Australian Government
Department of the Environment and Water Resources

Using a Risk Assessment Approach to Manage Landscape Change

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Change vs Impact

- Change is a technical value judgment
- Impact is a social value judgment
- There is a right & wrong in a technical value judgment
- No right or wrong in a social value judgment if all views are respected & so valid

Why risk assessment ?

Uncertainty in NRM

- Society invests heavily in research & management of natural systems
- Yet the world is filled with spectacular failures in fisheries, forests, food & biodiversity - WHY?
- Main reason – task is DIFFICULT because of uncertainty
  - environmental variability
  - observation error
  - lack of essential system knowledge
  - human factor
- Worse than uncertainty itself - we tend to underestimate it

Risk assessment is about assessing the benefits & costs of a decision in the face of uncertainty

Coping with uncertainty

- **Soulé (1990) identified 3 key issues for conservation**

    1. **Effects of predictable & various chance events**
    2. **Time frame used in planning**
    3. **Degree of security sought**

- **First requires scientific solution, 2 & 3 are society value judgments (cultural, socio- economic & political dimensions)**

Managing landscape "health" on Kakadu NP involves managing risks in the face of uncertainty

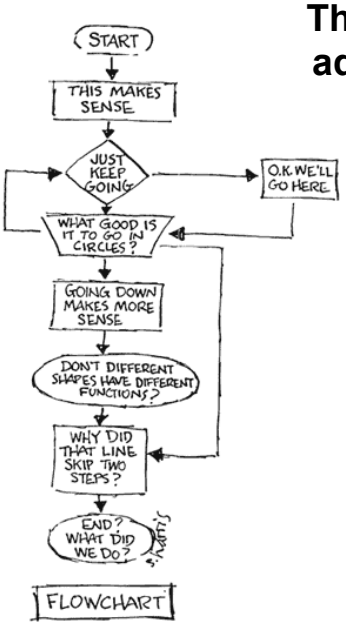
- **Multiple problems caused by multiple threats**
- **Key threats include**
    - **toxic contaminants from Ranger mine**
    - **invasive species**
    - **unmanaged fire**
    - **predicted climate change effects**
    - **infrastructure & developments**
    - **& so on**
- **Natural systems characterised by spatial & temporal**
    - **variability**
    - **complexity**
    - **uncertainty**
- **Only certainty is that managers need predictive tools such as ecological risk assessment & adaptive management**

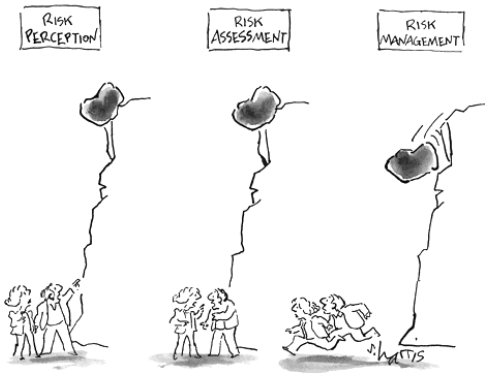
Ecological risk assessment principles

(Burgman 2005 – Risks & Decisions for Conservation & Environmental Management)

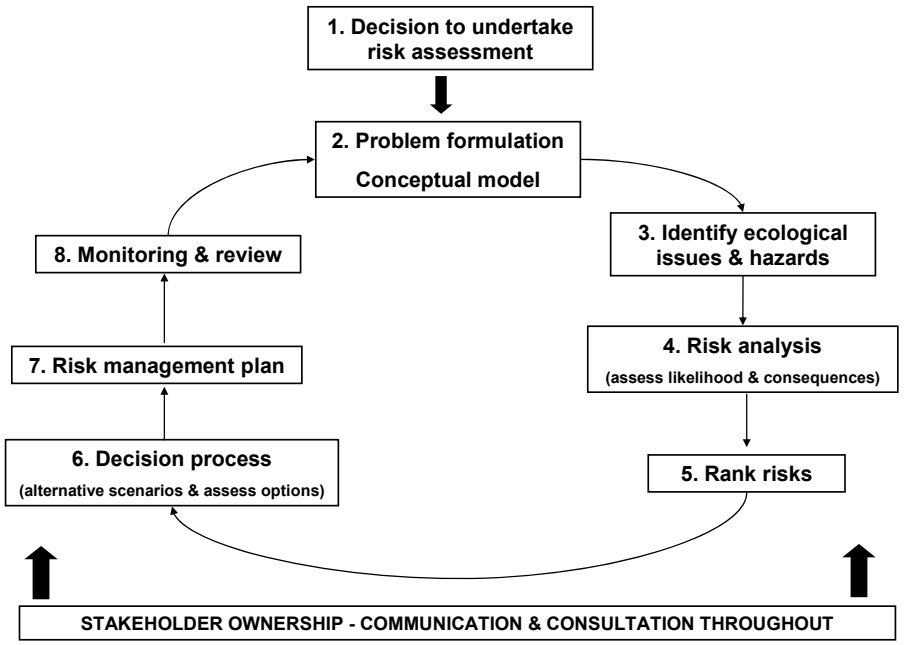
- Risk is the chance, within a time frame, of an adverse event with specific consequences.
- Risk assessment is about evaluating & communicating the nature and extent of uncertainty of adverse events.
- Assessments should be reliable, transparent & consistent.
- And guided at the outset by good conceptual models of how the world works.
- Always use a framework approach – a structured, systematic way of learning by doing.

