A framework for assessing heavy metal impacts on ecosystem services

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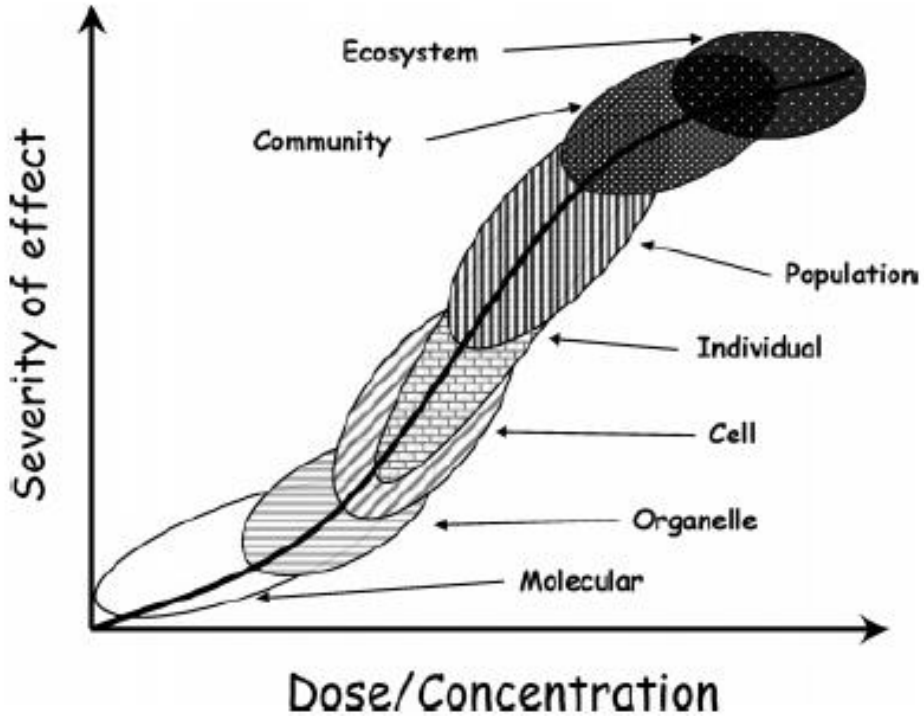
ECOLOGICAL IMPACTS

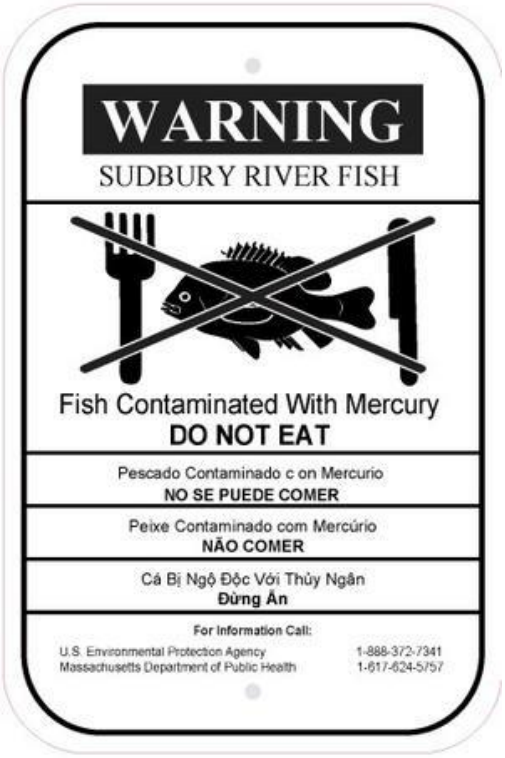
- Natural sources
- Industrial contamination
- Point source industrial emissions
- Sewage sludge
- Legacy deposition

