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Accounting for neoliberalism: "Social drivers" in environmental management

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ABSTRACT

Prevailing models of the human–environment relationship in environmental science, policy, and management (ESPM), largely based on the Drivers-Pressures-State-Impact-Responses (DPSIR) framework, are restricted in their ability to incorporate insights from the environmental social sciences and humanities (ESSH). A review of related literature suggests that ESSH scholars are more likely to critique these models for reinforcing problematic social trends than employ them as analytical tools. Nevertheless, the language of ESPM frameworks can be repurposed to account for a broader range of social considerations. As a first step, this paper develops the concept of "drivers" to focus on *social* drivers – i.e., the major social, political, economic, and cultural forces that shape social–ecological systems. For example, *neoliberalism* may be viewed as a major social driver that has significantly affected small-scale fisheries. While the ecological and economic goals for neoliberal strategies (such as catch shares) are optimistic, commonly observed social effects of these policies are less favorable. This paper illustrates how, if needed, indicators can be developed to assess the social effects of neoliberal policies so that they may be analyzed alongside their economic and ecological effects in an integrated assessment. Such an approach may help draw ESPM attention to the critical roles of social drivers and social conditions in interrelated social and environmental problems. Focusing on *social* drivers offers a potential avenue for bridging ESPM and ESSH, and collaborating toward mutual goals of environmental sustainability and human wellbeing.

1. Introduction: creating a space for social considerations in environmental problem-solving

Environmental scientists, decision-makers, and managers increasingly recognize the need to understand the "human dimensions" of environmental problems: humans largely cause environmental problems and social factors can thwart even the most rigorous science-based management strategies [1–4]. Yet there remains considerable uncertainty in the world of environmental science, policy and management (ESPM) as to how to account for human dimensions in ecosystem models and management plans [1,5]. The field has thus far relied predominantly on the natural sciences as a source of expertise, so recent years have witnessed a growing attempt to invite social scientists to participate in research, planning, and management teams, with the expectation that they will provide data and insights into the social aspects of natural resource management. As encouraging as these developments may be, and despite instances of successful collaboration [6,7], efforts to integrate natural and social science disciplines in ESPM continue to generate tension and confusion and fall short of their potential [1,8–10].

A major factor limiting the problem-solving capacity of ESPM is that the prevailing framings of the social–ecological system – such as the Drivers-Pressures-State-Impact-Responses (DPSIR) model, ecosystem services, and the integrated ecosystem assessment (IEA) approach – are limited in their ability to incorporate the diverse explanatory paradigms of the social sciences [8]. ESPM models are, not surprisingly, primarily focused on the condition of the natural environment, typically casting ecosystems as deliverers of benefits, and humans as sources of "pressures" and "threats." In contrast, fields in the environmental social sciences and humanities (ESSH) focus on social dynamics, casting human groups as diverse sets of actors whose distinct historical legacies, cultural values, knowledge systems, and power struggles shape both social and environmental conditions, for better or for worse. It is an unmet challenge, if not impossible, to account for this social complexity in existing ESPM models (as evidenced, for example, by the ongoing dilemma over how to account for "cultural ecosystem services" [11]). Furthermore, environmental

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social scientists and humanists are likely to view ESPM models as parts of the social system under study, rather than engage them directly as analytical tools. As evidenced below, they are quick to observe how these models reflect and reproduce the values and discourses of their contemporary social contexts. A common critique is that, despite their intentions to promote sustainability and human wellbeing, ESPM models risk *contributing* to the neoliberal forces (defined below) that are reshaping social and ecological systems to serve the global market economy [6].

It is for these reasons, among others, that several prominent ESSH scholars have recently called for an overall change in the "intellectual climate" and cautioned their colleagues against perpetuating the "truncated" language of global environmental science [8]. Yet ESPM models have become so well established, institutionalized in national and international environmental governance, that the chance of introducing alternative narratives into the world of ESPM appears slim, at least in the short term. In the interim, this paper proposes a way for ESSH scholars to directly engage with dominant ESPM frameworks, by repurposing and expanding their language and conceptual models in order to more meaningfully communicate social considerations. Specifically, a renewed and expanded engagement with the concept of "drivers," which permeates ESPM models, offers a potential opening for cross-disciplinary dialogue toward mutual goals of environmental sustainability and human wellbeing.

The paper begins with an overview of widespread ESPM conceptual models, followed by a review of social scientists' critical and constructive responses to them. The next section compares how a selection of natural scientists, social scientists and humanists have defined the concept of "drivers," illustrating the critical difference between "anthropogenic" and "social" drivers. The concept of social driver is then used to explore the transformative impact of *neoliberalism,* a major social driver that has significantly affected both marine ecosystems and maritime communities. *Neoliberalism* is the term used by a cross-disciplinary suite of social scientists and humanists to describe prevailing trends in the global political economy that shift the roles of government to firms, communities, and individuals via the privatization and marketization of everything, state deregulation, market-centered reregulation, and the promotion of community-based services and individualism [12]. (Note that the term "neoliberalism" is used as analytical shorthand to signify these multiple, related trends, rather than a monolithic force of its own [12].) As the authors of this special issue demonstrate, neoliberal forces, including prevailing approaches in fisheries management such as individual transferable quotas (ITQs) or catch shares, lead to significant social and ecological changes.

This paper outlines steps for systematically evaluating the effects of neoliberal strategies on the social–ecological system as a whole, by comparing indicators of their social effects to indicators of their ecological and economic effects. In this way the paper proposes a way to bridge the disparate languages and epistemologies of ESPM and ESSH, and to communicate social considerations to decision-makers in familiar terms. If the tools of ESPM are to successfully identify effective policy and management interventions, the *social* drivers of environmental problems – such as neoliberalism, and the other economic, political, social, cultural, and historical forces that constitute the major subjects of the social sciences – must be understood and accounted for [6,13].

