

**WORKSHOP NOTES**  
**1ST INTERNATIONAL WORKSHOP ON WEED RISK ASSESSMENT**  
**ADELAIDE 16-18TH FEBRUARY 1999**

**SESSION 1 - INVASIVENESS**

**INVASIVENESS**

**Group 2**

**Jean Turner**

Card sort exercise of 5 most important factors to consider to assess invasiveness – 10 main groupings of important factors

- |    |  |
|----|--|
| 9  | Previous weed history®   |
| 10 | Effective dispersal (= disperse + establish + propagules)                    |
| 4  | Survival mechanisms  |
| 4  | Climatic suitability® - if you have world distribution maps by rainfall zone |
| 2  | Competitive ability  |
| 8  | Reproductive capacity  |
| 5  | Environmental factors (invasibility)   |
| 3  | History in new environment   |
| 3  | Knowledge and information  |
| 1  | Context/framework (in which we are seeking to assess invasiveness = SCALE)   |

<p>= 5 most important factors identified by the group = individual vote (each participant had 5 votes to indicate their 5 main factors) 9 etc = # of votes for that factor most important - the higher the number the higher the ranking</p>
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Previous weed history and history in new environment are linked and are readily used in risk assessment systems.

Climatic suitability readily used

Competitive ability – difficult to quantify and use in risk assessment system.

**ISSUES**

- Are we supposed to be developing a weed risk assessment system here in 3 days?
- Where are we headed to by Thursday (end point expected?)
- Are we using world best practice?
- Need to clarify and define terms we are using – what do we mean and understand by "invasiveness" and other terms we'll be discussing?

**OUTCOMES PEOPLE WANT FROM THE WORKSHOP**

- Understanding/knowledge of how different people approach the issue of weed risk assessment
- Look for common approaches, differences and why
- 1<sup>st</sup> stage in development of a common national, state and local weed risk assessment process for Australia
- Explore options/opportunities to create an international weed risk assessment information system (data, modelling systems, libraries of models)

## **PROBLEMS WE HAVE WITH ASSESSING INVASIVENESS**

- How do we best use the knowledge we already have (to make decisions on invasiveness?)
- Do we have enough information and the right information?
- Are we sharing the information we have (around the world)? – info exchange
- Is prediction of invasiveness possible? (some think yes, others no) where do we draw the line (on information required) in practical, everyday situations, so we can make decisions about particular plants.
- Weed risk assessment is/should be a stepped process
  - with "fail safe" measures at each step (in case a species "falls through the net" of invasiveness detection)
  - not just one step to the process
- Each weed risk assessment is answering a specific question for a specific plant (different from prioritising existing weeds for control) - USA focus – prove a plant is guilty before you can stop it coming in.
- Evaluating risk after (deliberate) introduction as a step in the process?
- Quarantine issues/risks with small batches of seed purchased via the internet – clarify with AQIS legal issues / prosecution?
- Maintaining reference information systems used in decision making (eg updating changes in plant names/synonyms to prevent species slipping through on an unlisted name).
- Invasiveness and potential distribution – are they two different things?

## **IMPLICATIONS**

### **POLICY**

- Not much control of influence
- If can't predict invasiveness it's hard to get \$ or political commitment (need to demonstrate \$ values)
- Cost: benefit of stopping new weeds coming in vs control of existing weed problems (how is the total \$ pool best allocated?)

### **RESEARCH NEEDS**

- Sharing data bases (eg on the net), not just talking about it eg – meta data base
- Information content – biology, traits

- Information technology – how can we best share the information, will it cost, or be free?
- \$\$\$!

# **INVASIVENESS**

## **GROUP 4**

**Vicki Linton**

### **1) IMPORTANT FACTORS (no order of importance)**

- Dispersal
- Establishment / Habitat
- Reproductive capacity
- History
- Human activity
- Competitiveness

### **2) GAPS**

- Science to answer key factors
- Relative importance of each factor
- Definitions
- Time-scale
- Spatial-scale
- What to assess – detection, early warning
- Not all factors covered for all plants

### **3) CONFLICTS**

- Definitions and terminology (own jargon, broader meanings)
- Impacts are the reasons behind risk assessment, not invasiveness; but invasiveness is visual and can be measured

### **4) EMERGING THEMES**

- Assessment of invasiveness led/pursued/occurred because interested in impact invasiveness will have
- Don't have the information to make or influence policy

### **5) HOW READILY CAN FACTORS BE USED IN RISK ASSESSMENT (WILL DEPEND ON THE QUESTION EG QUARANTINE VS CONTAINMENT)**

History:

- easy to get for common agricultural weeds
- not so for native plants outside home range
- limited usefulness in yes/no because related to impact
- help with prediction – climate and distribution

Establishment / Habitat:

- essential but where is information?
- successional status as guide
- disturbance (do we know ? undecided)
- search out information
- help with predictions (climate)

Dispersal:

- yes to mechanisms, no to distance (difficulty in getting distance information)
- harder than think

- weight different types of dispersal

Reproductive capacity: hard to find information

- simplify into categories

Competitiveness: undecided on usefulness

- will give some ideas
- what it competes with eg is it a monoculture

Human: useful eg introductory frequency, desirable traits

## **FURTHER ACTIONS**

- Email groups
- Record information so it can be accessed by others
- Better communication between researchers and policy makers
- Weight different types of dispersal
- Categorise reproductive capacity
- Plus stuff in 2) GAPS

## **FACILITATORS COMMENTS**

- Trouble separating invasiveness and impact
- Can identify the traits important but not how they can be used in risk assessment system ie to translate known into prediction (is this because question was too generic)
- Need some simplification of complicated factors (dispersal, reproduction capacity) at the generic level
- All more comfortable with the "plant based traits" of invasiveness

**DETAIL BEHIND FACTORS – IMPORTANT FOR INVASIVENESS**  
**SESSION 1**  
**GROUP 4**  
**Vicki Linton**

**HISTORY**

- invaded elsewhere
- weed elsewhere
- history of weed elsewhere
- closely related to weeds

**ESTABLISHMENT/HABITAT**

- population size
- ability to establish
- ability to establish undisturbed and disturbed areas
- ability to encounter suitable climatic conditions
- conducive environment
- ability to establish undisturbed
- community disturbance, species turnover (opportunity to spread)
- species habitat interaction

**DISPERSAL**

- chance of dispersal > 1km
- dispersal mode
- transport long distance
- bird dispersal
- seed dispersal
- disseminates well
- vectors

**REPRODUCTIVE CAPACITY**

- suitable conditions to breed and set seed
- propagule production
- longevity of propagule
- lifecycle length
- population growth
- vegetative spread and reproduction
- reproductive capacity
- fecundity
- number of seeds
- produce viable propagules

**COMPETITIVENESS**

- large plant size → increased seed production
- competitive in habitat invaded
- withstand herbivory pressure
- physiological thresholds.

## **HUMAN ACTIVITY**

- rapid colonisation over long distances
- impact on community
- tolerance to weed management regimes
- human transmittance

## INVASIVENESS

Greg Cock

\*\*\* important, possible but hard

\*\* useful but very difficult

\* useful and easy

### FACTORS

### COMMENTS

Invasiveness elsewhere \*\*\*

- extremely useful and possible
- need international networks and big databases
- need info to be available

Introduction pressure \*\*\*

- core issue but frustrating
- need culture change and public awareness

Potential for long distance dispersal

- could put a lot into this with not much outcome

Bioclimatic suitability

- important but difficult
- more application at regional level
- need to link into other resource databases

Length of juvenile period

- even with perfect info it may not apply in situation of concern

Ecological plasticity

IMPOSSIBLE

Non-Native \*

Easy: A matter of database maintenance

Vegetative reproduction \*

Easy

Range of reproductive alternatives \*

Possible

Rapid growth rates

- depends on ecosystem and context
- not a guarantee but "signals" concern
- easy!

Regularity of production

DIFFICULT!

Seed size and number

Easy to get info, but not useful by itself and then only moderately useful as a surrogate

Ecosystem proneness

- useful but difficult
- requires basic research

Ability to grow in undisturbed areas \*\*

Very difficult but very useful

Invasive congeners \*

- easy and useful
- data base maintenance and accessibility

Life forms

- easy but of limited use



## **INVASIVENESS**

### **GROUP 5**

**Mark Williams**

#### **QUESTION 1 - IMPORTANT FACTORS - INVASIVENESS**

- Seed production / propagule pressure
- Dispersal
- Known invader elsewhere
- Competitive ability
- Characteristic of system being invaded
- Climatic adaptation