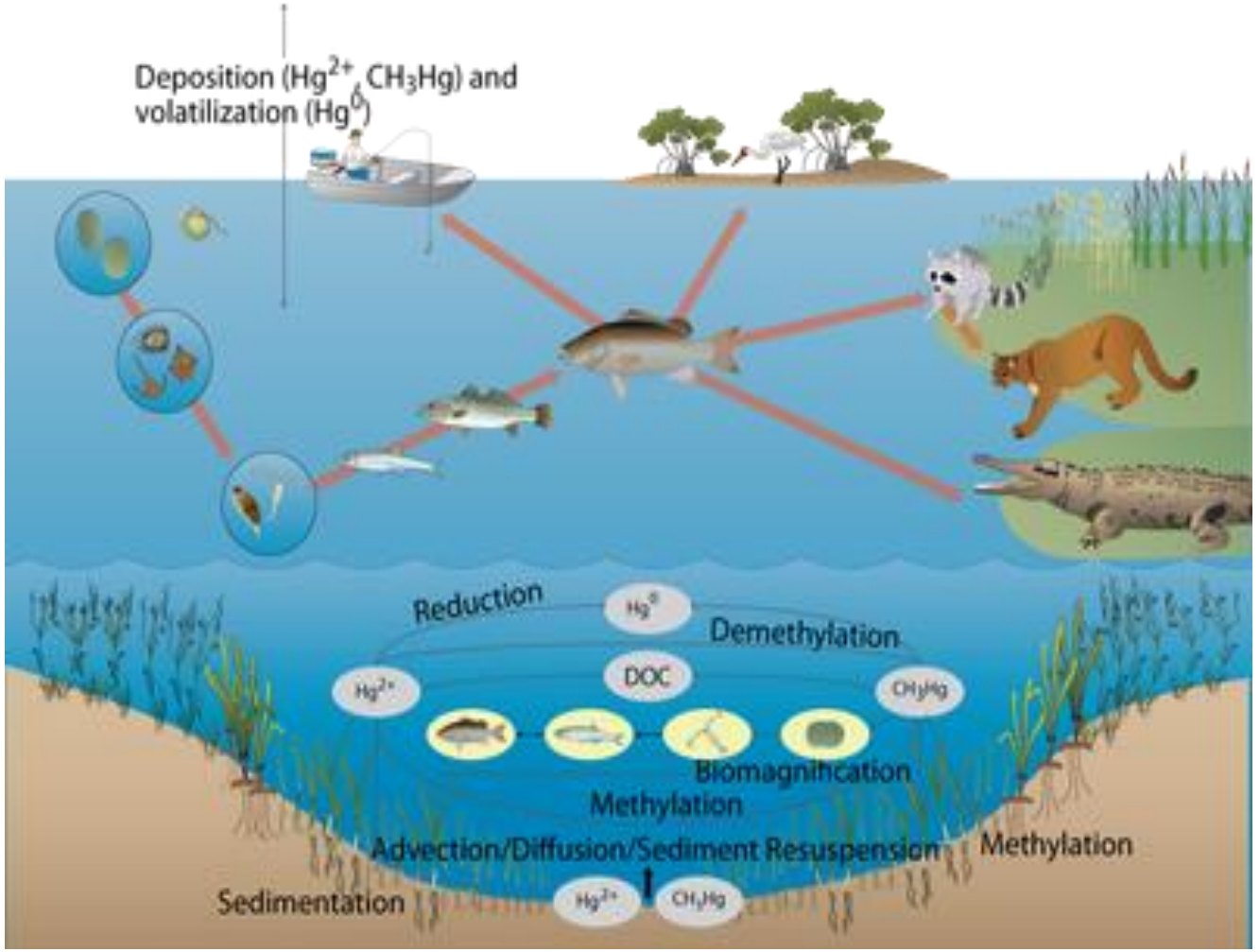
CASCADE EFFECTS



Spurgeon et al. 2005, Environ. Sci. Technol. 39, 5327-5334

