Indicators & EBFM in Australia

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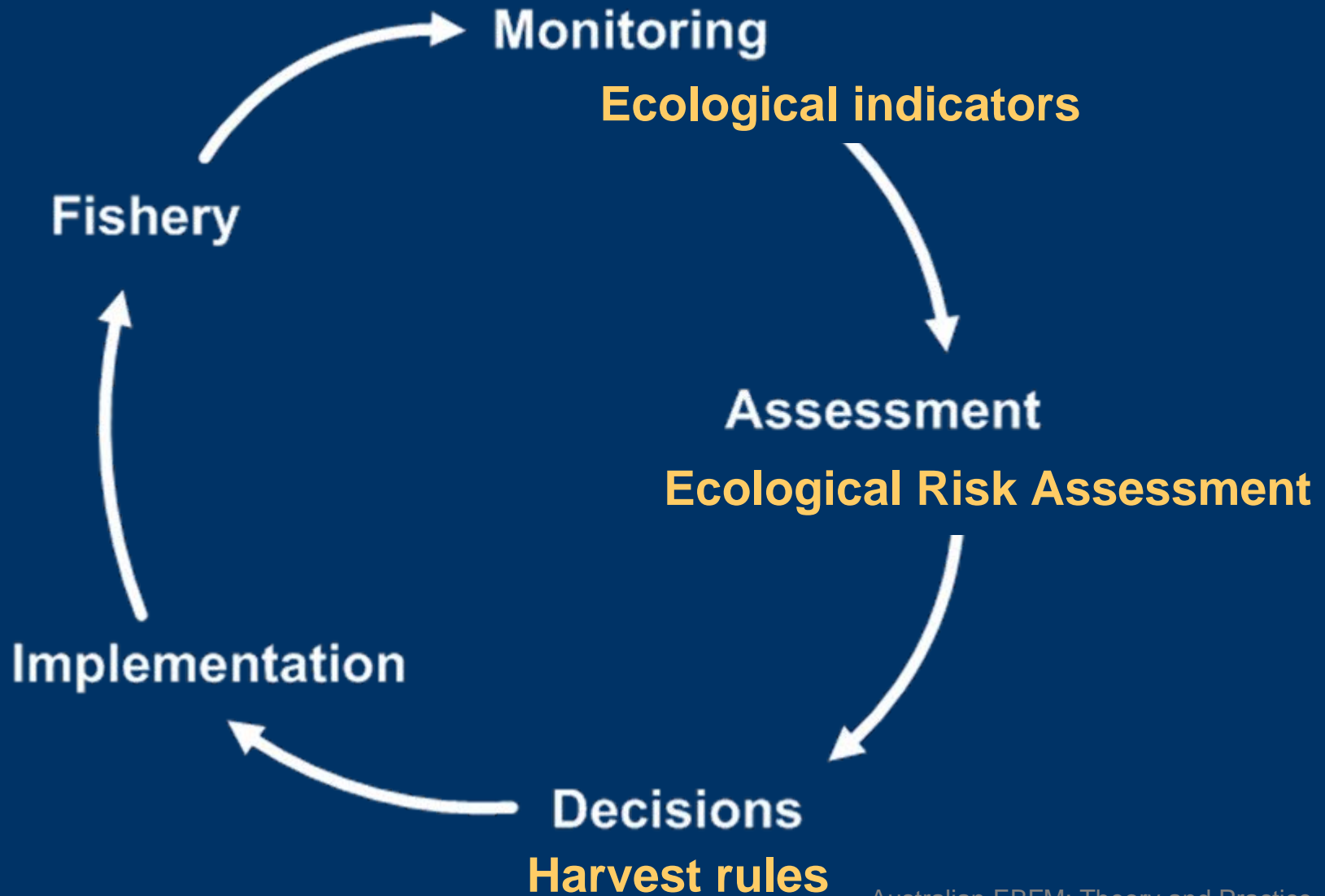CSIRO Marine and Atmospheric Research

