Integrated Landscape Monitoring:

Lessons Learned from the UK, Norway, USA, and Canada

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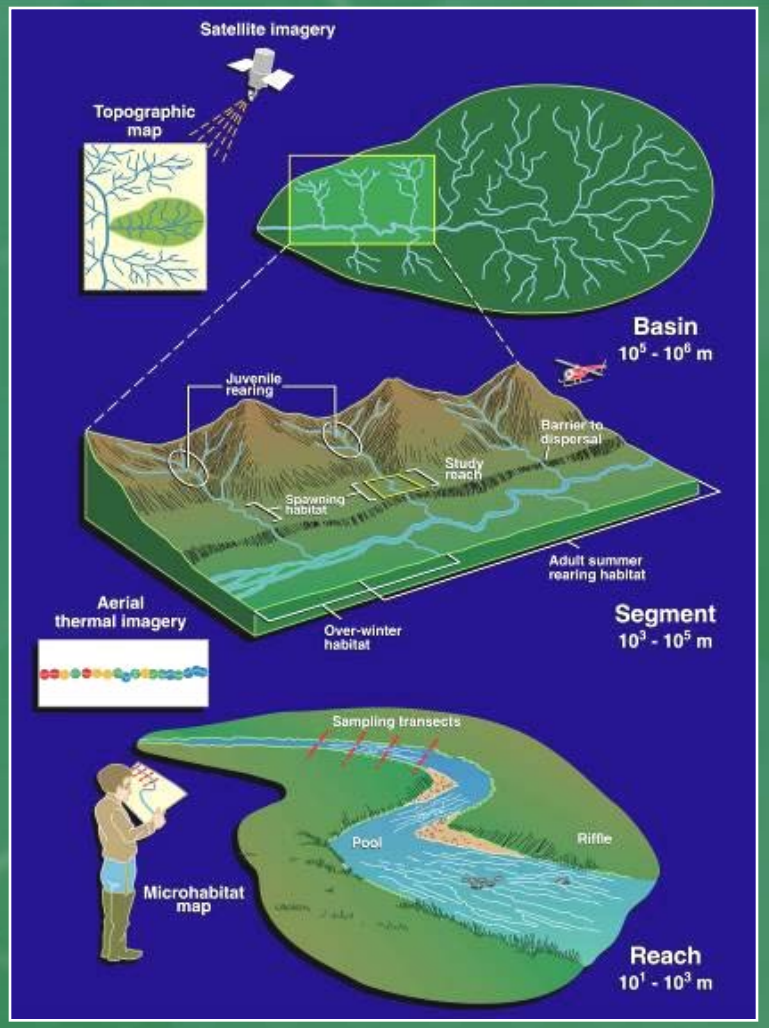
Questions

- What ecosystem components should be monitored?
- How should resources be allocated to best support decision-making?
- How should scale(s) be determined?
- How can landscape patterns be related to ecological responses?

