

# Variable Perceptions of Weeds and the Implications for WRA

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“Weeds are enemies to man. Before an enemy can be controlled and destroyed, it must be identified” (p. 1)

Lorenzi and Jeffery

*Weeds of the United States and their Control*

Use photos and drawings in this book  
to identify the weeds ...

# Issues

## Defining the objective

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What are we trying to identify with WRA?

“Without man there would be no weeds” (p. 1)

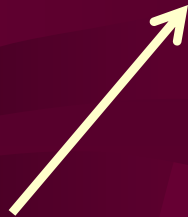
Muzik, *Weed Biology and Control*

# Issues

## Defining the objective

What are we trying to identify or screen out with WRA?

Risk = likelihood x consequences



'Escapes'  
Naturalization  
Roadside "weeds"



*Eragrostis tenella*

"harmless" Stone, 1970

# Issues

## Defining the objective

“Invaders” ?

*sensu* Richardson et al 2000



*Phaius tankervilleae*

# Issues

## Defining the objective

What are we trying to screen out with WRA?



“Weeds” of mis-managed pasture

# Issues

## Defining the objective

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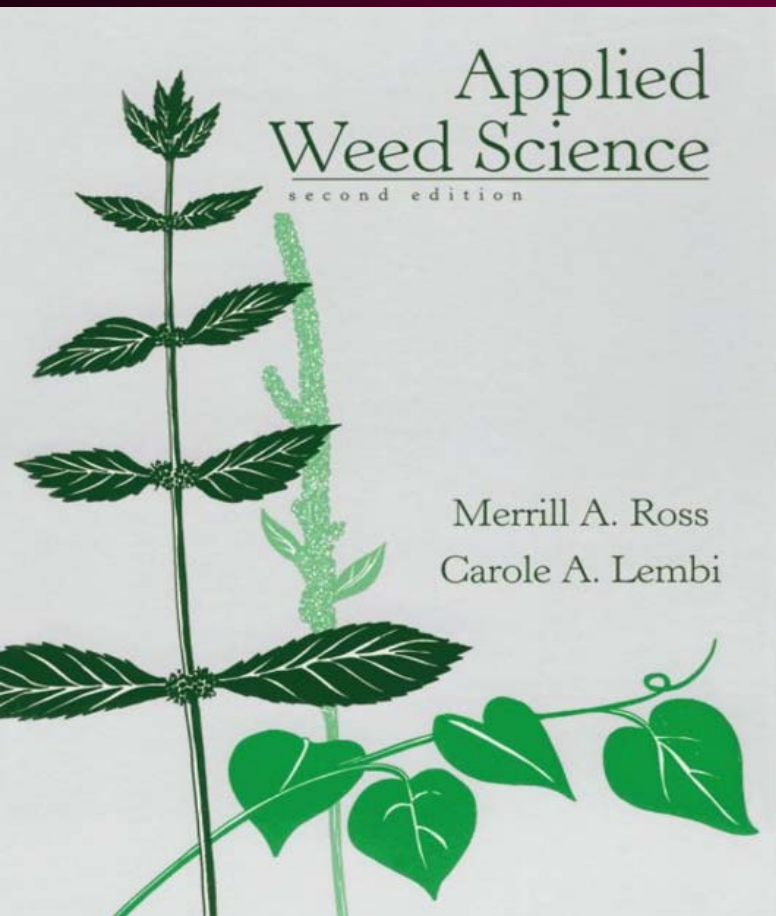
What about natural areas?

Natural area weed

“a plant that prevents attainment  
of management goals”

Randall 1997





# A recent weed science text

(Ross and Lembi)

*plants that interfere with the growth of desirable plants and that are unusually persistent and pernicious. They negatively impact human activities and as such are undesirable.*



# Issues

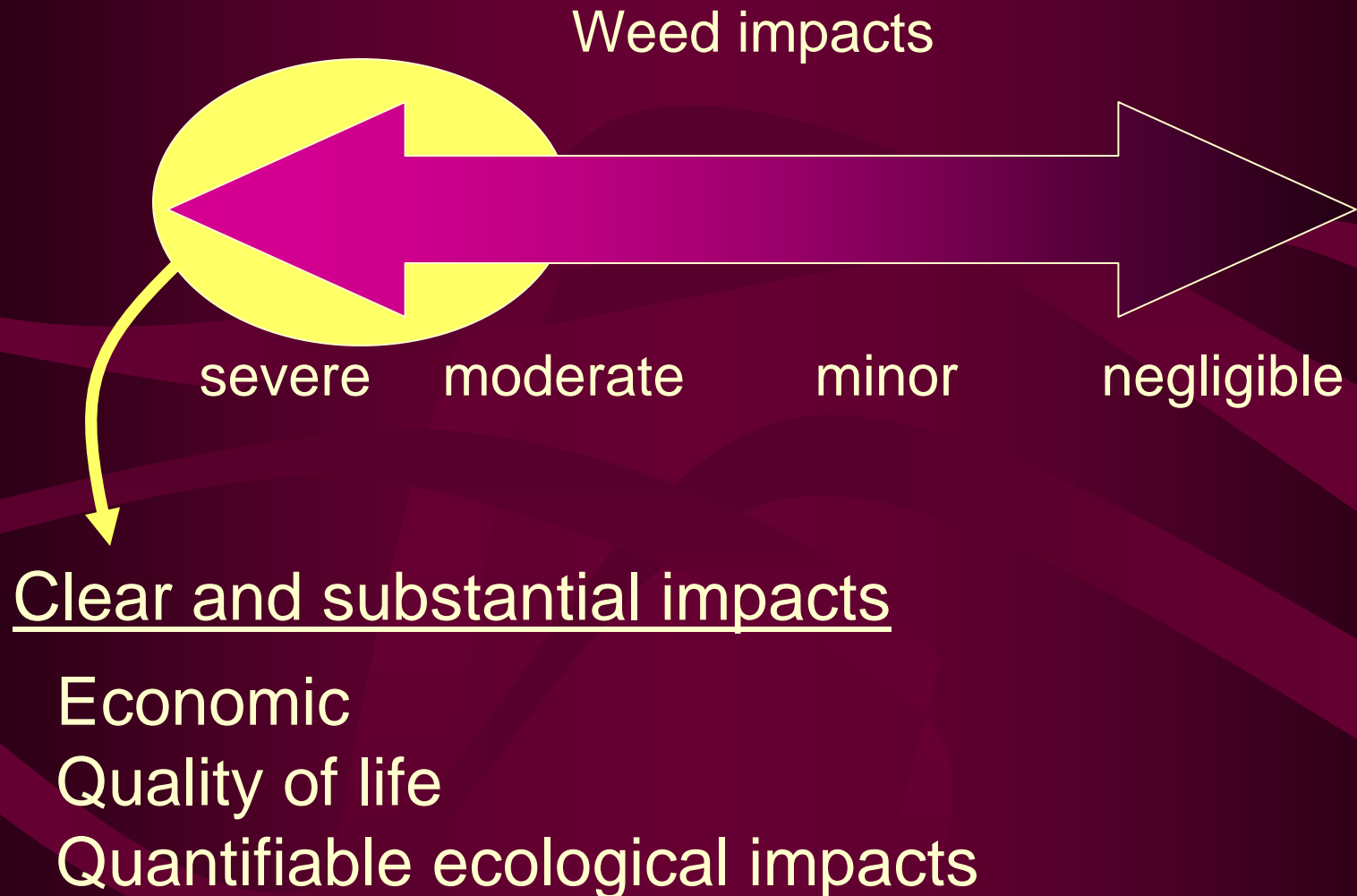
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## Defining the objective