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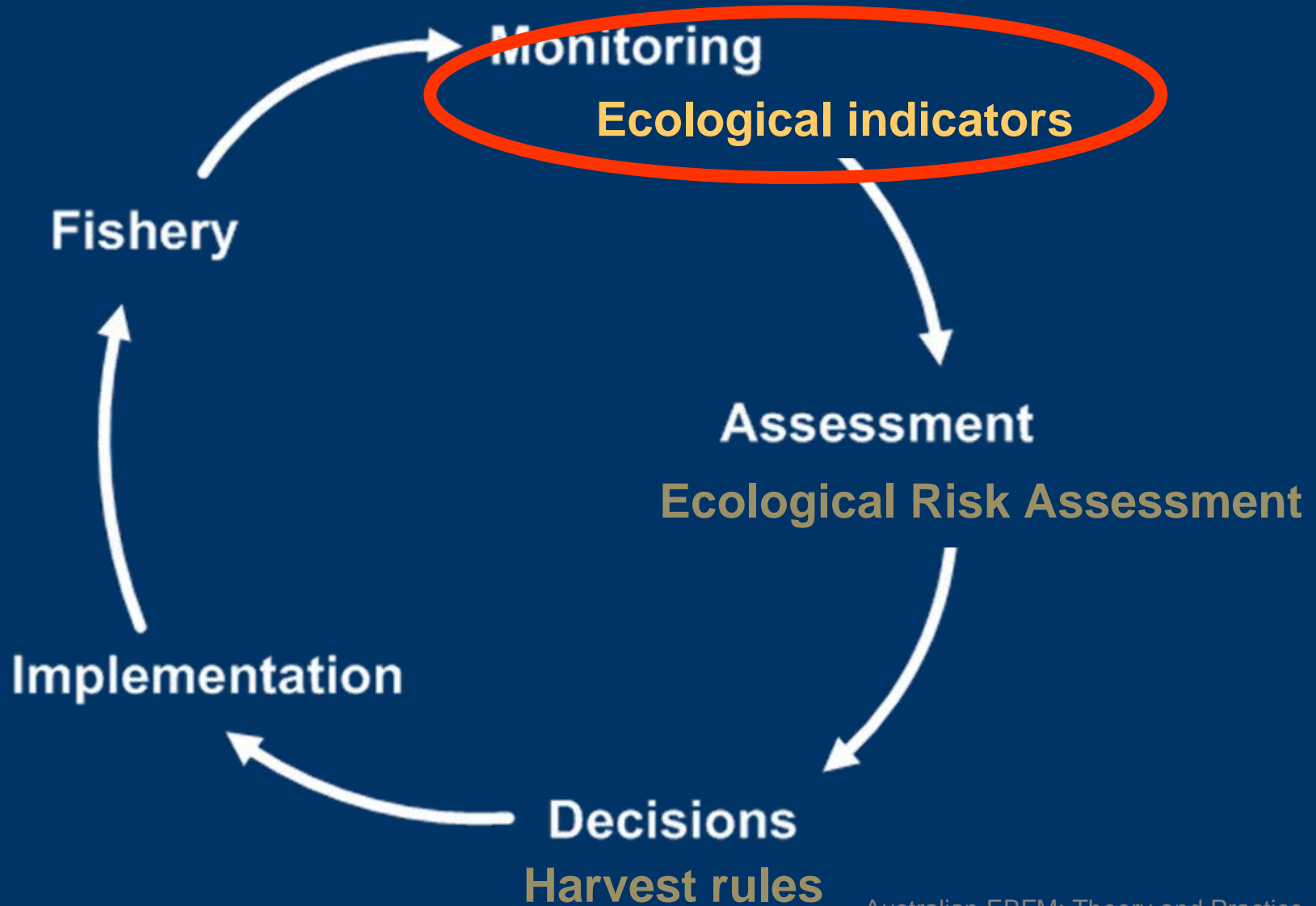- Campbell Davies

Tools Needed For EBFM

- Legislation requires assessment of fisheries impacts on the environment (e.g. in Australia)

  — fisheries management acts

  — EPBC (endangered, protected and biodiversity)

- Focus = developing reliable tools

  — targeted different points in Adaptive Management Cycle

Tools For EBFM

Monitoring
Ecological indicators

Fishery

Assessment
Ecological Risk Assessment

Implementation

Decisions
Harvest rules

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Australian EBFM: Theory and Practice

Indicators – General Properties

- Good indicators

  — easily measured and understood; cost effective

- Need a suite (no single indicator) as indicator performance may differ with

  — indicator performance can differ with ecosystem, history of exploitation, other pressures, quality of data

  — cover species: with fast turnover rates (potential early warning), targeted by fisheries, habitat defining, sensitive (often "integrating")

  — multiple spatial and temporal scales

  ► best combination of signal detection + system state

Current Aussie Indicators

Relative Biomass

  Gelatinous zooplankton

  Cephalopods

  Planktivores

  Scavengers

  Demersal fish

  Habitat forming epifauna (cover)

