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Research

Barriers to incorporating ecosystem services in coastal conservation practice: the case of blue carbon

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ABSTRACT. Over the past decade, the ecosystem services frame has had a tremendous and increasing influence on environmental governance and decision making. Yet the ecosystem services governance literature reveals key tensions related to scale, stakeholder identification and engagement, knowledge of ecosystem services, and dissemination of the framework. Those challenges remain unresolved in policy makers', nonprofit managers', and even researchers' understanding of how this emergent framework functions when put into practice. Understanding empirically the factors that influence uptake of this concept by stakeholders in a variety of contexts remains a key gap in the literature. Using coastal blue carbon as a case study, we assess barriers to and enabling factors for the uptake of the ecosystem service concept among stakeholders: local, place-based coastal conservation organizations. Through semi-structured interviews with individuals of coastal conservation organizations in two U.S. regions, we collected data that, upon analysis, suggest a typology of five barriers to action on blue carbon. Those are barriers related to (1) structural issues (time, finances, and access to other resources); (2) expertise and/or technical abilities; (3) politics and political beliefs; (4) personal motivation and identity; and (5) localism. Our results also suggest two necessary conditions for action within a local organization: a connection to a research laboratory and an awareness of, or connection to, a national backbone organization. As a whole, our work makes clear that, in the United States, the concept of ecosystem services remains far from the mainstream for local, place-based coastal conservation organizations. We also find specific challenges to realizing the promises of this emergent framework.

Key Words: *carbon; climate mitigation; coasts; conservation; ecosystem services; institutions; sense of place; social-ecological systems*

INTRODUCTION

Human activity is fundamentally altering the functioning of the earth system (Rockström et al. 2009, Nash et al. 2017). The consequences of such changes for all life on Earth, and especially for human well-being and livelihoods, are likely to be devastating (Steffen et al. 2015). Concurrently, as humanity has entered the Anthropocene Era (Crutzen 2006), and particularly in the past two decades, there has been growing recognition of the importance of ecosystem services, or the benefits that humans receive from ecosystem functions, and of incorporating values of those services into decision making (Daily et al. 2009).

Numerous studies have highlighted how considering ecosystem services can better inform environmental management by internalizing environmental-damage costs into markets (e.g., Gómez-Baggethun et al. 2010, Bellver-Domingo et al. 2016), elucidating trade-offs (e.g., Goldstein et al. 2012, Lester et al. 2013, Ellis et al. 2019), and highlighting the potential for win-win solutions (e.g., Howe et al. 2014, Kuyah et al. 2019). Although scientists in academia as well as in non-governmental organizations (NGOs) have produced much of the ecosystem services work focused on ecological conservation (Peterson et al. 2010), discussion and consideration are increasing among resource managers and policy makers in other sectors as they bring the ecosystem services frame into more formal environmental governance contexts (Guerry et al. 2015, Congreve and Cross 2019). New institutional frameworks—from models built to include valuation of ecosystem services used by coastal planners, to regulations that outline payments for ecosystem services programs, to nutrient pollution trading markets—are being constructed at multiple governance scales (Bagstad et al. 2013, Vorstius and Spray 2015, Martínez-López et al. 2019).

This increasing emphasis on ecosystem services is taking place in the context of rising government interest in, and, indeed, insistence on, the use of such a concept in environmental management (Donovan et al. 2015, Ruijs et al. 2019). NGOs, academic institutions, and regulatory agencies have developed new guidelines for considering ecosystem services in decision making (Olander et al. 2015, 2018, Rosenthal et al. 2015). Ecosystem service valuation as a basis for decision making is rapidly becoming a dominant paradigm within environmental management, and outlining approaches that describe how to consider these values within existing management frameworks is a growing enterprise (Schaefer et al. 2015).

Place-based environmental management implemented at local scales is generally seen as critical to effective environmental decision making (Olsen et al. 2011). The extent to which ecosystem services concepts and tools are used by local scale conservation organizations remains unclear, even though such ideas are actively promoted by international conservation NGOs and national and subnational governments for use in informing decision making. In this study, we use a case-study approach to assess barriers to, and facilitators of, the uptake of the ecosystem services concept in local-scale, place-based conservation practice. Specifically, we examine the treatment of carbon sequestration ecosystem services by place-based nonprofit coastal conservation organizations in two U.S. regions.

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Literature review: ecosystem services governance

To frame our case study, we review the literature on ecosystem services governance, focusing first on key themes relevant to local-scale conservation practice. Through this review, we identify three key tensions that help inform our study of the barriers to uptake of the ecosystem services concept in local-scale conservation practice: (1) knowledge and implementation of the serviceshed concept and associated tensions related to scale, (2) understanding of ecosystem services exchange pathways, and (3) structures related to the top-down dissemination of ecosystem services frameworks.