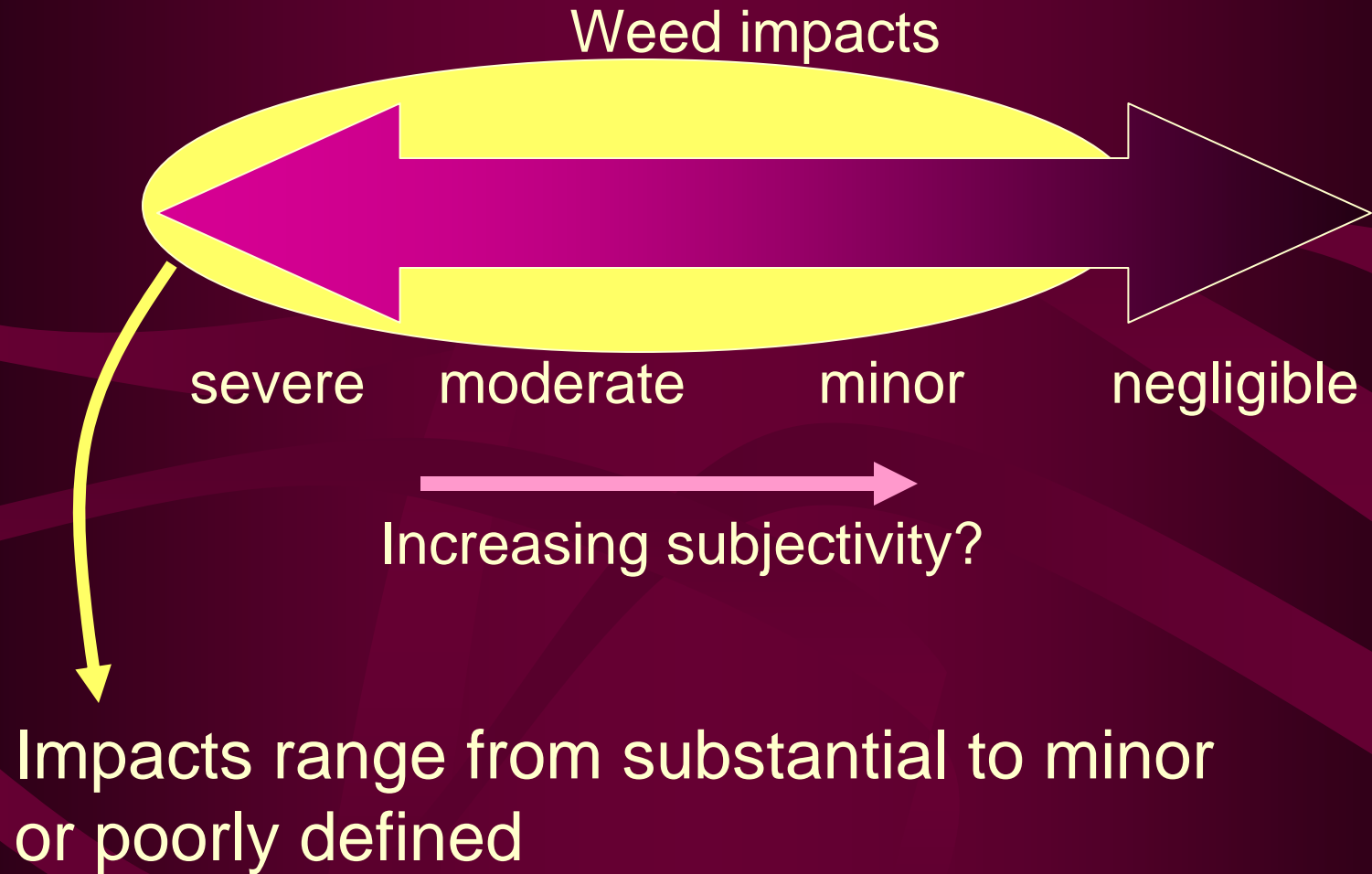
“The greatest value will come from an emphasis on the more troublesome elements of the vegetation” (p. xvii)

