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Current Practice and Future Prospects for Social Data in Coastal and Ocean Planning

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Abstract: *Coastal and ocean planning comprises a broad field of practice. The goals, political processes, and approaches applied to planning initiatives may vary widely. However, all planning processes ultimately require adequate information on both the biophysical and social attributes of a planning region. In coastal and ocean planning practice, there are well-established methods to assess biophysical attributes; however, less is understood about the role and assessment of social data. We conducted the first global assessment of the incorporation of social data in coastal and ocean planning. We drew on a comprehensive review of planning initiatives and a survey of coastal and ocean practitioners. There was significantly more incorporation of social data in multiuse versus conservation-oriented planning. Practitioners engaged a wide range of social data, including governance, economic, and cultural attributes of planning regions and human impacts data. Less attention was given to ecosystem services and social–ecological linkages, both of which could improve coastal and ocean planning practice. Although practitioners recognize the value of social data, little funding is devoted to its collection and incorporation in plans. Increased capacity and sophistication in acquiring critical social and ecological data for planning is necessary to develop plans for more resilient coastal and ocean ecosystems and communities. We suggest that improving social data monitoring, and in particular spatial social data, to complement biophysical data, is necessary for providing holistic information for decision-support tools and other methods. Moving beyond people as impacts to people as beneficiaries, through ecosystem services assessments, holds much potential to better incorporate the tenets of ecosystem-based management into coastal and ocean planning by providing targets for linked biodiversity conservation and human welfare outcomes.*

Keywords: coastal and ocean planning, conservation practice, ecosystem services, human dimensions, marine protected areas, marine spatial planning, social data, social–ecological systems

La Práctica Actual y los Prospectos Futuros para los Datos Sociales en la Planeación Costera y Oceánica

Resumen: *La planeación costera oceánica incluye un campo amplio de práctica. Las metas, los procesos políticos y los acercamientos aplicados a la planeación de iniciativas pueden variar ampliamente. Sin embargo, todos los procesos de planeación requieren finalmente de información adecuada sobre los atributos sociales y biofísicos de una región de planeación. En la práctica de la planeación costera y oceánica existen métodos bien establecidos para evaluar los atributos biofísicos; sin embargo, el papel y la evaluación de los datos sociales son entendidos mucho menos. Llevamos a cabo la primera evaluación global de la incorporación de los datos sociales en la planeación costera y oceánica. Partimos de un resumen comprensivo de la planeación de iniciativas y un censo de practicantes costeros y oceánicos. Hubo una incorporación más significativa de datos sociales en el uso múltiple contra la planeación orientada por la conservación. Los practicantes ocuparon un rango extenso de datos sociales, incluidos los atributos de gobernación, económicos*

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y culturales de las regiones de planeación y los datos de impacto humano. Se le prestó menos atención a los servicios ecosistémicos y a las conexiones socio-ecológicas, pudiendo ambas mejorar la práctica de planeación costera y oceánica. Aunque los practicantes reconocen el valor de los datos sociales, se le dedica poco financiamiento a su colección e incorporación en los planes. Un incremento en la capacidad y en la sofisticación para adquirir datos sociales y ecológicos críticos para la planeación es necesario para desarrollar planes para ecosistemas y comunidades costeras y oceánicas más resistentes. Sugerimos que mejorar el monitoreo de datos sociales, y en particular datos sociales espaciales, para complementar los datos biofísicos, es necesario para proporcionar información holística para las herramientas de apoyo a las decisiones y otros métodos. Ir más allá de las personas como impactos, y hacia las personas como beneficiarios, a través de la evaluación de servicios ecosistémicos, tiene mucho potencial para incorporar mejor los principios del manejo basado en ecosistemas a la planeación costera y oceánica al proporcionar objetivos para la conservación de la biodiversidad y los resultados de bienestar humano que estén conectados.

Palabras Clave: áreas marinas protegidas, datos sociales, dimensiones humanas, planeación costera y oceánica, práctica de la conservación, servicios ecosistémicos, sistemas socio-ecológicos

Introduction

Coastal and ocean planning encompasses conservation-oriented planning (e.g., for marine protected areas), sectoral planning (e.g., for fisheries or recreational activities), and multiuse planning (e.g., marine spatial planning or integrated coastal zone management). The goals for conservation-oriented plans are primarily ecological and focus on conserving biodiversity, protecting sensitive habitats, maintaining ecological resilience, and restoring key populations or ecological processes (Osmond et al. 2010; Leslie 2005). Multiuse plans are often broader in their remit because they encompass social goals such as reducing conflicts among uses or allocating space for ocean or coastal industries (e.g., renewable energy) (Dahl et al. 2009; Collie et al. 2013).