2. Dominant approaches to "human dimensions": the Drivers-Pressures-State-Impact-Responses (DPSIR), ecosystem services, and integrated ecosystem assessment (IEA) frameworks

Currently, three related frameworks dominate ESPM, all of which emerged in the 1990s:

(a) The *Drivers-Pressures-State-Impact-Responses* (DPSIR) model (Fig. 1) was developed in Europe and promoted by the United Nations as a way to organize environmental indicators into a simple conceptual framework of the human–environment relationship. It has been used to convey the significance of environmental information to decision-makers, raise public awareness, identify management strategies and track results, scope research priorities, and develop interdisciplinary indicator sets [14–17].

(b) *Ecosystem services* was conceptualized and promoted by ecological economists and conservation biologists to account for the tremendous economic value conferred by natural processes and thereby build a case for environmental protection within a capitalist society [18]. It gained significant purchase with the United Nation's 2005 Millennium Ecosystem Assessment (MA) as an all-encompassing framework to track environmental change and its effects on human wellbeing [19]. As illustrated in Fig. 2, the MA summarizes its conceptual foundation in a graphic showing a set of uni-directional arrows linking various dimensions of environmental benefits, or "ecosystem services" on the left, to various dimensions of the human condition, or "human wellbeing," on the right. In the MA and assessments like it, ecosystem services are divided into four categories: supporting, provisioning, regulating, and cultural. Human wellbeing is likewise typically divided into several domains, such as health, safety, material wealth, social relationships, and freedom.

(c) The *integrated ecosystem assessment* (IEA) is a tool developed by ecological scientists to understand and communicate the complexity of ecosystems and environmental management by tracking multiple ecological and social indicators under different environmental and management conditions [20]. It has gained international traction in the fields of ocean and fisheries ecosystem-based management (EBM) [21]. EBM emerged as a holistic alternative to conventional natural resource management approaches focused on maximizing resource extraction of individual species [22]. EBM aims to account for interactions among multiple species, ecological processes, and the impacts of cumulative human activities within and between diverse ecosystems. EBM specifically defines ecosystems to include humans, with a stated goal to "maintain an ecosystem in a healthy, productive and resilient condition so that it can provide the services that humans want and need" [3].

The overall purpose of these models is to provide clear, consistent and generalizable frameworks for analyzing and communicating changing environmental conditions, causes of change, and management strategies. As evidenced by a comparison of their representative visual models (Figs. 1–3), these ESPM framings share a language and set of assumptions about the human–environment relationship that largely reflect the DPSIR model. Major causes of environmental change are termed "drivers" (or in the case of the MA "indirect drivers"), which may be either "natural" or "anthropogenic." Drivers are in turn responsible for more specific "pressures" (or in the MA case "direct drivers") that act on specific aspects of the ecosystem. These effects

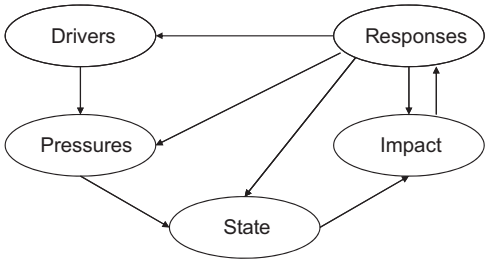

Fig. 1. The Drivers-Pressures-State-Impact-Responses (DPSIR) model [14].

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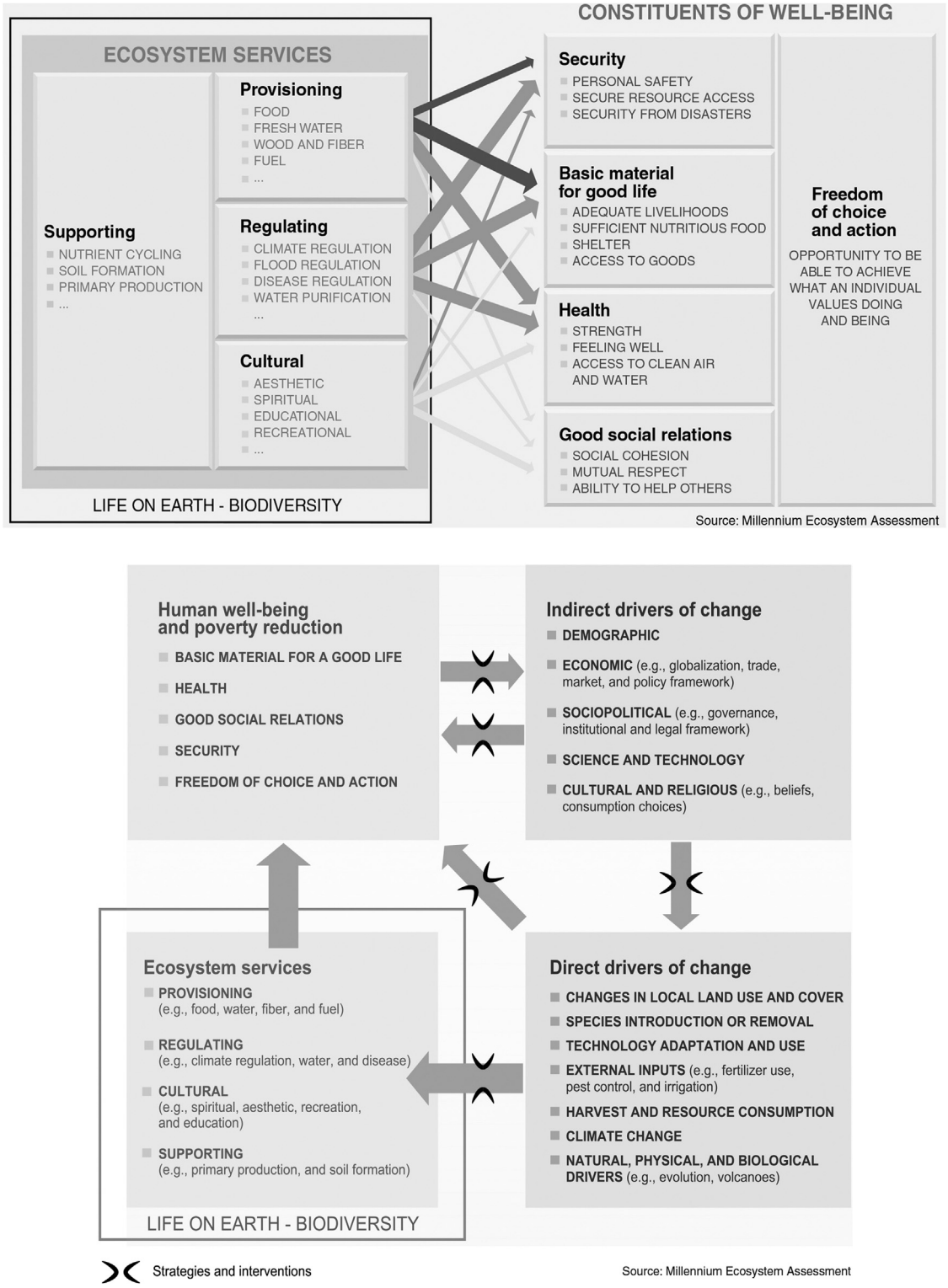