King, *Weeds of the World*

# WRA targets to screen out

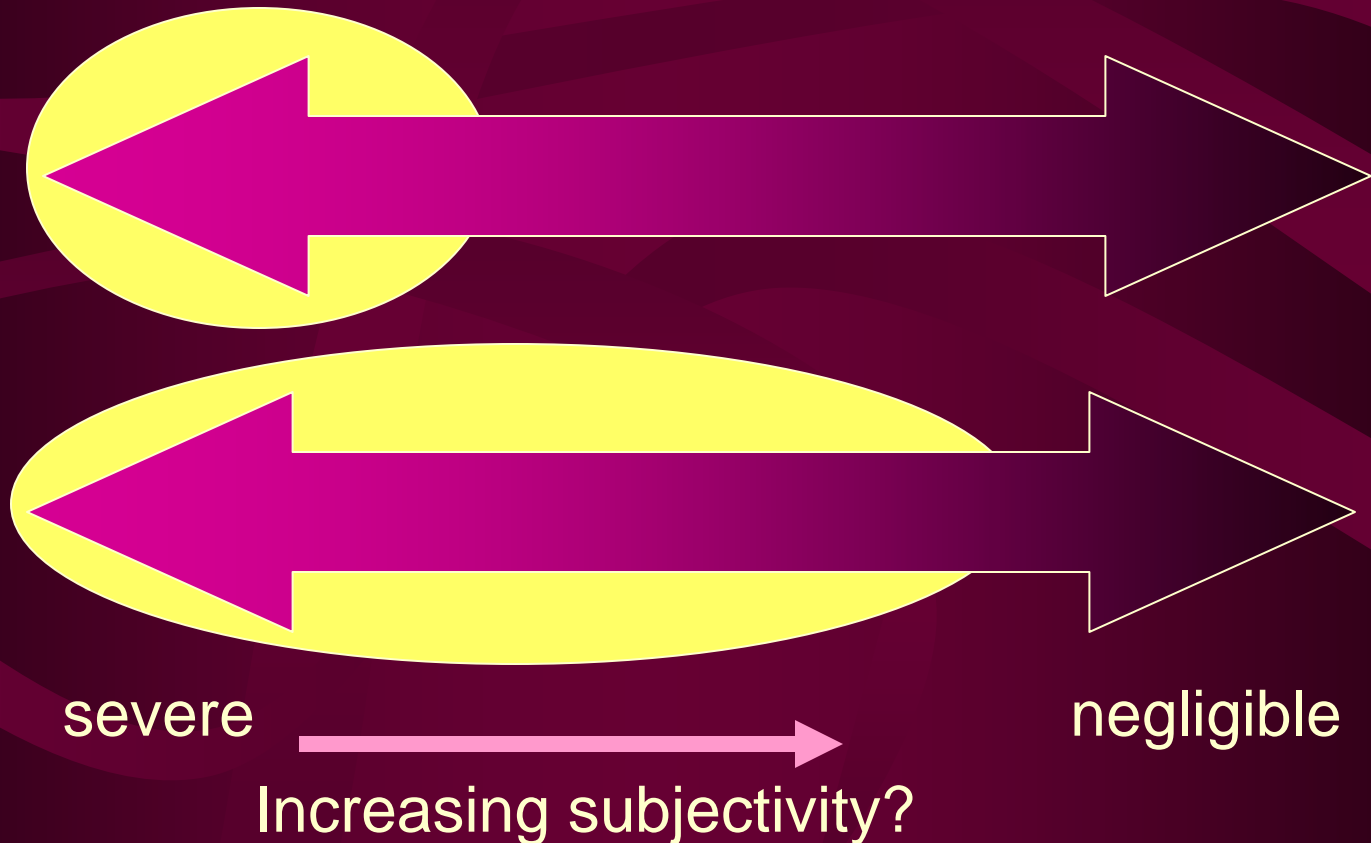


# Alternate WRA targets to screen out



# Why specify a target?

- Necessary to determine WRA effectiveness
- Optimal WRA structure or calibration may differ, depending on objective



# Australia/New Zealand Weed Risk Assessment System

49 questions

- climate/distribution
- domestication
- weed elsewhere
- undesirable traits
- plant type
- reproduction
- dispersal
- persistence attributes

	<b>Prediction</b>	
<b>Score</b>	< 1	not a pest
	1-6	evaluate
	> 6	pest

# Issues

## Weed elsewhere?

- Four “weed elsewhere” questions have a major impact on WRA scores
- Someone called it a weed? (e.g. on a website)
- Someone labeled it as “invasive”?
- The species is listed in a weed book?

Premise: Behavior elsewhere might predict behavior in Hawai‘i

# Issues

## Weed elsewhere?

3.02 *Garden/amenity/disturbance weed* -- an intrusive weed

3.03 *Weed of agriculture/horticulture/forestry* -- causes productivity losses and/or costs due to control

3.04 *Environmental weed* -- documented to alter the structure or normal activity of a natural ecosystem

3.05 *Congeneric weed*

Up to 12 points total



# Issues

## Weed elsewhere?



### Problems with “weed” references

*“Weeds of the United States and Their Control”*

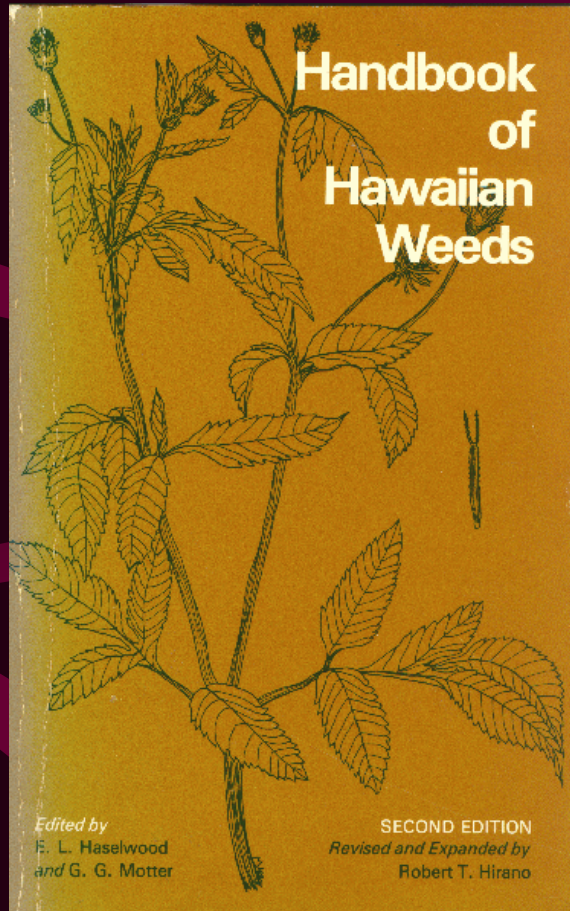
“In some cases, a plant is a weed just because it does not have proper aesthetic value”