The serviceshed tension

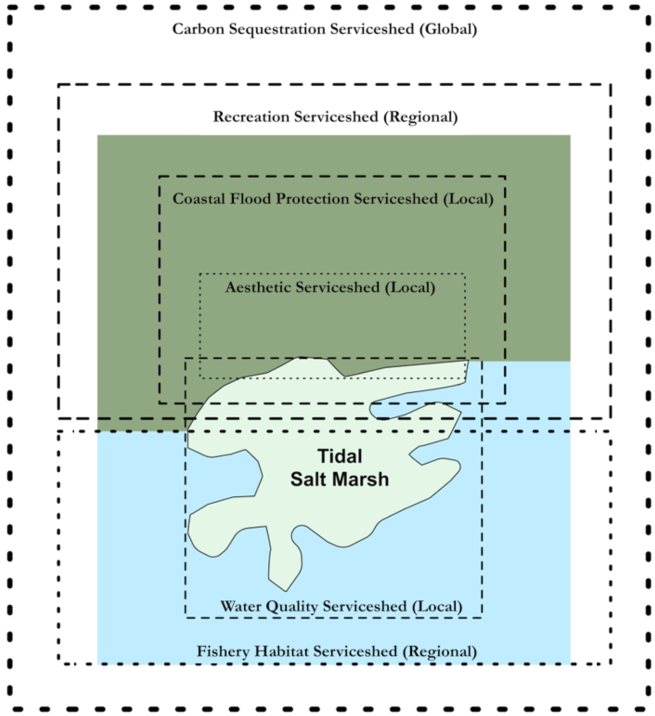
In the current theoretical understanding of resource management within social-ecological contexts, local stakeholders in a given resource are essential to effective management of resource-based institutions (Ostrom 2009). The lack of clear definitions about who has a stake in generating and delivering ecosystem service benefits thus complicates the prospects for emergent institutions.

Some benefits, such as water-quality maintenance, flood mitigation, recreational opportunities, and cooling effects, are delivered at local scales. Other ecosystem services benefits, such as carbon sequestration, are delivered at global scales and in more diffuse ways; as such, they provide value to everyone. And still other services are delivered at nearly every scale in between. The stewardship actions that produce those benefits may be disconnected spatially and temporally from the realization of the benefit; specific actions, taken locally, can generate ecosystem services elsewhere. A local decision about wetland restoration, for example, may simultaneously provide both local-scale and globally diffuse benefits.

To conceptualize these variations, scholars have developed the concept of the serviceshed (Tallis et al. 2012, 2015, Mandle et al. 2015, Olander et al. 2018, Charles et al. 2020), which refers to the spatial extent of the supply of ecosystem services produced from a specified location. Multiple servicesheds of varying spatial extents exist for each of the benefits generated from that ecosystem, whether salt marsh, lake, or forest property (Fig. 1). An organization making decisions based on multiple ecosystem services must navigate the variance of institutions, authorities, and governance systems across servicesheds, which occupy widely varying geographic scales.

The multiple-serviceshed issue creates a challenge for identifying stakeholders in ecosystem services production and delivery (García-Nieto et al. 2015, Vallet et al. 2019). The set of individuals and organizations who are stakeholders in producing ecosystem services, through land stewardship and management decisions, are different and potentially socially disconnected from those who are stakeholders benefitting from the service. Although stakeholder mapping is a perennial need in natural resource management (Reed et al. 2014), basing decisions on ecosystem services assessments can be particularly difficult because of the multiple spatial and social scales involved in the servicesheds of a single location or property. Navigating the geographic scales and various stakeholders within multiple servicesheds is a core challenge of incorporating the ecosystem services concept into environmental decision making (Gómez-Baggethun et al. 2013, Keeler et al. 2019, Vallet et al. 2019). How newly emergent institutional approaches address this issue is one of the key questions for understanding governance in this domain.

Fig. 1. Multiple servicesheds for ecosystem services from a single tidal salt marsh property representing the multiple scales across which a conserved salt marsh property delivers benefits.



Knowledge networks about ecosystem services

Until recently, few empirical studies had investigated the use of ecosystem services knowledge in decision-making contexts (Jordan and Russel 2014). McKenzie et al. (2014), drawing on Rich (1997), define three modes of ecosystem services knowledge use: instrumental (knowledge used on technical grounds to inform decisions), conceptual (knowledge shapes thinking of the organization), and strategic (knowledge deployed to support policy positions). McKenzie et al. (2014) find that the elements of ecosystem services knowledge that contribute to use of the concept connect to scenarios that increase transparency and enable a participatory process. Posner et al. (2016) expand on this analysis. Adopting frameworks that address sustainability, science credibility, salience, and legitimacy, they find that the legitimacy of scientific knowledge, or the perceived fairness of the process through which it was developed, shapes its effectiveness for informing decisions.

The emergent use of ecosystem services in decision making represents a form of policy innovation in which knowledge brokers access and accelerate information uptake (Cannavacciuolo et al. 2015, Haas 2015). Cowell and Lennon (2014) and Jordan and Russel (2014) highlight that "policy entrepreneurs" can improve the overall uptake of ecological knowledge by decision makers. Yet knowledge about the ecosystem services concept is neither culturally nor socially ingrained. Cultivating its use, therefore, requires building trust and spanning boundaries (Higgins et al. 2014). Environmental management researchers have identified understanding how decision makers experience, obtain, and use ecosystem services knowledge as a key knowledge-exchange question (Fazey et al. 2013). This area remains a gap in the literature (Jordan and Russel 2014), with few empirical studies, which likely reflects, in part, the limited extent of incorporation of ecosystem services in decision making in general. Our case study seeks to inform this gap in the literature.