  Piscivores

  Top predators

Biomass ratios

  Piscivore : Planktivore

  Pelagic : Demersal

  Infauna : Epifauna

Size structure (% big) & spectra

Maximum length of catch

CPUE

B and F estimate (coordinated)

Habitat-Fisheries Overlap

Diversity (counts)

Size at maturity (weight & length)

Biophysical (Chla, ^{o}C)

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Relative Biomass

⭐ Gelatinous zooplankton

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⭐ Planktivores

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⭐ Habitat forming epifauna (cover)

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Piscivore : Planktivore

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Size structure (% big) & spectra

Maximum length of catch

✚ CPUE

✚ B and F estimate (coordinated)

✚ Habitat-Fisheries Overlap

⭐ Diversity (counts)

Size at maturity (weight & length)

⭐ Biophysical (Chla, ^{o}C)

⭐ Survey / Strategic
⭐ Other
✚ Tactical
☐ Research / Future

Australian EBFM: Theory and Practice

Indicator Collection and Use

- Data collection

  — dedicated fisheries independent surveys (beginning)

  ▶ characterising the system (cost effectively)

  ▶ acoustics

  — in collaboration with industry

  ▶ observers

  ▶ fisherman as data collectors

- Indicators will be (beginning to be) used

  — for performance reporting vs management objectives

  — in feedback decision rules

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Ecological Risk Assessment

- Hobday *et al* (2004)

    — so far use existing data (e.g. swath mapped habitat; acoustics-based biomass estimates of various groups)

    — + expert knowledge

    — identify main hazards target, by-product, bycatch, PET species, habitats, communities

    — consider probability property of the system changes beyond acceptable limits
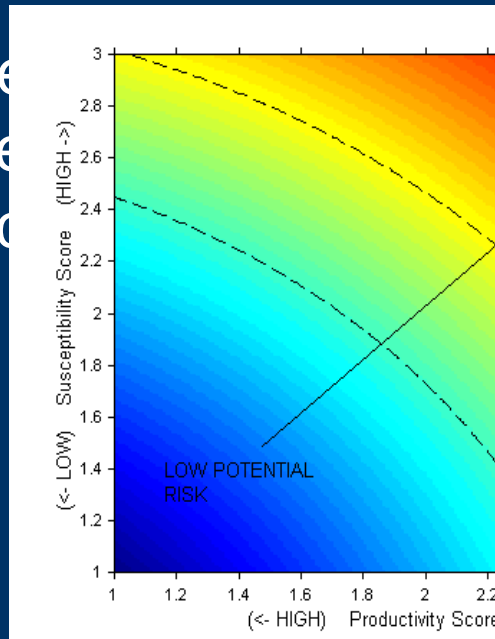
Ecological Risk Assessment

