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Global production network mapping for transforming socio-ecological systems

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In the seafood industry, global production networks (GPNs) are so complex that working with individual supply chains to improve sustainability is not enough to create systemic change. A system-level perspective can build upon supply-chain focused seafood certification and scorecard programs that currently dominate the sustainable seafood arena. We present a system-mapping method we piloted with seafood industry leaders, researchers, and experts, designed to visualize individual supply chains in a wider context and generate new ways of looking at old fishery sustainability problems. With simplified schematics of the GPNs of two fisheries, where pressure to transform came from the harvester and the buyer sides, respectively, we show how system maps helped seafood industry participants to locate major gaps in their understanding of the GPN, and to appreciate the extent of their leverage to address persistent problems.

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Introduction

Incremental improvements to single seafood supply chains are insufficient to create transformative change in fisheries globally. Even with aquaculture now accounting for half of the seafood in the marketplace, radical changes in the seafood system and wild capture fishery supply are needed to meet growing global seafood demand [1]. Achieving more sustainable practices in individual seafood supply chains is necessary and positive, but insufficient to transform fisheries systems overall. There is a disconnect between linear, one-directional supply chain management approaches, and today's globalized seafood supply context [2••]. The concept of global production networks (GPNs) better accounts for the relationships among actors and how they are embedded within local and global structures and institutions [3••] — a perspective that is more likely to facilitate the emergence of transformational ideas and actions.

NGOs and government agencies were once the main actors seeking to help seafood harvesters improve fishery sustainability. Today we see increased engagement of private-sector GPN actors, from large seafood companies to start-ups, applying their leverage and using market-based tools to improve harvesting, processing, sourcing and tracking, distribution of and communication about sustainable seafood. Over the past decade many seafood companies' efforts have focused on market-oriented strategies such as eco-label certification through the Marine Stewardship Council (MSC), and scorecards such as Seafood Watch that help buyers avoid sourcing from overfished fisheries [4•].

MSC is a widely recognized brand in seafood eco-certification [5] and as of 2009 seven percent of wild harvested seafood is certified or under review [6]. MSC also plays a role in industry-led Fisheries Improvement Projects (FIPs), which often prepare fisheries for MSC appraisal, or use the MSC sustainability criteria as a guide for improvement [7•]. Both MSC certification and FIPs currently are applied to single fisheries and species, although current system-focused research urges re-integrating species management into whole social–ecological systems [4]. Critiques of MSC certification include that many fisheries and actors in the GPN are excluded because they lack capital, data and organizational structures to participate (as in fisheries that are part of evolving economies [8]), or because their existing sustainability efforts compete with the MSC framework in some way (as in the case of Alaska, which has its own strictly regulated and enforced eco-labeling system). Most significantly from the perspective of resilience and large-scale transformation toward sustainability, evidence shows that incremental improvements at local-fishery scales or in specific markets or countries are insufficient to transform complex global seafood production networks. Single-chain/species/fishery-focused efforts all operate within a global seafood system [9••], and almost every system has leakage [10•]. In other words, cleaning up a fishery or chain of custody in one site may just displace the problem to

another area. For example, non-MSC certified resources have been fraudulently mislabeled as certified [11•,12].

Scorecards used by retailers, distributors, chefs and consumers are based on fishery stock and ecological parameters [4,13]. The goal is to create pressure for fisheries to get onto approved species lists. Scorecards do appear to affect consumer buying behavior [13], despite confusion caused by multiple scoring systems [14] and frequent lack of verification of seafood sourcing. Leakage can occur when buyers opt to blacklist fisheries that do not rise to approved lists in short time scales, and fisheries may have to seek other markets (perhaps with less stringent sustainability standards). The same problem has been documented for commodity species interventions outside of certifications and scorecards. An example is restricting international trade through the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) for sturgeon and sea cucumber [15–17]. Following the CITES listing, sturgeon sales were reduced by 10% [17], and the harvest of some types of sturgeon reduced by half [18]. However, mislabeled or counterfeit sturgeon was still for sale [17,19,20]. Purcell *et al.*'s analysis of the status of sea cucumbers shows that CITES listing alone was not enough to protect luxury seafood items on global markets [15].