Top-down dissemination

The ecosystem services concept initially emerged from academic scientific researchers. After a push to move the concept into the conservation mainstream (Young 2013), NGOs and federal agencies have subsequently adopted the concept (Donovan et al. 2015), including the use of "benefit relevant indicators" for management (Olander et al. 2018) resulting, in many ways, in the move from theory to practice evident in the decade of the 2010s (Tallis et al. 2011). Yet, this dissemination process has been driven through larger governance institutions, rather than through grassroots efforts (Primmer et al. 2015). The resulting top-down structuring of institutions, including those that involve payments for ecosystem services (PES), creates a tension with much of the theoretical and empirical understanding of what makes common-pool resource management institutions function and endure, especially at local scales (Ostrom 1990, Cox et al. 2010). The institutional design of ecosystem services-management systems thus lacks alignment with the empirical experience necessary for successful natural resource management institutions. More empirical attention is therefore needed to understand how place-based, local institutions are engaging in ecosystem services governance.

Carbon sequestration case study

As real-world experience in navigating the rise of the ecosystem services concept grows, studying emergent cases that magnify these challenges can shed light on dynamics and improve theoretical understanding of their governance. In particular, selecting a case that engages extreme challenges of scale, stakeholder definition, knowledge, and top-down dissemination is likely to reveal key insights (Flyvbjerg 2006). Here, we adopt a single case study approach to examine a particular context of emergent ecosystem services governance: local conservation organizations' consideration of coastal carbon sequestration, or blue carbon.

The increased interest in blue carbon demonstrates all three of the key tensions in a particularly pronounced manner. First, unlike many other ecosystem services, a distinct mismatching of scales occurs between local actions required to provide carbon sequestration services and the globally diffuse benefits they provide. Carbon sequestration provides a marginal benefit to overall climate mitigation—the reduction in the social cost of climate change—which is a benefit that each individual on the planet realizes. Second, coastal carbon sequestration is dissimilar from more traditional provisioning ecosystem services resources, such as forest products or fish, which have long histories of resource management. Rather, as an emergent concern, stakeholders do not widely hold expertise, knowledge about, or familiarity with blue carbon. Third, coastal carbon sequestration is connected to global and national markets for payments for ecosystem services, which global and regional-scale actors have promoted in a top-down manner.

Understanding how place-based, local conservation organizations engage with this relatively new top-down resource management framework, as potential stakeholders in the stewardship of coastal carbon cycle ecosystem services (Connolly et al. 2013), is critical. Theoretically, this is important for understanding public good and common-pool resource management; from a policy perspective, this is important because it contributes to the future composition of conservation policy and practice.

BACKGROUND

The case of blue carbon

Before presenting our analysis, we first describe what constitutes blue carbon as well as the political and policy contexts in which this interest in blue carbon has grown. Any ecosystem where net primary production (from photosynthesis) is greater than respiration over time functions as a natural carbon sink in that the flux of carbon from the atmosphere into the ecosystem is greater than the loss of carbon from the ecosystem. Over time in ecosystems that are carbon sinks, carbon accumulates in soils, organic matter, peat, and/or standing vegetation, such as trees. If the carbon that has accumulated remains out of the atmosphere for a long time, generally understood to be at least 100 years in contemporary environmental management, it is said to be "sequestered." Blue carbon refers to the carbon sequestered and stored in coastal ecosystems; blue carbon has been highlighted increasingly as a meaningful and policy-relevant ecosystem service (Ullman et al. 2013).

Salt marshes, mangroves, sea grass meadows, and tidal flats are all carbon sinks, as they fix carbon not only from the atmosphere, but also trap and accumulate organic carbon delivered from outside the ecosystem by tides, waves, currents, and rivers. Globally, these blue carbon ecosystems sequester on the order of hundreds of millions of metric tons of CO_2 each year (McLeod et al. 2011). This is nearly equivalent to the annual greenhouse gas emissions from the economy of the U.S. state of California. On a per-unit-area basis, blue carbon ecosystems are among the largest carbon sinks on the planet (Chmura et al. 2003), sequestering between 84 and 234 million metric tons of carbon each year (McLeod et al. 2011), which is roughly equivalent to 0.9% to 2.3% of global anthropogenic emissions each year.

In many regions of the world, blue carbon ecosystems are rapidly being degraded or destroyed for aquaculture, such as shrimp farming in Southeast Asia, or urban development along coastlines (Pendleton et al. 2012, Howard et al. 2017, Macreadie et al. 2019). In the United States, many blue carbon ecosystems have already been destroyed. In California, over 90% of historical coastal wetlands have been destroyed (California Coastal Commission 2013), and in coastal New England, 37% of the original, pre-1800 salt marshes have been lost, with over 80% loss in areas around Boston (Bromberg and Bertness 2005). Environmental nonprofit organizations, academic scientists, and government agencies have indicated growing interest in building institutional mechanisms to manage the service of carbon storage within coastal ecosystems (Nellemann et al. 2009, Hejnowicz et al. 2015). Agency-affiliated researchers have issued calls to incorporate coastal carbon sequestration services into existing regulatory frameworks in the United States, highlighting that new statutory authorities are not needed to build institutional frameworks based on ecosystem services (Sutton-Grier et al. 2014).

Unlike forest carbon, blue carbon is not currently included within California's cap-and-trade program's categories of available compliance-level carbon offsets; however, Restore America's Estuaries (RAE), in conjunction with partner group Silvestrum, recently developed rules concerning the accounting for blue carbon services for use in the voluntary carbon market (RAE 2015). RAE, a national non-profit organization formed in the 1990s, has led U.S. efforts to advocate for enhancement and management of blue carbon ecosystem services, sponsoring several major pilot blue carbon projects, attending national scientific conferences to present information about blue carbon research, and convening workshops on blue carbon.