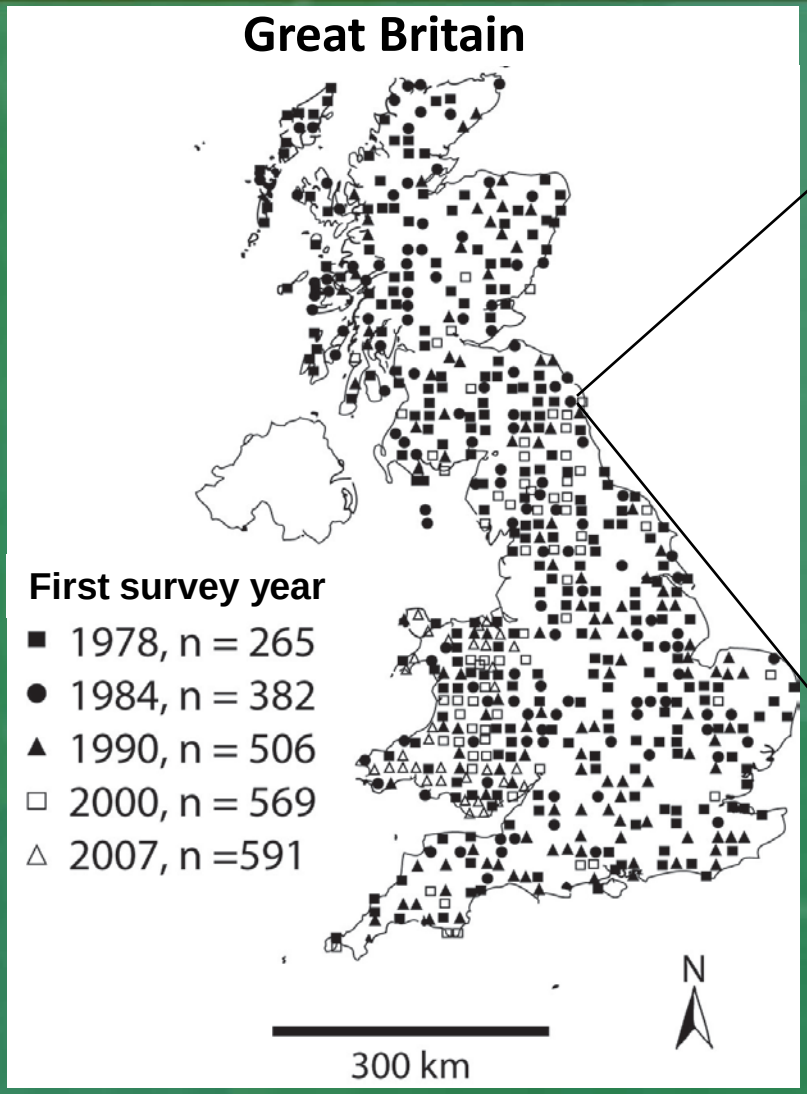


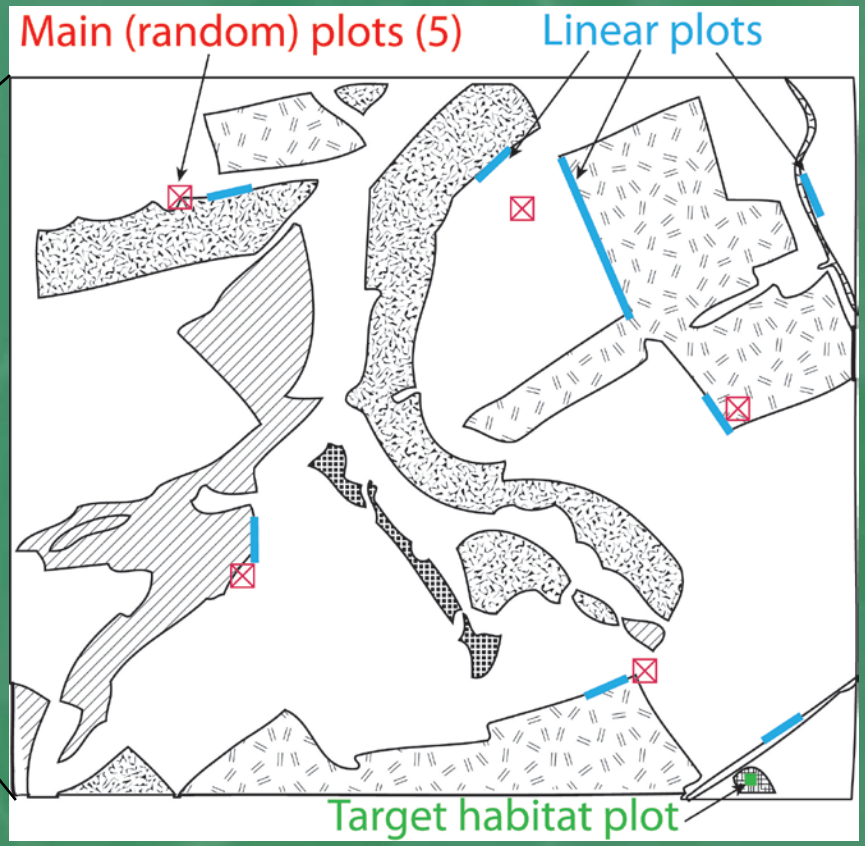
(Fausch et al. 2002)

Programs

- Countryside Survey – Great Britain/UK
- 3Q Programme – Norway
- Environmental Monitoring and Assessment Program – US EPA
- Ecological Monitoring and Assessment Network - Canada

