica*

INVASIVE SPECIES IMPACT RANK

	A	B	C	D	Sub rank	Max Pts	Min Pts		I-RANK	High/Med
I.	50	33	17	0	B	33	33		76-100	High
II.	25	17	8	0	A	25	25		51-75	Medium
III.	15	10	5	0	AC	15	5		26-50	Low
IV.	10	7	3	0	A	10	10		0-25	Insignificant
					Max Pts	83	73	Min Pts		
					Max I-Rank	A	B	Min I-Rank		

Subrank scores provide valuable information

Species A

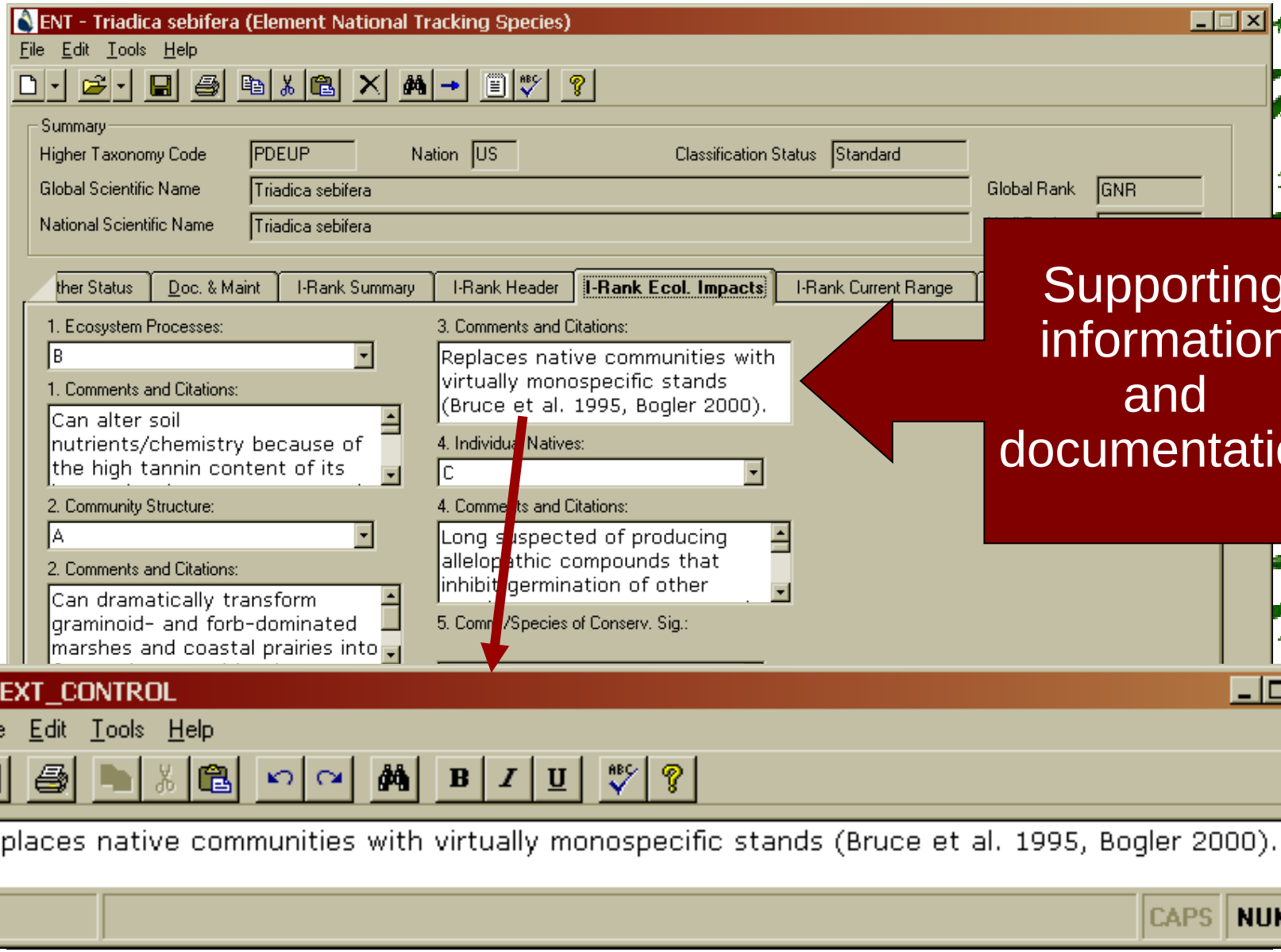
I = High
II = High
III = Low
IV = Medium
Overall = HIGH

Species B

I = High
II = Low
III = High
IV = Medium
Overall = HIGH

Urgent!