The all too familiar trial & error ad hoc approach to managing risks



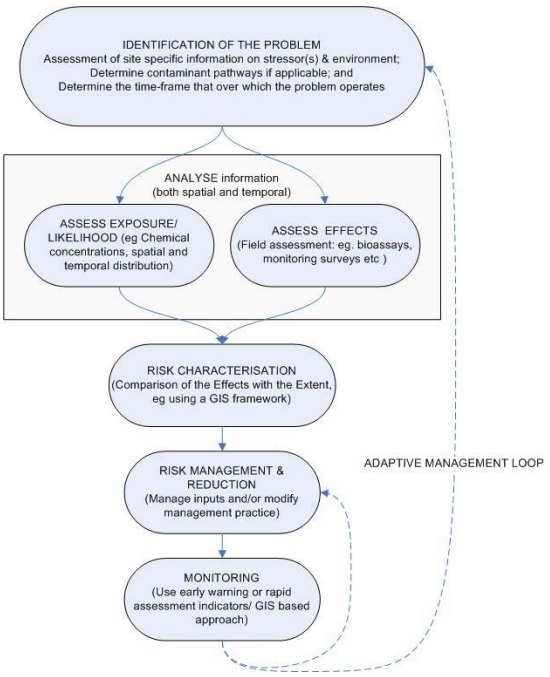


Risk assessment framework



STEP 1

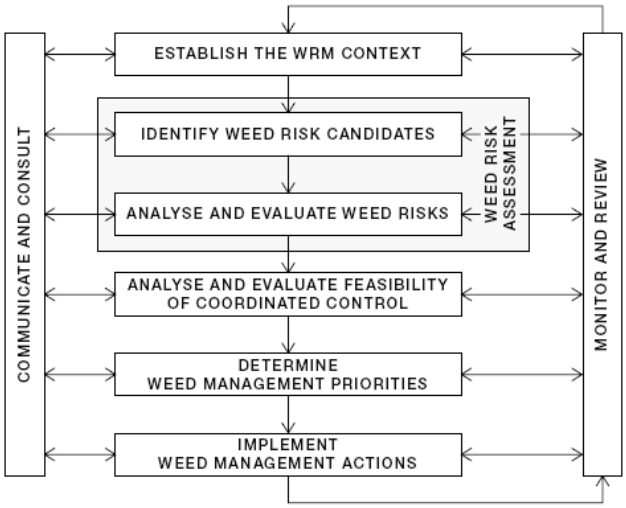
- **Undertake risk assessment? Yes or No?**
- **If Yes choose a framework.**