Fig. 2. The Millennium Ecosystem Assessment (MA)'s conceptual models of linkages between ecosystem services, human wellbeing, and drivers of change [19] (used with permission).

can be assessed by tracking the changing "state" or "condition" of the ecosystem. Environmental conditions and processes in turn generate "impacts" on environmental or social areas of concern, which if beneficial are termed "ecosystem services." Finally, this overall analysis enables consideration of various management "responses" by evaluating "risk" and "uncertainty" in the system through a series of "scenarios." All of these assessment approaches involve the use of "indicators": quantitative measurements of science- or policy-significant variables that ideally reveal broader underlying conditions and distill the complexity of environmental challenges for decision-makers into a more manageable form. Indicators are intended to track all parts of the system, including changes in drivers and pressures, effects on social and environmental conditions, and the progress and consequences of management responses. Although the DPSIR model was originally developed as a way to simply organize diverse environmental indicators into a systematic framework, it has

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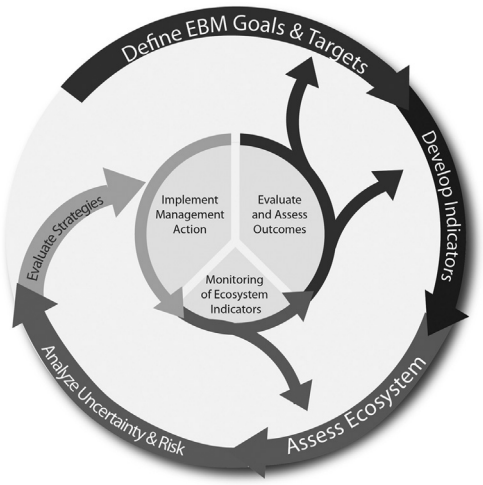

Fig. 3. Steps in an "Integrated Ecosystem Assessment," a major analytical tool used internationally in ecosystem-based management [20,21] (http://www.noaa.gov/iea/loop.html) (used with permission). Note the caption for "Analyze Uncertainty & Risk" reads: "Ecosystem analyses and models evaluate risk to the indicators and thus the ecosystem posed by human activities and natural processes. These methods incorporate the degree of uncertainty in each indicator's response to pressures. This determines incremental improvements or declines in ecosystem indicators in response to changes in drivers and pressures and to predict the potential that an indicator will reach or remain in an undesirable state."

subsequently become a widespread paradigm for conceptualizing environmental assessment and decision-making in general [16].

These ESPM models create placeholders for "human dimensions" such as "anthropogenic drivers and pressures," various "ecosystem services," "links between human societies and ecosystem services," "constituents of human well-being," and "impacts on society." The expectation is that social scientists will populate these categories with "social data" in order to produce a comprehensive and integrated analysis [3]. The most commonly identified gap in "social data" is in how the environment benefits humans directly, i.e., through the effects of ecosystem services on human wellbeing [e.g. 23]. Meanwhile, "management responses" themselves are less often recognized as "human dimensions" needing social scientists' attention. Instead, a commonly perceived role for social scientists – albeit misguided – is to help implement outreach strategies that have already been developed.

What limits cross-disciplinary integration is that these ESPM models represent a particular theoretical framing of the human–environment relationship that research in the environmental social sciences and humanities does not necessarily support [8]. As the following section illustrates, many social scientists are more likely to view these ESPM models as interesting social phenomena in their own right, representing contemporary and often problematic trends in environmental science and governance, rather than as authoritative frameworks for social–ecological analysis. As geographer Rob Fish notes, "cultural theorists … would be more likely to regard cultural ecosystem services as an object of critique, rather than a concept to be embraced" [24]. Indeed, critical social scientists have gone so far as to characterize ecosystem services as utilitarian and reductionistic, "a case of commodity fetishism" that "masks … unequal social relations," exclusionary, "Euro-centric," "counterproductive to conservation," morally questionable, unethical in "placing the burden of environmental protection on the poor," and a form of "epistemological and ontological violence" [25]. Nevertheless, a closer look at several social scientists' critiques reveals potential avenues for engaging with and repurposing these models in order to improve social literacy in ESPM and advance shared cross-disciplinary commitments to environmental sustainability and human wellbeing.

3. Social scientists' responses to dominant ecosystem models: critiques and openings

The social science discipline that has contributed most directly to the ESPM models outlined here is economics. Other fields in the social sciences and humanities that address the human–environment relationship as a subject of study, including environmental anthropology, geography, political ecology, environmental sociology, rural sociology, and environmental history, do not typically engage these models. Instead, they draw analytical guidance from their respective disciplinary traditions and from transdisciplinary literatures in social, cultural, and political theory. Nevertheless, expertise in ecosystem services is beginning to be characterized as "social science" in the world of ESPM – an interesting if dismaying social phenomenon in its own right.