The goals, political process, and context of coastal and ocean planning initiatives can vary widely, but ultimately all planning processes require adequate information on both biophysical and social attributes to accurately represent the planning region. Conservation planning practitioners use well-established methods to assess biodiversity, species distribution, and other critical biophysical attributes of ecosystems (Margules & Pressey 2000). Although social data are recognized as important (Naidoo et al. 2006; Stephenson & Mascia 2009), approaches that characterize the human dimensions of these ecosystems remain fragmented, sectoral, and limited in scope. Practitioners tend to rely on readily available biophysical and social data rather than information more likely to illuminate the linkages among the social and ecological systems. This knowledge gap constrains our understanding of how human–environment interactions drive ecological outcomes in coastal and ocean ecosystems. It also limits the approaches practitioners can take to achieve better social and ecological outcomes.

We conducted the first global assessment of the use of social data in coastal and ocean planning and identified key challenges and opportunities associated with social data across planning initiatives and governance scales. We reviewed 66 planning initiatives across governance scales, from local to international (Fig. 1; Supporting Information), and conducted a survey of 44 researchers, managers, and planners (hereafter practitioners) involved in developing these initiatives. We assessed the collection, synthesis, analysis, and use of social data in a comparison of conservation-oriented and multiuse planning. Specifically, we assessed what types and how social data are incorporated in each plan and whether these attributes differed across types of initiatives, governance scales, and geographical regions. We also identified key challenges and opportunities to improve the utility of social data and to better incorporate the tenets of ecosystem-based management into coastal and ocean planning.

Methods

Literature Review

We undertook the first global review of coastal and ocean planning initiatives. We focused on multiuse planning and conservation planning as differentiated from initiatives based on their primary goals (e.g., multiuse, multisectoral goals vs. conservation of marine biological diversity; for details, see Supporting Information). To identify candidate plans, we searched Google Scholar and Scopus between April 2012 and January 2013 for the following keywords: *marine spatial planning*, *ocean management plan*, *marine management plan*, *coastal management plan*, *integrated coastal zone management*, *marine conservation planning*, *marine protected area management plan*, *national biodiversity plan* in English, French, and Spanish. Due to the large number of initiatives initially identified (>200), many of which lacked evidence of official action toward planning goals, we restricted our analysis to cases that met the