BIO-ACCUMULATION





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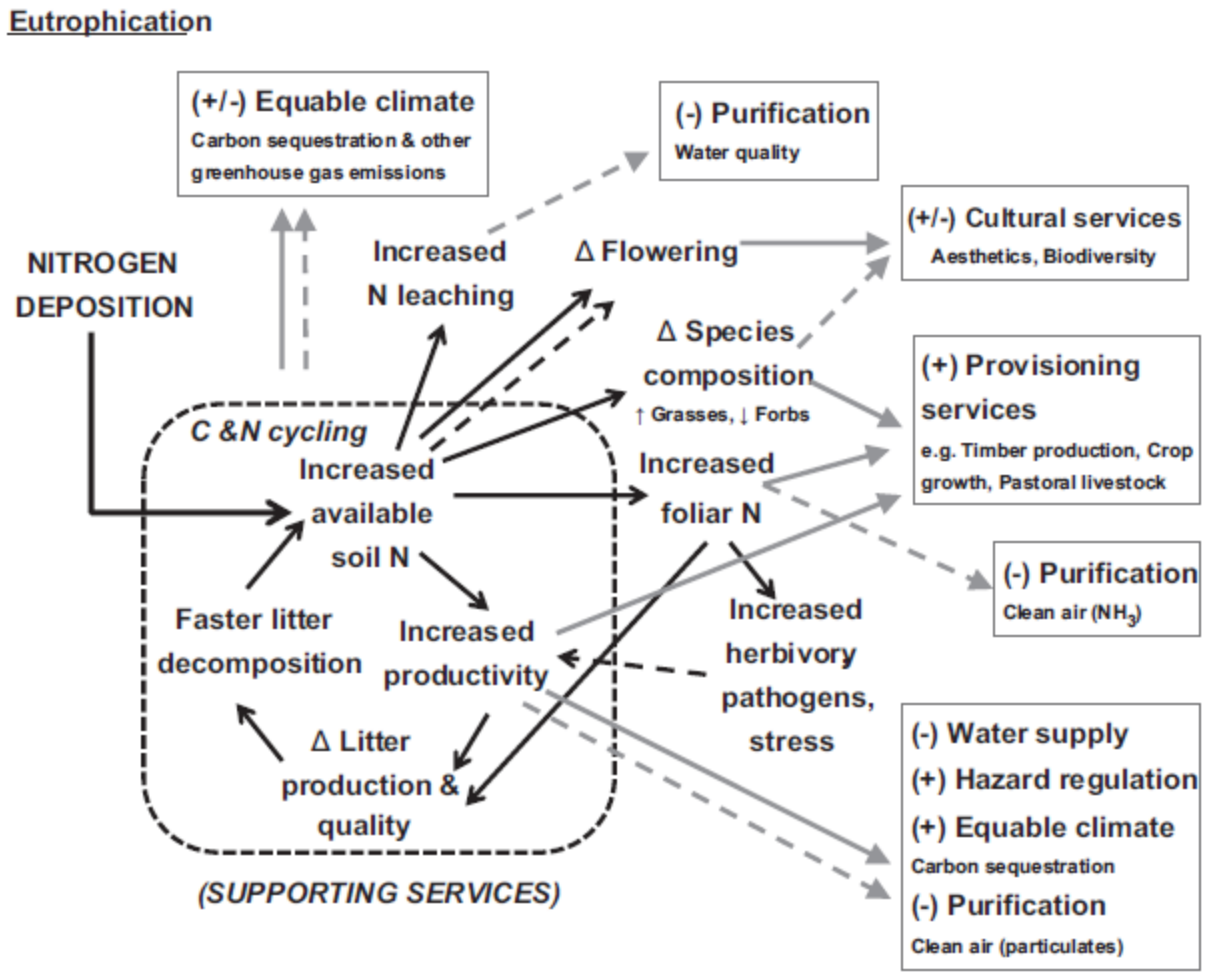
NITROGEN APPROACHES