Like all scientists, social scientists strive to understand the world by collecting and analyzing empirical information and situating their findings within larger theoretical conversations. In the social sciences and humanities these conversations have centered on the roots and consequences of major social phenomena, such as the rise of the nation-state, colonialism, modernization, the emergence of science and technology, cultural and economic globalization, and social movements. In addition, like conservation biologists and many other scientists, social scientists usually care about what they study and strive to bring about a better world, typically with an emphasis on social justice. ESSH researchers often additionally express care and concern for the natural world. As evidenced below, social scientists and humanists are typically concerned with structures of power and inequality that constrain cultural diversity, self-determination, and human rights.

A common feature of DPSIR, ecosystem services, and indicators is their aura of objectivity and universalism, what social theorist Haraway calls the "god-trick of seeing everything from nowhere," despite having particular origins, built-in assumptions, and intentions [26]. From this vantage point, universalistic frameworks such as these ESPM models are generally viewed with skepticism by ESSH scholars as tools of power and standardization [26–31]. They harness the discursive authority of science to communicate the knowledge and values of professional elites to centralized political and financial bodies that have the power to reshape social–ecological relationships. The concern is that large-scale scientific management schemes are prone to reshaping the systems they attempt to manipulate according to simplified and poorly understood models of them [29], resulting in "tragic consequences for people and the environment" [31]. The "techno-utopian faith in fisheries science and management" that accompanied international adoption of the 200-mile exclusive economic zones (EEZs), for example, has been associated with the subsequent collapse of fish stocks [31]. To draw an imperfect analogy, a universalistic framework such as DPSIR is like a monoculture in that it crowds out "alternative interpretations and actions" with a single, pervasive paradigm, or what social scientists term a "hegemonic discourse" [15]. Thus social scientists typically view ESPM models as emerging "technologies of governance" [32] that have the power – indeed, that are designed to have the power – to transform human–environment relationships to serve large-scale managerial agendas, and it is for this reason that they deserve critical attention.

3.1. Critiques of the Drivers-Pressures-State-Impact-Responses (DPSIR) framework

The DPSIR model has been criticized by social and natural scientists alike for presenting a simplistic, linear, uni-directional, and hierarchical view of the human–environment relationship

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that misses the cultural contexts, causal complexities, social impacts, and aggregate social responses that characterize environmental problems and resource management [15,16,33,34]. As a report that included an early iteration of DPSIR ("PSR") warned, this approach "tends to suggest linear relationships in the human activity-environment interaction … [and] should not obstruct the view of more complex relationships in ecosystems and in environment-economy interactions" [35].

Yet as sociologist Svarstad and co-authors argue [15], this obstruction of other views is exactly what DPSIR does do, having gained the status of a "hegemonic discourse" in ESPM. The authors explain that the popular DPSIR framework is typically presented as a straightforward depiction of reality with little acknowledgment of its inherent biases. By analyzing four dominant narratives about biodiversity, they find that DPSIR fully supports a preservationist approach to biodiversity conservation, but, tellingly, cannot accommodate the narratives that capture the major concerns of social scientists and human rights advocates. This is in part because, in their analysis of DPSIR, "Drivers" refer strictly to "external forces damaging the area or species that need protection rather than [to] socio-economic and cultural processes that are integrated with developments in biodiversity." In addition, in their reading, "State" refers only to biophysical but not social conditions. The authors conclude that, despite its professed function to promote stakeholder dialogue, DPSIR constrains conversations and interventions to those that fit its terms, and therefore risks losing credibility and relevance with people whose "perspectives and concerns have been ignored" [15].

Geographers Carr and colleagues furthermore dismiss DPSIR as an inappropriate framework for evaluating sustainable development due to its hierarchical structure that reproduces "existing inequalities between actors and stakeholders" [33]. Indeed, although the United Nations initially helped to promote DPSIR as a model, the UN Commission on Sustainable Development decided to abandon DPSIR in 2001, stating it was too simple and ambiguous to adequately communicate the relevance of sustainability indicators for policy decisions. Nevertheless, the same report notes that DPSIR continues to be used in ESPM contexts [17].

3.2. Critiques of ecosystem services

Social scientists raise similar concerns about the concept of ecosystem services. Economist Norgaard explains that what began as a metaphor – to recognize the earth's natural processes as economically valuable "services" such as water filtration and carbon sequestration – is now taken at face value in ESPM [18]. The idea of ecosystem services was initially promoted to highlight the social-ecological problems caused by a consumption-based economy; subsequently it has led to the idea that the market can be "fine-tuned" with credits and payments for ecosystem services. As Norgaard laments, "The metaphor's ties to the problems of continued economic growth have largely been broken. Indeed, through carbon offsets and optimizing the use of ecosystem services in poor countries, the delusion of continuing consumption along its old path in the rich countries is being sustained" [18]. An empirical review of the United Nation's Reducing Emissions from Deforestation and Forest Degradation (REDD) program, which has relied on payments for ecosystem services (PES) as a major tool, underscores social scientists' concerns [36]. To date, REDD projects have been shown to benefit elites while exacerbating poverty and marginalizing local forest communities. To explain this inequity, the authors recommend conducting research on "the power structures and social processes affecting how REDD is designed and implemented," and "sharing the burden of forest management" with the "drivers of deforestation" that exist at multiple scales "beyond forest communities" [36]. Norgaard captures the broader problem with ESPM models when he cautions, "The ecosystem services approach can be part of a larger solution, but its dominance in our characterization of our situation and the solution is blinding us to the ecological, economic, and political complexities of the challenges we actually face."

Indeed, far from helping to integrate social science insights into ESPM, the concept of ecosystem services arguably reduces social literacy among ESPM professionals. As geographer Fish notes [24], there is the problematic environmental determinism represented by the MA's oft-cited unidirectional arrows (see Fig. 2a) suggesting that ecosystems somehow create culture, and moreover provide it as a "service." And to the chagrin of anthropologists, for whom "culture" includes material culture, "cultural services" are often assumed to be "intangible" things such as aesthetics, spirituality, and education [23].

