SIZEMIC
Body-size and ecosystem dynamics: Integrating pure and applied approaches from aquatic and terrestrial ecology to support an ecosystem approach

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2nd Workshop of the ESF Research Networking Programme SIZEMIC

Body size and ecosystem dynamics:
Implications for conservation and management of natural resources

The Sven Lovén Centre for Marine Sciences, University of Gothenburg, Strömstad, Sweden (http://www.tmbl.gu.se/)
June 1-6, 2009

Organiser: Andrea Belgrano (Swedish Board of Fisheries, Institute of Marine Research)

Co-organisers: Bo Ebenman (Linköping University) and Tomas Jonsson (University of Skövde)

SUMMARY

The processes generating the trophic structures of ecosystems and how these structures in turn affect the vulnerability of ecosystems to different kind of perturbations are central issues in ecology. Much recent research has centred on the role of bottom-up versus top-down processes in controlling the structure and dynamics of ecosystems, the risk and extent of trophic cascades following species loss, and the role of top predators for the robustness and resilience of ecosystems. Several recent studies points to the importance of considering the distribution of body sizes within ecosystems when exploring these issues.

The second SIZEMIC workshop aims to generate a dialogue between theoretical, experimental ecologists, and socio-economics researchers engaged in ecosystems management and conservation to discuss the current use of size-based food web models and their integration into a framework for an ecosystem-based management of natural resources.

The workshop encourages participants from different backgrounds to participate in active discussion beyond the current research boundaries and develop novel approaches and ideas that will form the base for new and exciting research avenues.

SCIENTIFIC REPORT

The first days of the workshop 1st-3rd June were dedicated to the activities of the SIZEMIC working group. In Fig. 1. the main topics discussed by each WGs and their possible integration across the current and future WG activities are illustrated in a diagram (Owen Petchey 2009).