We situate our analysis of place-based coastal conservation organizations that steward coastal ecosystems at local spatial scales within this context of rising interest and attention to carbon offsets. Specifically, we examine the organizations in light of the growing interest in incorporating blue carbon ecosystem services into decision making and promoting mutually beneficial coastal habitat restoration as well as coastal carbon sequestration. We seek to understand the role of local coastal conservation organizations as stakeholders in managing carbon sequestration. Our research is particularly concerned with how locally based organizations, as stewards of particular geographies, interact with a management paradigm that has been developed, promoted, and reproduced by a set of international NGO, academic, and U.S. federal agency actors.

METHODOLOGICAL APPROACH

Understanding the contextual reasons why place-based organizations might choose to use the ecosystem services concept and take action on blue carbon necessitates a qualitative approach. Our primary research aim is to generate new understanding of the types of barriers to the use of the ecosystem services concept faced by place-based conservation organizations and the conditions under which such organizations engage with the concept. Because the aim is theory-generation, based on firsthand accounts of lived experience, we adopt a modified grounded-theory approach. As Stern and Porr (2011:26) describe, "the grounded theorist embarks on an inductive generational pathway as opposed to a deductive verificational pathway. Grounded theories come from data about firsthand experiences."

To understand the barriers to and facilitators of the use of the ecosystem services concept, we conducted 34 semi-structured interviews with directors of nonprofit place-based coastal conservation organizations. The interview protocol was designed to elicit a nuanced conversation about the organization's mission. Such a structure allowed us to address specific areas of interest, such as blue carbon, guided by literature-identified themes focused on governance structures, stakeholders, and sense of place, while also allowing for flexibility should responses warrant further pursuit. We used an inductive coding approach (Corbin and Strauss 1990) to develop a typology of barriers and facilitators consistent with modified grounded theory.

Selection criteria: coastal conservation organization identification

To increase the likelihood of including in our sample organizations actively engaged in managing carbon-sequestration ecosystem services, we restricted selected cases to place-based conservation organizations in the coastal California and Gulf of Maine bioregions. California and the New England states are among the few U.S. sub-national jurisdictions with active climate change mitigation policies (in California, the Cap-and-Trade Program; in New England, the Regional Greenhouse Gas Initiative and state-level climate policies). Both regions have active, robust traditions of coastal conservation, linked with climate change-related concerns (Heberle et al. 2014, Chornesky et al. 2015).

We specifically sampled for place-based conservation organizations in these regions because the conditions (described above) suggested that the regions were more likely to be home to organizations perceived as innovative in terms of the way that they incorporate in their work emergent issues and frames, such as ecosystem services (Ruckelshaus et al. 2013, Börger et al. 2014). To ensure a maximal focus on place-based organizations, our sample population comprised non-profit coastal conservation organizations in these two regions with organizational missions dedicated to conserving a particular coastal geography, often a single estuary, lagoon, coastal watershed, or embayment. We excluded from analysis any national and international-scope organizations given their complex, layered structures (Brechin et al. 2003), and given our core focus on place-based conservation organizations.

We used these exclusion criteria to ensure both adequate diversity within some dimensions as well as consistency within others (Robinson 2014). We wished to avoid, for example, focusing on local chapters of global nonprofit organizations, which may approach carbon sequestration ecosystem services according to the norms of their parent organization. Property ownership was not an important characteristic for defining an organization as "place-based" (Williams et al. 2013). Some organizations were property owners, such as coastal or estuarine-oriented land trusts. Others were stewards of lands or aquatic spaces owned by the state or other private property owners, often focused on water-quality maintenance. The majority of organizations were chartered 501(c)3 nonprofit organizations.

Using extensive online searches and snowball sampling, we identified a list of 71 place-based coastal conservation organizations within our two study regions that passed our exclusion criteria tests. This set included 32 organizations in California and 39 in the Gulf of Maine region. We solicited organizational participation in our study via an email sent to an executive director, conservation director, education/outreach specialist, or general contact email address at each identified organization. Organizational participation in this study was confidential.

Interview coding and analysis

Between June 2012 and December 2014, we interviewed 34 representatives of coastal conservation organizations in California and New England (see Table 1 for a summary of the sample's descriptive characteristics for both bioregions). Our overall response rate was 48% and did not vary significantly

Table 1. Interview response rate from organizations contacted.

	California	Gulf of Maine	Total
Total Organizations Interviewed/Contacted	14 of 32 (44%)	20 of 39 (51%)	34 of 71 (48%)
Based on Place Focus			
Watershed Focused Orgs. Interviewed/Contacted	5 of 14 (36%)	8 of 16 (50%)	13 of 30 (43%)
Marsh Focused Orgs.Interviewed/Contacted	3 of 7 (43%)	4 of 9 (44%)	7 of 16 (44%)
Bay/Estuary Focused Orgs. Interviewed/Contacted	6 of 11 (55%)	8 of 14 (57%)	13 of 25 (56%)
Based on # of Employees			
All Volunteer or < 5 Employees	8 of 20 (40%)	11 of 19 (58%)	19 of 39 (49%)
5–10 Employees	5 of 7 (71%)	5 of 13 (38%)	10 of 20 (50%)
> 10 Employees	1 of 5 (20%)	4 of 7 (57%)	5 of 12 (42%)

between geographies. It also did not vary significantly among organizational types (watershed alliances, marsh conservation groups, bay stewardship nonprofits, etc.), although response rates were slightly higher from bay-focused organizations. Response rate also did not differ based on the number of employees in an organization.