Geographers Dempsey and Robertson level a more biting critique: "Ecosystem services is at least in the vanguard of the neoliberalization of nature, if not the flagship case … Nature is now found frequently represented as credits, information, or services, purportedly unbound from material essences and free to move through global circuits of credit and finance commodities" [25]. Here, from a critical social science perspective, putting a price on all of nature in the framework of ecosystem services only serves to reinforce and reinscribe a major driver of contemporary social as well as environmental problems, namely, the free market ideology of neoliberalism. In a pointed example, Robertson reports on botanists who are expected to jettison scientific principles in order to produce the information required to identify wetland mitigation banks, or the "nature that capital can see" [28]. Piecemeal ecosystem services projects are not going to solve our dire environmental problems, Norgaard argues; what is needed are major changes in our politics, institutions, and economic systems [18].

3.3. Critiques of indicators

In the context of ESPM, indicators are proxy measurements intended to distill the complexity of environmental problems for easy digestion and evaluation by decision-makers [2]. Yet, as social foresters McCool and Stankey succinctly state, speaking about using indicators to assess sustainability, "efforts to simplify complexity can go awry" [38]. Likewise, anthropologist Merry, reflecting on indicators through a look at performance measurements of human rights programs, observes, "Numerical measures produce a world knowable without the detailed particulars of context and history"; indicators "convey an aura of objective truth and facilitate comparisons" yet "typically conceal their political and theoretical origins and underlying theories of social change and activism" [38]. Furthermore, these authors argue that the dominant assumption that indicators are the domain of scientists constructs social and environmental problems as technical rather than moral and political challenges. Indicators thus risk replacing political debate about the issue at hand with technical debate over indicator selection and measurement, and can delude decision-makers into thinking their solutions are a matter of technical fixes rather than policy initiatives.

Merry notes that indicators tend to consolidate power in the hands of those with expert knowledge, and in particular experts in the global north where most indicator systems are developed. They also reify categories, such as race, class, and gender and, most of all, the overall category that they measure, such as rule of law, poverty, or in the case of ecosystem services, human wellbeing. Finally, Merry notes, "the growing reliance on indicators is an instance of the dissemination of the corporate form of thinking and governance into broader social spheres." They are a "technology of audit and performance evaluation" that often devolves the state's responsibility to measure and manage to local communities

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or entities which are then evaluated and compared via performance measures [38].

From a critical perspective, the growing momentum to account for natural processes as "ecosystem services" and to measure their benefits to humans through "indicators of human wellbeing" is part of a larger, worrisome trend to capture the natural and cultural richness of the world in economistic terms that allows it to be traded off through seemingly dispassionate cost-benefit analyses.

3.4. Potential openings

The irony in these critiques is that ecosystem services and indicators of wellbeing started as critical alternatives to conventional economic assessments, which were viewed as short-sighted and reductionist. Ecosystem services was coined approximately 20 years ago as a metaphor to illustrate the incompatibility between continuing economic growth and achieving a sustainable planet, and to inspire conservation of nature in what was seen as an inevitably market-dominated discourse [18]. Likewise, "human wellbeing" emerged in the 60s and 70s as a progressive and alternative response to the ubiquitous use of gross domestic product (GDP) as a proxy for social conditions and quality of life [39]. Similarly, EBM posits itself as a holistic alternative to commodity-focused and industry-specific approaches that previously dominated natural resource management [3,22]. Thus, a more generous reading of these ESPM frameworks is that they are a good start, considering where they started from, but they do not go far enough.

Many of the authors whose work is reviewed here state that, despite their misgivings, social scientists *should engage* with DPSIR, ecosystem services and indicator assessments. Not only are these models seemingly here to stay, as polyvalent concepts and evolving technologies of governance, they may have the potential to be used as progressive counter-measures to assess the social–ecological effects of contemporary social forces such as neoliberalism. Svarstad and colleagues do not dismiss DPSIR, but recommend it be expanded to incorporate "social and economic concerns," "the state of social matters," "socio-economic and cultural drivers," and "social, economic and cultural conflicts" [15]. Cautiously, Dempsey and Robertson ask if "the ecosystem services concept can be deployed in ways that help people … achieve increased autonomy and well-being without imposing a commodity logic on their resources?" [25]. Anthropologist Merry observes, "Indicators are like witchcraft. Witchcraft is the power to guide the flow of supernatural forces for good or evil" [38]. She explains that indicators can "provide a technology for reform as well as control" and can "make visible forms of violation and inequality that are otherwise obscured." At the very least, as McCool and Stankey offer, the value of indicators is that they can "reveal what additional analysis might be needed to gain an improved understanding of a phenomenon" [37].

Collectively, these social scientists suggest there is a way forward with these ESPM framings, but it will require considerable conceptual work. First, if the ecosystem now truly includes humans, then ESPM models must recognize that the human – i.e., sociocultural – world is at least as complex and worthy of concern as the biophysical world. Specifically, all pieces of these models – drivers, conditions, impacts, and so on – must, at the very least, pay as much attention to social forces, processes, and conditions, as they do to biophysical factors. If human dimensions are to be adequately accounted for, in other words, these need to become fully *social–ecological* conceptual frameworks, and not simply ecosystem-centered models that only accept certain types of social data. The literature on social–ecological systems provides considerable guidance for generating more balanced conceptual frameworks [6,40,41].

Furthermore, the models and related indicators should be carefully developed and wielded to promote curiosity and further investigation, rather than reproduce economistic, mechanistic, Cartesian, preservationist or universalistic paradigms that hinder the creative thinking and diversity of approaches needed to solve the world's wickedly complex environmental problems. Social scientists, and even the original modelers, caution that ESPM models should not blind us to underlying complexity nor constrain political engagement. The models should be presented alongside explanations of related social–ecological contexts and causal linkages, and should state their embedded assumptions about social and ecological change. While each model and its various elements clearly need rethinking in light of these and other considerations, this paper specifically focuses on the promise of repurposing the concept of "driver" as a first step – or at least experiment – toward integrating the central concerns of ESSH into the widely used frameworks of ESPM.