*“Monocot Weeds<sup>3</sup>”*

“In this volume are treated the adventive members of nine families”

Ruderal life history  $\neq$  Economic or intrusive impacts

# Weed elsewhere?



“found in arid,  
rocky regions”

Endemic to Hawai‘i, “rare to extremely rare”  
NatureServe Rank G2 (Imperiled)



*Ipomoea tuboides*

# Weed elsewhere?

## A Geographical Atlas of World Weeds

Holm (1979)

- “sparingly naturalized”
- one known location

Serious weed ✓

Principle weed ✓

Common weed

Present (rank of importance unknown)

Flora (confirming evidence needed)



*Dianthus armeria*



# Issues

## Weed elsewhere?



Problems with “environmental weed” references and websites

Criteria for listing not provided

Naturalization  $\neq$  Environmental weed  
(e.g. decreased native biodiversity)

# Issues

## Weed elsewhere?

Misinterpretation of website intent seems common

*Institute of Pacific Islands Forestry*  
**Pacific Island Ecosystems at Risk**  
(PIER)  
Plant threats to Pacific ecosystems



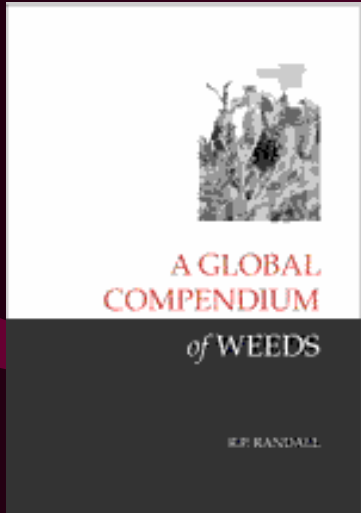
*Caring for the  
Land and  
Serving People*

**Plant Threats to Pacific Ecosystems**

“invasive and potentially invasive plant species”

# Issues

## Weed elsewhere?



“A global compendium of weeds”  
(Randall 2002)

We don't use it to answer “weed elsewhere” questions in WRA.

- Useful for identifying references to be checked

# Weed elsewhere?

## A Geographical Atlas of World Weeds



Why not just be “conservative”?

Inflated Scores, False positives

### Potential WRA uses

Increasingly  
problematic



Education

Identifying low risk alternatives

“Buy-in” from industry groups

Pressure growers to destroy stock

Declare as noxious

Deny entry



# Weed elsewhere?

## Why not just be “conservative”?

### IPPC Guidelines

“The whole process from initiation to pest risk management should be sufficiently documented so that when a review or a dispute arises, the sources of information and rationale used in reaching the management decision can be clearly demonstrated.”

p. 133

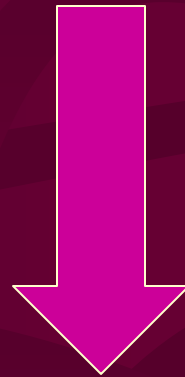
**INTERNATIONAL STANDARDS FOR  
PHYTOSANITARY MEASURES (ISPM No. 11)**

Joe's website list → Intrusive  
Economic harm  
Documented ecological harm

# Issues: Evaluating retrospective tests

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WRA scores versus actual plant behavior



% correct decisions

# Issues: Evaluating WRA decisions

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- Compared H-WRA decisions with 25 expert opinions

## The expert evaluators:

- botanists/weed scientists
- first hand knowledge of weeds in Hawai'i and other Pacific Islands
- native ecosystems
- managed ecosystems

# Question to Experts

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What is the plant's current status?

- not a pest (but present)
- minor pest (minor economic/ecological harm)
- major pest (major economic/ecological harm)

# Evaluating the H-WRA decisions

## Species classification based on the expert surveys

- individual opinions varied
- differences in personal experience

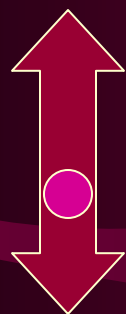
### Classification criteria

Major pest --	at least 3 experts agreed
Minor pest --	at least 3 experts agreed (but not a major pest)
Not a pest --	all other species (with at least 3 evaluations)

# Issues

## Judging WRA performance

### Survey data



1 agree  
2 agree  
3 agree  
4 agree

- Major pest
- Minor pest
- Not a pest

	Major pests admitted (%)	Minor pests admitted (%)	Nonpests admitted (%)	Evaluate further (%)
3 agree H-WRA + 2nd screen	5	33	92	8
1 agree	22	73	98	8
Pest elsewhere criterion alone	18	24	86	0

# Weed problems

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- Weed?
- Weed elsewhere?
- Weed here? [testing, calibration]



# Risk: Likelihood and Consequences

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$$\text{Risk} = \text{Likelihood}_{(\text{Consequences})} \times \text{Consequences}$$

- Perhaps the most widely used formulation

Hypotheses: Separation of WRA score into L and C components will

- Reveal new patterns
- Improve separation of pests and non-pests
- Reduce “evaluate further”

# Risk: Likelihood and Consequences

$$\text{Risk} = \text{Likelihood} \text{ (Consequences)} \times \text{Consequences}$$

A function of a plant's ability to succeed when introduced (naturalize, spread, invade)

**“Invasiveness”**

The (usually negative) economic, environmental and/or social effects of a weed

**Impacts**

# Risk: Likelihood and Consequences

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Partition of WRA scores into C and L elements

## Examples

3.01	Naturalised beyond native range?	L
4.01	Produces spines, thorns or burrs?	C
4.12	Forms dense thickets?	C
7.01	Propagules dispersed unintentionally?	L
8.01	Prolific seed production?	L

# Risk: Likelihood and Consequences

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Impacts



Consequences questions

Range

–1 to 21

Likelihood questions

– 26 to 36



“Invasiveness”