All interviews were conducted by author ALS either in person or via telephone with approval from, and following the regulations of, Stanford University's Institutional Review Board. Interviews focused on organizational directors' perceptions of the barriers to their organization's engagement with, or use of, the ecosystem services framework as well as the blue carbon concept specifically. Interviews lasted between 30 minutes and three hours. We recognize that the author who conducted the interviews is a white male from an academic institution who, concurrent with the qualitative interest described herein, also conducts quantitative, ecosystem-oriented biophysical scientific research. Many interviewees asked questions about the author's other scientific research in the course of the interviews, which may have influenced discussions about expertise and technical analyses of ecosystem services. Both the first and second author (NMA), who provided support on interview development, implementation, and analysis, have prior experience in ecosystem services framing through work with nonprofit conservation organizations. Such an orientation may have impacted their conceptualizations of the idea at various stages of the process.

Interview transcripts and/or notes were coded using NVivo Qualitative Analysis Software (QSR International). Coding focused on three primary areas: defining action on blue carbon, identifying barriers to action, and identifying conditions under which action was taken (see Fig. 2 for our coding tree, which also describes each area of coding emphasis). First, we categorized organizations dichotomously as either "engaging in action" on blue carbon or "not engaging in action." To do this, we defined "action" on blue carbon as one of the following: (a) any project or other activity that the organization designed or undertook, in whole or in part, to enhance carbon sequestration of the coastal ecosystems that the organization managed or stewarded; and/or (b) any written or publicized statement highlighting or mentioning the carbon sequestration or climate change mitigation value, whether qualitative or quantitative, of the coastal ecosystem that the organization worked to conserve. Among organizations engaging in action, we coded actions based on whether organizations mentioned blue carbon or carbon-sequestration in materials, how a project to enhance carbon-sequestration ecosystem services was being conducted, and whether/how ecosystem services were being quantified. For those organizations coded as having taken (or as planning to take) some form of action on blue carbon, we coded for enabling conditions of that action. We then reviewed those from organizations categorized as "not engaging in action" for the presence or absence of each of those same categorized enabling conditions.

RESULTS

Minimal action on blue carbon

All of the place-based coastal conservation organizations in our sample engaged in some form of ecosystem restoration or habitat conservation projects that might be understood to include enhancing carbon sequestration through a simple description that would not require additional resources. The majority (82%) of these organizations, however, reported that they are not currently taking any action on blue carbon. They also noted that their conservation missions do not include enhancing climate change mitigation ecosystem services.

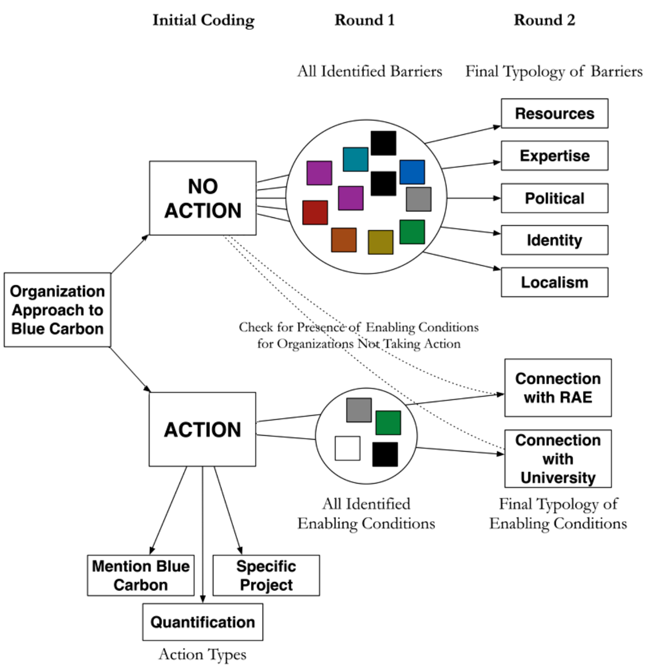
Six organizations (18% of those interviewed) reported that they were currently taking some kind of action on carbon-cycle ecosystem services. Those organizations primarily engaged in pilot projects enhancing living shorelines, quantifying blue carbon storage in conjunction with other ecosystem services, or are otherwise focused on ameliorating hypoxic conditions with explicit carbon-cycling connections.

Although the total number of organizations was small, making quantitative conclusions challenging, the rate of "action" on blue carbon did not significantly vary as a function of geography. We found no variance when comparing those groups that took action located in the Gulf of Maine (n = 3) and California (n = 3) bioregions; similarly, we found no significant variance as a function of the organizations' ecological focus or size, based on number of employees (see Table 2).

Table 2. Organizations taking action on blue carbon.

	California	Gulf of Maine	Total
Total Organizations Taking Action on Blue Carbon	3 of 14 (21%)	3 of 20 (15%)	6 of 34 (18%)
Based on Place Focus			
Watershed Focused Orgs. Action/Interviewed	0 of 5	1 of 8	1 of 13
Marsh Focused Orgs. Action/Interviewed	2 of 3	0 of 4	2 of 7
Bay/Estuary Focused Orgs.Action/Interviewed	1 of 6	2 of 8	4 of 14
Based on # of Employees			
All Volunteer or < 5 Employees	2 of 8	1 of 11	3 of 19
5–10 Employees	1 of 5	1 of 5	2 of 10
> 10 Employees	0 of 1	1 of 4	1 of 5

Fig. 2. Coding tree for interview transcript analysis.