Australian EBFM: Theory and Practice
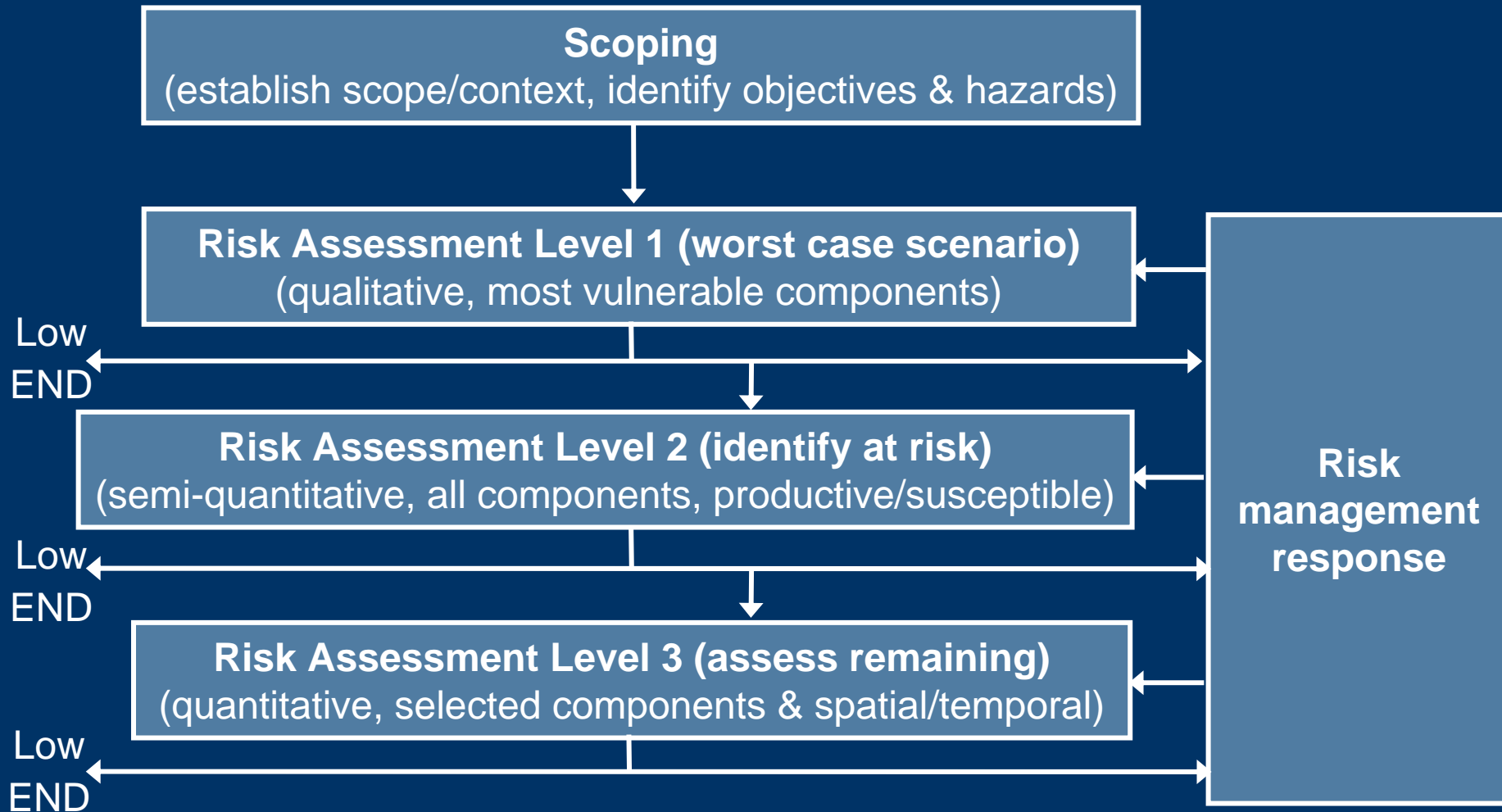
Ecological Risk Assessment

- End results

  — susceptibility plots

  — identify research gaps and major threats

  — allows conside[...]
 fisheries & unde[...]
  management s[...]
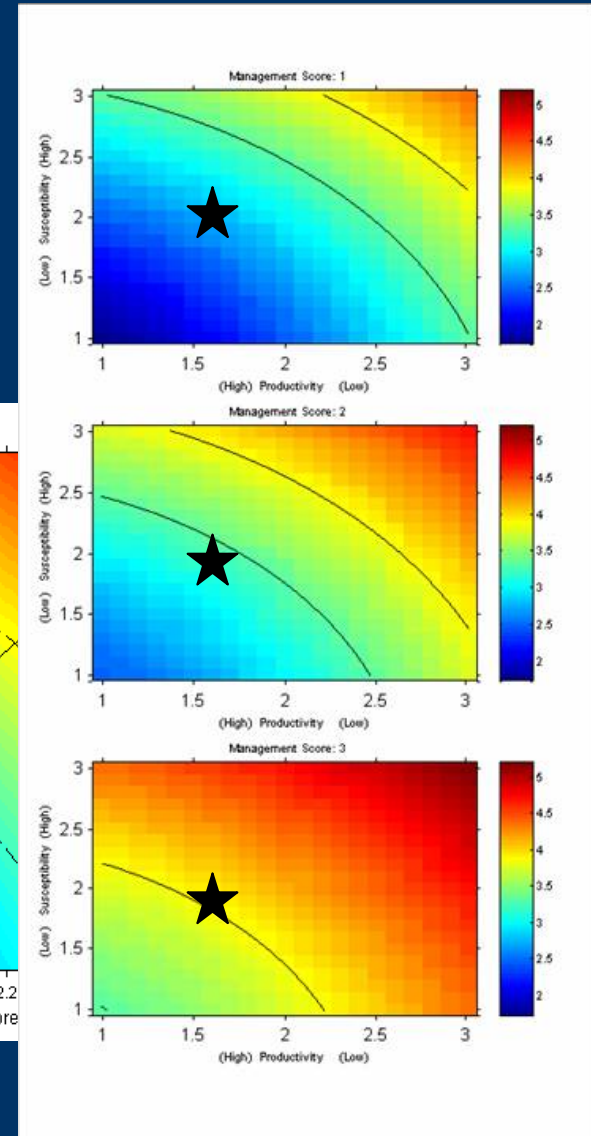
Ecological Risk Assessment