Ramsar wetlands risk assessment framework

Weeds risk management framework

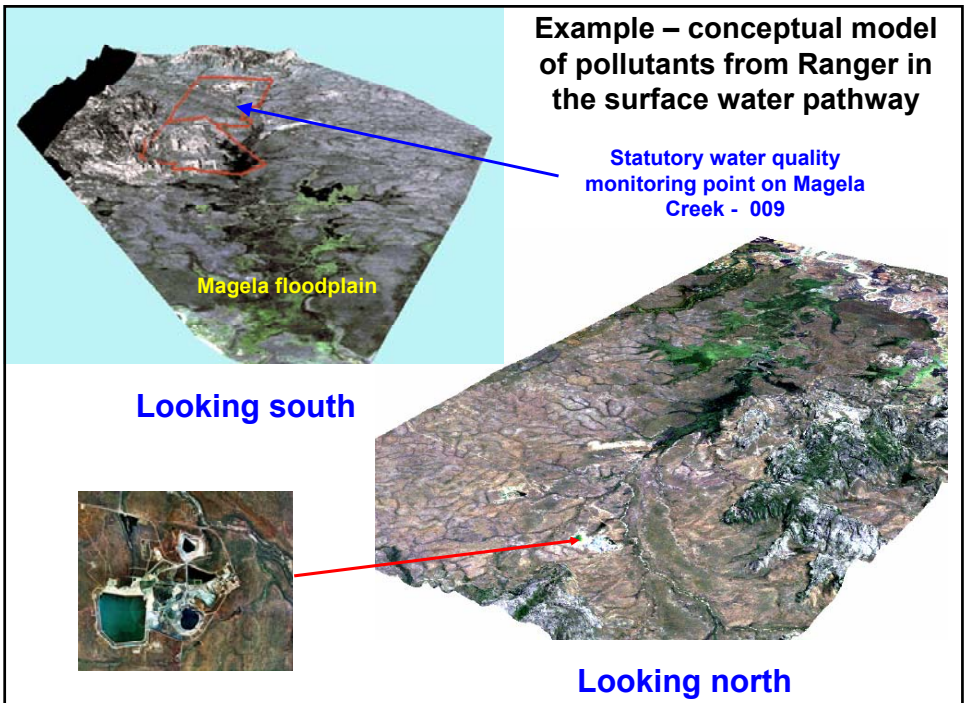
(Handbook National Post-Border Weed Risk Management Protocol)



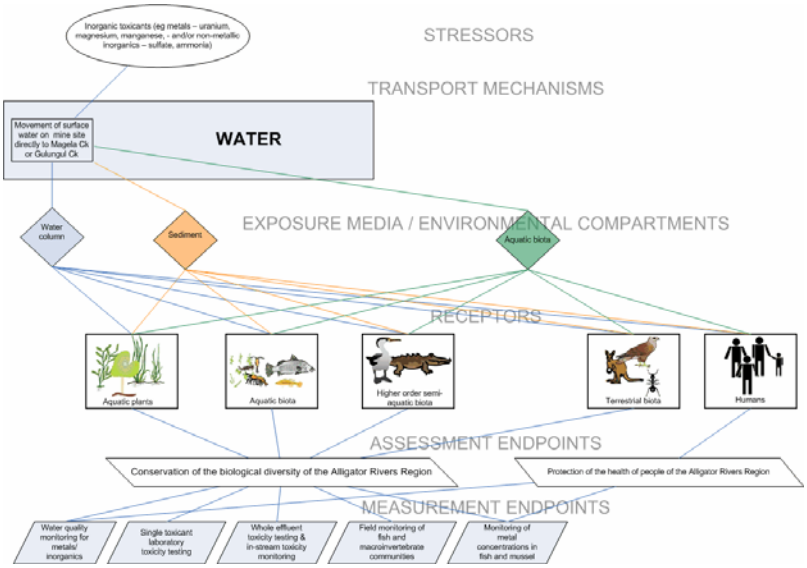
STEP 2

Clearly define the problem

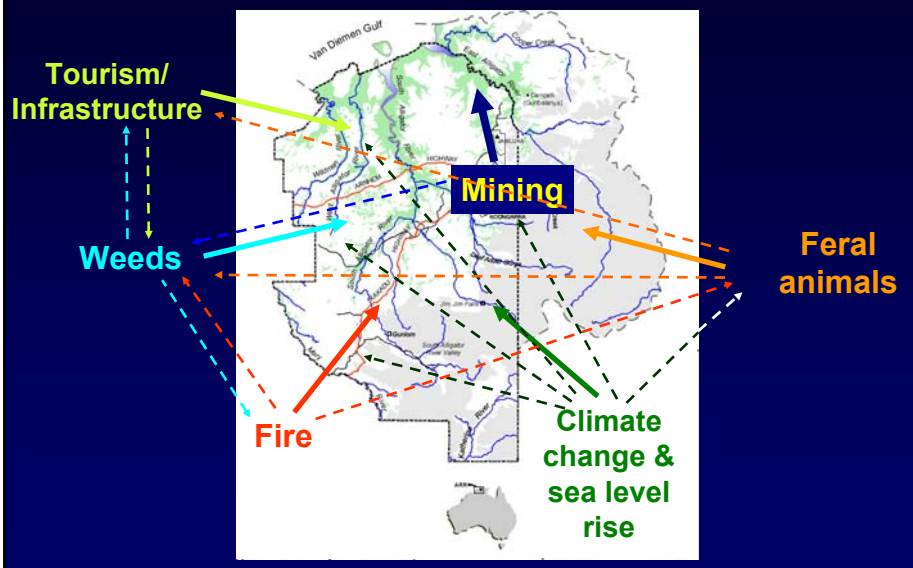
- Develop a conceptual model to identify the ecological issues and hazards.
- Identify assessment (objective) and measurement (performance) endpoints. For example:
  - maintenance of biodiversity (ecological endpoint)
  - % cover of mimosa on a wetland (measurement endpoint)
- Construct an assets & threats matrix to guide risk assessment – basically a one page check list.