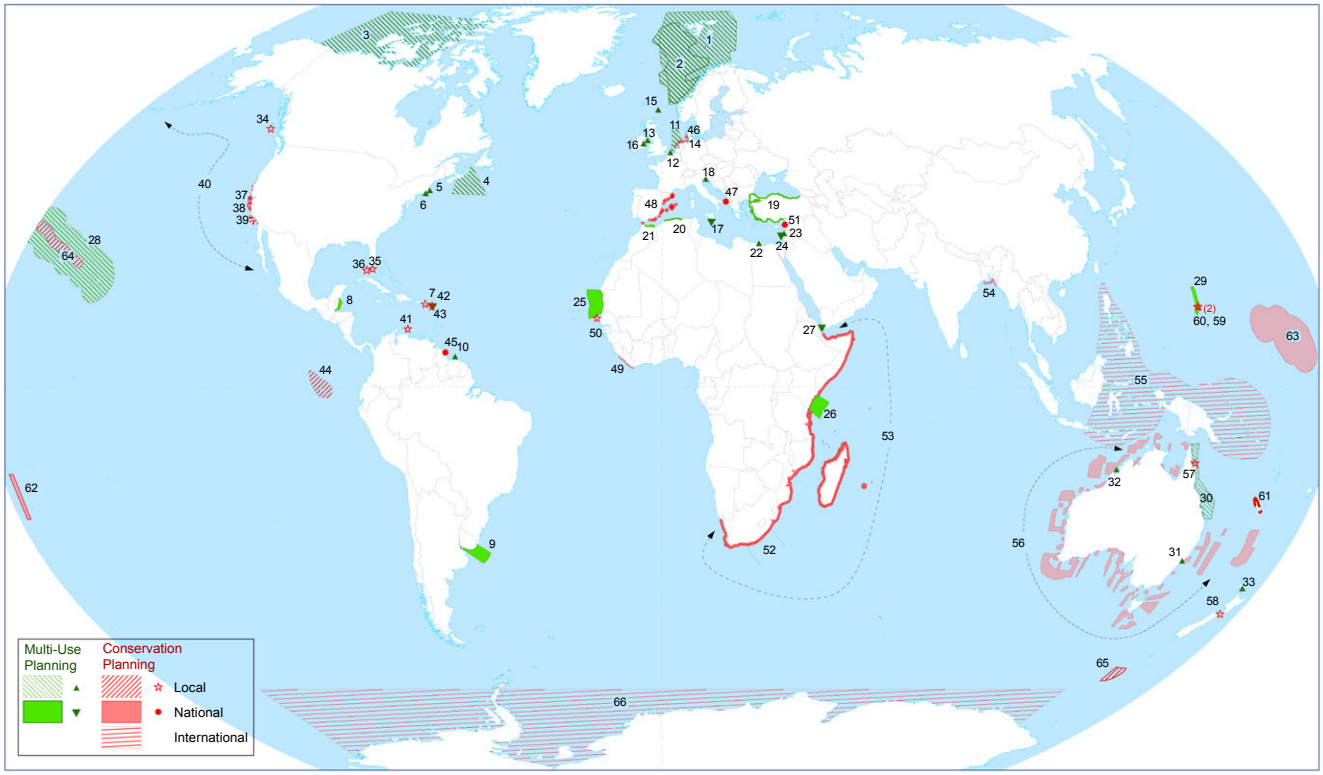

Figure 1. Global distribution and extent of multiuse (numbers 1–33) and conservation (numbers 34–66) coastal and ocean planning initiatives included in the review of 66 plans.

following criteria: plans implemented or in the process of implementation, written plan or report we could review, and plans available across a range of geographies and scales (local, national, and international). Based on these criteria, we compiled 66 (see Supporting Information) planning initiatives comprising 33 multiuse and 33 conservation initiatives and spanning governance scales from local to international (Fig. 1).

To assess social data use in these plans, we created a social data index of 30 social indicators (Table 1). We initially developed a list of indicators that we derived from a human dimensions framework (Kittinger et al. 2012) and indicators from other published metrics (Supporting Information). Our social data index included 30 indicators from the initial list that were used in at least 80.0% of plans (Supporting Information). Indicators fell into 2 main categories and 6 subcategories: social attributes (indicators for demographic, economic, cultural, and governance attributes) and social–ecological interactions (indicators for human impacts and ecosystem services). These categories primarily captured the social attributes of human uses as well as linkages between social and ecological systems. We evaluated differences in social data incorporation in planning initiatives across geographic scales and between multiuse and conservation planning initiatives with nonparametric Kruskal–Wallis rank sum tests (Supporting Information) in R (R Development Core Team 2008).

Surveys of Practitioners

We developed a comprehensive survey to assess how practitioners identified and collected social data, perceptions of the challenges and opportunities of acquiring social data, and the approaches used to analyze and incorporate social data into plans. Our survey included both open-ended and close-ended questions and was administered with Qualtrics, an on-line survey tool. The survey pool included practitioners associated with the plans we reviewed (Supporting Information).

We used a modified version of Dillman's (2007) tailored design method to implement the survey. This approach entails engaging respondents through a series of repetitive interactions to elicit higher survey response rates. We first contacted prospective participants and followed up with 3 weekly reminders to each (Claycomb et al. 2000; Yun & Trumbo 2000). In total, 75 researchers, managers, and planning practitioners involved in 78 plans were queried and 44 completed the survey (total response rate = 58.7%). All responses from participants were aggregated to make data anonymous and safeguard confidentiality (Supporting Information contains entire survey).