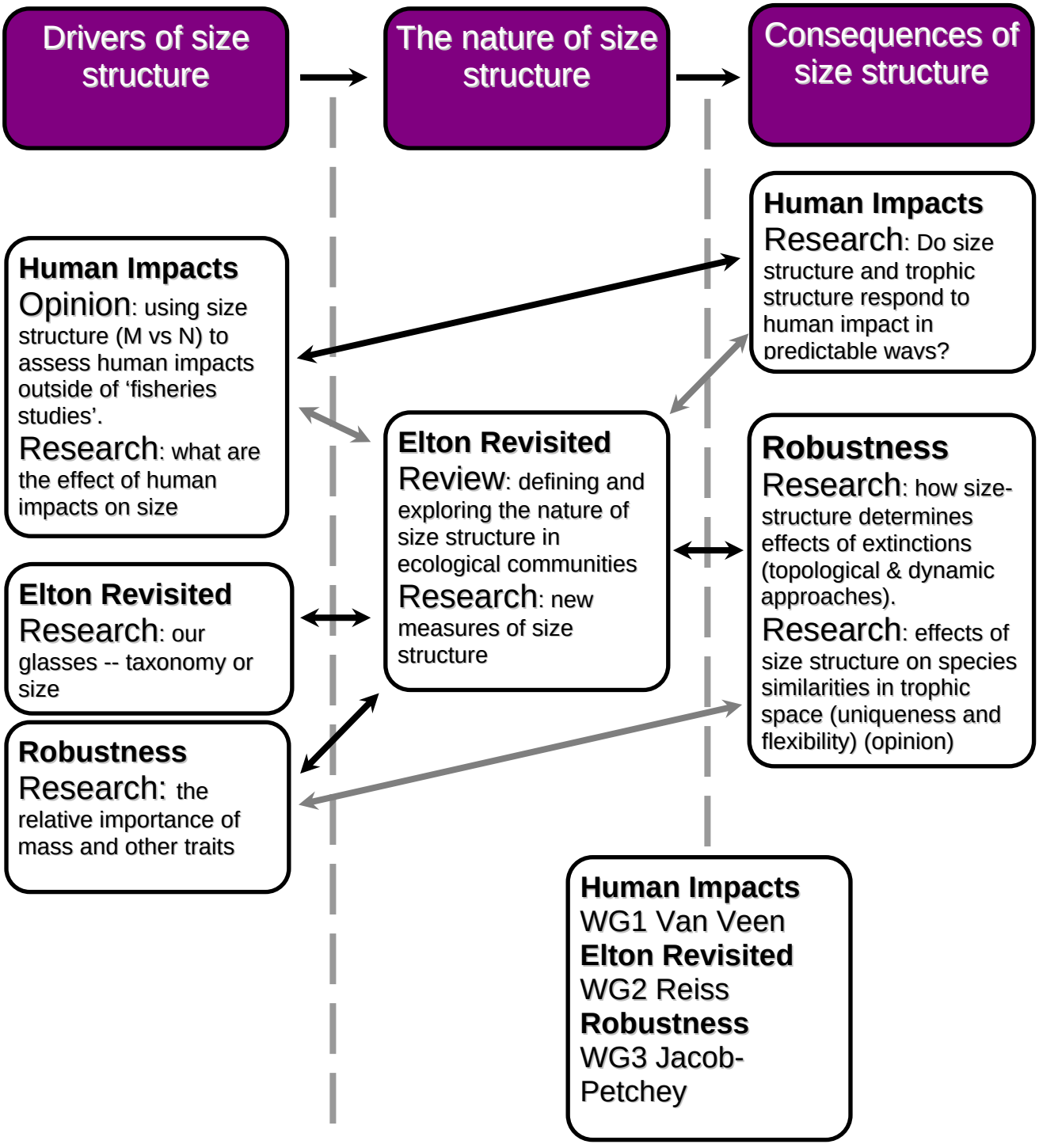

Fig 1. Diagram illustrating the main research topics of each SIZEMIC working group and their integration across themes (Owen Petchey 2009).

The second part of the meeting 4th-6th June was dedicated to the 2nd SIZEMIC workshop. The workshop scientific content and discussions developed around five main topics as listed below:

TOPICS

1) Trophic cascades in food webs– effects of climate change and decreasing abundances of to predators. *Key-note speaker: Chris Carbone*

Size-based top down food web dynamics and size-selective predation have been documented for different ecosystems. Trophic cascade effects can lead to irreversible ecosystem states that will have a severe implication in the way we are currently managing natural resources. Aquatic and terrestrial ecosystems (Shurin et al. 2006) will be compared and linked to specific case studies that will highlight the importance of considering trophic cascade dynamics in relation to multi-species fisheries and wildlife management and conservation policy.

2) Resilience and resistance of size-based food webs to perturbations – identifying keystone species and keystone links. *Key-note speaker: Eric Berlow*

What determines stability in food web dynamics is one of the central themes in ecological research. The interplay between trophic and nontrophic species interaction strengths and the resilience of complex food webs and ecosystem will be discussed to underline the importance of understanding these key processes for conservation and management.

3) Ecosystem-based management of natural resources using size-based approaches (including applications to Baltic Sea). *Key-note speaker: Carlos Melian*

The Ecosystem Based Management (EBM) concept can be improved by the use of macroecology to address a variety of questions relevant to management. For example, for data-rich systems most harvested species may be the most abundant and with broadest ranges. Do these species support higher predation rates by non-human predators? The most harvested species may be embedded in highly reliable and flexible trophic modules. Is there a pattern in predation rates for these species that is different from other species? If harvested species are embedded in isolated subwebs, or are part of important subwebs with high probability of intensive trophic cascades through the network, do these differences show patterns in predation rates? (Melian & Bascompte 2004; Bascompte et al. 2005).

4) Macroecological patterns and the impacts of climate change and exploitation. *Key-note speaker: Ken Frank*

Macroecology is a statistical approach to investigate processes related to invariant-variant patterns of structured class-size, body mass, species abundances, composition and interactions across different spatial and temporal scales (Brown 1995). In this session macroecological principles will be discussed and presented as a tool for understanding complex systems such as multi-species fisheries and wildlife management.

5) Ideas about size-based adaptive management in linked ecological and socio-economic systems. *Key-note speaker: Jon Norberg*

Critical to management within complex systems is the understanding that known problems are partially explained by compounded human influences. We already know that there are growing sets of problems observed in both marine and terrestrial systems for which management solutions have not been clearly identified. Today's approach to the translation of complex information to guidance, policy, and objectives for management involves deep-seated and extensive inconsistency in the face of disparate agendas by various stakeholders (Steele 2006). An even more fundamental problem is continued intense effort to involve stakeholders in this translation in spite of recognized human limitations. We have not been able to deal with (account for) complexity (Fowler 2003), which now stands as a roadblock (Taylor 2005). There is complexity to the systems (e.g., ecosystems) at levels to which we want to expand management (Norberg and Cumming 2008) but we find it impossible with conventional approaches.

Concluding session. *Key-note speaker: Owen Petchey*

The main discussions for future directions were dedicated to the importance of understanding how different body size distributions across systems can be used to assess different ecosystem "properties" including robustness and resilience. Further discussion were also developed on the implication of body size in the relationship between food web complexity and stability, and ultimately the current use of size spectra and future development applied to the management of natural resources across systems.

The work presented and discussed during the 2nd SIZEMIC workshop may result in a special SIZEMIC theme within the scientific journal OIKOS (*in progress*).

References

Bascompte, J., C. J. Melian, E. Sala (2005) Interaction strength combinations and the overfishing of a marine food web. *PNAS*, 102: 5443-5447.

Brown, J. H. (1995) Macroecology. University of Chicago Press.

Fowler, C.W. (2003) Tenets, principles, and criteria for management: the basis for systemic management. *Marine Fisheries Review* 65(2):1-55.

Melian, C. J., J. Bascompte. (2004) Food web cohesion. *Ecology*, 88(2):352-358.