Jones et al. 2014, Ecosystem Services 7, 76-88

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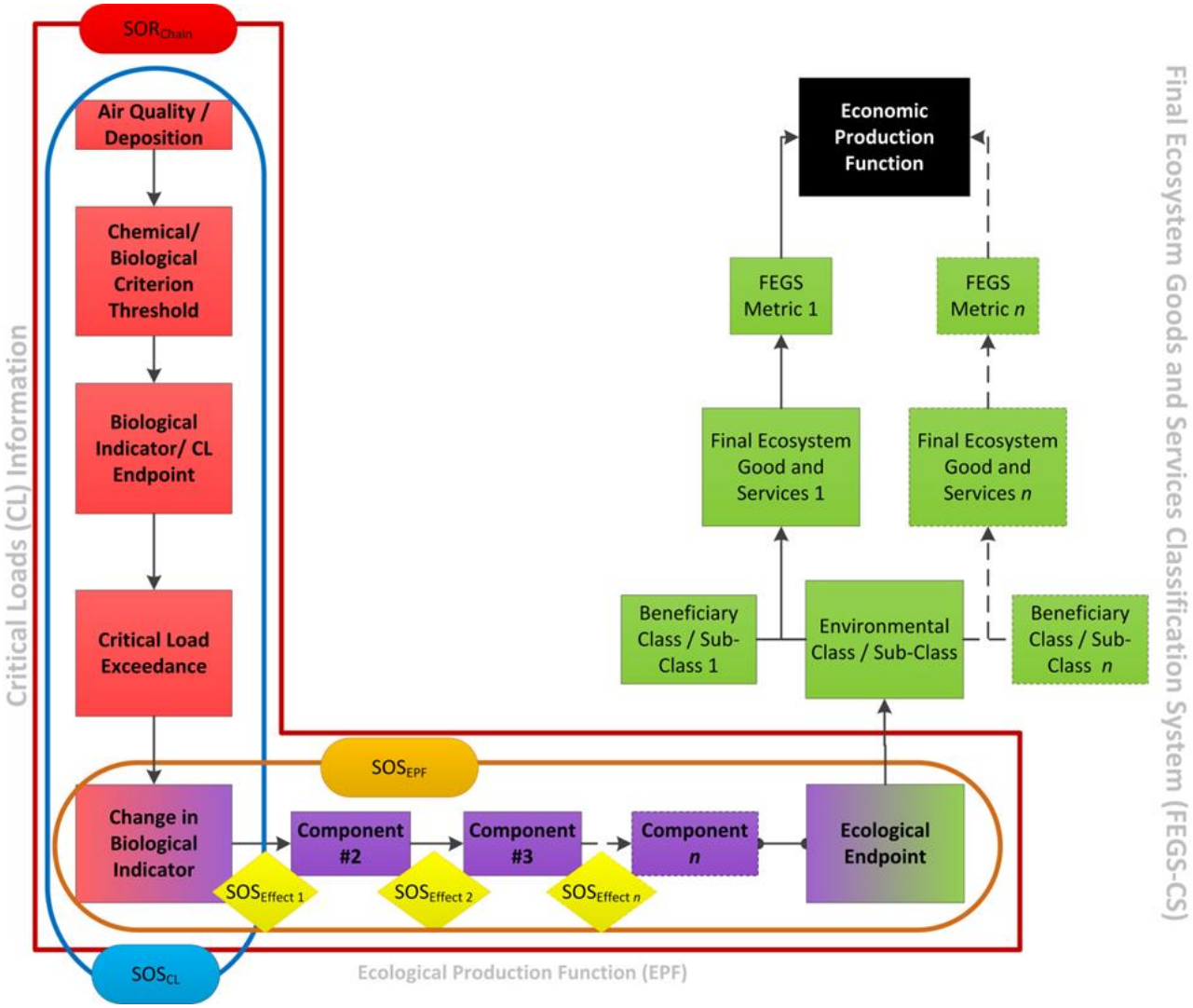

