

Working Group-28 Development of Ecosystem Indicators to Characterize Ecosystem Responses to Multiple Stressors

Business Meeting, **Draft** Agenda
Friday, October 16, 2013, 9:00-18:00
Hotel Shangri-La, Qingdao, China

Meeting objective:

To review activities during the 4th (2014-15) year of WG-28, and to discuss the final report. Note that reports from previous WG28 meetings and sponsored sessions are on the WG28 web page at http://www.pices.int/members/working_groups/wg28.aspx

This is expected to be the final in-person meeting of WG28, with the final report presented to Science Board for approval in late Spring 2016.

NOTE: a (still rather drafty) draft of WG28 report will be made available prior to this meeting. Please review the draft and be prepared to discuss its contents

9:00 Welcome, Introduction and sign-in (all) (co-chairs; see Appendix 2 for list of WG members)

9:10 Review of WG-28 ToR and accomplishments

General review of Terms of Reference (see Appendix 1) in the context of what has been achieved by WG28 (all)

9:30 Review and discussion of draft report, by Chapter

a) Introduction (leads: Perry, Takahashi)

10:30 Coffee Break

11:00 Review and discussion of draft report, by Chapter (continued)

b) Chapter 2 “Frameworks linking pressures to impacts and changes in North Pacific marine ecosystems”, and “Multiple pressures on North Pacific marine ecosystems” (leads: Perry, Takahashi)

12:00 Lunch

13:30 Review and discussion of draft report, by Chapter (continued)

c) Chapter 3 “Ecosystem indicators” and “Indicators for ecosystem responses to multiple pressures” (leads: Boldt, and ?)

To include discussion of recommendations for leading indicators of ecosystem responses to multiple pressures, for possible inclusion in next North Pacific Ecosystem Status Report

15:30 Coffee Break

16:00 Review and discussion of draft report, by Chapter (continued)

d) Chapter 4 “Case study examples” Discussion of common formats and materials for each of our Case Studies:

Inland seas, e.g. Salish Sea (Strait of Georgia; Puget Sound), Seto Inland Sea (discussion leads: Samhouri, Perry, Takahashi)

High latitude seas, e.g. Sea of Okhotsk, Bering Sea (discussion leads: Kullik, Lukyanova, Zador)

17:30 Discussion of plans for primary publications resulting from the WG28 report (Samhouri)

17:45 Next steps

1800 Adjorn

Evening: WG28 dinner?

NOTE: WG28 has available a second day (Saturday, October 17, 2014, 0900-1800) for its business meeting if needed for work on the various chapters, etc. At present the agenda for day 2 is unscheduled.

Appendix 1

Terms of Reference

1. Identify and characterize the spatial (and temporal) extent of critical stressors in North Pacific ecosystems both coastal and offshore and identify locations where multiple stressors interact. Identify trends in these stressors if possible.
2. Review and identify categories of indicators needed to document status and trends of ecosystem change at the most appropriate spatial scale (e.g., coastal, regional, basin).
3. Using criteria agreed to at the 2011 PICES FUTURE Inter-sessional Workshop in Honolulu, determine the most appropriate weighting for indicators used for:
 - a. documenting status and trends
 - b. documenting extent of critical stressors
 - c. assessing ecosystem impacts/change
4. Review existing frameworks to link stressors to impacts/change, assessing their applicability to North Pacific ecosystems and identify the most appropriate for application to North Pacific ecosystems.
5. Determine if ecosystem indicators provide a mechanistic understanding of how ecosystems respond to multiple stressors and evaluate the potential to identify vulnerable ecosystem components.
6. For 1-2 case studies, identify and characterize how ecosystems respond to multiple stressors using indicators identified above. Are responses to stressors simply linear or are changes non-linear such that small additional stressors result in much larger ecosystem responses? Do different parts of the ecosystem respond differently (e.g., trophic level responses)? How do stressors interact?
7. Publish a final report summarizing results with special attention to FUTURE needs. This WG will focus primarily on delivery of FUTURE Questions 3 and 1 (outlined below).

Linkages to the FUTURE Science Plan:

1. What determines an ecosystem's intrinsic resilience and vulnerability to natural and anthropogenic forcing?
2. How do ecosystems respond to natural and anthropogenic forcing, and how might they change in the future?
3. How do human activities affect coastal ecosystems and how are societies affected by changes in these ecosystems?