- Status

  — initial level 1 (and 1.5) done for all federal fisheries (32+ fisheries)

  — all new fisheries will be assessed

  — periodic updates and extension = standard practice

  — methods being refined

  — = method of turning detailed indicators into prioritised list across species and communities

- Likely spatial management will be easiest method of covering as many highlighted issues as possible cost effectively
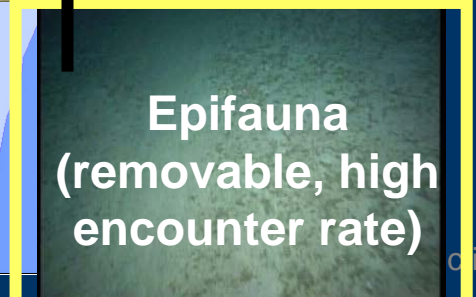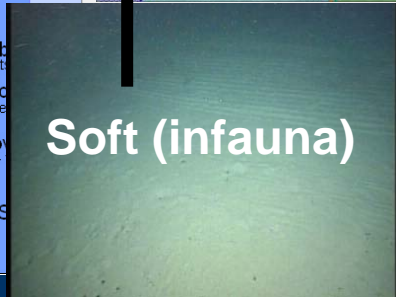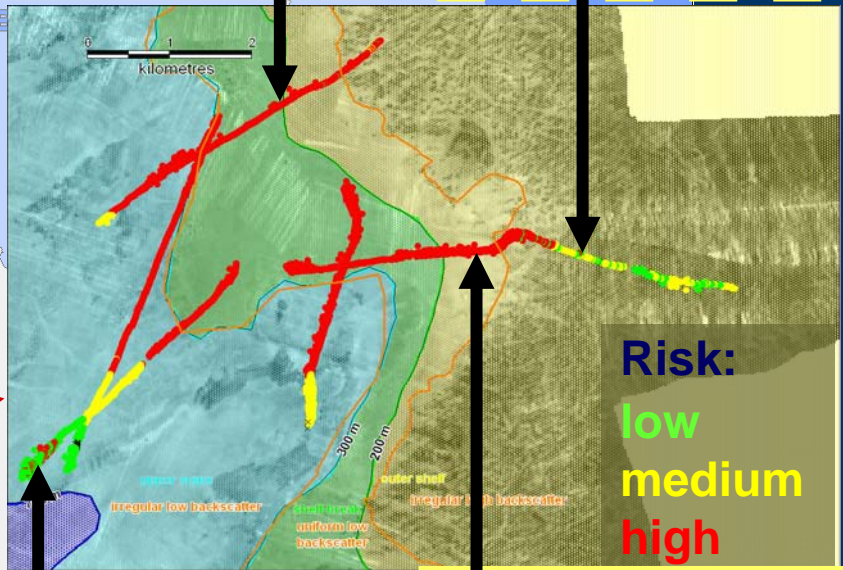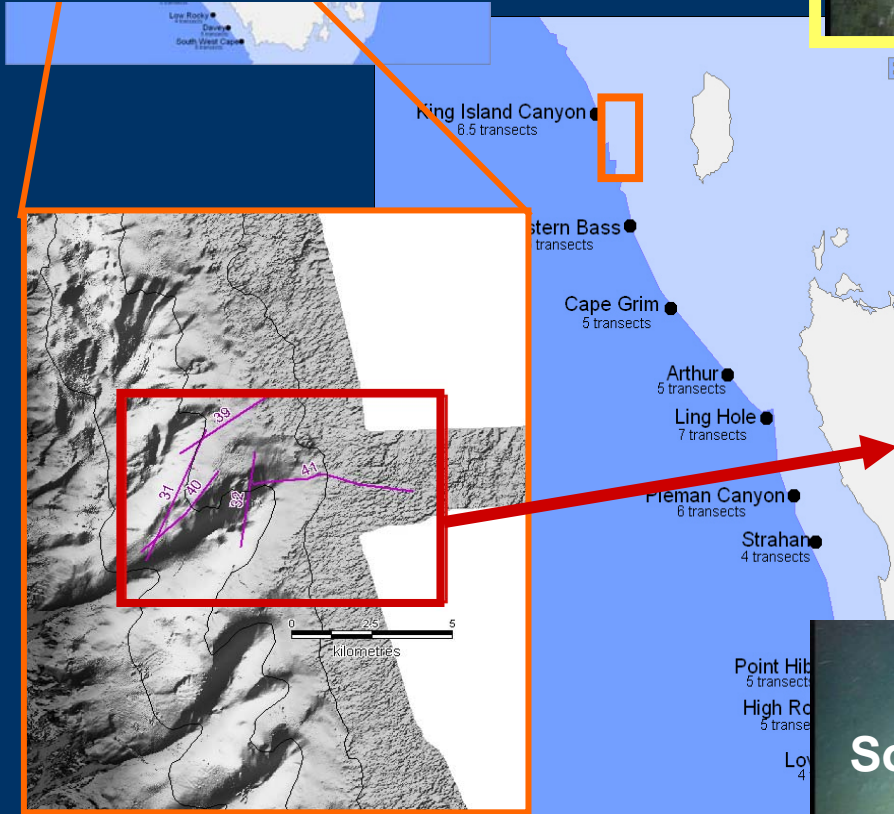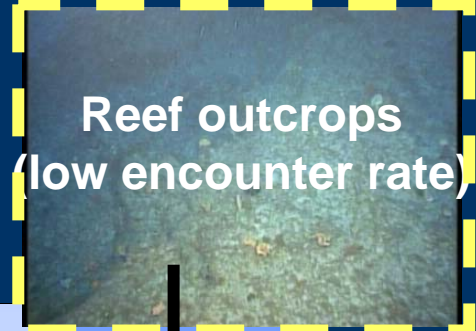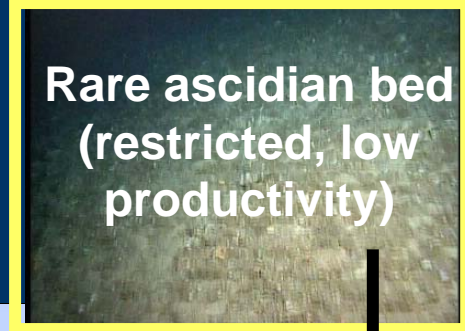
Ecological Risk Assessment