4. What is a "social driver"?

A cross-disciplinary sampling of papers by prominent natural scientists, social scientists, humanists, and SES scholars studying marine and coastal ecosystems reveals differences in how they conceptualize "social," "human," and "anthropogenic" drivers of ecosystem change, as well as the targets of those drivers and, therefore, how they conceptualize environmental problems (Table 1). In papers by four of the five groups of natural scientists [3,42–44], the focus with respect to human dimensions is on "anthropogenic" drivers of change and their impacts on the natural environment. For the fifth group [1] the focus is on "micro scale drivers of human behavior" in response to management strategies. For all the social scientists and humanists reviewed [13,45–48], the focus is on "social" drivers or processes of change either affecting a social–ecological system or a resource-dependent community.

The anthropogenic drivers of environmental change identified by natural scientists refer mostly to processes of human reproduction (e.g., population growth), consumption (e.g., demand for seafood), and production (e.g., fishing). Long lists of the "impacts" of these "pressures" or "activities" on the environment follow, such as changes in fish populations and pollution. In effect, these natural scientists view humans through the same lens through which they view other organisms: as producers and consumers of material and energy that generate population changes, habitat structure, and waste. Fulton et al. differ by discussing "micro scale drivers of human behavior" that are hypothesized to be related to job expectations, profit maximization, social status, and lifestyle preferences [1]. Here, human drivers are located in the behavior of individual managers and resource users. In contrast, the majority of social drivers identified by social scientists are not material or individual drivers, but in fact *social* – referring to the broad social, cultural, economic, institutional, legal, political, and historical forces that enable and constrain human activities and motivations. Collectively, the social scientists and humanists reviewed here identify the major social drivers of marine social–ecological change to involve colonization, globalization, neoliberalization, governance, social movements, science and technology, commercialization, industrialization, cultural dynamics, and disease (Table 1). This distinction between focusing on individuals and their material effects versus on social forces as drivers of social–ecological change is critically important because these different framings suggest different solutions.

Furthermore, these authors' distinct areas of concern – the natural environment and human responses to management, on the one hand, and a joint social–ecological system and human

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Table 1
Driver-change relationships (italics) and human-related drivers (bullet points) identified by natural scientists (left hand column) and social scientists, humanists, and social–ecological system scholars (right hand column) studying marine, coastal and fishery systems. Principle disciplines of first authors are noted.

"Anthropogenic" drivers identified by natural scientists	"Social" drivers identified by social scientists, humanists, and social–ecological system scholars
McLeod et al. [3] – fishery science *How humans impact marine ecosystems* • Activities on land, coasts, and in ocean • Pollutants, alteration of coastal habitats • Climate change • Aquaculture • Coastal development • Fishing • Military activities • Shipping	**McEvoy** [45] – environmental history *Drivers of change in the California fisheries, 1850–1980* • Interdependence among ecological, economic and social processes • Economic enterprise • Legal processes • Cultural interactions; racism • Colonialism • Infectious disease • Industrialization and mechanization • Commercialization • State power • Population growth • Fisheries science and management
Halpern et al. [42]– marine ecology *Global anthropogenic drivers of marine ecosystems* • Nutrients (fertilizer) • Organic pollutants (pesticides) • Inorganic pollutants (impervious surfaces) • Direct human (population density) • Commercial fishing (low by-catch, high-bycatch, and destructive) • Artisanal fishing • Oil rigs • Invasive species • Ocean pollution • Shipping • Climate change (sea surface temperature, ultra violet radiation, ocean acidification)	**Berkes** [13] – social–ecological systems *Drivers of social–ecological change involving globalization* • Globalized markets for marine products • Environmental monitoring and activism, such as certification and ecolabeling • UN millennium development goals • Infectious disease
Levin and Schwing [43] – ecology *Anthropogenic forcing factors in marine ecosystems* • Human population size in the coastal zone • Coastal development • Demand for seafood	**Murray** [46] – natural resource sociology and marine ecology *Key processes that shape the case study fishing communities* • Governance emphasizing economic rationality, conservation, and privatization • Globalization of input (e.g. fuel, vessels, gear) and of output (e.g. fisheries products) • Changes in harvesting technologies
Guerry et al. [44] – zoology and ecology *Impacts and stressors on marine ecosystems* • Population growth • Increasing standards of living	**Thébaud and Blanchard** [47] – resource economics *Drivers of change in fisheries* • Growing influence of markets • Institutional context and economic incentives such as regulated open access
Fulton et al. [1] – marine ecology and modeling *Micro scale drivers of human behavior in response to management strategies* Managers: • Pressure to produce results • Maximizing resource rents • Restricting the ecological impacts of fishing to acceptable levels Resource users: • Shorter-term profits • Status of their investments • Social standing in their communities • Lifestyle choices	**Moerlein and Carothers** [48] – environmental anthropology *Causes of social change in Native Alaskan subsistence fisheries* • Historic and continuing dramatic political, social, cultural, and economic changes • Introduction of industrialization and consumerism • Ownership and management of natural resources by outside bureaucratic bodies • Colonialism • Acculturation • Technology

community, on the other – partly explain the different "drivers" that each group identifies. The natural and social scientists construct their object of study and its major influencing forces in their own familiar – and therefore distinct – terms. Yet all of these drivers are interconnected in a social–ecological system and must be collectively understood in order to assess their effects on the ecosystem as a whole. As Ommer notes, "Whatever socio-economic, cultural and legal drivers affect the fishing activities of fishing communities will, by extension, also affect the fish assemblages and marine ecosystems with which they interdependently interact" [49]. Likewise, natural and social drivers affecting the biophysical environment will affect the people who depend on it [49]. Table 1 underscores the need for integrated analyses to investigate how social and anthropogenic drivers are linked.