Clark et al. in prep,

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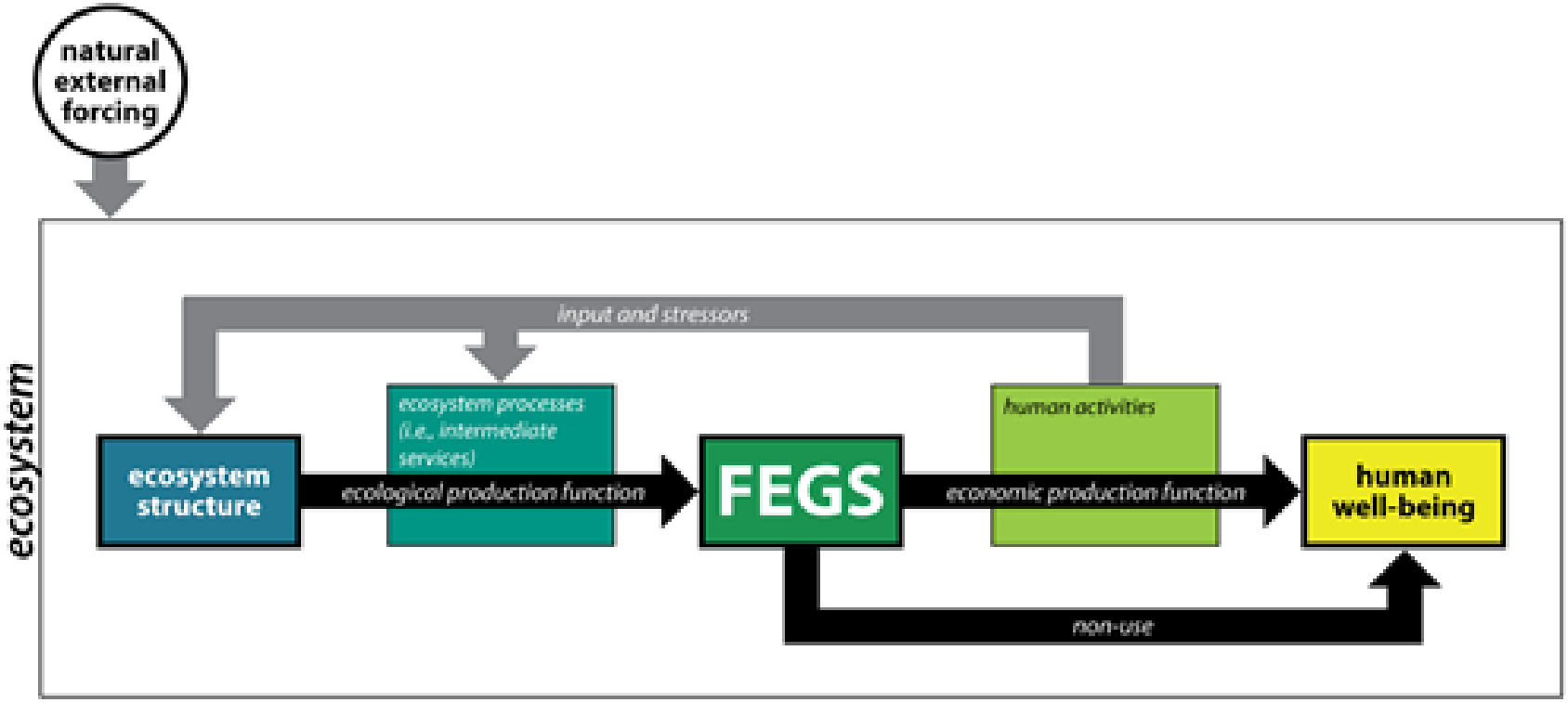
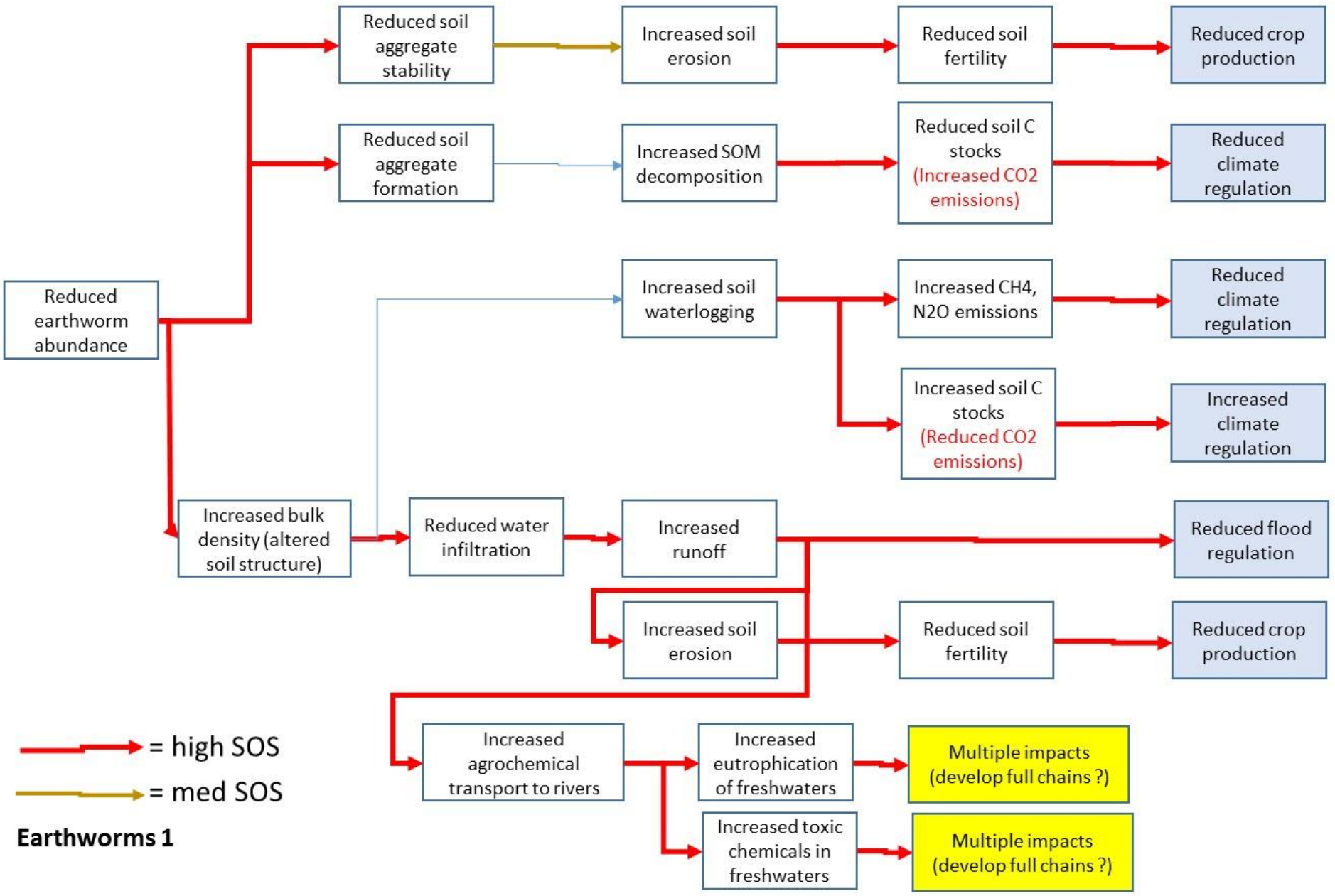
FEGS – FINAL ECOSYSTEM GOODS AND SERVICES