- Characterisations being used to advise management decisions

— e.g. overlap of fishing grounds and vulnerable habitat types
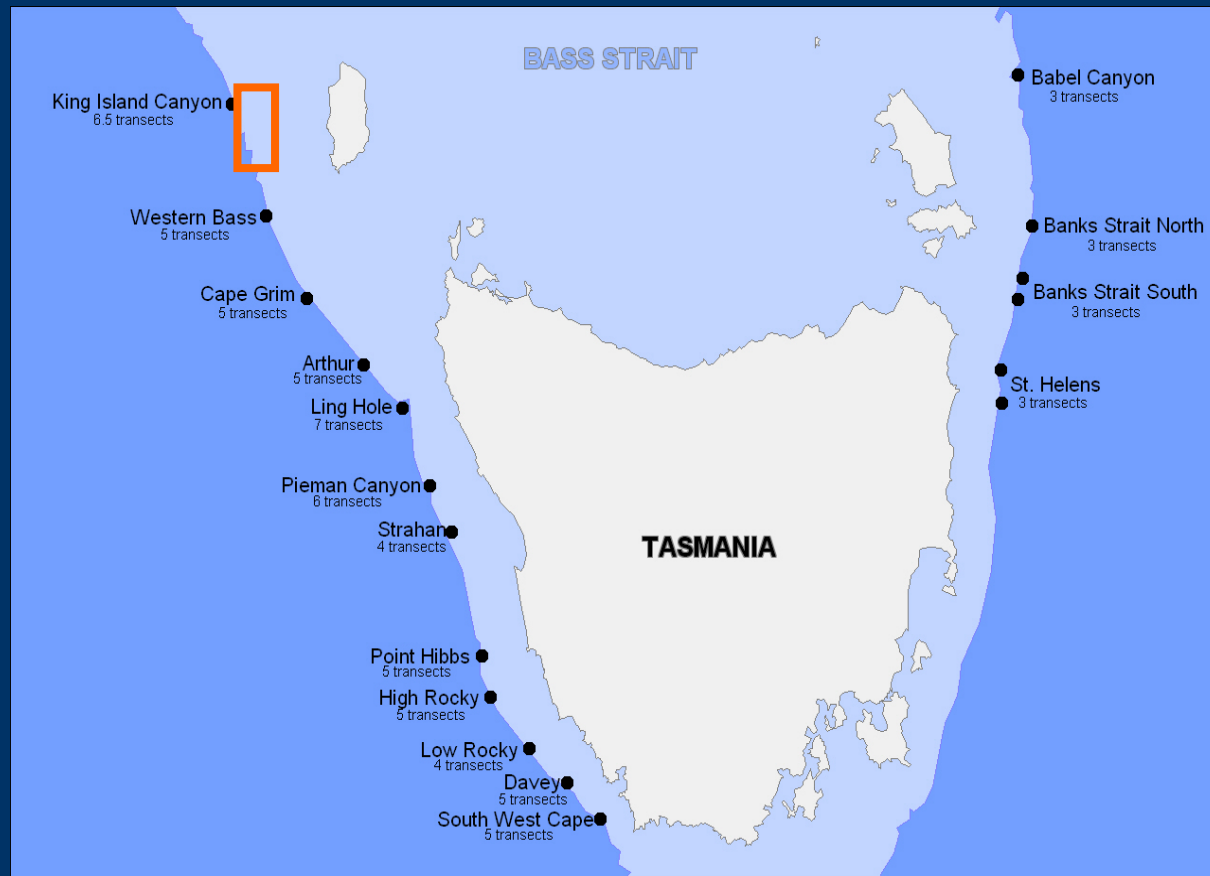
Habitat Overlap Assessment