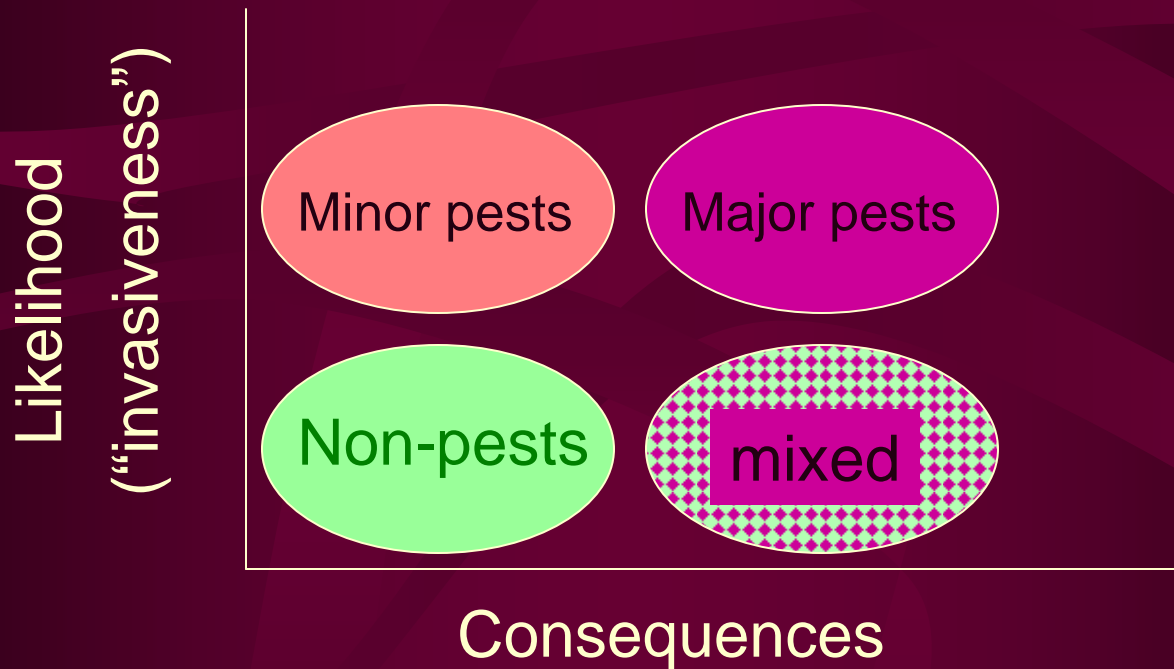


Scaled

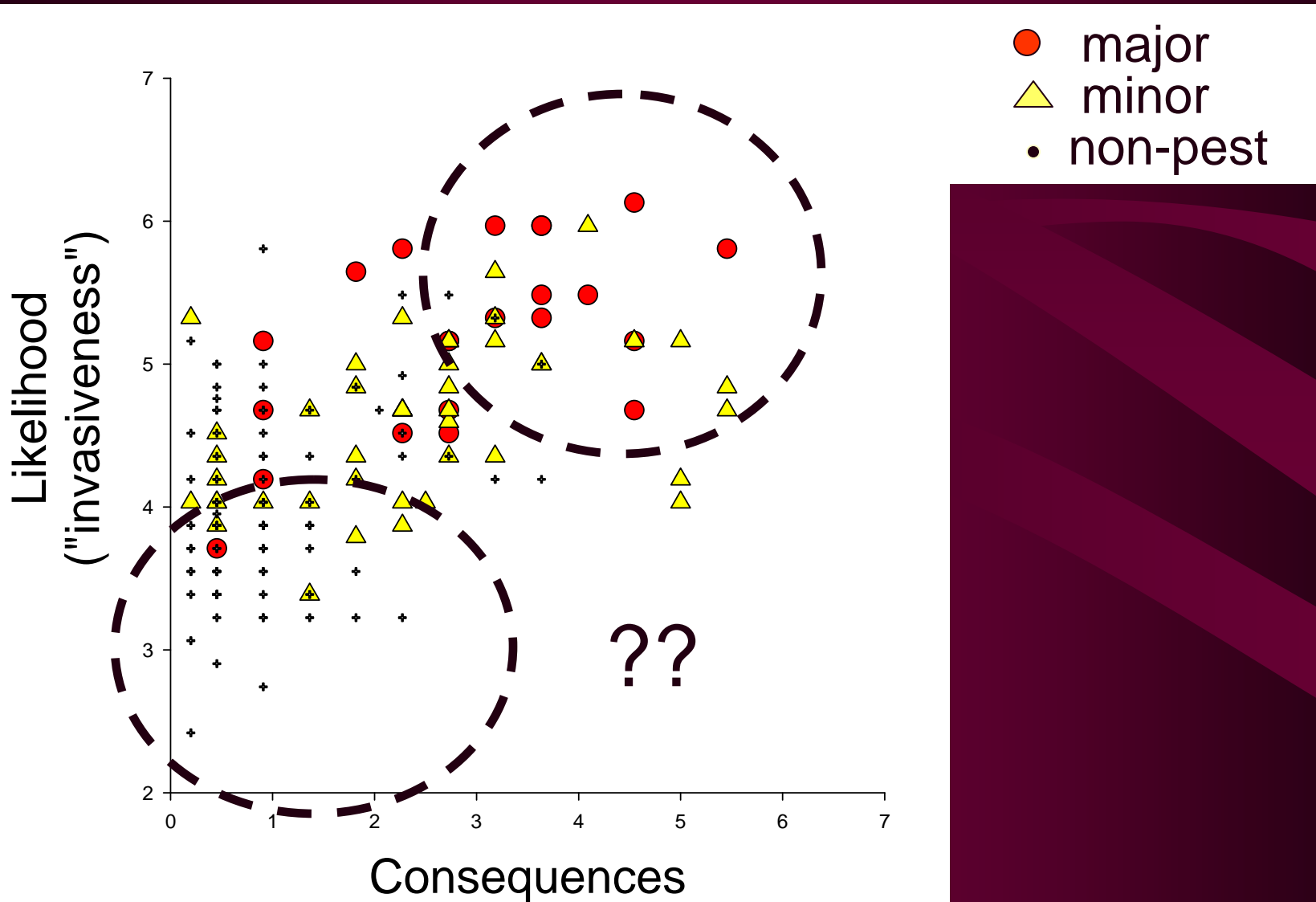
0 to 10

# Risk: Likelihood and Consequences

Hypothesis: Separation of L and C will reveal new patterns

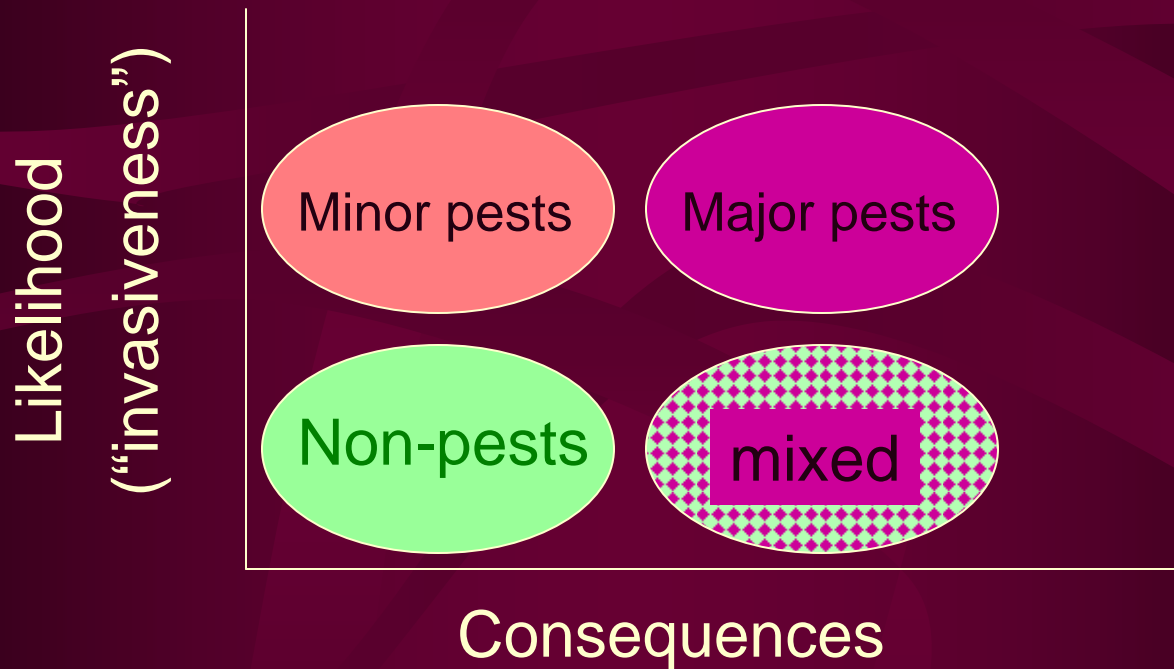


# Risk: Likelihood and Consequences



# Risk: Likelihood and Consequences

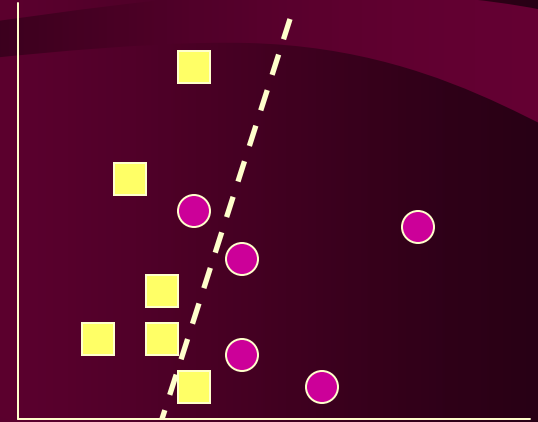
Hypothesis: Separation of L and C will reveal new patterns





# Original WRA versus LxC

## Discriminant analysis



Identifies a discriminant function (“break-point”) that maximizes correct classification of *pre-defined* groups