#### **QUESTION 3 - HOW READILY CAN THEY BE USED**

1. Some hard data available - factor measureable and predictable
2. Modes of dispersal can be identified (biology)
3. Information available from:
  - historical data
  - research and extension sources
  - regulatory bodies
  - sources of data becoming more readily available
  - high no. of species → limits data available
  - lack of invader status overseas → no guarantee species will not be invasive
4.
  - Lack of information / context
  - assessment complex – based on anecdote
  - research gaps exist
5. Characteristics of environment – can use the following:
  - biogeographic systems
  - landuse
  - content defined by jurisdiction (affected by political decisions, national vs regional approach)
6. Data available – but problem with accessibility

#### **QUESTION 4**

- If invasiveness can be supported by hard data or high level probability → high value in weed risk assessment system
- Information for any given species often incomplete – often must operate on best knowledge
- Assessment complex, difficult

## **INVASIVENESS**

### **GROUP 1**

**Rebecca Lang**

## **REPRODUCTIVE ABILITY AND GENERATION TIME**

### **Factors considered important:**

- High fecundity – how many propagules are produced
- Speed/rate of reproduction – number of propagules available
- Reproduction mode / system – vegetative / sexual / both

## **COMPETITIVE ABILITY AND ENVIRONMENTAL RANGE**

### **Factors considered important:**

- Growth
  - rapid growth rate
  - how competitive is the weed
  - habit
- Environmental range
  - the range of conditions the weed can survive under
  - tolerance of environmental stress
    - individual stress depends on conditions in "new" country
  - wide distribution in country of origin
  - the environmental conditions could be favourable for the weed plant (weed)
  - the plant can grow up under the same conditions of one crop (environment, host, spread)

## **ESTABLISHMENT**

### **Factors considered important:**

- is critical as it determines naturalisation
- variety of habitats invaded (eg disturbed and undisturbed)
- wide ecological amplitude
- potential area of spread
- capable of occupying a wider range of environments
- can adapt to local conditions
- has the right potential for establishment
- seed dormancy – can wait for favourable conditions
- disturbance of environment – invasion is easier in disturbed environments
- history of introduction – when, where, how much, link to management
- change of management – a change in management leading to change in biological factors
  - fire, grazing, cropping – can alter direction of invasion

## **DISPERSAL**

- How it arrives; initial introduction
- Once it's here, how it gets spread around

### Mechanism:

- both how it arrives, then how it spreads
- how much (ability)
- how far (distance)
- how quickly (rate)
- type of vector (biotic interactions)
- vegetative / sexual
- ecosystem interactions

### Issues:

- seed dispersal can influence rate of spread and allow expression of biotic potential; this is largely unrecognised
- rate of spread is linked to cost of delay in control
- likelihood of
  - seed dispersal
  - competition
  - herbivoryto influence direction
- animals and climatic factors could be useful to the weed
- countries importing crop seeds have more possibilities to get new weeds

## **TWO QUESTIONS:**

- a) What are the biological characteristics of an invasive species?
- b) How does that allow us to predict what species would be invasive?

## **WHERE WE HAVE AGREEMENT ON FACTORS**

- Frequency and distribution of introduction
- History of introduction
- Chance
- Biological characteristics:
  - dispersal
  - establishment
  - reproduction
  - growth and competitive ability
  - genetic plasticity

For these there are things we know, but heaps of gaps in the detail

- Under each category there are a couple of crucial questions that need to be asked; the debate might be "what questions".
- Conditions favourable for establishment – disturbance, climate etc

### **GAPS IN WHAT WE KNOW:**

- Chance (?ignorance)
- local and specific knowledge
- we don't have a full picture of what our weed flora is, at any scale
  - isn't collected
  - lack of documentation, access, and availability
  - lack of linkage between organisations
- Lack of appreciation of the variability of systems

### **ISSUES**

- Risk assessment
  - what level of accuracy is acceptable
  - what kind of risk do you want to take?
- How do we package the information we do have into a form that is useful to decision makers?
  - how do you build the intrinsic (known biological attributes of the plant) and the non-intrinsic (environmental, etc) factors into the system?
- Deliberate introduction for "weedy" characteristics in agriculture, forestry and horticulture
- Uncontrolled introductions ie regulated versus unregulated introductions
- Environmental versus agricultural weeds → may still be possible to come up with one way of assessing them
- For policymakers trying to assess invasiveness, the issue of probability of establishment
  - is a plant a weed elsewhere ? is the first "filter".