- **Essential (deep water target) fish habitat tends to be in vulnerable areas**

Rare ascidian bed (restricted, low productivity)

Reef outcrops (low encounter rate)

Risk:

low

medium

high

Soft (infauna)

Epifauna (removable, high encounter rate)

Fine and Intermediate Scale Zones

'hard steep bottom' targeted by trap

Mid-depth Video System
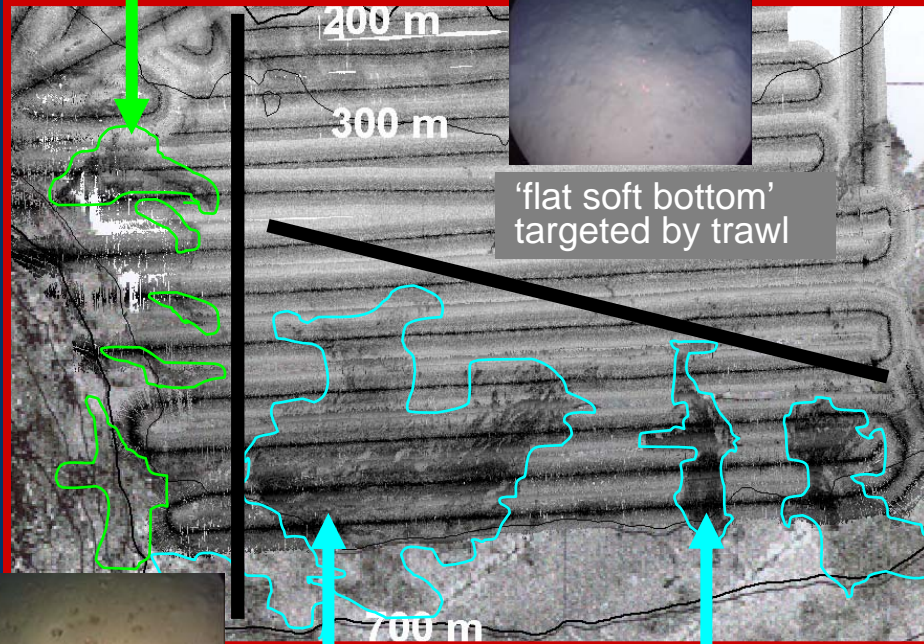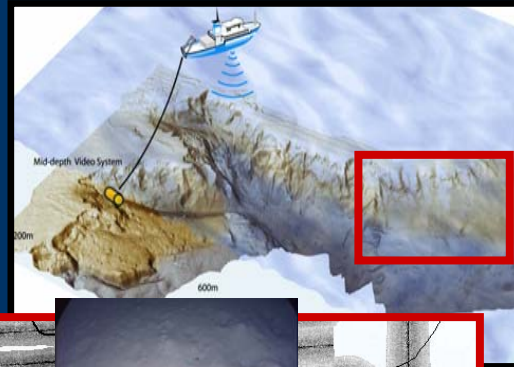
'flat soft bottom' targeted by trawl

400 m

300 m

700 m

'hard bottom' targeted by long-line

- **Acoustic and photo habitat classification**

- **Intermediate scale (100s sq km):**
  - **spawning aggregations**
  - **remnant populations (gulpers)**
  - **conserving areas of fishery habitat**
  - **performance reporting**

- **Fine scales (m to km) relevant to:**
  - **understanding habitat role**
  - **impact assessment**
  - **boundary placement (fishery habitat + surveillance buffers)**

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Harvest Rules

- Clear decision rules needed (by legislation now implemented)

  — standardised (precautionary) harvest strategies

  — tiered determination of recommended catch (RBC):