Norberg, J., and Cumming, G. S. (2008) Complexity theory for a sustainable future. Chicago University Press.

Shurin, J. B. et al. (2006) All wet or dried up? Real differences between aquatic and terrestrial food webs. *Proc. R. Soc. B.* 273: 1-9.

Peter, J, Taylor. (2005) Unruly Complexity. Ecology, Interpretation, Engagement. University of Chicago Press, pp. 289.

WORKSHOP PROGRAMME

KEYNOTE SPEAKERS

The workshop will begin each day with stimulating talks from internationally recognised ecologists including: Eric Berlow (University of California, Merced, USA), Chris Carbone (Institute of Zoology, London, UK), Carlos Melian (NCEAS, Santa Barbara, USA), Jon Norberg (Resilience Center, Stockholm, Sweden), Ken Frank (DFO, Canada), Owen Petchey (University of Sheffield, UK).

Day 1 - Morning Thursday 4th June

08:45 – 09:00	Andrea Belgrano **– Introduction to meeting**
THEME 1	**Trophic cascades in food webs – effects of climate change and decreasing abundances of predators**
09:00 -10:00	Chris Carbone - *key-note speaker* - Linking energetics with population responses to prey abundance: implications for carnivore conservation
10:00-10:30	Mark Emmerson - Marine reserves, climate forcing and the robustness of intact ecosystems
10:30 – 11:00	Coffee & Tea
11:00 – 11:30	Eoin O'Gorman - Strong and weak interactors stabilise communities in nature
11:30 – 12:00	Michele Casini – Trophic cascades promote threshold-like shifts in marine ecosystem dynamics: the Baltic Sea case
12:00 – 12:30	Ken Andersen - Damped trophic cascades driven by fishing in a size-based model of a marine ecosystem
12:30 – 13:00	Discussion
13:00 – 14:00	Lunch

Afternoon Thursday 4th June

THEME 2	**Resilience and resistance of size-based food webs to perturbations – identifying keystone species and keystone links**
14:00 – 15:00	Eric Berlow - *key-note speaker* – Simplicity on the other side of ecological complexity?
15:00 – 15:30	Sofia Berg - Effects of changes in species mortality rates on resilience and structure of ecological communities: the role of body size
15:30 – 16:00	Tea & Coffee Break
16:00 – 16:30	Julia Blanchard – Size-based feeding traits and the stability of marine populations and communities
16:30 – 17:00	Samik Datta - A jump-growth model for predator-prey dynamics: derivation and application to marine ecosystems
17:00 – 17:30	John G. Pope - Progress in basing ecosystem models on the moments of length.
17:30 – 18:00	Anna Eklöf - Cascading extinctions in food webs – local and regional processes
18:00	Open Discussion
19:00	Workshop Dinner

Day 2 - Morning Friday 5th June

THEME 3	**Macroecological patterns and the impacts of climate change and exploitation**
08:30 – 09:30	Ken Frank - *key-note speaker – Title to be announced*
09:30 – 10:00	Axel G. Rossberg - A network of fundamental concepts: ideas, data, modelling, and application
10:00 – 10:30	Tea & Coffee Break
10:30 – 11:00	Patrik Stromberg – Slopes from space – general patterns in community size distributions and its implications
11:00 – 11:30	Jonathan A. D. Fisher Global patterns of marine fish body sizes and the 'tropicalization' of Northwest Atlantic large marine ecosystems
11:30 – 12:00	Tom Webb - Linking individual size and community composition to reveal the macroecological consequences of exploitation in marine fish
12:00 – 15:00	Lunch

Afternoon Friday 5th June

THEME 4	**Ecosystem-based management of natural resources using size-based approaches**
15:00 – 16:00	Carlos Melian - *key-note speaker* – Towards a general framework in food webs driven by data at multiple biological levels
16:30 – 17:00	Frank van Veen - Body size distribution as a measure of human impact on food web structure
17:00 – 17:30 –	Coffee & Tea
17:30 – 18:00	Anieke van Leeuwen - How cod shapes its world
18:00 – 18:30	A.Jan Hendriks - Size dependence of ecological rate, time, density and area parameters: a review of empirical regressions put into a consistent framework
18:30 – 19:00	Christian Mulder - How ecological stoichiometry explains the faunal size–specific distribution of food webs
19:00	Dinner

Day 3 - Saturday 6th June

THEME 5	**Size-based adaptive management in linked ecological and socio-economic systems.**
08:30 – 09:30	Jon Norberg - *Key-note speaker* - Ecological consequences of body size in the trait-based framework
09:30 – 10:00	Richard Law – Adaptive exploitation of renewable resources
10:00 – 10:30	Tea & Coffee Break
10:30 – 11:30	**Concluding session.** *Owen Petchey* - *Key-note speaker* - Dimensions of size structure in food webs and comparisons across ecosystems
11:30 – 12:30	Open discussion
12:30 – 14:00	Lunch and departure

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