Countryside Survey – Field Survey





Countryside Survey

Digital mapping in the field

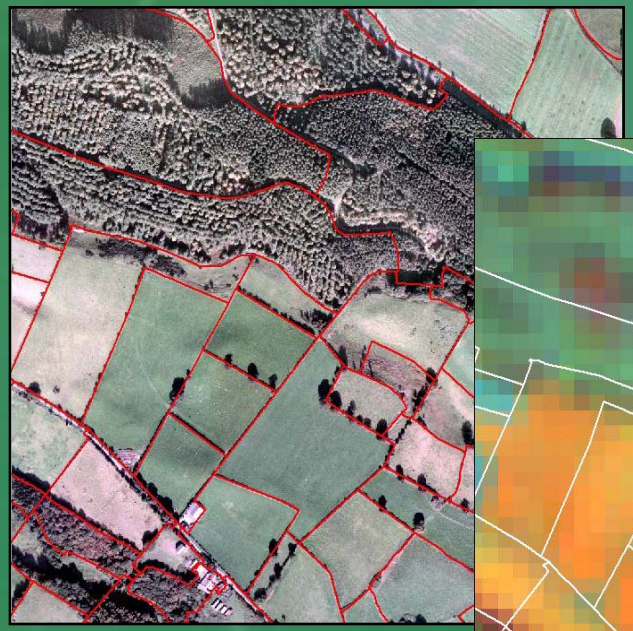
18 teams,
4 surveyors,
~4 days/square

Vegetation, freshwater habitat, breeding birds, and soil quality

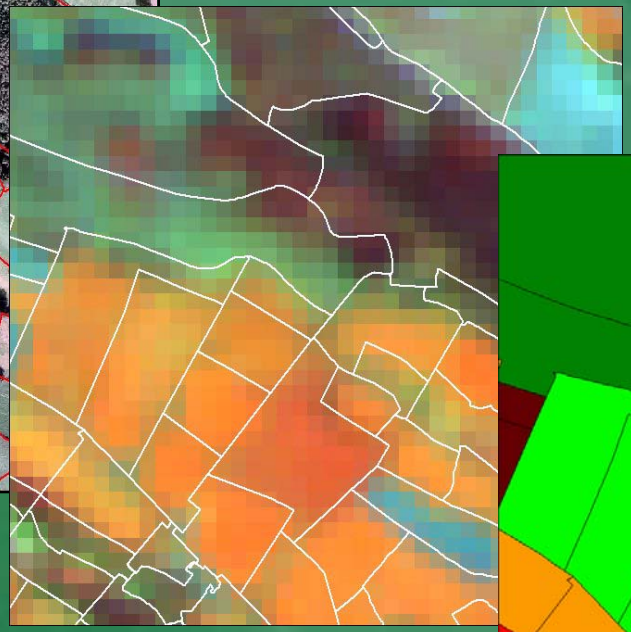
Countryside Survey

CEH Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

Countryside Survey – Land Cover Map



AP & generalised OS MM



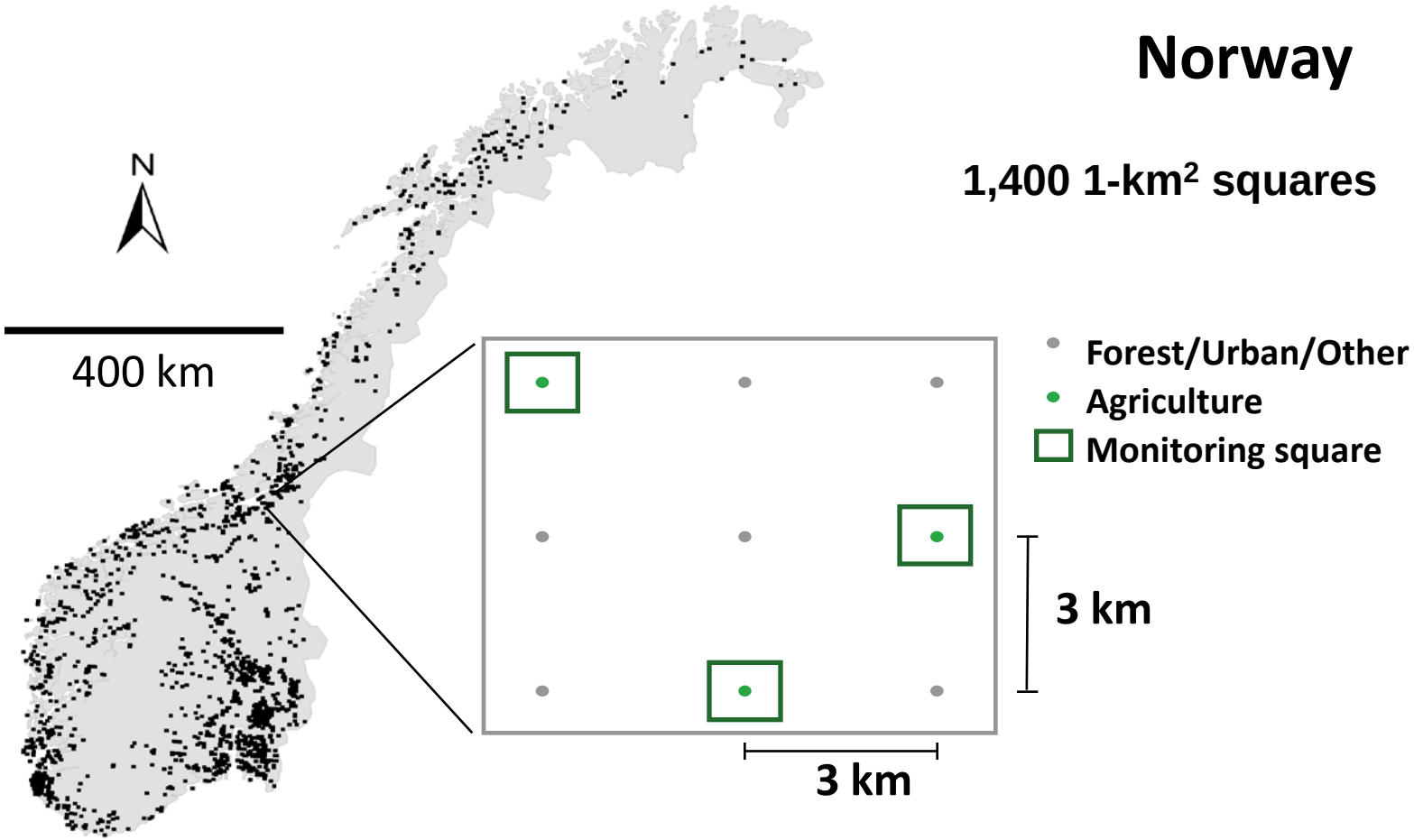
Satellite image & generalised MM

Classified generalised MM (LCM2007)

Countryside Survey

(Smith 2008)

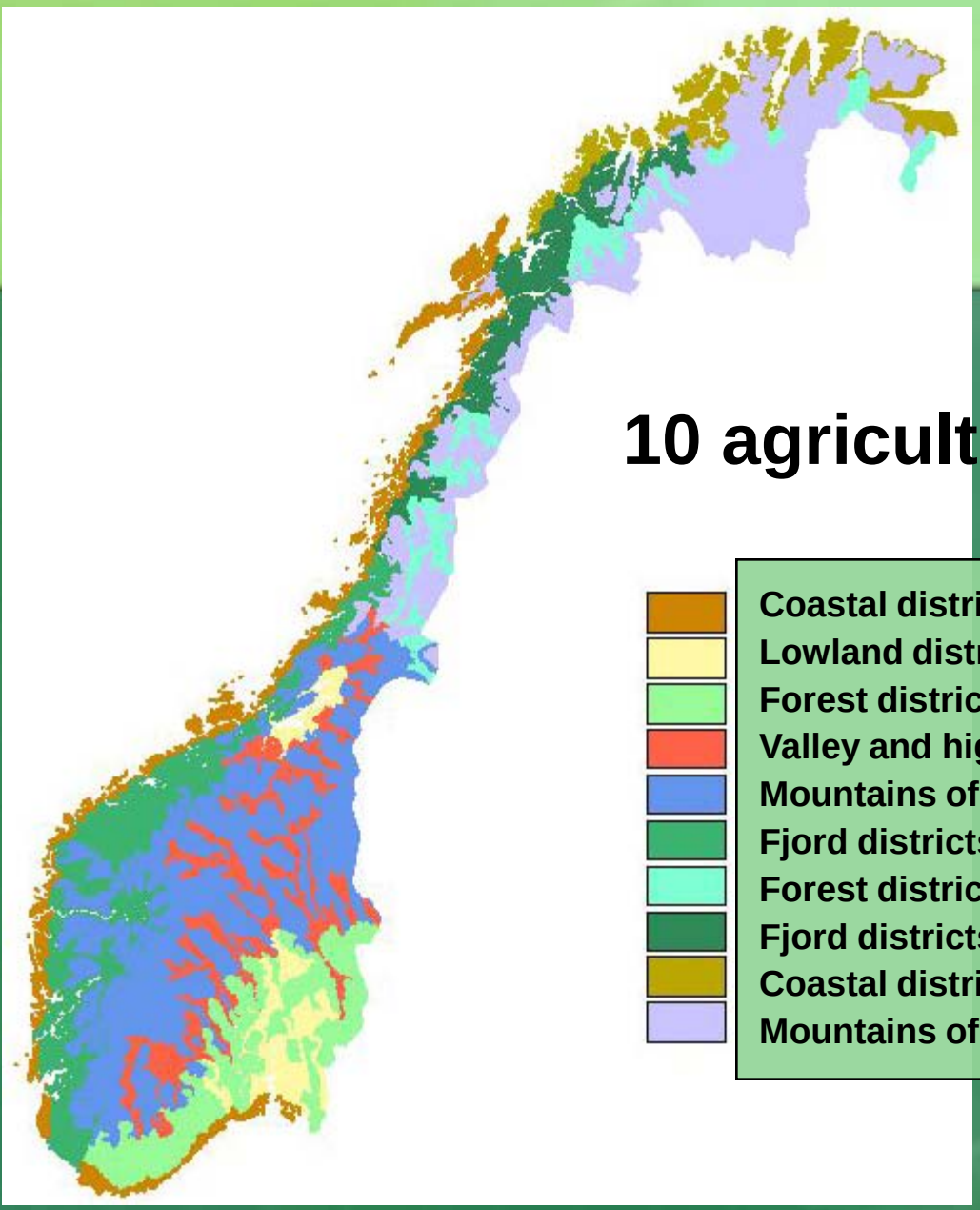
3Q Programme



skog+ landskap

3 Q Programme

10 agricultural landscape regions



- Coastal districts from Southern Norway to Nordland
- Lowland districts of Eastern Norway and Trøndelag
- Forest districts of Southern and Eastern Norway
- Valley and highland districts of Southern Norway
- Mountains of Southern Norway
- Fjord districts of Western Norway and Trøndelag
- Forest districts of Northern Norway
- Fjord districts of Nordland and Troms
- Coastal districts of Troms and Finnmark
- Mountains of Northern Norway