    ► Tier 1: Robust quantitative assessment ➔ $RBC(F_{40}, B_{cur})$

    ► Tier 2: Quantitative assessment ➔ $RBC(F=M, B_{cur})$

    ► Tier 3: M and F estimates ➔ $RBC(\alpha * C_{cur} \mid F \text{ vs } M)$

    ► Tier 4: Catch trends ➔ $RBC = (1 + \alpha * C_{slope}) * C_{cur}$

  — TAC set based on RBC (and discarding, multispecies catch composition)

  — ERA ~ Tier 5

Harvest Rules

- Squeeze F based on reference points and level of knowledge
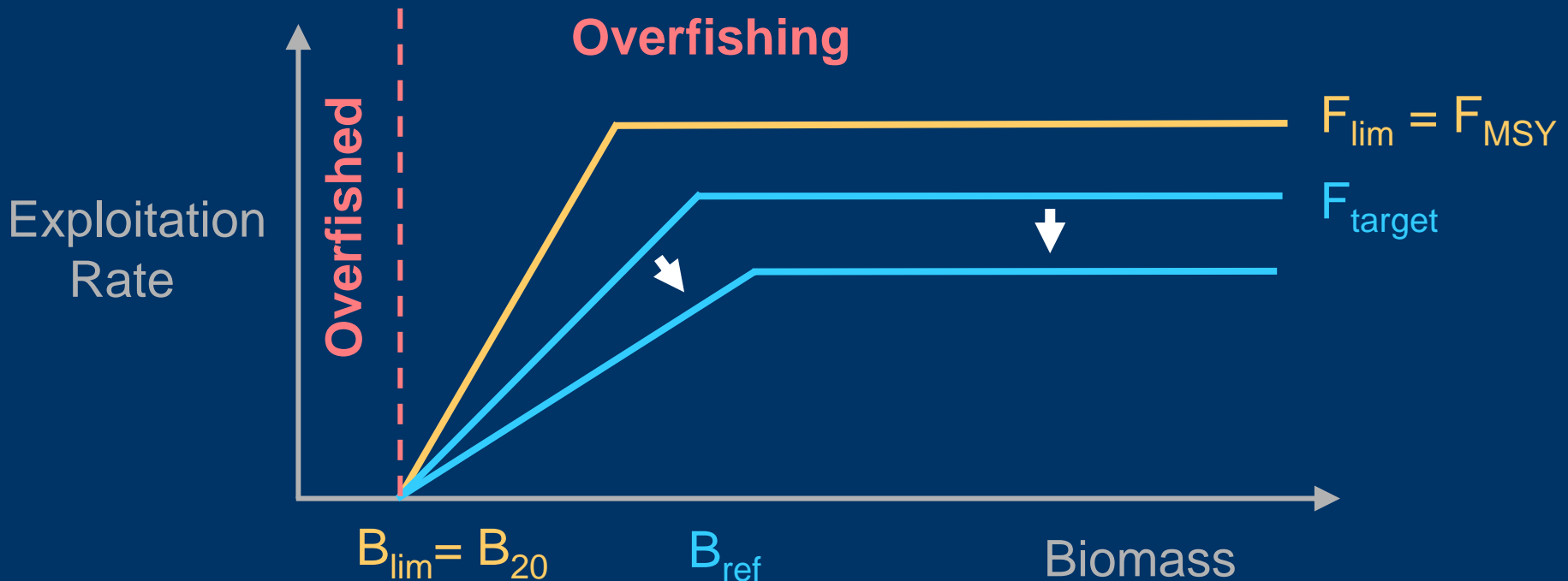
- New introduction so currently target only, but eventually similar method applied more broadly (e.g. bycatch too)

Aussie Indicators in Practice

- Still under development (MSE testing)

- Value of data collection has been recognised (surveys have begun)

- Tactical management will still involve single species assessments (e.g. harvest rules start there)

- ERA = strategic, but can focus more tactical actions too

  — pragmatic researchers are seeing value of qualitative tools (and straightforward use of "unmolested" data)

- Indicators also strategic, but put tactical management in context (check for wider unanticipated effects)

Aussie EBFM in Practice

- Still under development tool wise, but sector management structure in place

- Beyond ecology

  — integrated across sectors ultimately (new institutions needed?)

  — ecological focus in talk, but socio-economics explicitly considered too (costs, revenue, access, stability etc)

- Stakeholders in from the ground level

  — Industry, NGO, management, scientists, economists etc all on advisory councils and assessment groups

  — ownership has eased the path somewhat (e.g. collaborations)