Table 1. Attributes of the social data index (SDI) used to evaluate the incorporation of social data in coastal and ocean plans.[a]

Social attributes		
category	*subcategory*	*indicator*
Demographic	demography	population size or density
		population settlement pattern
	well-being	access to basic utilities and facilities
Economic	employment	employment and unemployment rate
	macroindicators	GNP/GDP
Cultural	cultural heritage	archaeological
		historical
	cultural rights and traditions	mores and values
Governance	existing legal and administrative system	local
		national
		international
	future legal and administrative system	local
		national
	existing institutions	local
		national
Social–ecological interactions		
category	*subcategory*	*indicator*
Impacts	anthropogenic-driven pressures	physical damage or loss
		other physical disturbances
		pollution
		introduction of nonindigenous species
		biological disturbances
	external pressures	natural hazards
		conflicts between uses and users
		inadequate or weak enforcement system
		climate change
	impact on SES[b]	social impact
		economic impact
		environmental impact
Ecosystem services	ecosystem services and benefits	provisioning services
		regulating services
		cultural services

[a] *This table includes indicators present in at least 80.0% of the plans (Supporting Information contains a full list of indicators).*
[b] *Social–ecological system.*

Comparison between the Review and the Surveys

Following independent analyses of our global review of coastal and ocean planning initiatives and the surveys of practitioners, we compared the findings from these 2 sources to contrast practitioner's perceptions of incorporation of social data in plans with actual data from plans. Specifically we compared the types of social data included; how different types of social data were prioritized; and how social data were prioritized in planning relative to biophysical data. We began by matching survey respondents with plans (this was possible in only 10 case studies, 6 multiuse planning initiatives, and 4 conservation planning initiatives) (Supporting Information). We based our analysis on social attributes (social, economic, cultural, and governance), ecosystem services, and human impact indicators.

Results

Literature Review

Most plans we reviewed were at local (57.6%) or national (34.8%) planning scales with good worldwide coverage. We reviewed fewer plans (7.6%) of international extent (i.e., multiple national boundaries) because such plans were less prevalent (Supporting Information). Multiuse plans were mostly from Europe, Africa, Oceania, and the Arctic, and conservation plans were mostly from North America, Oceania, Africa, and Europe (Fig. 1 & Supporting Information). On average, most of the planning initiatives we reviewed were from developed countries (71.2% vs. 28.8% in developing countries), and 51.5% of the plans were implemented after 2006 (period from 1998 to 2011).

On average, multiuse initiatives in the Arctic, South America, and Africa and conservation initiatives in Oceania, Africa, and Europe had the highest proportion of social data included in their plans (Supporting Information). Developing countries tended to include slightly more social data than developed countries (49.4% vs. 43.0% [Supporting Information]). On average, plans at the national scale included more social data (49.4% of the social data indicator [SDI]) than local (45.5% of SDI) and international plans (32.7% of SDI) (Supporting Information), but these differences were not statistically significant.

Multiuse plans included significantly more social data (49.6% of SDI) than conservation plans (41.6% of SDI, Kruskal–Wallis rank sum test, $p = 0.05$ [Fig. 2a]). This difference was primarily due to greater inclusion of economic indicators in multiuse plans (Fig. 2b, Kruskal–Wallis rank sum test, $p = 0.04$).

Our results also show some congruence regarding the type of social data included in plans. Both multiuse and conservation plans tended to include the same proportions of governance, human impacts, economic, cultural, demographic, and ecosystem services indicators (Fig. 2b), in that order. Regarding social–ecological linkages data, practitioners typically included information on ecological impacts from human activities;