skog+ landskap

3Q Programme – Landscape Patterns to Processes

Landscape

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Aerial photo of landscape

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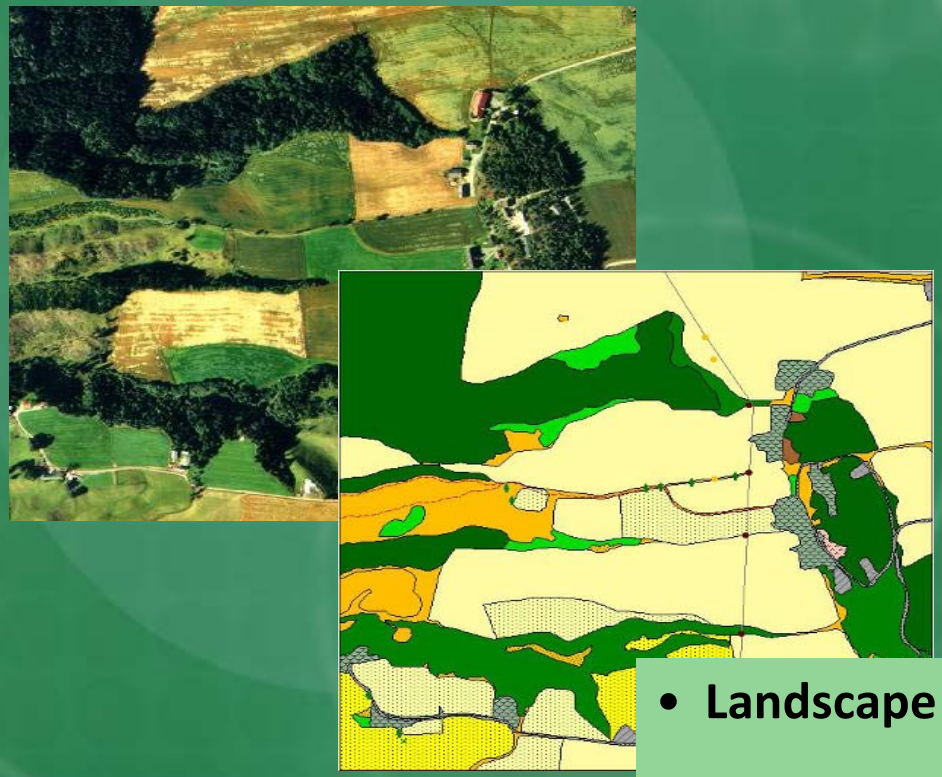
Map from aerial photo