Chains within networks

Language used to conceptualize industry-led sustainability actions — namely the pervasive linear supply 'chain' metaphors used in business strategy and academic writings — may hinder our ability to visualize GPNs as complex systems with feedbacks and non-linear relationships within them. Bush *et al.* [2••] reviewed how sustainability governance has been conceptualized in the supply chains and networks literature, and they also provide insight into how corporate social responsibility relates to resource governance, filling spaces not occupied by government, NGOs, and other institutions. In Bush *et al.*'s typology, two modes of sustainability governance include '*in chain*' governance actions within the firm (in our terms, managing the logistics of seafood certification schemes internally) and '*of chains*' inter-firm governance (i.e. leading buyers setting conditions of market access) [2••]. Both of these chain-focused approaches have some elements of 'one-way' flows where a single firm sets the terms. But a third mode, governance '*through chains*', focuses on effecting change beyond the chain [2••], including two-way influences between other firms (even competitors), consumers, and NGOs, among others. Governance through chains recalls concepts of interactive governance, that is, paying attention to these two-way influences of how the agents being governed, for example, also influence governance [21,22••] and new institutional economics and transaction costs, policy networks, polycentric governance, and complex adaptive systems [23••]. That chain thinking may reinforce top-down ways of seeing multi-dimensional problems is highlighted by Mol's analysis of seafood transparency/traceability initiatives, [24••] which can have the same unintended adverse effects as certification and scorecards: all isolate specific chains within a globalized production network and label them as good or bad. This disempowers people working in fisheries and the approach requires increased surveillance and top-down control, without necessarily generating new information about whether environmental performance is improved. A critique by Von Geibler cites palm oil production [25, see Table 3 in the article] to illustrate how the chain approach leaves out parts of the value chain, fails to integrate small-scale farmers, small companies, and consumer stakeholders, and discourages big-picture sustainability vision (e.g. area-wide conservation systems).

To move beyond single supply chain approaches, collaborative tools are needed that bring into the frame more actors, processes, and environments. In the next section we discuss one such tool we developed and piloted with participants representing fisheries and supply networks in Indonesia and Chile.

Methods

We hosted a workshop at the Royal Swedish Academy of Sciences in Stockholm, Sweden, with participants representing fishery cases with diverse geographies, market structures, and socio-ecological contexts (Textbox 1). The workshop preparation and process was designed to facilitate network and system thinking about the cases. We mapped schematic networks to rapidly represent fishery systems and highlight barriers and opportunities for sustainability actions and transformative change. Mapping can clarify the most effective areas and people to engage in a system, referred to as leverage points in systems thinking [26••].

Box 1 Workshop participants from different sectors were central to the co-design process and included:

Head of Sustainability of Denmark-based seafood company Espersen A/B, that led what is considered a successful fishery transformation and the MSC certification of Baltic Cod, by uniting cod processors in the region to extinguish illegal landings [27].

- Co-founder of Pesca en Línea, a fisher-led start-up in Chile that sells artisan-caught seafood direct to chefs and consumers.
- Production network representatives of Indonesia's small-scale blue swimming crab industry including the director of Asosiasi Pengelolaan Rajungan Indonesia (APRI), an association of crab processors, and leaders of the National Fisheries Institute Crab Council ('Crab Council' hereafter).
- The CEO and founder of the NGO Sustainable Fisheries Partnership, a main player in efforts to improve sustainability through Fishery Improvement Projects (FIPs).
- A sustainability consultant experienced in agricultural transformation design.
- Researchers with expertise in social, economic and ecological dimensions of fisheries, system resilience and transformations.