Documentation



Supporting information and documentation

NatureServe's Project

To evaluate all of the estimated 3,500 non-native vascular plant species established outside cultivation in the U.S. using this new methodology.

Yellow star thistle *(Centaurea solstitialis)*

→ 385 done so far

http://www.natureserve.org

Or directly:

http://www.natureserve.org/getData/plantData.jsp

- Protocol
- Example species
- Scoresheet
- Data form
- List of species evaluated
- Press release

Exercise

- Divide into groups
- Each group finds I-Rank for a species
- 30 min
- Discussion

I-Rank Results

- *Alternanthera philoxeroides* (Alligator-weed):
  - Established in US? Yes
  - In native species habitats? Yes
  - Ecological Impacts: High/Med
  - Current Distrib. & Abundance: Low
  - Trend in Distrib. & Abundance: Med/Low
  - Management Difficulty: Medium
  - National I-Rank: **Medium**
    - Date: 4/20/04

I-Rank Results

- *Myriophyllum aquaticum* (Parrot-feather):
  - Established in US? Yes
  - In native species habitats? Yes
  - Ecological Impacts: Medium
  - Current Distrib. & Abundance: High/Low
  - Trend in Distrib. & Abundance: Med/Low
  - Management Difficulty: High
  - National I-Rank: **High/Med**
    - Date: 5/14/04

I-Rank Results

- *Myriophyllum spicatum* (Eurasian water-milfoil):
  - Established in US? Yes
  - In native species habitats? Yes
  - Ecological Impacts: High
  - Current Distrib. & Abundance: High
  - Trend in Distrib. & Abundance: High
  - Management Difficulty: High
  - National I-Rank: **High**
    - Date: 5/14/04

I-Rank Results

- *Salvinia molesta* (Giant salvinia):
  - Established in US? Yes
  - In native species habitats? Yes
  - Ecological Impacts: Medium
  - Current Distrib. & Abundance: Medium
  - Trend in Distrib. & Abundance: High
  - Management Difficulty: Unknown
  - National I-Rank: **Medium**
    - Date: 4/14/04

I-Rank Results

- *Egeria densa* (Brazilian water-weed):
  - Established in US? Yes
  - In native species habitats? Yes
  - Ecological Impacts: High/Med
  - Current Distrib. & Abundance: High
  - Trend in Distrib. & Abundance: High/Low
  - Management Difficulty: High/Med
  - National I-Rank: **High/Med**
    - Date: 2/17/04

I-Rank Results

- *Paspalum notatum* (Bahia grass):
  - Established in US? Yes
  - In native species habitats? No
  - Ecological Impacts: n/a
  - Current Distrib. & Abundance: n/a
  - Trend in Distrib. & Abundance: n/a
  - Management Difficulty: n/a
  - National I-Rank: **Insignificant**
    - Date: 4/12/04

I-Rank Results

- *Arundo donax* (Giant reed):
  - Established in US? Yes
  - In native species habitats? Yes
  - Ecological Impacts: High
  - Current Distrib. & Abundance: High/Med
  - Trend in Distrib. & Abundance: High/Med
  - Management Difficulty: Low
  - National I-Rank: **High**
    - Date: 2/25/04

I-Rank Results

- *Triadica sebifera* (Chinese tallow-tree):
  - Established in US? Yes
  - In native species habitats? Yes
  - Ecological Impacts: High
  - Current Distrib. & Abundance: Medium
  - Trend in Distrib. & Abundance: High/Med
  - Management Difficulty: High/Med
  - National I-Rank: **High**
    - Date: 2/27/04