↓

Indicators from map

↓

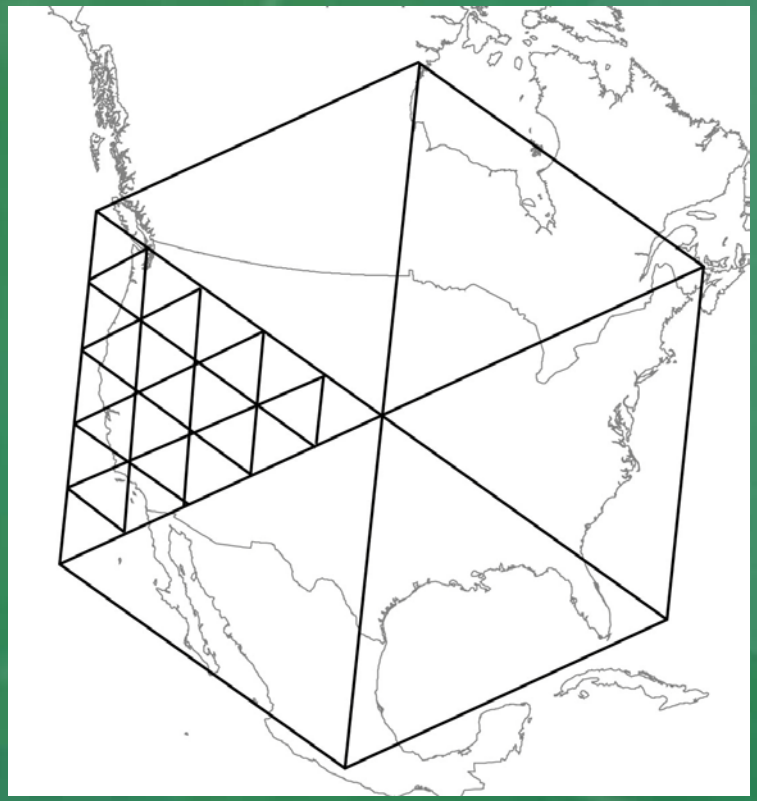
Attributes related to indicators

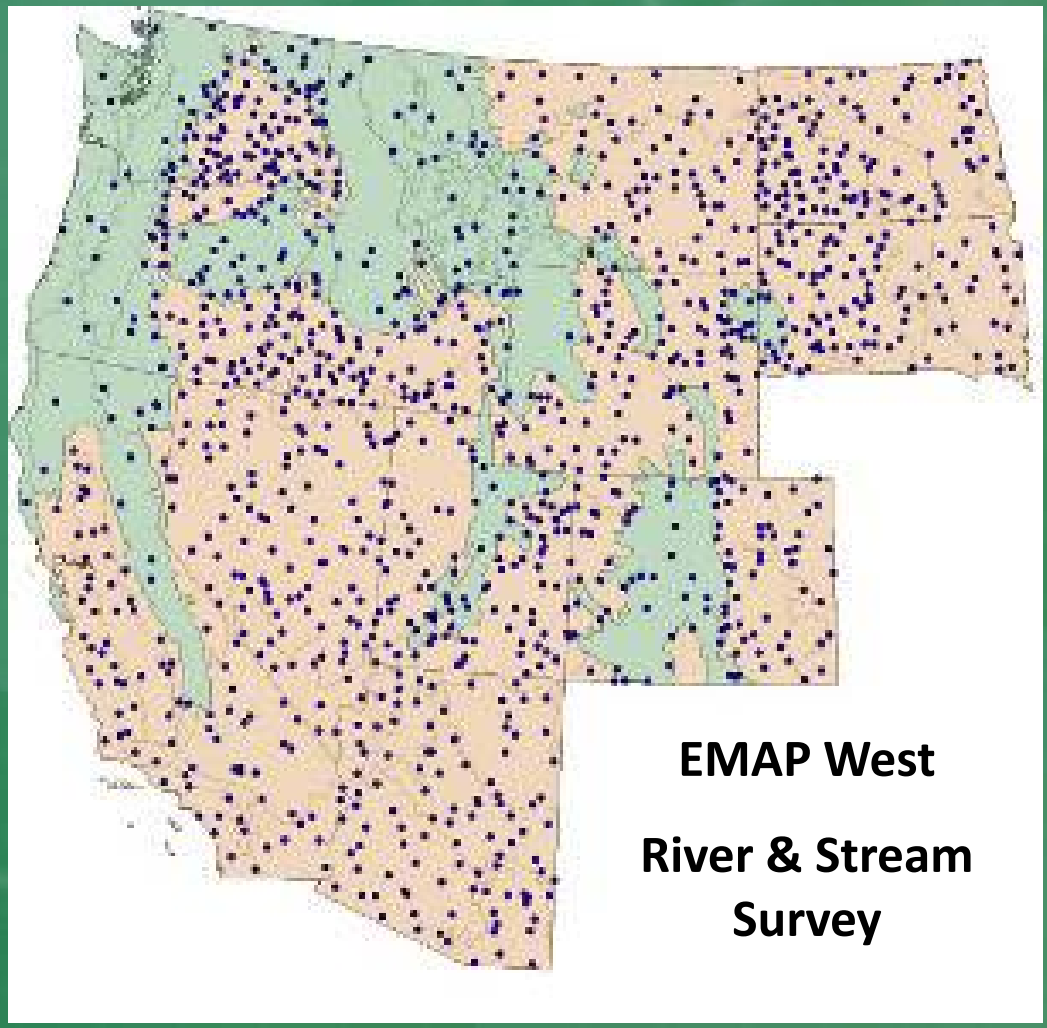


- **Landscape heterogeneity**
- **Habitat fragmentation**
- **Patch shape of agricultural land units**

(Fjellstad and Dramstad 2008)