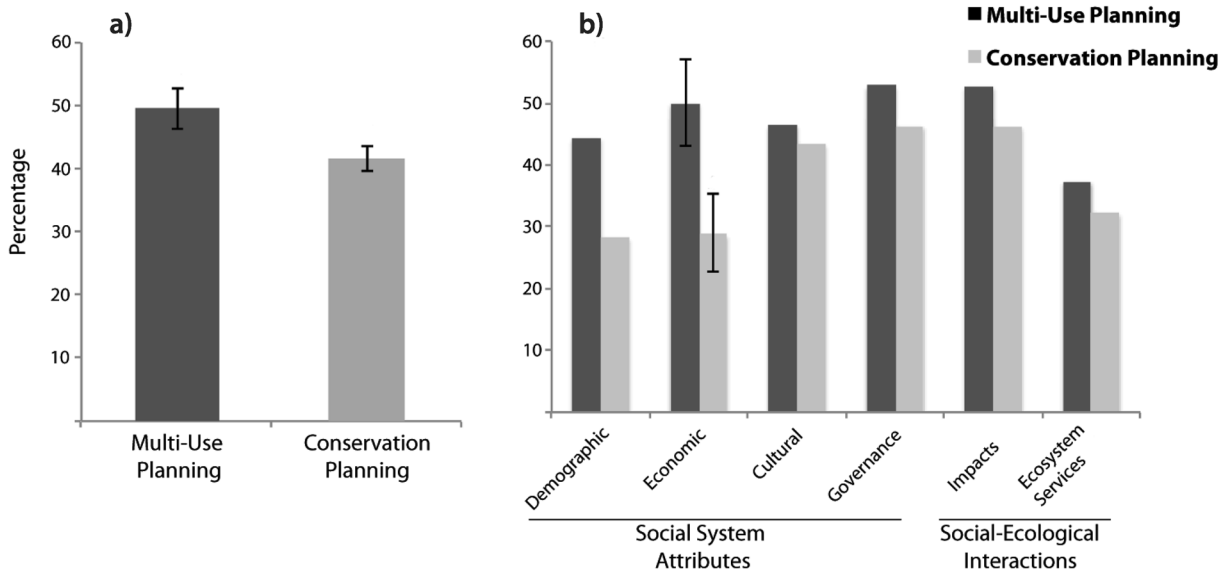

Figure 2. (a) Total and (b) categorized average percentages of the most commonly used social indicators included in multiuse and conservation coastal and ocean planning initiatives.

however, data on ecosystem services were absent in the majority of the plans, irrespective of the type of plan (Fig. 2b).

Most social indicators were not spatial; 10.8% of the most commonly used indictors had a spatial component (Supporting Information). The proportion of spatial data used did not vary between multiuse and conservation plans.

Surveys of Practitioners

Most respondents were from developed world regions (e.g., North America, Europe, and Oceania [Supporting Information]) and were involved in initiatives at the local level (63.0%). Fewer were involved at the national (33.0%) or international (4.0%) levels. Between 1998 and 2011, almost all planning initiatives were the first of their kind in the region (88.0%) and were completed within the last 6 months to 5 years (88 .0%).

Practitioners involved in multiuse plans reported a higher likelihood of incorporating social data, even if it was not required by legislation or policy (85.0%), than practitioners involved in conservation-oriented plans (67.0%). Irrespective of the type of plans, practitioners tended to favor biophysical over social data in terms of effort devoted to collection, analysis, and incorporation of data in support of planning. Indeed, 38.0% of the respondents reported that more biophysical data than social data were used, whereas 19.0% reported that more social data than biological data were used. Furthermore, the budget allocated to acquisition of these data showed a much stronger contribution toward the collection, analysis, and incorporation of biophysical (67.0% of the budget) data than social data (33.0% of the budget) (Supporting Information).

Practitioners identified several key advantages and disadvantages to incorporating social data. Key advantages included use of social data as a mechanism for stakeholder engagement; in assessment of stakeholder values and perceptions and human impacts; and to characterize demographic, economic, cultural, and governance aspects of the planning area (Fig. 3 & Supporting Information). Practitioners reported fewer disadvantages than advantages of incorporating social data; however, the lack of availability was identified as a key barrier. Other limitations such as integrating social with biophysical data or confidentiality regarding certain uses (e.g., commercial fishing and military activities) were perceived as disadvantages.

Methods used to collect social data relied most frequently on existing secondary data and survey or interview-based or participatory (user-generated) approaches (both 73.0%). Social data included in planning were quantitative (29.0%) or qualitative (29.0%), and few practitioners reported even distribution of quantitative and qualitative data (14%). Some plans mixed approaches, though more plans tended to favor a mix of approaches that were mostly qualitative (19%) rather than mostly quantitative (10%). A majority of practitioners (60.0% of them) reported that most (51–75%), almost all (76–99%), or all (100%) of the social data they included were spatially explicit. Practitioners reported that they frequently used spatial analysis for social data (96.0%). Other common analytical methods included gathering temporal social data for time-series analysis (61.0%), layering preexisting social data sets (57.0%), and combining social and biophysical data (48.0%).