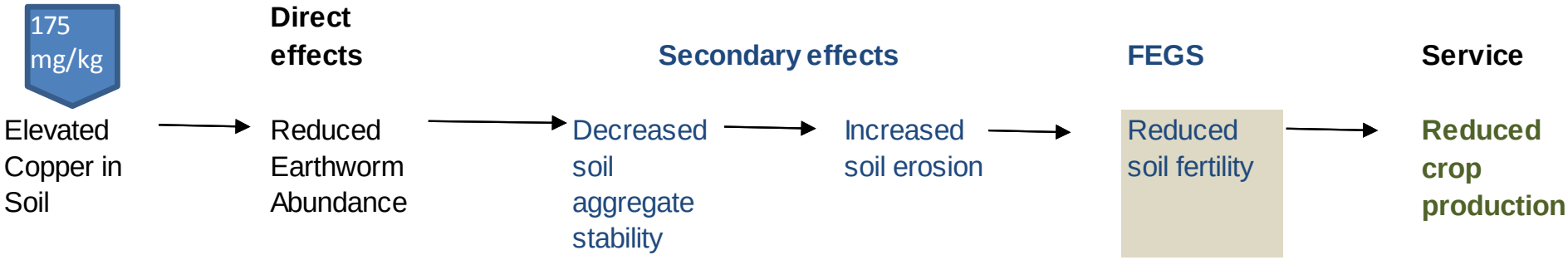


Blett et al. 2015. Air Quality and Ecosystem Services Workshop Report, NPS

CONCEPTUAL MODEL OF IMPACTS



POPULATING THE IMPACT CHAINS



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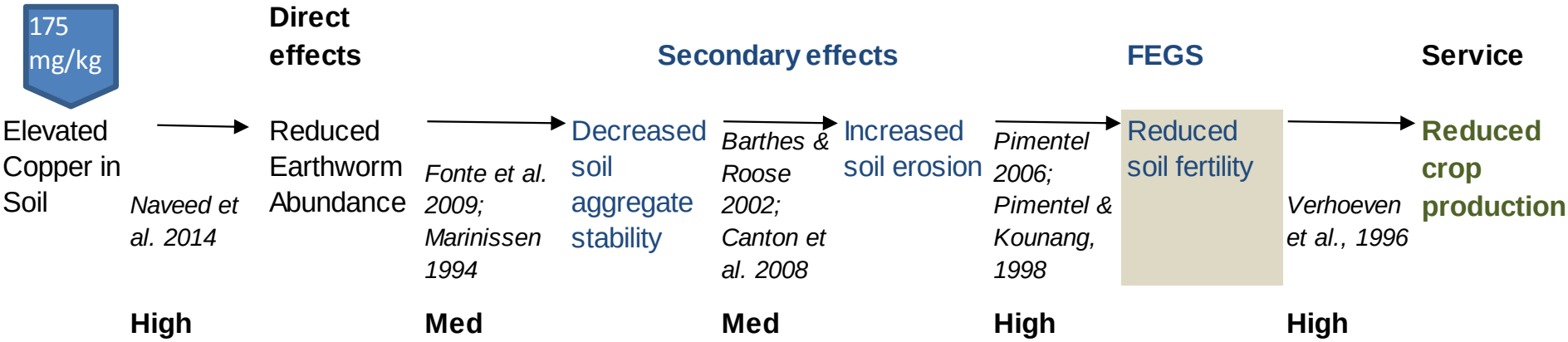

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POPULATING THE IMPACT CHAINS