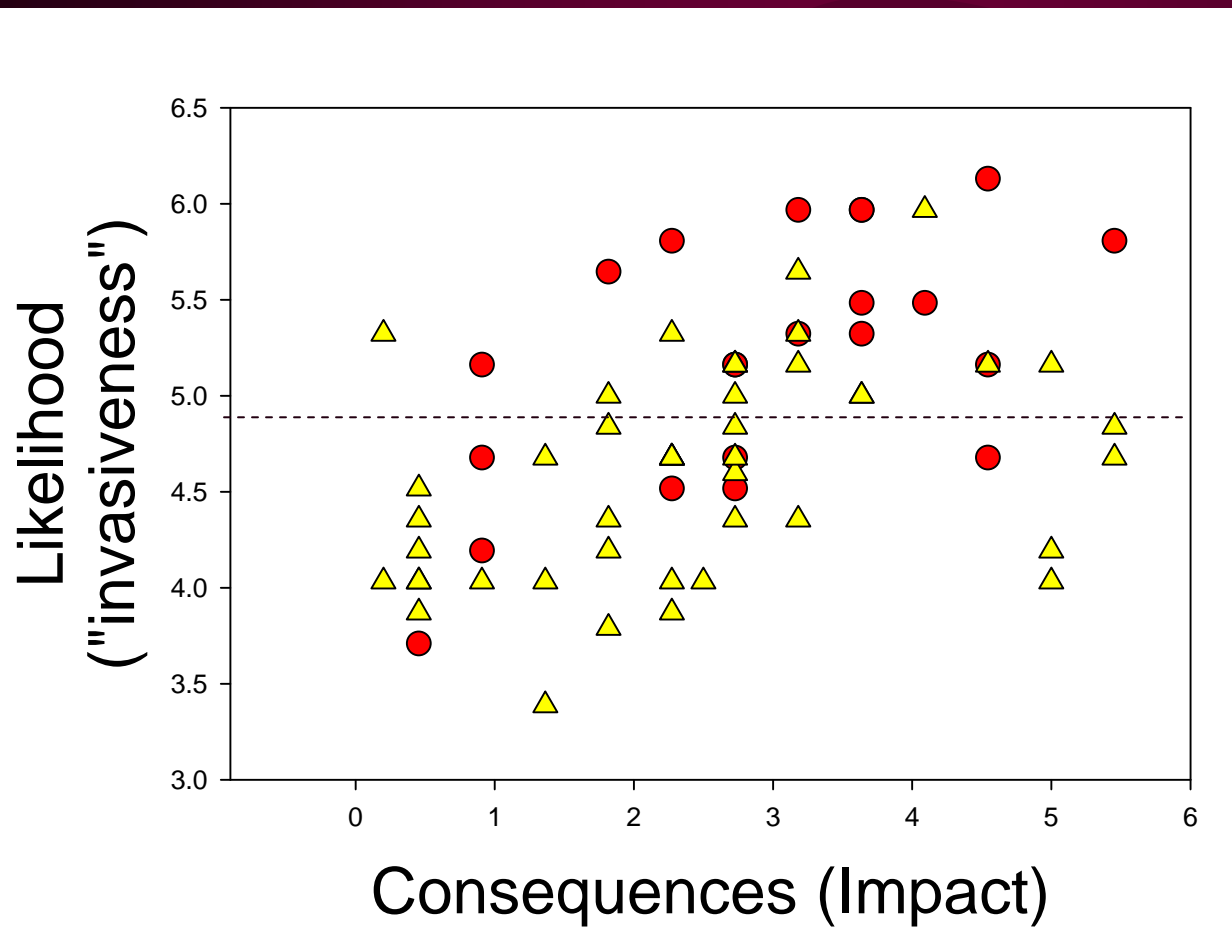
Major versus minor pests

- 65% of data used for training
- Prediction based on remaining 35%

# Risk: Likelihood and Consequences

Discriminant analysis:

Major versus minor pests



- Impact not useful for discrimination
- Major pests have higher Likelihood scores

% correct

Major 68

Minor 69

$P = 0.0002$

# Risk: Likelihood and Consequences

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Hypothesis:

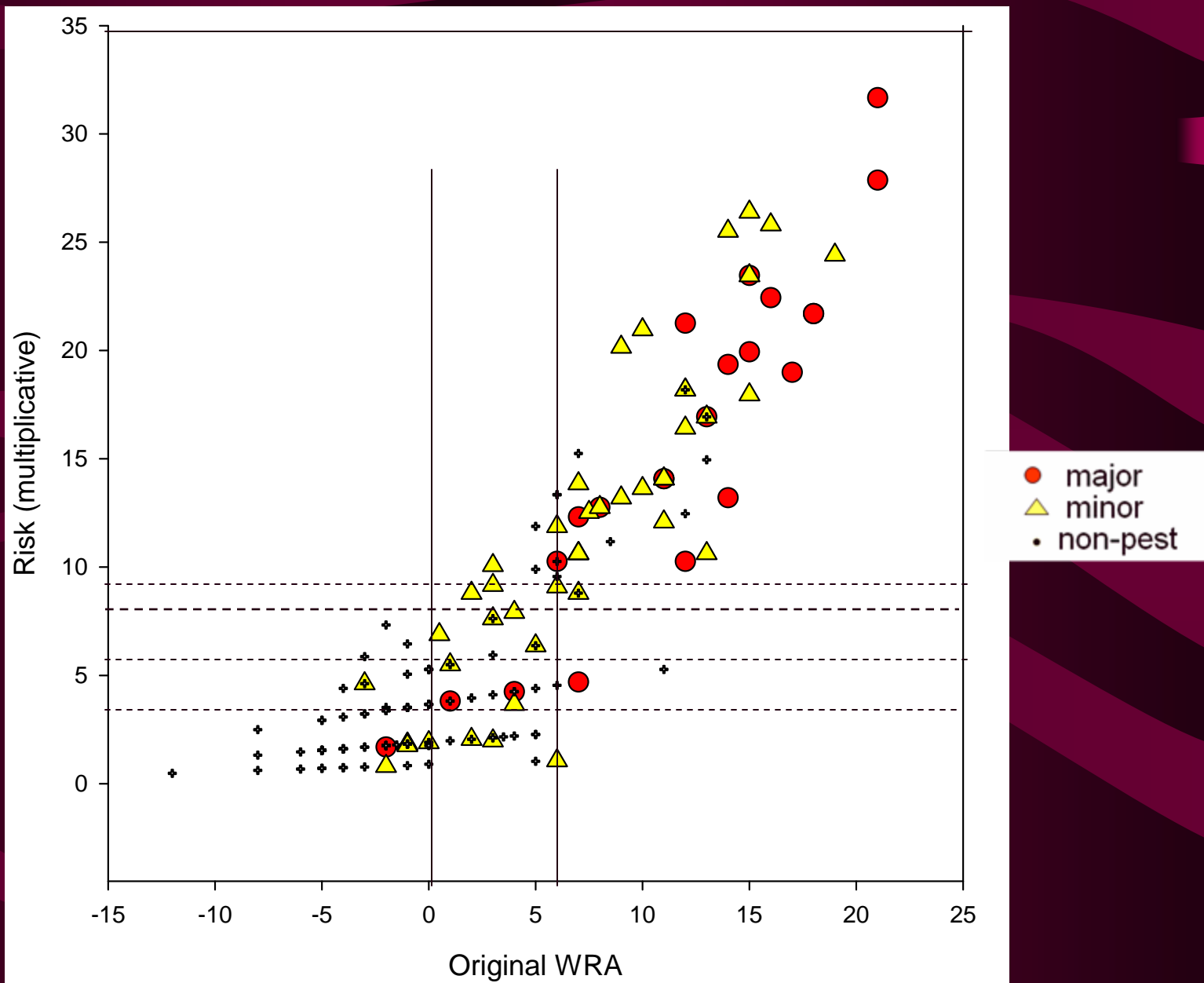
Reformatting the WRA score as

$$\text{Risk} = \text{Likelihood}(\text{consequences}) \times \text{Consequences}$$

Could:

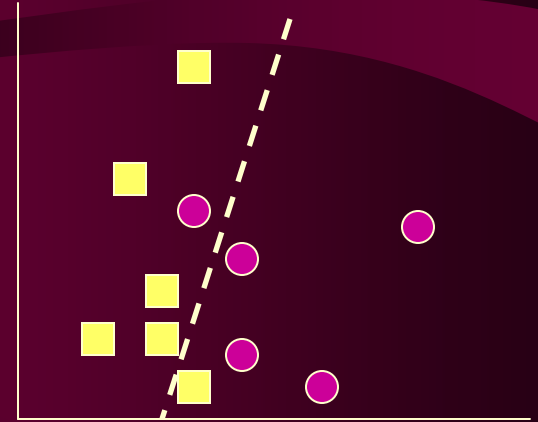
- Improve separation of pests and non-pests
- Reduce evaluate further category