Appendix 2. Working Group 28 members as of September 2015**Dr. Jennifer L. Boldt (Canada)****Dr. Ian Perry (Canada)**
WG-28 Co-Chairman**Prof. Min Chao (China)****Dr. Baisong Chen (China)****Dr. Honghui Huang (China)****Dr. Chaolun Li (China)****Prof. Cuihua Wang (China)****Dr. Heng Zhang (China)****Dr. Kazuhiko Mochida (Japan)****Dr. Sachihiko Itoh (Japan)****Dr. Motomitsu Takahashi (Japan)**
WG-28 Co-Chairman**Dr. Naoki Yoshie (Japan)****Prof. Chang-Ik Zhang (Korea)****Dr. Jaebong Lee (Korea)****Dr. Olga N. Lukyanova (Russia)****Dr. Vladimir V. Kulik (Russia)****Dr. Jameal F. Samhuri (US)****Dr. Rebecca G. Martone (US)****Dr. Stephani G. Zador (US)**

Appendix 3.

Draft outlines for each chapter of WG 28 final report

(revised from the version originally developed at the WG 28 meeting at PICES-2012 in Hiroshima)

General Outline*Chapter 1. Introduction* (Co-Chairs: Takahashi/Perry)

- Background to the WG
- ToR/Objectives
- Brief overview of the issue of multiple activities/stressors on marine ecosystems
 - *e.g.*, use of the phrase “activities/stressors (or “pressures”) to indicate both natural and anthropogenic pressures, and that not all of these are always “bad” for the ecosystem. Define what is a “bad” ecosystem? – *e.g.*, different objectives for ecosystem states, what is “bad” varies for fishers vs conservationists. Perhaps recommend the broader concept of retaining the natural resilience of ecosystems?
 - Include definitions for “stressors”. Note the issue that information to construct indicators is often available at multiple but different time and space scales, *etc.*
 - Brief literature review of problems of multiple and cumulative stressors in marine systems – *e.g.*, the norm, but difficult to assess more than 2–3 stressors at one time
 - presentation by Dr. Coté in Session S8 later in this PICES meeting provides an excellent overview and access to key literature.
 - include reference to climate change and fishing issues (*e.g.*, age structures are truncated and this can create problems with resilience to climate change).
 - two general types of approaches:
 - mesocosm experiments,
 - whole ecosystem studies and statistical methods.
- Organization and guide to report contents

Chapter 2. Multiple stressors on North Pacific marine ecosystems (Perry, Takahashi, Samhour, Zhang, Lee, Martone, others welcome!)

- Frameworks linking pressures to impacts and changes in North Pacific marine ecosystems (*e.g.*, PICES Session S10 at 2012 Annual Meeting in Hiroshima)
 - brief review of potential frameworks that could be used to link activities and stressors to ecosystem responses,
 - assessment of their applicability to North Pacific marine ecosystems,
 - recommendations for applications.
 - *e.g.*,
 - Pathways of Effects
 - Driver-Pressure-States-Impact-Response models,
 - simulation and other analytical modeling approaches, *e.g.*, Ecopath with Ecosim,
 - probabilistic (Bayesian) networks,
 - Integrated Ecosystem Analyses,
 - IFRAME, INVEST,
 - others?
- Multiple pressures on North Pacific marine ecosystems
 - identification of the spatial (and temporal, where possible) extent of important activities and stressors in North Pacific marine ecosystems,
 - identify habitats and general locations (if possible) where multiple stressors overlap,
 - identify trends in these activities/stressors if possible,
 - use existing literature as a starting point, but also build on own analyses.
- Sub-sections of this chapter for each PICES country, preferably using a common approach (???), plus a synthesis section. Or perhaps these might be included in the case studies?

Chapter 3 Ecosystem Indicators for multiple stressors (Boldt, Samhouri, Itoh, Yoshie, Chung, Martone, others?)