175 mg/kg

Elevated Copper in Soil

Naveed et al. 2014

High

Direct effects

Reduced Earthworm Abundance

Fonte et al. 2009; Marinissen 1994

Med

Secondary effects

Decreased soil aggregate stability

Barthes & Roose 2002; Canton et al. 2008

Med

Increased soil erosion

Pimentel 2006; Pimentel & Kounang, 1998

High

FEGS

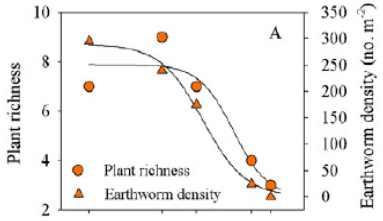
Reduced soil fertility

Verhoeven et al., 1996

High

Service

Reduced crop production



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INTERIM RESULTS SUMMARY

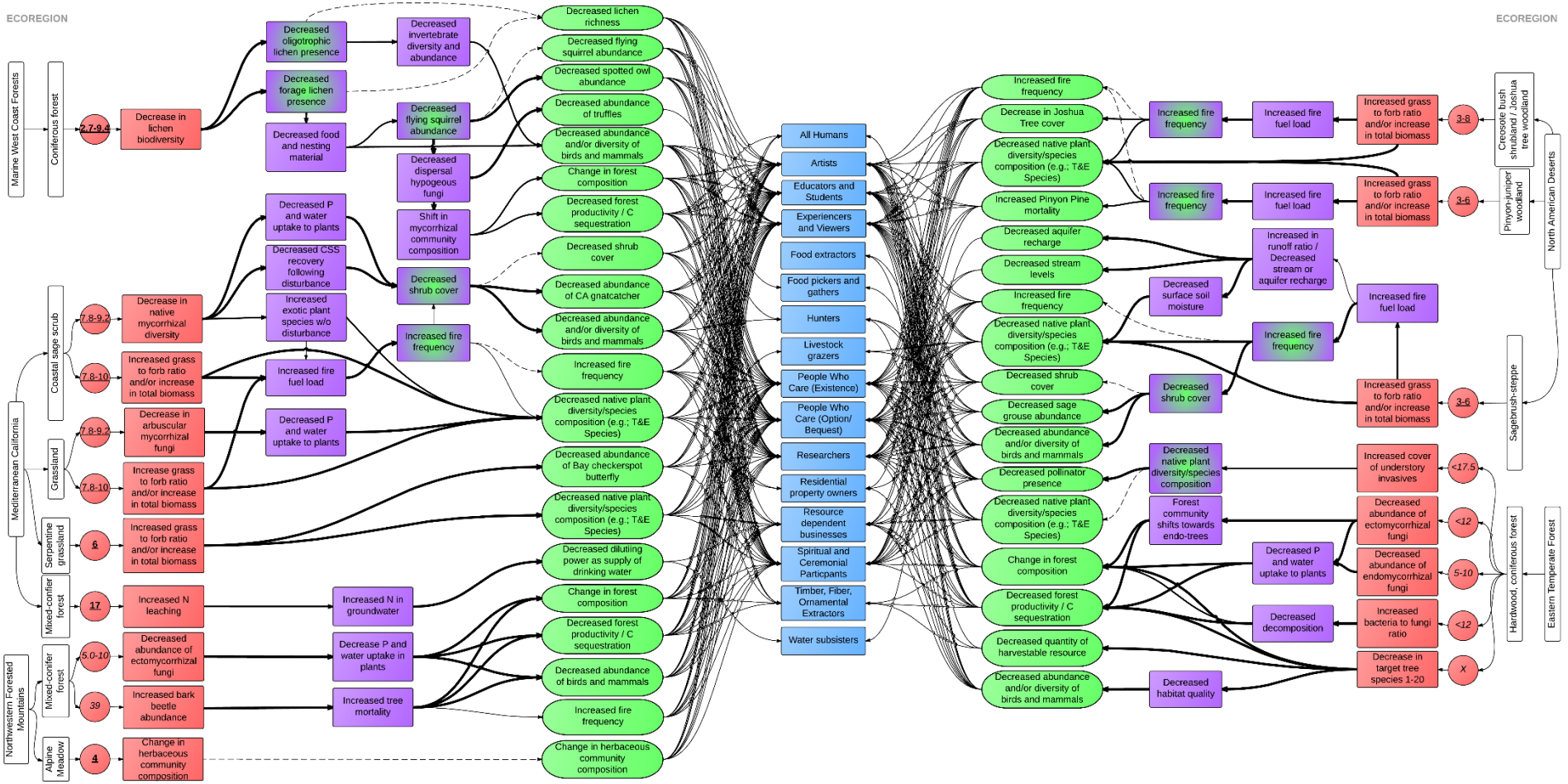
- 111 unique impact chains
- 13 services