The Millennium Ecosystem Assessment (MA) models a more comprehensive approach to social drivers, in that it identifies five "indirect drivers" of change in ecosystem services, including "demographic, economic, sociopolitical, scientific and technological, and cultural and religious" drivers [19]. These are thought to have a diffuse influence on "direct drivers," whose effect on the environment can be identified and measured, and are "primarily physical, chemical, and biological, such as land cover change, climate change, air and water pollution, irrigation, use of fertilizers, harvesting, and the introduction of alien species" [19]. The MA also distinguishes between "endogenous" drivers (those that a decision-maker can affect) and "exogenous drivers" (those beyond their scope), noting that drivers may be endogenous or exogenous depending on the level of decision-making. For example, a local resource user may be more able to affect direct drivers of environmental change, while regional or national decision-makers may be able to affect indirect drivers. The MA states that environmental change is driven by multiple drivers with multiplicative and interactive effects, and that there is no one "root" driver. Finally, it observers, "The many processes of globalization

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Table 2
Social effects of neoliberal marine management strategies collectively observed in three reviews [50–52]. Note that this is not necessarily a comprehensive list of all salient themes.

***Resource use*: Shifts in use of marine space and resources from local resource users to other users**
Uses of marine space and resources shift from local small-scale or artisanal fishing to larger scale commercial fishing, scientific research, recreation, coastal tourism, bio-prospecting, and military uses.
***Geography:* Geographic consolidation and urbanization of fisheries**
Small, rural communities lose quota, which destabilizes these communities and depopulates rural areas, while larger and more urban ports gain quota, causing a rural-urban migration of the fishing industry.
***Governance:* Changes in or displacement of local management systems and decision-making**
Local resource management systems are displaced and political debate is bypassed; new forms of co-management are observed.
***Civil society:* Emergence of local social, political and legal resistance and counter-discourses**
Fishermen and fishing communities mobilize anti-ITQ social movements, including protests, legal action, and regulatory non-compliance, and a narrative about fairness and equity emerges that critiques the effects of fisheries privatization.
***Economic structure:* Concentration of capital in larger operations**
Capital and market power is increasingly concentrated in the largest and most profitable enterprises, and is associated with increased vessel capacity and profitability, vertical integration of larger operations, and increased leasing costs, dept-dependence, or dispossession of smaller operations, with cumulative effects on shore-side businesses, decreases in local ownership, sale of ITQs by low-income and indigenous fishermen, and strain on rural and mixed commercial and subsistence economies.
***Employment:* Changes and limitations in employment and upward mobility, with particular effects on crew**
With capital concentration, vertical integration, and urbanization of fisheries, employment opportunities change, usually with significant job losses, notably for crew, shore-side employment, and fishermen and processing workers in rural and indigenous communities where labor is not necessarily mobile and alternative income sources are not necessarily available; it becomes more difficult to enter a fishery and follow the traditional upward path from crew member to owner-operator.
***Income:* Shift of crew income from shares to wages**
Crew income is distributed via wages rather than shares, with mixed results: in some cases it decreases and in others it increases, though typically not as much as overall harvest value, representing a proportional decrease.
***Job quality*: Diminished job quality**
Longer working hours diminish job quality.
***Self-determination:* Loss of control over livelihoods**
Smaller scale fishermen and crew lose power and certainty to determine the direction of their livelihoods
***Social relations:* Increased hierarchy and polarization among social groups**
Shifts in power relationships create ill will between boat owners and operators, with a new sense of dependency on "quota lords," while the rationalization of coastal management polarizes communities along interest and class lines.
***Identity:* Change in what it means to be a successful fisherman**
Fishermen begin to identify as profit- versus livelihood-driven fishermen, with livelihood fishermen increasingly marginalized.
***Community structure:* Changes in identities and roles, and increased social hierarchies within communities**
Changing identities, roles, and incentives, and increased discrepancies in wealth and privilege within communities changes their structure, integrity, and stability, with particular consequences for women, livelihood fishermen, and traditional and indigenous communities, while local resistance to privatization is associated with community solidarity.
***Cultural values:* Shift in values from fairness and attachment to place to competition and individualism**
The promotion and rise of competitiveness and individualism violates traditional egalitarian and community-centered values and definitions of success, and undermines place-based fishing, affiliation with ancestral resources, local stewardship, and other attachments to place.

are leading to new forms of interactions among drivers of changes in ecosystem services" [19].

Although the MA promotes the framework of ecosystem services and emphasizes drivers of biophysical change, its relatively sophisticated conceptualization of drivers (see Fig. 2b) provides a helpful and familiar starting point for focusing attention on forces of change that affect both social and environmental conditions and their interrelationships. The MA's "indirect" and "direct" drivers are analogous to the "social" and "anthropogenic" drivers defined here, yet by qualifying social drivers as "indirect" the MA risks obscuring their real and powerful effects on human-environment relationships. To achieve meaningful integration, ESPM models must fully recognize and account for how truly *social* drivers affect the social–ecological system as a whole – which is the major subject of the environmental social sciences and humanities.

5. Analyzing neoliberalism as a social driver in an ESPM framework

"Neoliberalism" is the term used by critical social scientists to describe a host of contemporary political and economic trends that are promoting market forces while dismantling traditional governmental roles [12]. In the critical social science literature, neoliberalism is viewed as a major – if not the major – contemporary force, or driver, of social change, on a par with and related to economic globalization. ESSH researchers observe the effects of neoliberalism on both social and environmental conditions and their interconnections. As evidenced by the articles in this special issue, a major focus of non-economic social scientists studying marine systems is on how the neoliberalization of fisheries and coastal management is affecting social conditions, and thereby the marine ecosystem as a whole [49]. While much of this research is in the form of case studies, it collectively reveals a recurrent set of themes.