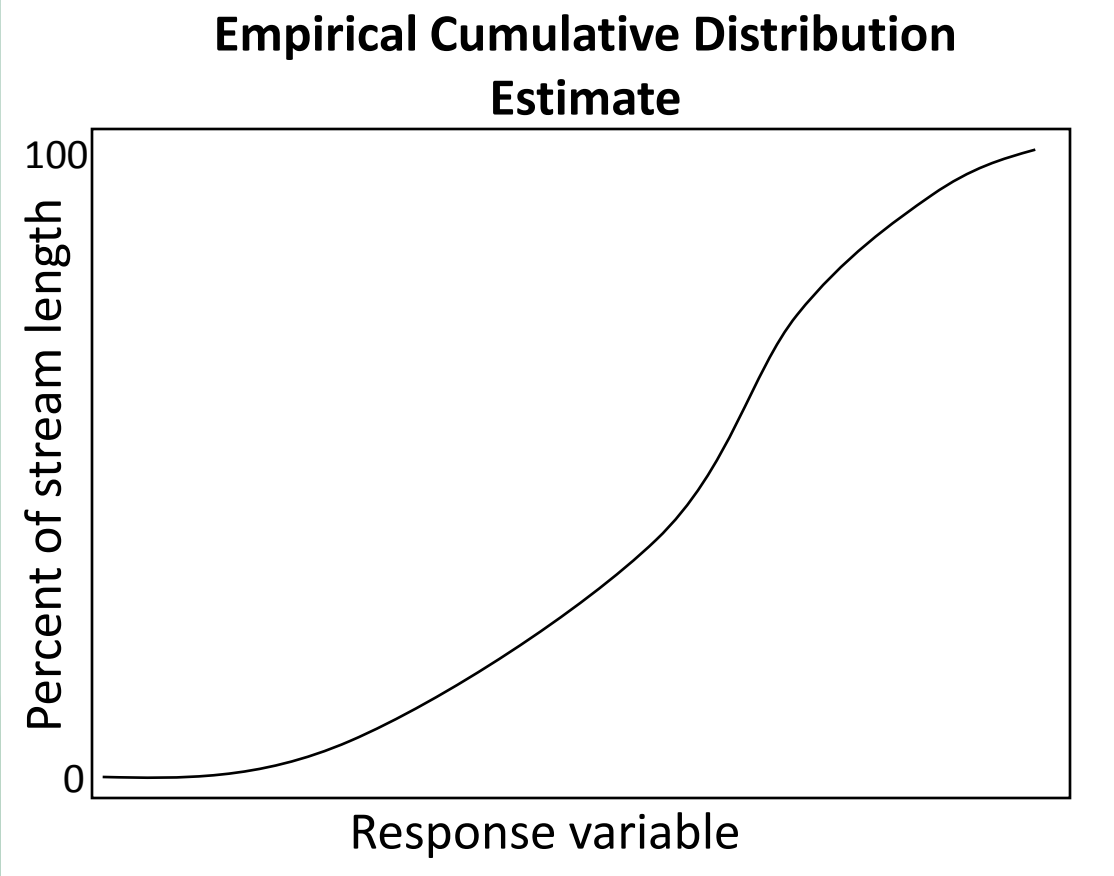
EMAP – Statistical Sampling Design





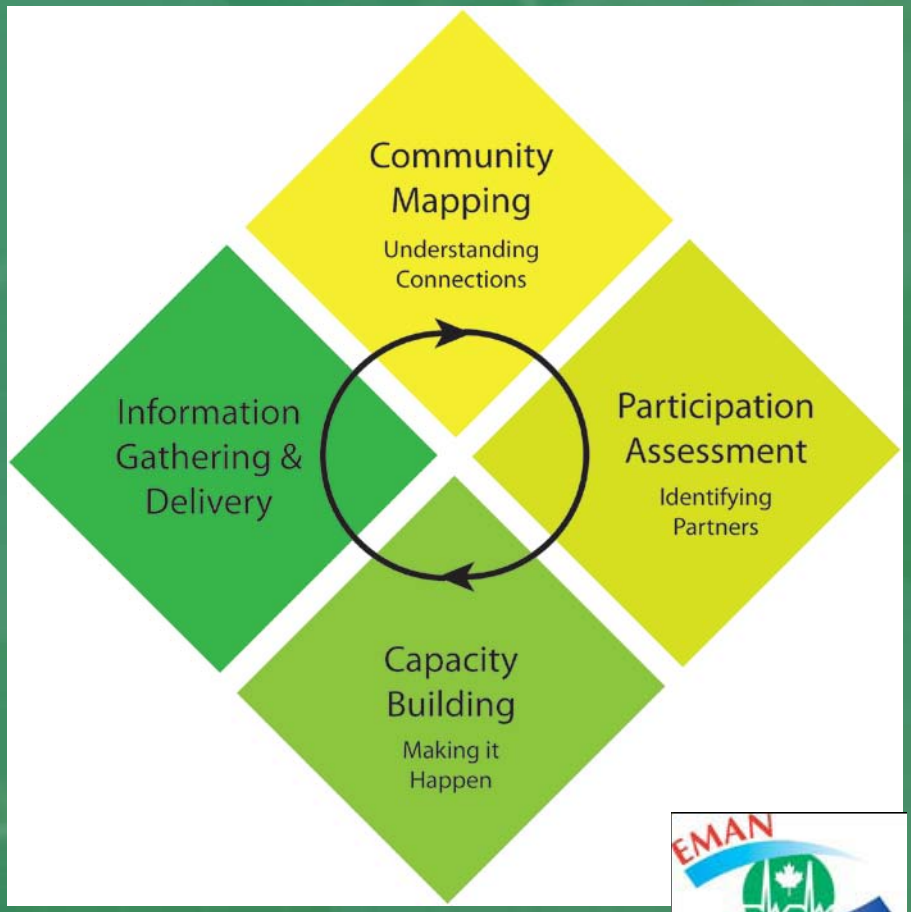
EMAP - Indicators

- Indicators of biological integrity (IBI)
- Physical and chemical condition
- Associations between stressors and condition
- Reference conditions from sample of “healthy” sites



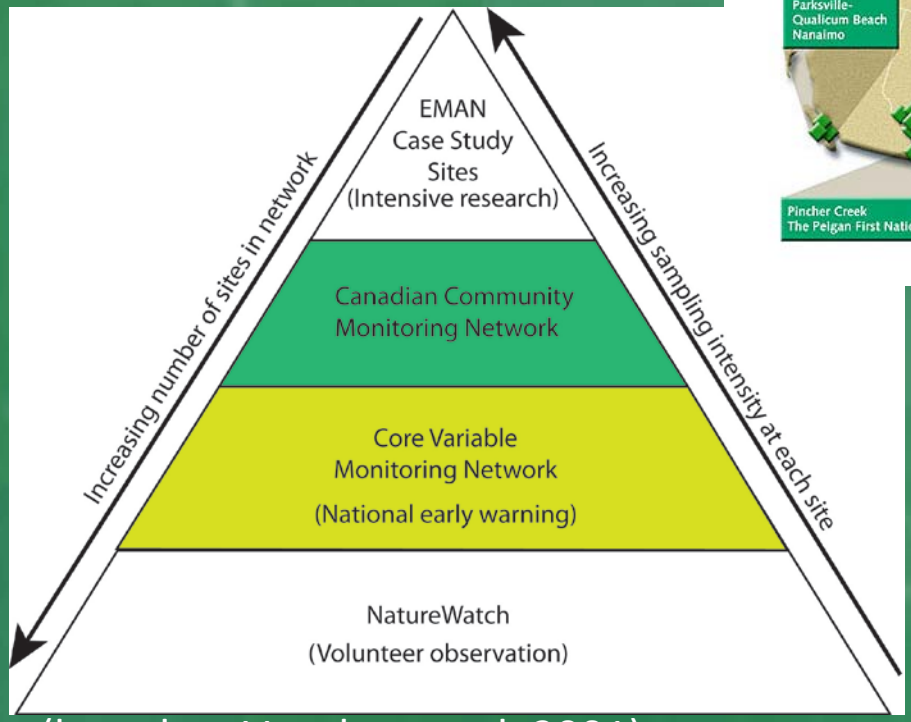
EMAN – Communication & Early Warning

- Communication
  - Between partners
  - Of monitoring results to decision-makers
- "Early warning"
  - Not waiting for statistical certainty
  - Policy relevance of information
- Community-Based Monitoring Framework