## **INVASIVENESS**

### **GROUP 6**

**Mary Reiger**

## **INVASIVENESS**

**Name the five most important factors to predict invasiveness:**

- 1) Invader elsewhere
- 2) Propagule pressure
- 3) Total range
- 4) Bioclimatic matching
- 5) Dispersal mechanism

**Other factors named:**

- disturbance
- same genus which already exist in the area
- conspicuousness of the weed
- What is the value of the weed ie, attractiveness, desirability, commercial value

**Why are these factors important in predicting invasiveness?**

- 1) Easy to get information about these factors
- 2) Have already been used to discriminate past introductions
- 3) They are efficient
- 4) These factors are widely accepted and credible

**How readily can these factors be used in a risk assessment system?**

- 1) Invader elsewhere – good, practical in most cases and measurable
- 2) Propagule pressure – difficult to use, and difficult to define but is a good predictor
- 3) Bioclimatic matching – good factor but shouldn't be used alone
- 4) Total Range – good factor but shouldn't be used alone
- 5) Dispersal mechanism – difficult issue of minimal use

**What does this tell us about determining "invasiveness" as part of an assessment system?**

- Needs to have multiple factors but always use factor 1 in your system
- Need a balance of factors - simple but not too simple

**Research/policy implications**

- This type of system isn't foolproof. Need other systems.
- Need response plan for plants that invade but the risk is not picked up by the risk assessment system
- Risk assessment system still have errors, remember this system is only an indicator

- Global databases are needed and the system/database need to be current and remain current
- How can we accurately test a weed risk assessment system?
- Need to monitor how the system is going.
- Not much policy implications simply to invasiveness
- Need to identify the range of limitations in bioclimatic models used at the moment:
  - need more data
  - assess the strengths and weaknesses of the models is needed
- What are the policy implications for genetically modified organisms

## **SUMMARY FOR INVASIVENESS (From Thursday lunch butchers paper)**

### **1. IMPORTANT FACTORS**

- Previous weed history, weed elsewhere, history, weedy relatives, known invader, invasiveness elsewhere, non-native
- Effective dispersal, long distance dispersal
- Reproductive capacity, seed production, propagule pressure, reproductive alternatives, vegetative reproduction, length of juvenile period, rapid growth rates, generation time, survival mechanisms
- Environmental factors (Invasibility): establishment, habitat, grow in undisturbed, ecological plasticity, total range, characteristics of system being invaded, environmental range
- Climate suitability/matching, bioclimate, climate adaption
- Human activity, introduction pressure
- Competitiveness (ability)

### **2. HOW READILY USED IN RISK ASSESSMENT ?**

- History etc.
  - yes, readily, some hard data available
  - practical and measurable
  - for many species is not a reliable indicator of how will behave elsewhere
  - use research + extension + regulatory bodies for history information
- Dispersal etc.
  - difficult
  - yes to mechanisms
  - no to distance
- Reproductive etc.
  - hard to find info
  - difficult to use and define
  - good predictor
- Environment etc.
  - essential but where is the information?
  - biogeographic, land use
  - context defined by jurisdiction
  - not on its own
- Climate etc.

- good to use but not on its own
- data is available, but is it accessible?
- Human etc.
  - useful
  - commitment to keep records
- Competitiveness etc.
  - undecided
  - difficult, lack of information and context
  - anecdotal assessments
  - research gaps

#### Conclusions

- need multiple factors
- always use history
- not fool-proof
- indicator

### 3. GAPS

- relative importance of each factor?
- how do we use the knowledge to make decisions?
- enough information? right information? science able to answer? accessible?  
where is the information?
- definitions
- time scales, spatial scales, context, local and specific knowledge
- specific questions for specific plants
  - ➔ don't cover all plants
  - ➔ doesn't help with prioritising control
- don't have the full picture of weed flora

### 4. ISSUES

- needs to be a stepped process with "fallback"
- early warning and detection
- impacts are reasons behind risk assessment, not invasiveness



- what about chance?
- information is incomplete, working on base knowledge
- how to build intrinsic (plant factors) and non-intrinsic (eg. environment factors) into the system?
- what level of risk is acceptable?
- what about deliberate introductions for other "benefits" eg. forestry?
- we know a lot about plants but still plenty of gaps in the detail
- policy makers interested in establishment
- environmental vs. agricultural contexts
- genetically modified organisms

## **5. WHAT WE NEED TO PROGRESS**

- email groups to share information
- commitment to record information
- better communication between researchers and policy makers
- simple system to categorise reproductive capacity
- system to weight different types of dispersal
- testing of risk assessment models/systems
- identify range limitations in a plants bioclimate
- models need more data
- SWOT analysis (Stength/Weakness/Opportunity/Threat) of models and monitoring
- international networks and big databases
- identify/recognise the difference between core issues and signals
- packages to be useful to decision makers