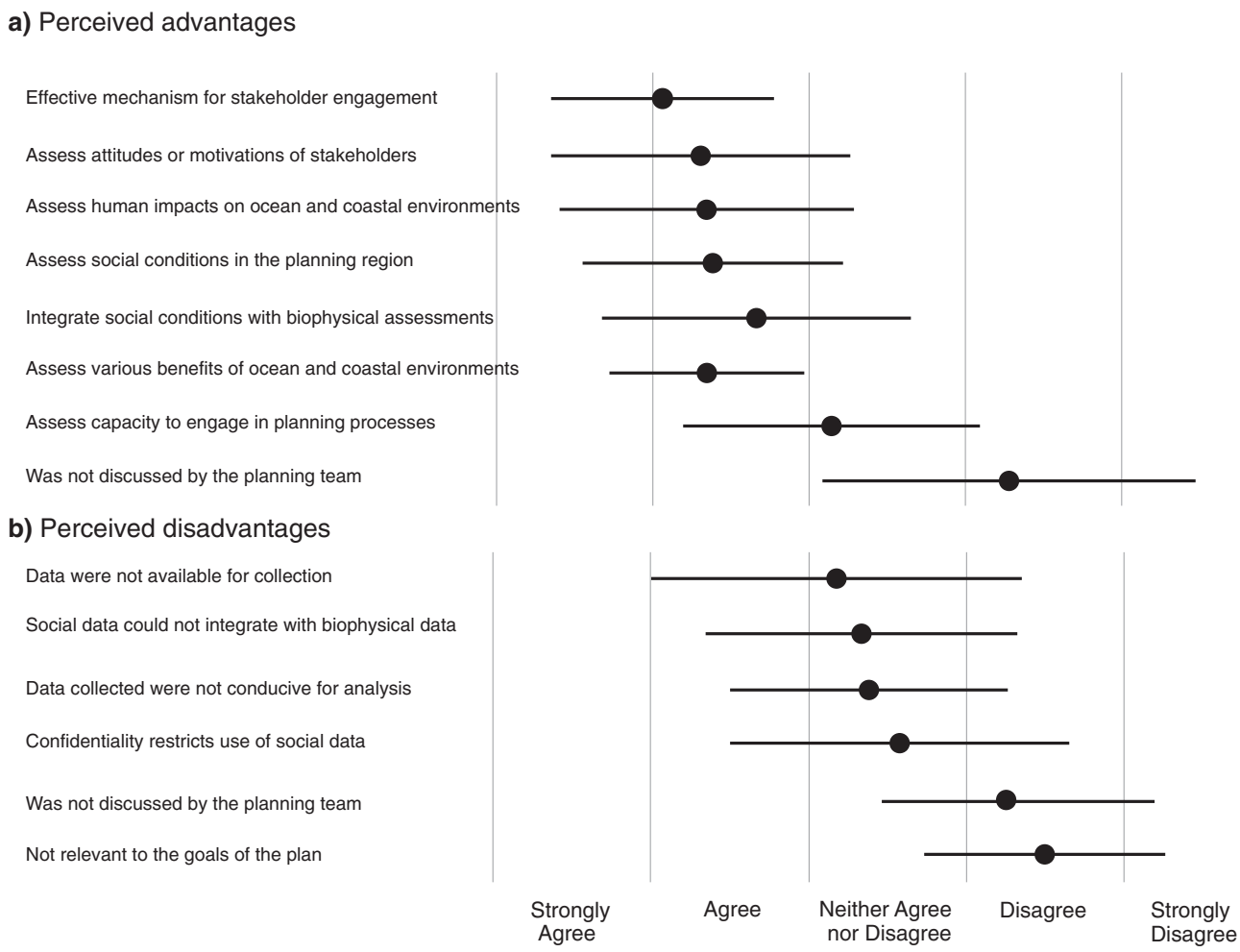

Figure 3. Perceived (a) advantages and (b) disadvantages of incorporating social data in coastal and ocean planning initiatives according to practitioners. Responses were averaged for respondent's agreement with each perceived advantage and disadvantage (center point, mean; line, standard deviation; n = 25).

Comparison of the Literature Review and the Surveys

Our survey respondent pool was biased because all respondents came from developed countries (Supporting Information). Accordingly, these comparative results should be interpreted conservatively.

There was general congruence among survey results and plan review results with respect to the types of social data incorporated in coastal and ocean planning practice. As reported above, planning practitioners gave higher priority to social data that characterized governance, cultural, or economic aspects of the planning region (Supporting Information) than to ecosystem services. However, practitioners perceived a higher inclusion of ecosystem services than the results from our planning review (Supporting Information). Results of spatial data use in the plan review also contrasted with survey findings. Only a small fraction of social data from the SDI was spatially characterized (10.8%), whereas at least 60.0% of the practitioners reported that most, almost all, or all (51–100%) of their social data were spatially explicit.