A summary of three worldwide reviews – one on the social effects of integrated coastal management [50] and two on the social effects of fisheries privatization [51,52] – suggests a list of major social attributes that may be tracked in assessing the social effects of neoliberalization of marine ecosystems (Table 2). The authors collectively observe that the rationalization and privatization of marine space and resources is engendering significant geographic, political, economic, social, cultural, and psychological changes. On the whole their results suggest that worldwide processes of neoliberalization are consolidating wealth and power into larger, more urban, and more capitalized fishing operations. Meanwhile, this geographic and economic shift, along with the promotion of competition and individualism, is severely straining and in some cases destroying the livelihood-based identities, egalitarian and place-based cultural values, and internal social structures of small, rural, traditional, and indigenous fisheries and fishing communities. These are often place-based communities in which labor is not necessarily mobile and economic alternatives are lacking, despite the assumptions of economic modelers. Particularly noticeable are effects on crew, often in terms of job loss, loss of opportunities for entry and

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upward mobility, and a shift in income from shares to wages. For these and other reasons local resistance movements have emerged, characterized by protests, legal action, regulatory non-compliance, and counter-discourses that contrast values of equity and fairness with the economic and apparently conservationist rationales behind neoliberal management strategies.

The three review papers [50–52] collectively note that the stated goals and rationales for neoliberal marine management strategies are to increase economic efficiency, flexibility, and profitability; end overfishing; improve the sustainability of fisheries; improve the sustainability of fishing communities; stabilize the length of the fishing season; increase human safety; foster environmental stewardship; and improve ecosystem health. In contrast to this optimism, the observed social effects of these strategies constitute a more negative picture. Indeed, a systematic comparison of the anticipated outcomes of neoliberal strategies with their observed social effects could test whether these strategies achieve their stated social, as well as economic and ecological goals, and how these effects may be interrelated. As Carothers and Chambers [51] point out, Melnychuk et al.'s [53] analysis of 345 privatized fisheries shows that catch share programs limited overfishing largely because of an overall catch limit, and only marginally because that total allowance was divided into tradable quotas. Yet it is the tradable quota policy that has driven the social changes listed above. Furthermore, these social changes have provoked resistance to privatization, and because privatization is increasingly associated with conservation, resistance targets this environmental rationale rather than the larger paradigm and driver of neoliberalism. Thus, in hitching conservation to neoliberal management strategies, the goal of fostering an environmental ethic appears to backfire [51]. In an economic model neoliberalization may appear to be the best conservation plan, but when viewed through the dynamics of the full social–ecological system, its merits are called into question.

This question can be investigated systematically, by jointly assessing the economic, ecological and social effects of the neoliberalization of fisheries and coastal management, including how privatization compares to what came before and to alternative strategies. Collectively, the themes outlined in Table 2, in addition to other themes (such as mental health [54]) collected from additional sources, suggest potential attributes of the social–ecological system that could be measured through indicators in order to assess the effects of neoliberalism as a social driver in marine ecosystems. Such indicators could potentially deliver the "social data" that is demanded by ESPM frameworks and decision-makers. Results may also help social scientists deconstruct the idea of neoliberalism as a monolithic driver into observable sets of dynamic and heterogeneous forces, or processes of neoliberalization [12]. In this way these themes begin to outline a systematic research agenda for social scientists and humanists hoping to develop and communicate their critical insights about the social–ecological effects of neoliberal policies to the world of ESPM.

6. Four proposed steps to account for social drivers in environmental management models

In summary, this paper proposes a way to translate major themes of ESSH into the language and frameworks of ESPM via the following steps:

(1) Expand the concept of "drivers" to include "social drivers," or broad social forces such as neoliberalization (for other examples see Table 1), and read the associated literature to clearly understand the meaning and nature of this social driver.
(2) Review and summarize research related to how this driver affects the social–ecological system, such as how ITQs affect small-scale fisheries. (Note that many of these studies are published in books and book chapters [e.g. 41], which are often overlooked by environmental scientists [e.g. 23]).
(3) Analyze emergent themes for potential attributes to track using indicators – if indicators are required as deliverables for management or decision-making. For example, in the case of neoliberalism these attributes might include the categories listed in Table 2.
(4) Measure these social variables or indicators alongside economic and ecological variables in order to produce an integrated assessment of how a particular social driver affects multiple dimensions of the ecosystem.

The goal is to illuminate broad social forces in order to contextualize analyses of more proximate and material relationships at work in a social–ecological system. The caveat is that these steps are simply proposed as a pragmatic strategy for introducing the world of ESPM to the theoretical foundations of ESSH, and provoking curiosity about potential areas needing further attention. The reviews summarized here, plus much of the ESSH literature, illustrate the need for a much richer study of the human–environment relationship, unrestricted by ESPM frameworks, in order to illuminate the actual, interrelated social and ecological causes and consequences of environmental problems. The literatures in social–ecological systems [e.g. 6,7,40,41], political ecology [e.g. 55,56], and environmental history [e.g. 45,57] offer rich models for this type of analysis.

7. Conclusion

According to critical social scientists, ESPM models risk contributing to social–ecological problems by reproducing the discursive assumptions and real-world consequences of major social drivers. DPSIR, ecosystem services, and indicators reflect trends in neoliberal governance, with the risk of simplifying social–ecological understanding, perpetuating the commodification of nature, and marginalizing local people, diverse knowledges, and political dialogue. Yet, given their rising influence, this paper explores how these frameworks may be used with caution to communicate important ESSH insights to the world of ESPM. As the social scientists reviewed here suggest, if these models are developed conceptually to account for social complexity and the interrelationships between social and ecological systems, they may be able illuminate some of the social drivers, dynamics, and consequences that complicate environmental management. This paper proposes a series of steps for social as well as natural scientists to navigate and transform ESPM models in order to shift critical attention to "social drivers" and how they are linked to "anthropogenic drivers" and social–ecological change.

The key cautionary principle here is to sufficiently grasp the social contexts – those "power structures and social processes" [36] – in which the models and their results are built and implemented, in order to avoid inadvertently exacerbating social forces that can ultimately undermine goals of sustainability and human wellbeing. As sociologist Neis writes, "effective and coherent knowledge about social–ecological systems requires reflexivity – attention to the knowledge producer's own social ecology," in which "social power is a dynamic and central driver" [31]. Accounting for *social* drivers in environmental management thus includes accounting for how these drivers affect the language, conceptual frameworks, knowledge, and people informing management. The critical question for ESPM models is whether and how they will ultimately serve to effect the major political, economic, and institutional changes necessary to address urgent social–ecological problems.

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