Conceptual contaminants pathway model – Ranger U mine
SURFACE WATER PATHWAY

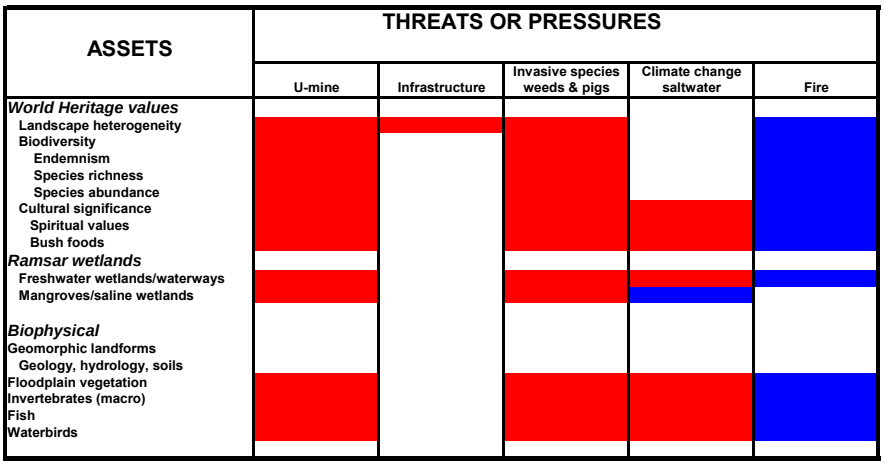


Conceptual model 'landscape" risks



LANDSCAPE "HEALTH or CONDITION"

Matrix of susceptible assets & threats (for SoE reporting)



STEP 3

Risk analysis

(assess likelihood & consequences of hazards)

- **If data poor undertake a qualitative ecological risk assessment and/or use "expert opinion".**
- **If data rich undertake a quantitative ecological risk assessment.**
- **But can combine both methods – e.g. in Bayesian Belief Networks.**

Qualitative risk measures (adapted from AS/NZS 1999)

Risk Matrix of consequences v. likelihood

Likelihood	Consequences				
	Insignificant (1)	Minor (2)	Moderate (3)	Major (4)	Catastrophic (5)
Almost certain (5)	5	10	15	20	25
Likely (4)	4	8	12	16	20
Possible (3)	3	6	9	12	15
Unlikely (2)	2	4	6	8	10
Rare (1)	1	2	3	4	5

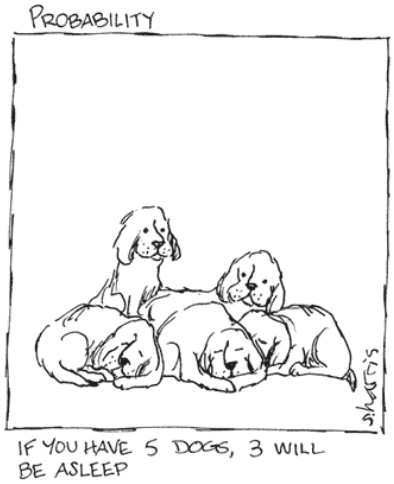
1 - 4 Low Risk
5 - 12 Moderate Risk
15 - 25 High Risk

Quantitative Ecological Risk Assessment

- Quantitative risk assessment is estimating the probability of an adverse event
- Two components of risk
- Basically a frequentist approach
  - Effects consequences of adverse event
  - Exposure likelihood of exposure to adverse event

Pr (Risk) = Pr (effects) x Pr (exposure)

Bayesian statistics – subjective belief
Conditional probability theory



STEP 4

- **Rank all risks – filter & prioritise.**
- **For landscape risks we recommend the semi-quantitative Relative Risk Model**
  - **spatially explicit and so friendly to stakeholders**
  - **uses basic GIS mapping data of assets & threats**
  - **suited to multiple threats to multiple assets**