Discussion

We assessed the current state of the use and incorporation of social data in coastal and ocean planning as well as the challenges and opportunities associated with the use of social data. Our results have several important implications regarding the role of social data in ocean and coastal planning practice.

Our global assessment shows that, in general, practitioners are actively incorporating social data in their plans. On average, existing initiatives include 45.6% of the most commonly used SDIs, with an emphasis on governance, cultural, and economic data for the social attributes category and human impacts data for the interactions category (Fig. 2b). This result is congruent with

findings from our survey, which showed that practitioners included information primarily on the governance systems of a planning region and on ecological impacts from human activities.

Our research shows that to date, coastal and ocean planning practice has primarily focused on characterizing human impacts as the primary social–ecological relationship (Fig. 2b). Practitioners were less engaged in characterizing ecosystem services from these environments. The ecosystem services approach has garnered much attention in the literature for its potential to provide targets for linked biodiversity conservation and human welfare outcomes (Chan et al. 2006, 2011; Fisher et al. 2009; Granek et al. 2010). Methods for measuring ecosystem services have recently increased in their refinement and level of sophistication (e.g., Kareiva et al. 2011), and empirical evidence supports the value of ecosystem service approaches in conservation in practice (Goldman et al. 2008; Tallis et al. 2009). These studies and our research suggest substantial room for growth in incorporating ecosystem services in coastal and ocean planning practice. Moving beyond people as impacts to people as beneficiaries may help prevent an overreliance on analysis of impacts and negative connotations associated with human uses (Kittinger et al. 2012). Although we highlight here the potential advantages of planning for multiple ecosystem services, it is also important to note that management approaches that incorporate ecosystem services through economic optimization schemes should be tempered with an understanding of potential negative impacts of such schemes. Economic optimization approaches such as catch shares or territorial user rights approaches may not be applicable in all contexts (Ruddle & Davis 2013), and there are increasing examples of unintended consequences on resource user communities, such as consolidation effects that reduce livelihood diversification and consequently may increase economic vulnerability (e.g., Kasperski & Holland 2013).

Planning approaches that make use of ecosystem services may foster solutions by helping practitioners capture information about service flows and beneficiaries. This can aid in assessing impacts of proposed alternatives and in moving beyond simplistic, descriptive assessments and toward approaches that capture the dynamic social–ecological profile for a specific region (i.e., social and biophysical attributes, as well as their interactions). Such approaches have been advanced for planning in terrestrial systems (e.g., Pasquini et al. 2010), and approaches that integrate data in social–ecological assessments in coastal and ocean planning are also emerging (e.g., Alessa et al. 2008; Okey & Loucks 2011). There is much opportunity to expand these integrated approaches (Ban et al. 2013). Potential benefits of social–ecological assessments for practitioners include the ability to ascribe specific social benefits and ecological impacts to different uses, activities, or sectors; to assess the cumulative impacts of human uses and the cumulative benefits provided to human communities by ecosystems in the planning region; and to associate specific human interactions with specific ecological outcomes, which has implications for trade-off analysis and development of planning alternatives.

We report significant differences in the use of social data between multiuse and conservation plans (49.6% vs. 41.6%). Regarding conservation planning initiatives, less use of social data may reflect an epistemological bias toward biodiversity protection among conservation-oriented initiatives. The relative lack of social data in conservation planning poses several potential risks to planning practitioners. First, criticisms of such approaches have long held that lack of incorporation of the social dynamics of conservation can have both significant socioeconomic and cultural impacts on local communities and stakeholders (Agrawal & Redford 2009; Mascia et al. 2010). Second, failure to account for the social dimensions of a conservation initiative can result in unintended consequences if conservation regulations are not adhered to by resource users, particularly if basic social needs conflict with biodiversity protection (Agrawal & Gibson 1999; Adams et al. 2004; Christie 2004). In response, conservation practitioners have begun to incorporate more social data through a variety of mechanisms and approaches. In systematic conservation planning, for example, social data are often included as costs and are characterized in terms of economic values for different uses in decision-support tools (Ban & Klein 2009). Participatory approaches that allow for the inclusion of stakeholder-generated data on values and benefits are becoming more prevalent (e.g., Scholz et al. 2010), and such data can help planners prioritize areas that provide key benefits to communities and design conservation protections that minimize socioeconomic impacts to stakeholders (Friedlander et al. 2003; Green et al. 2009).