# Original WRA scores versus Multiplicative Risk scores (LXC)



# Original WRA versus LxC

## Discriminant analysis



Identifies a discriminant function (“break-point”) that maximizes correct classification of *pre-defined* groups

Pests versus non-pests

No “evaluate further” category

- 65% of data used for training
- Prediction based on remaining 35%

# Risk: Likelihood and Consequences

## Discriminant analysis

	Percent correct predictions		
	WRA score	C*L(C)	C, L(C)
Pests	81.8	91**	87**
Non-pests	78.2	78.2	80.2
Overall	80.2	85.8	83.8

\*\*P<0.01

# Summary of issues



- Defining what we want to screen out



- Consistent and accurate answers to “weed elsewhere?”
- Narrowing the “evaluate further” category
- Formulation as  $\text{Risk} = \text{Likelihood} \times \text{Consequences}$

**Q: What is an invasive species?**

**A:** Invasive species are those which spread from human settings (gardens, agricultural areas, etc.) into the wild.

### Rod Randall's Big Weed List

**Q: What if a plant is... on this list?**

**A:** "...one of the best predictors of a plant's invasiveness in a specific area is whether it has been observed as being invasive in other areas ... So if a plant is included on this list (and especially if it is listed multiple times), it may be wise to consider the plant to be a potential invader.

"Arable Weeds of the World"

"USA Composite List of Weeds" (WSSA 1966)

"Western Australian Prohibited List"



# Issues

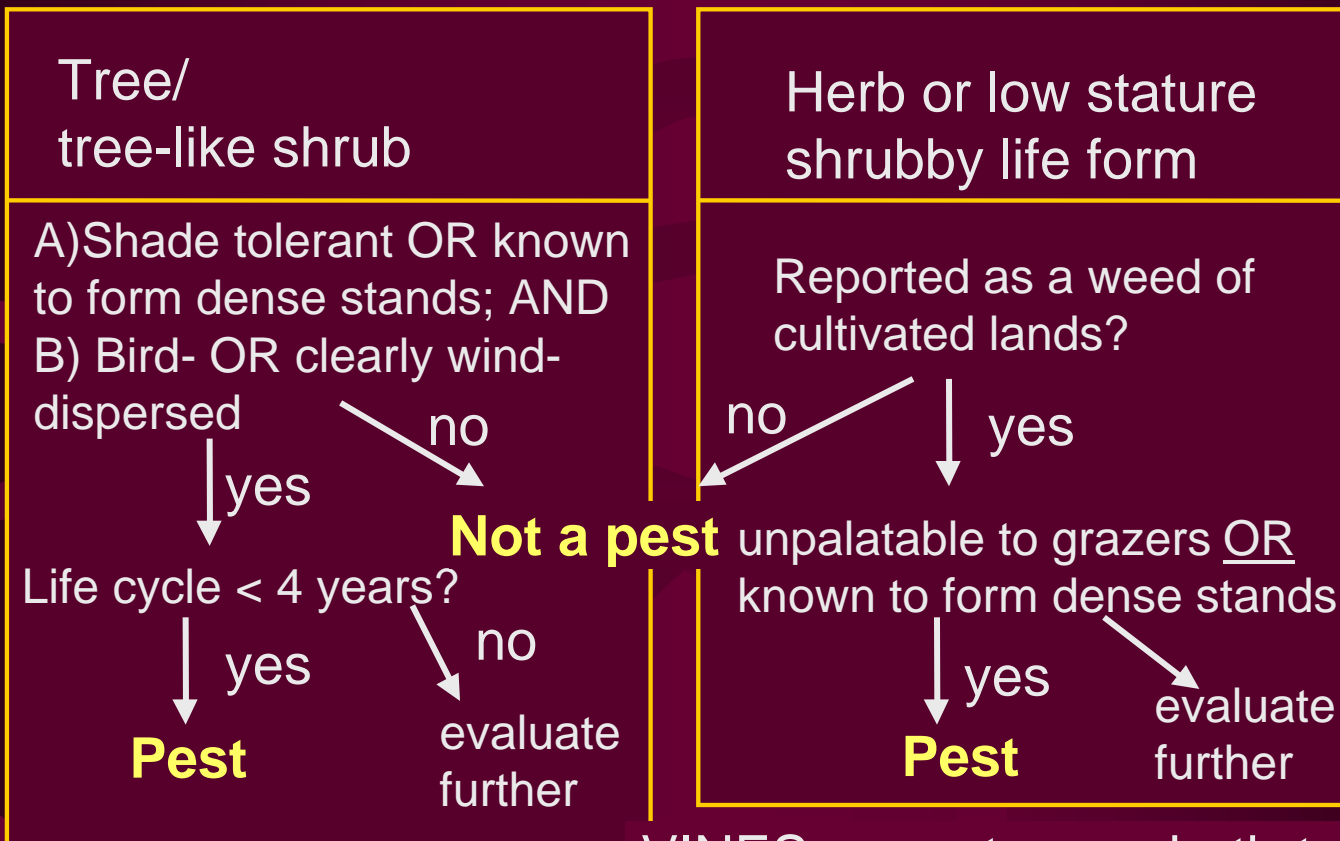
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“Your system is critically flawed”

Doesn't take into account

- Economic benefits
  - Cultural benefits
  - Health benefits
  - Ecological benefits
- Etc.

# Further assessment (species scoring between 1 and 6)



VINES -- must pass both tests

# Australia/New Zealand Weed Risk Assessment System

49 questions

- climate/distribution
- domestication
- weed elsewhere
- undesirable traits
- plant type
- reproduction
- dispersal
- persistence attributes

<b>Prediction</b>	
<b>Score</b> < 1	<b>not a pest</b>
<b>Score</b> 1-6	<b>evaluate</b>
> 6	<b>pest</b>

25-30% "Evaluate further"

# WRA decision versus expert classifications

## Native and/or managed ecosystems

	Major pests admitted (%)	Minor pests admitted (%)	Nonpests admitted (%)	Evaluate further (%)
H-WRA NO 2nd screen	5	26	66	24
H-WRA + 2nd screen	5	36	92	8
Pest elsewhere criterion alone	18	24	86	0