- A. Chapter Introduction
 - Identify need to include indicators of multiple stressors when evaluating the state of marine ecosystems.
 - Purposes of chapter:
 - review existing indicators,
 - review potential sources of data available from national and international programs,
 - indicator-selection criteria, and
 - approaches for evaluating indicators.
- B. Review of indicators in literature
 - General definition of indicators
 - General categories of indicators:
 - Human, biological (including trophodynamics), environmental, socio-economic-political,
 - State and trend,
 - Fulton (2003): strong, intermediate, and weak indicators.
 - Examples of indicators:
 - PICES Scientific Report No. 37:
 - Relative biomass, *e.g.*, top predators,
 - Biomass ratios, *e.g.*, Piscivore:planktivore,
 - Habitat-forming taxa, *e.g.*, proportional area covered by epifauna,
 - Community size spectra slopes,
 - Taxonomic diversity (richness),
 - Total fishery removals,
 - Maximum (or mean) length of species in catch,
 - Size-at-maturity,
 - Trophic level or trophic spectrum of the catch,
 - Biophysical characteristics, *e.g.*, temperature, chlorophyll a.
 - IndiSeas1 (focused on effects of fishing):
 - Mean length,
 - Trophic level of landed catch,
 - Proportion under/ moderately exploited species,
 - Proportion predatory fish,
 - Mean life span,
 - 1/CV biomass,
 - Biomass of surveyed species,
 - 1/landings/biomass.
 - IndiSeas2 (in addition to IndiSeas1 indicators; expanded to include effects of environment and indicators of human dimensions)
 - Environmental indicators: SST, Chl-*a*, global and regional climate
 - Human dimensions indicators:
 - Effectiveness, efficiency and fairness of fisheries management and quality of governance,
 - Contribution of fisheries to food provision, economic and social well being,
 - Well being and resilience of fisher communities.
 - Biodiversity indicators:
 - Mean intrinsic vulnerability index of fish catch,
 - Trophic level of the community,
 - Mixed trophic index ($TL \geq 3.25$),
 - Proportion of exploited species with declining biomass,
 - Relative abundance of flagship species,
 - Discards/landings.
- C. Indicator Selection Criteria
 - Rice and Rochet (2005) 8-step process for selecting a suite of ecosystem indicators:
 - Step 1 determine user needs,
 - Step 2 develop list of candidate indicators,
 - Step 3 determine screening criteria,
 - Step 4 score candidate indicators against screening criteria,

- Step 5 summarise scoring results,
- Step 6 decide how many indicators are needed,
- Step 7 make final selection,
- Step 8 report on chosen suite of indicators.
- PICES 2011 FUTURE workshop criteria (each criterion should be weighted for relevance to end user identified):
 - available regularly and in a timely manner,
 - available as a time series,
 - statistical properties are understood and provided,
 - related to attribute either empirically or theoretically,
 - specific to attribute,
 - spatial and temporal scales of indicator appropriate to attribute,
 - responsive (sensitive to perturbation),
 - relevant to objective,
 - understandable by target audience,
 - provides a basis for comparison between ecosystems.
- D. Indicators of ecosystem responses to multiple stressors
 - Approaches:
 - Halpern *et al.* (2007, 2008, 2009), Teck *et al.* (2010) – cumulative impact scores,
 - Samhuri and Levin (2012).
 - IndiSeas2 exploring approaches to integrating/combining indicators (Shin *et al.*, 2012):
 - scoring approach to aggregate all indicators into a single indicator,
 - multidimensional approach,
 - multi-criteria decision analysis.
 - Ban:
 - Data-based: Meta-analysis,
 - Expert-based elicitation,
 - Combined above, spatial: Regional mapping, GIS approaches,
 - Experimental,
 - Model-based.
 - Evaluation of indicators to identify vulnerable ecosystem components
 - despite pros and cons of each approach there is a need to use multiple approaches (expert elicitation, model-based simulation, and empirical analysis) to identify and evaluate critical multiple stressors of North Pacific marine ecosystems and indicators to assess their impacts.

Chapter 4. Case Studies

- Coastal systems (using Strait of Georgia, Canada, Puget Sound (US), Seto Inland Sea (Japan)
 - *e.g.*, Perry *et al.* S8 presentation (but at the moment development of Indicators is lacking)
- Possibly: Sea of Okhotsk, Bering Sea (?Lukyanova, Kullik, Zador?)

Chapter 5. Conclusions and recommendations (drafted by Co-Chairs but developed by all WG 28 members)

Appendices

1. Terms of Reference
 2. Membership
 3. Reports of sessions held by WG 28
- etc.*