









Center for Health and the Global Environment Quantitative Tools for Linking Adverse Outcome Pathways with Process Models: Bayesian Relative Risk Networks

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Center for Global Health and the Environment at Harvard University

- Help people understand that our health and wellbeing, and that of our children, depends on the well-being of the environment, and that we must do everything we can to protect the environment
 - Biodiversity sustains all life on earth
 - Food choices impact human health and global environmental health
 - www.chgeharvard.org







Natural Environment is a Constraint - Optimization, Not a Tradeoff



http://www.nmfs.noaa.gov/stories/20 12/10/noaa_fisheries_education.html



Built-Social-Economic Environment within the Natural Environment

Natural Environment Land management **Decision-making Built-Social-Economic** Environment HWB – human well-**HWB** being **Decision** context - AOP to map influence of AOP – adverse **Biodiversity** Values (e.g., exposures and outcomes outcome pathway recreational - GIS-based decisionfisheries, urban analysis to evaluate ES – ecosystem green space etc. tradeoffs services ES - ES mapping **Ecosystem Types**



Continuum of the Natural-Social-Built Environments



Perception of the natural environment across the continuum from "pristine" to urban ecosystems

Implications for operational definitions of sustainability

80% of Americans live in urban areas – removed from the natural environment (with implications for ecosystem services)



- Subjective and objective aspects to HWB
 - Social and economic indicators
 - Satisfaction and happiness at the individual level
- Understanding of importance of ES to HWB
 - Nature relatedness
 - Perception of the natural environment as separate
- Dynamic relationship but policy decisions rely on single snapshot
 - Both ES, HWB and preferences change over time



An AOP is a conceptual construct that portrays existing knowledge concerning the linkage between a direct molecular initiating event and an adverse outcome at a *biological level of organization* relevant to outcomes of interest from an ecosystem services perspective

AOPs are basically cause-effect pathways written at a molecular to organismal level

They actually have a physical basis within the organism and follow the signal from initiating event(s) to apical outcome(s)

It is the etiology of the effect-----



How the AOP Links to Ecosystem Services



Management context

Declines in fish and wildlife populations

Recreational fishery Existence/nonuse value for wildlife



Relative Risk and AOP Context



Note: The sources, habitats, effects, impacts, and the components within ecological context are expressed probabilistically in a spatial and temporal context



Adverse Outcome Pathway Framework





Quantitative Frameworks for Adverse Outcome Pathways





Quantitative Frameworks for Adverse Outcome Pathways



Decision Analysis as Integrating Framework

Decision Analytic Strategies for Integrating Ecosystem Services and Risk Assessment

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EDITOR'S NOTE

This paper is one of it articles generated from the SETAC Special Symposium. Ecosystem Services, from Policy in Fractice (15-16) Pobruary 2012, Brunele, Belgium). The sprepanium sized to give a broad overview of the application of the occupitern services concept in environmental assessment and management, against the background of the implementation of the European environmental policies such as the bindressetty agenda, agricultural policy, and the water framework directive

upland portion of site In ABSTRACT Ecosystem services as a concept and grading principle are enjoying with popularity and evolutionent from high-level policy Bypism to industry as support for sustainability yoan continue to grow Novewet, suplicit incorporation of acarystem service into electrony reading diff to be precised regularization at more fixed scales and faces storide and regulatory and technical constraints. Hok associatent represents in exemple of a regulatory process for which guidance exists that makes 8 challenging rate acception service andpoints. Inclused constraints only in the quantification of the relationsh ecological functions and services and endpoints valued by humans, and the complicity of those interactions with resp transfiring and stacking. In addition, willingshare percess, by their very definition, represent an anthropogenic constraint with Criteria against which alternatives are evaluated (predicted fish tissue concentrations \rightarrow probabilistic risk results

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Dr Fini Ameter Assistant Administrator Office of Basseth and Development U.S. Environmental Protection Agency

responses#deci09

This is a report from the Dougl of Scientific Counseliers (NOSC) conversing the proceedings of the Decision Analysis Workshop, positive hold by ORD and the DOLE on March 30-April 1, 2009. The workshop win intended to around OED in manimum decrears madyne options to improve its strategic planning, manimum meansh efficiency, and ingurous presentantizes and decadors making processes, while doing to in a more structured, eligective, and transported manual

The workshop committed of presentations from expects in the field of dermans marbon and panel durants or the ming on the colling any nucleus that torid be used in three GRD case studies. The panels due contained the differentiate that representations such as OED face as using introduced approaches to decision making, but also offered suggestions for their mercenthal anglementation.

Several key observations resulted from the wethology, and they ary summerzed as the opper. These observations were used by the SOSE to develop specific recommendations: for OED. The BOSE would blac to continue the discussion with OED on the use of deviation mathematic techniques, and would therefore request that ORD request to the substances on this request

- Network-based approaches for quantifying conditional probabilities
- AOP portion of network consists of one or more concentration-response functions
- Concentration-response function outputs at the individual level link to population models
- Population models predict regulatory outcome(s) of interest
- Exposures and initial MIEs may differ
- Exposures may impact different key events via different mechanisms
- Different approaches depending on data
 - High-throughput / in vitro results at each MIE, KE
 - *in vivo* lab or field data that collapses early KE to outcome

- Tools and approaches exist to support decision making
 - Bayesian Network Relative Risk Models
 - GIS-based decision analytic approaches
- Stakeholders may not fully appreciate relationship of ES to HWB
 - Nature-relatedness and biophilia
 - Push to quantify-monetize ES
 - Static versus dynamic
 - Significance of biodiversity across all domains of ES
 - Key to resilience
 - Key to thriving ecosystems

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