Typology of barriers

Based on our data, we developed a typology of five distinguishable barriers to action on carbon cycle ecosystem services: (1) time, financial, and resource barriers, (2) expertise and/or technical barriers, (3) political barriers, (4) motivation/identity barriers, and (5) localism barriers. We consider each of these in more detail below, supported with examples from the data.

Temporal, financial, and resource barriers

Sixty-five percent (22 of 34) of respondents indicated that they lacked the financial resources to pursue a blue carbon project or, otherwise, had too many projects already in process. In those cases, the interviewee was sympathetic to the desire to engage in work oriented toward the ecosystem services frame but felt that other needs were more pressing. Therefore, the workers prioritized the organization's limited resources—employee and volunteer time as well as financial resources—in a way so as not to allow "taking on something new." One employee described it as follows:

> *We're barely able to do what we've already got going on, so we haven't really thought about it ... [we haven't] had time to think about it ... to be honest.*

The Executive Director of a coastal watershed alliance noted that the volunteer nature and large number of issues involved in conservation work could be prohibitive to engaging with carbon-cycle management:

> *It's not that I don't want to do these kinda things ... it's just ... I mean I'm a volunteer, you understand, there's no salary involved ... and I mean we're involved in this whole litigation thing ...*

There are numerous pressures on conservation organizations as they carry out their mission, and our interviewees frequently suggested that adding new campaigns around carbon-cycle ecosystem services might compete with existing time and resource commitments.

Expertise and/or technical barriers

Thirty-five percent (12 of 34) of conservation directors indicated that they had contemplated trying to engage in a carbon-cycle-oriented pilot project, but they described becoming quickly overwhelmed by the technical details and requirements for measuring and monitoring. The director of one organization indicated that they started work in this vein, but realized that the measurements they could make (mostly from measuring soil and peat samples) would be insufficient for quantifying carbon dioxide (CO_2) gas fluxes; therefore, in the end, their organization did not pursue the idea:

> *We talked about doing that, but we didn't have any of the expertise and the more we read, it was like ... we didn't know where to begin.*

As one Executive Director of a non-profit organization highlighted,

> *We decided to do a study ... but we didn't have any intention of looking at the gas fluxes, I mean, I was like, "Are you kidding me with this stuff?" So maybe the complexity of the gas fluxes are, y'know, along the lines of why no one's really trying to do [blue carbon] ... it seems.*

Other organizational directors reported the challenge of how to connect their core conservation work to something they felt was somewhat abstract, namely carbon sequestration. Whereas the organizations did focus on the values of the services provided by ecosystems, when it came to the carbon and nitrogen cycling, they backed away from specifics, often due to a lack of data. As one respondent said, "The biggest challenge I think ... I would say it's the lack of [biogeochemical] data, actually." For some organizations, the lack of availability of adequate monitoring information represented a major strategic gap that needs to be filled before such actions around ecosystem services could be contemplated.

Political barriers

Five respondents in the California Current bioregion and nine respondents in the Gulf of Maine bioregion indicated that discussing climate change-related ecosystem services with the people who accessed and recreationally used the coastal lands might be considered off-topic or controversial. In some instances, respondents specifically mentioned avoiding discussion of carbon services because of the perceived political and controversial nature of climate change. An education and outreach manager in a conservation organization noted:

> *We don't talk about that, really... The people we get in here, they want a pretty space to walk around and explore and anything climate change-it's just way too ... it wouldn't work.*

As one environmental stewardship manager in New England indicated, "The political climate is probably the biggest impediment right now." And as an education and outreach manager for a watershed conservation nonprofit organization noted: "I wouldn't touch carbon with a 10-foot pole."

When asked about how climate change comes up in their work, 59% of respondents (20 of 34) highlighted that, in coastal systems, scientists, agencies, and organizations rarely discuss climate change in terms of carbon mitigation, water-quality impacts, or temperature change. More commonly, coastal systems' climate change is discussed only in terms of major impacts, such as sea level rise. One environmental manager noted,

> *Climate change comes into our work in one area only: sea level rise. We assume a three-foot sea level rise over the next 100 years. That's it.*

Motivation/Identity barriers

In addition to the three barrier types we have highlighted, 19 interviewees described other reasons their organizations would not engage with carbon-related ecosystem services, even through simple actions, such as highlighting the benefits of restoration for carbon sequestration in their promotional materials or interpretive activities. The data suggest issues around notions of carbon and ecosystem services, which are essentially understood to be novel and perhaps not easily comprehended. As one program manager described,

> *Ecosystem services is not an approachable concept for most folks. It is more of a policy or management idea, not an idea that resonates with the public.*

Another education and outreach coordinator added,

> *People don't understand ecosystem services or that you can sell the air or something. What they understand is what they see in front of them, the physical things they can touch and feel.*

The data also suggest that some individuals engaged in conservation activities within the organization were hesitant, or even fully resistant, to embrace, learn about, or discuss these concepts. This hesitancy and resistance does not represent a barrier of expertise but, rather, suggests another distinguishable barrier: resistance to ecosystem services-related concepts based on the motivation and identity of being a conservationist. One respondent described it in this way,

> *There's a lot of people here who still think in terms of species-fish-rather than in terms of ecosystems. It's their habit, what they're used to, so why should they change?*

Several organizational representatives repeated this refrain: ecosystem services were opaque to the majority of those working in the practice of coastal stewardship and conservation. Those individuals had motivations grounded in identities as "naturalists" or "birders," which drew, in part, from an ecological understanding based in habitat delineation and species identification. Although the individuals purported to understand climate change as a threat in those places, primarily to specific species' life cycles, the role of ecosystem carbon sequestration in mitigating climate change does not align with the naturalist identity.