RELATIVE RISK METHOD

Adapted from Walker et al. (2001) and Obery and Landis (2002)

Determine ecological assessment endpoints (assets) based on stakeholder input

↓

Describing the habitats and threats to be examined

↓

Develop conceptual model

↓

Identify & create risk regions

↓

Ranking of threats based on a 2-point scheme

↓

Ranking of habitats based on % of habitat in risk region

↓

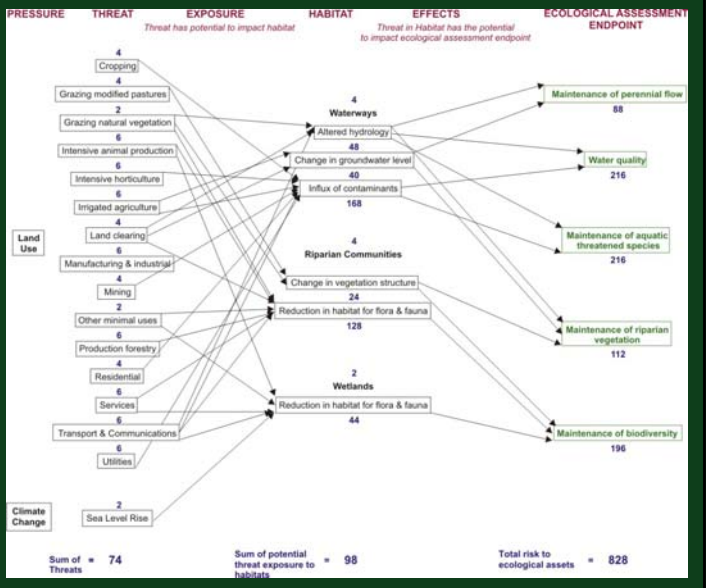
Relative Risk Calculations

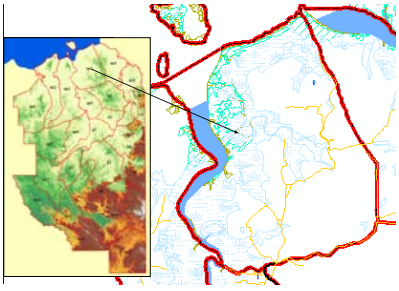
Example - calculating Relative Risk for Risk Region 9 Katherine River

Sum of Threats in Risk Region = Σ Threats

Sum of potential Exposure= Σ (Threat * Habitat)

Total Risk to End-point = Σ (Threat * Habitat)





Relative Risk Model is compatible with the SoMI for

Kakadu management regions

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Region Name: sa1 **District:** South Alligator

Area (km2)	949	Proportion of park (%)	4.7

1. Landscape

River Catchments

Sub Catchments
South Alligator Flood Plain(93%) East Alligator River(7%)

Geomorphology
Weathered Koolpinyah surface(59%) Coastal floodplains(40%)

Land Systems
Kay(30%) Cyperus(29%) Jay(15%) Knifehandle(7%) Littoral(6%)

Soils
kandosols(55%) vertasols(35%) hydrosols(6%) tenosols(4%)

Assets

Vegetation	km2	% region
Dry Monsoon Forest	0	0
Riparian Forest	0	0
Allosyncarpia Forest	0	0
Spring fed forest	3	0.3
Melaluca Open Forest	20	2.1
Other Melaluca Community	3	0.3
Sandstone Heath	0	0
Grassland/ Rock Platform	364	38.4
Open Woodland	9	0.9
Woodland	127	13.4
Open Forest Sparse	216	22.8
Open Forest Dense	50	5.3
Other Closed Forest	5	0.5

Wetlands	%	km2
Mangrove	1.9	18
Salt Flat	4.1	38
Seasonally Inundated	29.7	281
Swamp	3	28
Waterbody	0.2	1
Watercourse	5.5	52

Elevation (meters)	Average	Range
	15	78

8. Features of the Management Area

Features	Descriptor / General Statement
Visitors (Permit Areas)	Fishing South Alligator
Visitor (Special Permit)	
Visitors (General)	Restricted to SA River
Weeds	
Feral animals	
Cultural Resources	
Art and cultural sites	
Living areas	
Infrastructure	
Enterprises	
Access (roads etc)	