For multiuse planning initiatives, higher levels of engagement with social data may reflect the multisector nature of such planning efforts, which consequently require practitioners to more explicitly consider trade-offs among different human activities in a planning region. As such multisector trade-off analyses have become more prevalent, the need for spatial social data is becoming more acute (Ban & Klein 2009). Our survey results suggest practitioners may be limited by the availability of relevant and spatial social data. High reliance on secondary data sets point to the value of monitoring programs for social data and a need to adequately fund more robust programs that gather a wide variety of social attributes of planning regions (including benefits and impacts of different human uses). When implemented together with existing biophysical monitoring programs, social data may help provision planning processes with adequate data for assessing dynamic social–ecological linkages.

One of the most striking outcomes of our research is the lack of spatial social data in the plans. Only 10.8% of the most commonly used indictors were spatially characterized, which contrasts greatly with our survey results. The gap between our survey and plan review results may be a result of the bias in our respondent pool or differences in our methods for reviewing plans versus survey practitioners. Despite these limitations, we uncovered a general lack of spatial social data, which may present a major barrier in planning practice. Spatial data are becoming increasingly important due to the use of decision-support tools that allow decision makers to weigh the costs and benefits of proposed management actions (Center for Ocean Solutions 2011). Although characterizing social data can be challenging (e.g., Knight et al. 2010), researchers are developing innovative techniques to map human dimensions in ocean environments (e.g., St. Martin 2001; Klain & Chan 2012; see Koehn et al. 2013 for a review). Social data sets that are spatial provide much promise for integrating analyses with ecological data. For example, understanding the spatial distribution of activities can help practitioners optimize spatial plans to maximize benefits among user groups (e.g., White et al. 2012). Alternatively, where uses with greatest ecological impact occur, understanding the cumulative and synergistic effects of overlapping impacts can help practitioners alleviate pressures to protect ecosystem integrity and the services from these environments. However, practitioners should be aware that an overreliance on spatially explicit data may exclude important data that either are not spatial in nature or are difficult to ascribe to spatially. Such approaches can potentially devalue or preclude the use and consideration of nonspatial social data, which may be critical to understanding the planning region (Hall-Arber et al. 2009).

Practitioners face a number of real-world constraints, including inadequate resources and data, rapid shifts in political support, conflicting management goals, and immediate demands that may present barriers to the planning process. As practitioners develop ways to implement ecosystem-based planning approaches, social data hold much promise in helping them develop alternatives to reduce user conflicts, maximize economic efficiency, and conserve biodiversity. We uncovered substantial diversity in planning practice with regards to the use of social data, which is consistent with other reviews (Ban & Klein 2009; Collie et al. 2013). This diversity has fostered innovation in planning practice, but integrated frameworks and practical approaches that guide practitioners on how to systematically collect and integrate social data—together with ecological information—into planning and management initiatives may help achieve better outcomes. The explicit consideration of social–ecological linkages and outcomes that derive from these relationships is an emerging frontier both for research and application in planning practice. Finally, although planning processes require adequate social and ecological data, they are also highly dependent on other aspects such as stakeholder engagement; the processes used to develop and implement plans, strategies, and activities; and decision making processes. Although these aspects are outside of the scope of this paper, these factors can be critical to the long-term success of planning initiatives (Osmond et al. 2010).

In conclusion, practitioners are actively including social data into coastal and ocean planning with the goal of achieving better environmental and social outcomes. Although incorporating available data on various attributes of the social system into planning is beneficial, more explicit consideration of social–ecological linkages is necessary to evaluate trade-offs that often need to be made between social and ecological objectives and to produce more prospective and dynamic management plans. Our research uncovered contrasts in the use of social data between conservation-oriented ocean plans and those oriented toward multiuse. But more research is necessary to fully assess the outcomes of planning initiatives and the relative role of available data for social and ecological attributes as well as coupled social–ecological linkages in affecting these outcomes. Increased capacity and sophistication in acquiring critical social and ecological data for planning should focus on these dynamic social–ecological linkages and so promote the development of plans for more resilient ocean ecosystems and communities.

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Supporting Information

The survey of ocean and coastal planning practitioners (Appendix S1) is available online. The authors are solely responsible for the content and functionality of these

materials. Queries (other than absence of the material) should be directed to the corresponding author.

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