Age played an important role in the identification of this barrier. In each case, the respondents describing this barrier mentioned that those involved in land stewardship and conservation outreach were either of an older demographic or far-removed from educational programming focused on sustainability or ecosystem services:

> *We've got a lot of retired people, so part of what happens is you get people entrenched ... they've learned [to be naturalists], and they're gonna teach it and you don't get the new information [about carbon sequestration] finding its way in ... That's part of what limits the scope of what we do.*

Respondents described organizational staff and volunteers in this category as having motivations centered on the maintenance of habitat and the conservation of specific species, such as unique or endemic plants, fish, migratory birds, or commercially important species. One respondent said, for example,

> *For us, "ecosystem services" would be about the values we get from the environment and that's about sustaining a commercially viable fishery and not having any fish consumption advisories.*

Another respondent indicated,

> *I think that, for ecosystem services, we don't use that term, but we talk about values. I think that for clam flats, the value is clear. People stay working and employed, and that's economic benefits and jobs in the community. It's very clear to make the link that poor water quality means less money.*

Nearly all respondents (25 of 34) made these points consistently: they are discussing some ecosystem services, but without using the term, if the services connect with pre-existing conservation motivations. Yet they rarely, if ever, consider carbon sequestration, which is not a traditional focus of naturalist training nor is it a motivation for conservation in the eyes of these individuals.

Localism barriers

The barrier of motivation and identity closely relates to a barrier of localism. Despite co-benefits with services such as habitat protection and water-quality maintenance, several organizations indicated they were hesitant to work on ecosystem carbon sequestration because they did not perceive it to be a local concern. Specifically, those organizations regarded engaging in carbon accounting of land and carbon markets as something that "big NGOs like TNC and EDF" do and not something that place-based conservation organizations with just a few employees would contemplate. The executive director of a marsh conservation organization explained that calculating blue carbon was something that his organization had to do to comply with specific regulations, rather than something arising out of the organization's mission. He said,

> *You know, carbon storage in coastal wetlands only comes up in our California Environmental Quality Act (CEQA) and Coastal Conservancy reports that we have to do. We don't really talk about it outside of that; it's not really a great way to connect with people locally.*

Eight of the 34 respondents explicitly indicated that the entire "carbon idea" was operating at a different scale than their conservation work, which is why they had not participated or engaged in such activities. One interviewee, a science director representing a coastal watershed organization, said,

> *I see carbon [management] as being out of my league. As a little guy, working on the ground, thinking about the carbon stored in these trees, as opposed to their caché, their cooling effect, it's just a decision being made at a different scale.*

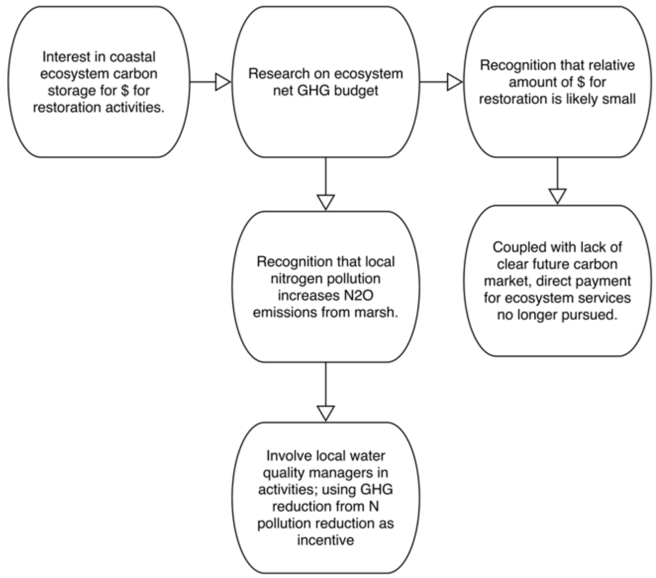
For some conservationists, the history of the specific place to be conserved and its conservation struggles was an important aspect of the mission, one apparently not fulfilled by blue carbon or similar ecosystem services. Another Executive Director said,

> *We talk about alewives and sturgeon and the histories of these fish, so we connect people with a history of this place as well. Carbon and nitrogen cycles don't really come into play.*

More than half (65%) of respondents highlighted concerns about place-based motivations restricting work on ecosystem services; one respondent, however, argued that his organization's local-scale were frustrating because larger scale governance actions and institutions would facilitate ecosystem-services work.

Notably, our data include an instance of an attempt to overcome the barrier of scale misalignment through re-articulating the global-scale blue carbon ecosystem service. This reframing occurred by transforming the scale to the local domain of water-quality services related to nutrient pollution (see Fig. 3). After completing a greenhouse gas (GHG) budget for the marsh, one organizational representative explained:

Fig. 3. Conceptual diagram of re-articulation of greenhouse gas (GHG) ecosystem services in terms of local water quality issues.



> *Blue carbon was new. It wasn't like water quality where you can feed back into the [management] community ... who are used to working on it. What do local communities know? They know eutrophication, [so there was] kind of a flip-flop of greenhouse gas work back to water quality.*

Enabling conditions under which action is taken

We have highlighted five barriers to coastal conservation organizations embracing carbon sequestration work in their stewardship and conservation activities. Despite those barriers, some organizations reported actively working on blue carbon-related ecosystem services. Based on the organizations that we categorized as taking some form of blue carbon-related "action," we developed a typology of conditions under which organizations take action on blue carbon. The two conditions necessary for action, which we found were met 100% of the time that actions were taken, were (1) some form of established connection with a research laboratory or university, and (2) an expressed awareness of, or direct connection with, Restore America's Estuaries (RAE).