Assets

9. Threats and Risk 1 = low, 2 = moderate, 3 = high

Values	Threats (eg. weeds, feral animals, wildfire, salt water intrusion)	Risk (1-3)
Visitors		
Sacred sites		
Rock Art Sites		
Ecosystem function		
Living areas		
access		
biodiversity		
Other		

Threats

STEPS 5 - 8

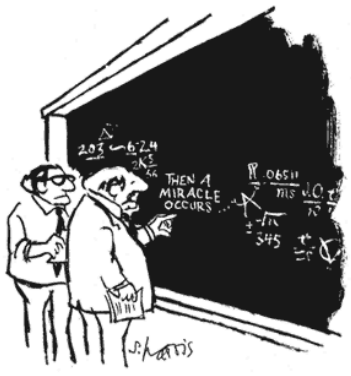
5. **Decision process** – use risk analysis to assess options based on best available information but where all uncertainties are explicit.
6. Implement or revise **Risk Management Plan** – good luck!
7. **Monitoring** – part & parcel of risk assessment process. Track performance of risk management plan via measurement endpoint.
8. Continuing **communications, consultation & review**.

Risk management principles

"HERE'S THE GROUND RULE: DON'T TELL ME WHAT I SHOULD HAVE DONE."

"'BE CAREFUL'! ALL YOU CAN TELL ME IS 'BE CAREFUL'?"

Caveats about knowledge & research data in risk assessment



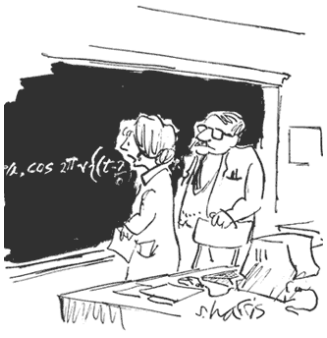
"I THINK YOU SHOULD BE MORE EXPLICIT HERE IN STEP TWO."

Caveats about knowledge & research data in risk assessment

- At some point more detailed knowledge incorporated into landscape ecology models used to assess risk just increases predictive error.
- Risk assessment at landscape scales often reduce to higher order knowledge anyway i.e. the stand back & look to the horizon approach.
- And, more often than not, social-cultural values about what is an acceptable risk.

Caveats about knowledge & research data in risk assessment

- Hence, "qualitative" risk assessments using best available knowledge about exposure, effects and socially acceptable levels of impact may suffice – i.e. they should not be viewed as second best to detailed quantitative risk assessments.



"IT'S AN EXCELLENT PROOF, BUT IT LACKS WARMTH AND FEELING."

Desired outcomes of Kakadu landscape workshop series within a risk assessment context

- Consolidated and accessible knowledge base to support informed and consistent management decisions.
- Identification of key knowledge gaps? Do we need more, less, something different or better ways to use what we have?
- Strategic directions for existing and new research, to enhance management programs aimed at the conservation of Kakadu's biodiversity and heritage values.
- Increased efficiency of current operational frameworks for managing natural & cultural resources on Kakadu NP.

How to contribute to ecological risk assessment process in this workshop

- Identify the conservation values and priorities for ecosystems within Kakadu's landscapes.
- Identify the pressures (or threats) on these ecosystems.
- Identify and prioritise management actions.
- Identify priority locations, habitats & species for monitoring.
- Identify standardised indicators & monitoring protocols.

Managing Landscape Risks Take Home Messages

- **Involves making choices**
  - how much management intervention at what cost ($)?
  - what benefit is delivered?
- **Challenge is to make choices that are**
  - sensible
  - pragmatic
  - defensible
- **Requires benefits & costs to be balanced**
  - much focus worldwide is on "activity-based" management
  - need to focus on "damage-based" mge within a budget
  - so need to embed socio-economics into risk frameworks

Role of Presenters

- Summarise current knowledge relevant to Kakadu National Park management objectives in current Plan of Management, highlighting new findings.
- Identify the main threats to landscape health.
- Suggest how these threats can be managed to maintain and/or restore a resilient and healthy landscape.
- Identify the remaining key knowledge gaps for effective management.

Role of Workshop Facilitators & Participants

Address the focus Park management questions by:

- **Considering the issues, questions & recommendations posed by landscape presenters.**
- **Identifying what questions managers & Traditional Owners want answered to help guide future research and management.**
- **Reviewing how identified threats are currently being managed and at what cost (environmentally & budgetary).**
- **Making suggestions for improvement.**
- **Identifying additional key knowledge gaps needed for effective resource management.**