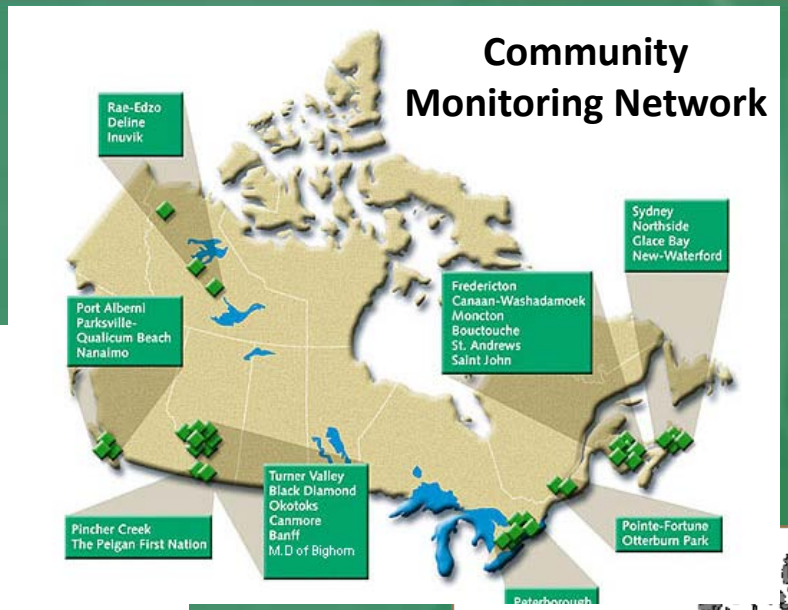


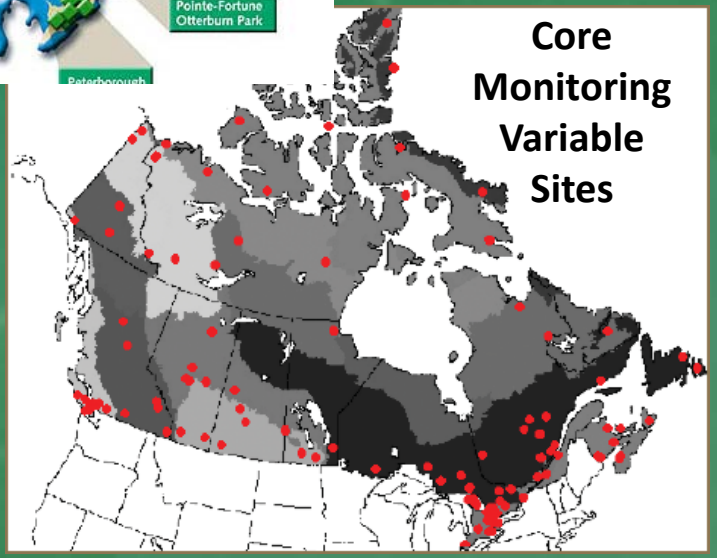
(EMAN Coordinating Office 2003)

EMAN – Tiered Monitoring Network

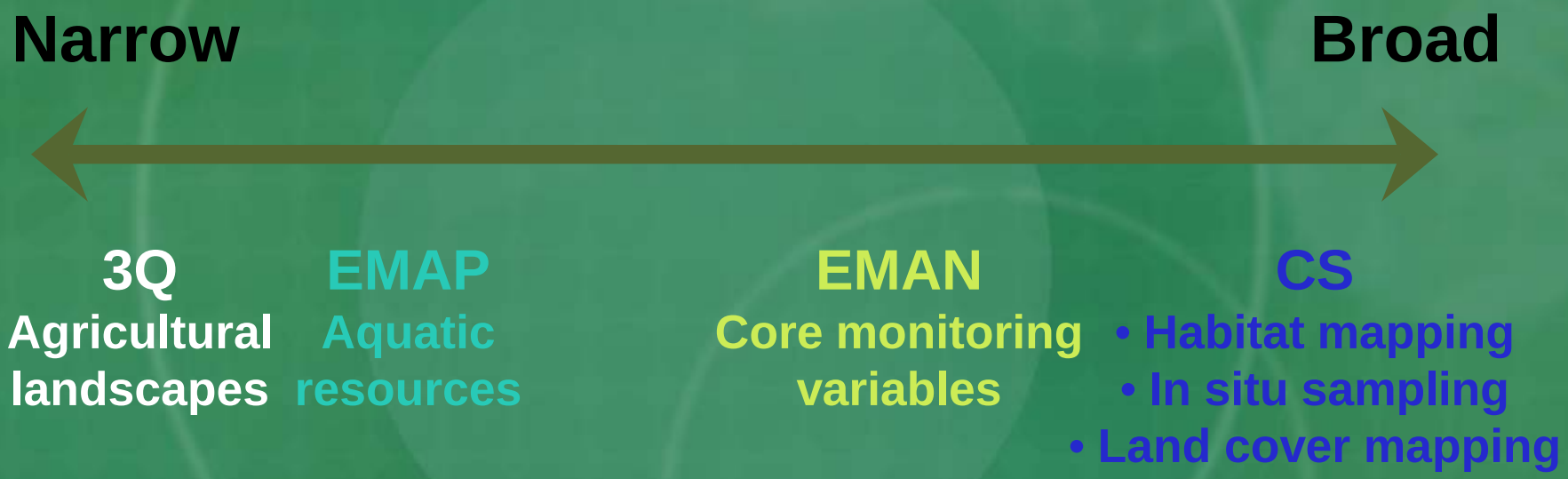


(based on Vaughan et al. 2001)





Ecosystem Components Monitored

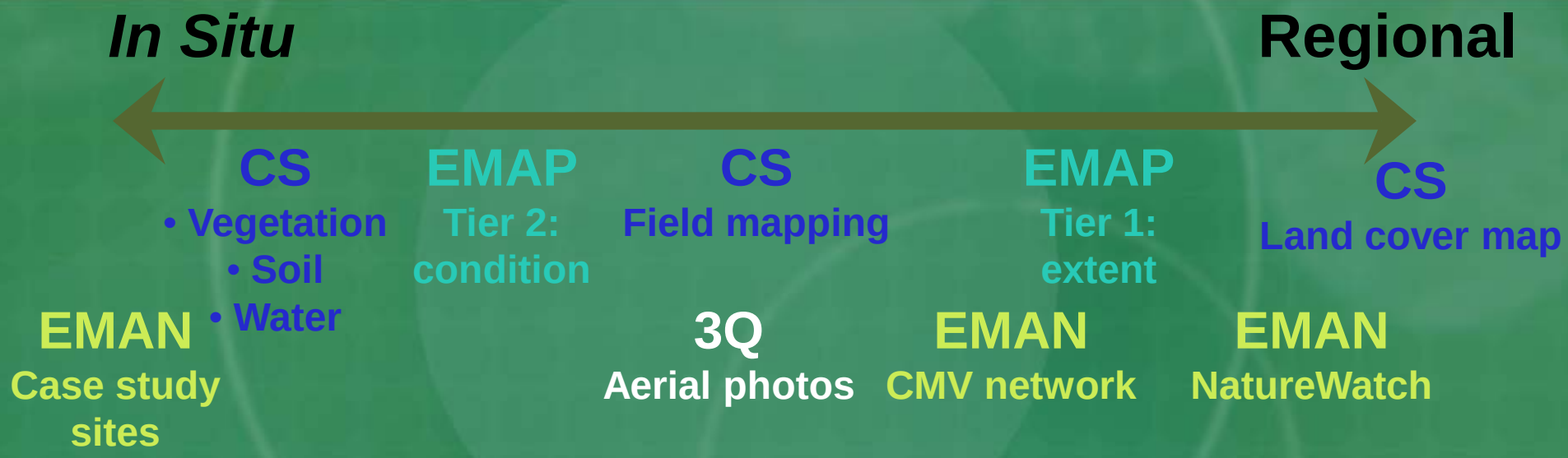


- Broad coverage provides long-term continuity in the face of uncertainty

Statistical Validity and Decision-Making

- Allocation of monitoring resources
- Timeliness of information
- Communication and coordination