Mechanisms/pathways

- Earthworms
- Fungal
- Bacterial
- Rhizobacteria
- Rhizobium (N-fixers)
- Plants
- Aquatic impacts – direct toxicity
- Biomagnification

Reduced animal production (milk, meat)
Reduced animal products (milk, meat) fit for human consumption
Reduced crop production
Reduced crops fit for human consumption
Reduced drinking water (quality)
Increased/Reduced climate regulation
Reduced flood regulation
Reduced soil purification
Reduced human use impacts (amenity)
Reduced human use impacts (hunting, food)
Reduced human use impacts (recreational fishing, food)
Increased/Reduced human non-use impacts
Reduced human health

POTENTIAL OUTPUTS – N IMPACT CHAINS



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CONCLUSIONS

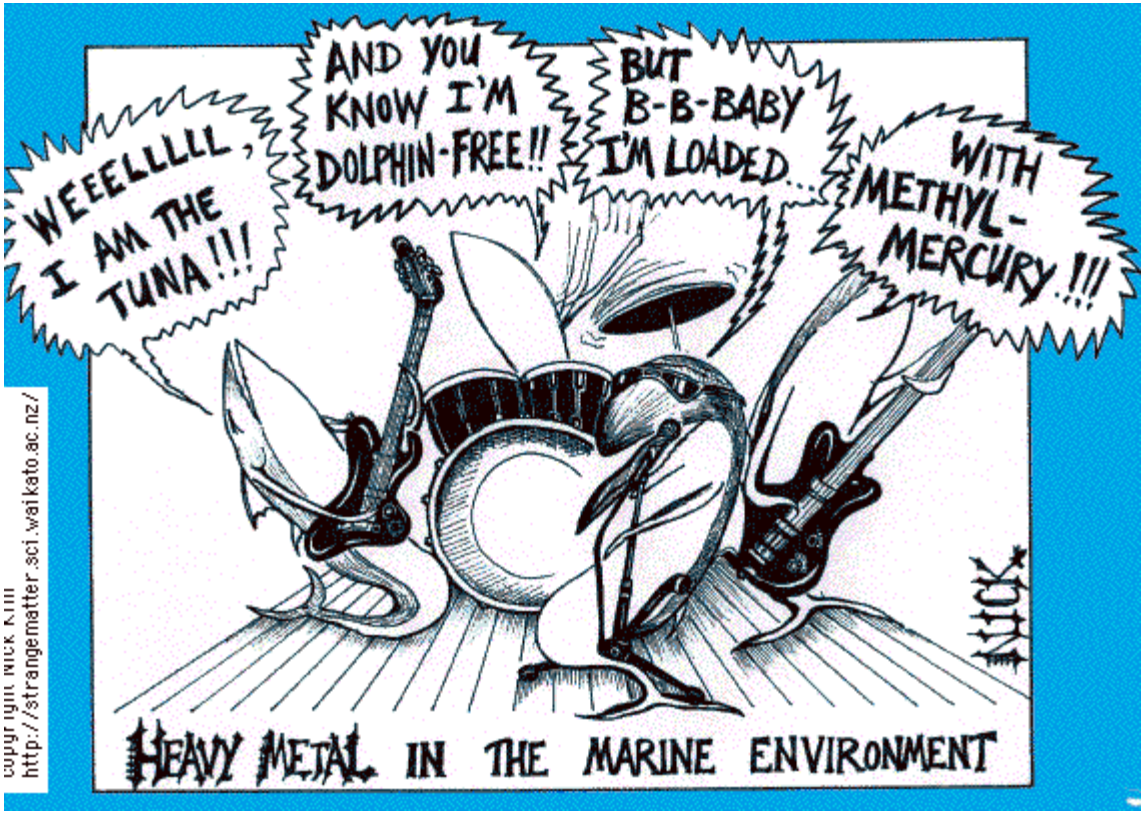
- Rigorous way to assess evidence-based impacts on ES
- Allows subsequent hand-over to economists (if required)
- Majority of metal impacts are negative, but some positive
- Magnitude of impact along chains often unknown

Dibaeis baeomyces

Thlaspi caerulescens

Snottites

Thank you !



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