Scales of Monitoring



- Within- and between-sample variation
- Relevant to management
- Multiple scales

Strengths

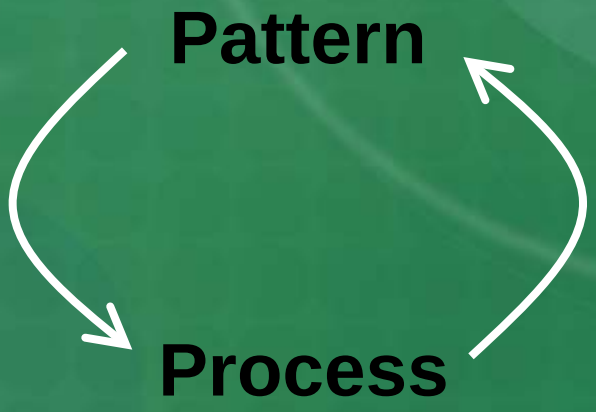
- **Countryside Survey** – Complete and spatially coherent *national dataset*
- **EMAP** – *Statistically valid* measures of ecosystem condition; unbiased; can be reported simply
- **EMAN** – Monitoring information *incorporated into decision-making*

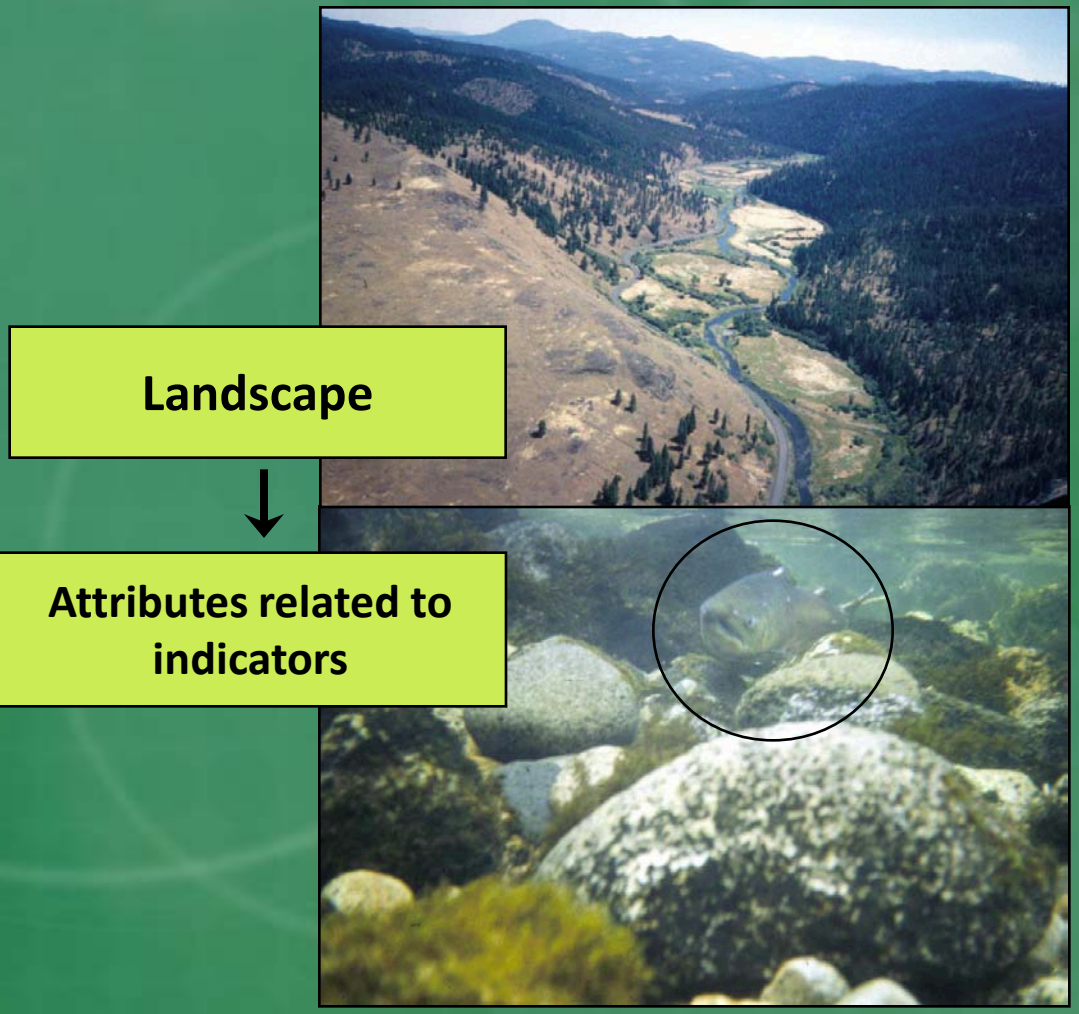
Weaknesses

- **Countryside Survey** – Relevance and application of data *not fully developed*
- **EMAP** – Focus on statistical representativeness; *limited information on spatial pattern*
- **EMAN** – *Lack of true national dataset;* no national picture of conditions

Landscape Pattern and Ecosystem Processes

- 3Q explicit connection of landscape indicators to responses
- EMAP indicators and concept of distribution functions to measure responses





Lessons Learned

1) Ask questions about relationships between landscape **pattern** and ecosystem **processes**
2) Err on the side of **comprehensiveness** in **spatial continuity** and in selecting components to monitor
3) Balance **statistical certainty** with **timeliness** for decision-making
4) Monitor at scales commensurate with the **landscape elements** of interest
5) Incorporate **multiple scales** of monitoring

Acknowledgements

- **Countryside Survey**: Peter Carey, France Gerard, David Howard, Lisa Norton, Terry Parr, Jennifer Reeves, Simon Smart, Geoff Smith, Rick Stuart
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