Connection with research laboratory and/or university

Every organization that pursued action on carbon cycle ecosystem services, whether small or more substantial, had a personal, network, or established professional connection with a research laboratory, defined as a laboratory facility with the capacity to engage in biogeochemical scientific research. Although the laboratory was frequently part of a university or research institution, those connections also included non-university-affiliated research labs. Connections were often of a practical nature. For example, organizations reported actively collecting water quality samples for analysis in the laboratory, establishing grant-based collaborations with university researchers, or employing part-time students who continued to work with laboratory researchers. As one respondent explained, "Collaboration and connections with research scientists were absolutely key." Our data provided no indication that the connection with the research laboratory directly facilitated knowledge of ecosystem services in general, or carbon sequestration specifically. Rather, organizations viewed the connections as an avenue to providing technical expertise, support, or back-up in the case of unexpected (or expected) roadblocks or issues.

Awareness of, or direct collaboration with, RAE

The six organizations taking blue carbon-related action reported one common connection: some kind of relationship to the nonprofit organization RAE. The nature and depth of the connection with RAE varied among the organizations, although in every case conservation organizations taking action on blue carbon had immediate recognition of RAE and its work and were generally aware of the group's activities. As one respondent said,

> *So I went to a panel that was being held by the Restore America's Estuaries group, and I got hooked in there and heard more about blue carbon ...*

In a few instances, organizations reported collaborating directly with RAE on a project and seeking out RAE for its expertise with carbon markets in particular. One respondent described,

> *RAE has a history of working on blue carbon, and they were the way we got involved with the broader initiatives ... The carbon market "hook" went through RAE. We sought out the involvement of RAE; they didn't seek us out. RAE had the methodology [for carbon markets].*

In particular, as for the university connections, these organizations saw RAE as providing technical expertise and experience with all aspects of blue carbon, most notably quantification and methodological standardization.

DISCUSSION

Our findings illustrate the status quo of how certain U.S. coastal conservation organizations incorporate carbon sequestration ecosystem services in their work. Surfacing stakeholders' barriers to incorporating ecosystem services in local-scale conservation efforts is important in developing our understanding of the future of ecosystem services governance. Our results identify five specific barriers to deploying the ecosystem services concept. The results also demonstrate that frequently identified barriers to conservation practices, such as insufficient financial or temporal resources (Ekstrom and Moser 2014) and lack of technical expertise (Hamin et al. 2014), also create barriers to conservation organizations incorporating ecosystem services into their work.

Beyond these barriers, our results highlight that the politics of climate change play a strong role in organizational approaches to blue carbon. Because carbon sequestration provides a service of climate change mitigation, U.S. climate change politics complicates incorporating these ecosystem services into conservation organizations' work. This phenomenon, also observed in numerous local-scale regulatory and social contexts (Clar et al. 2013), appears within the context of coastal stewardship among conservation organizations, even in U.S. regions that have enacted climate mitigation policies. Thus, climate change politics distinguishes carbon cycle-related ecosystem services from others. Overall, these perhaps unsurprising results suggest that some of the barriers that exist with regard to U.S. conservation organizations' uptake of blue carbon are analogous to those that exist with regard to taking action on climate change more broadly. Many perceive action on blue carbon as a climate change-related conservation activity. Our identified barriers of motivation and localism, however, merit more detailed discussion about scale and place.

Navigating the tension of scale

Our research sought specifically to investigate how the real-world context of coastal conservation organizations, in relation to the case of blue carbon, navigate three key tensions in ecosystem services governance: (1) the serviceshed tension; (2) the tension around environmental knowledge; and (3) the tension of scale. Below, we assess our data in light of each of those, as situated in the literature.

One of the tensions observed in the ecosystem services governance literature relates to how organizations address the multiple scales inherent in servicesheds. Scale mismatches between the production and delivery of ecosystem services benefits create a significant challenge in environmental management. Our data are consistent with previous work highlighting the challenges of managing ecosystem services across scales (Cash and Moser 2000, Redford and Adams 2009).

No interviewees specifically discussed servicesheds or the delivery of ecosystem services to different sets of stakeholders across multiple scales. Yet the data for blue carbon suggest that its large-scale serviceshed creates a challenge for local conservation organizations. Several respondents highlighted that "work on carbon" was conducted at a different scale of stewardship and conservation than the one on which they typically operate. Our findings indicate that respondents regarded carbon-related coastal land-stewardship decisions either as being in the conservation niche domain of larger nonprofits, governments, and international organizations (Balboa 2017), as ineffective, or as making limited difference in the collective-action problem of climate change. These responses may seem somewhat surprising in light of the increasingly common discussion of individual "carbon footprints" in the pro-environmental behavior literature (Whitmarsh et al. 2011, Cooke et al. 2016) as well as the growing body of literature suggesting that climate change impact indicators at local scales increase individual desire to take mitigation actions (van Valkengoed and Steg 2019).

Further, our results suggest that conservation-minded organizations may seek to re-scale their approach to climate mitigation to a scale more suited to their mission and expertise. Thus, the instance of re-articulation from the "novel" blue carbon to water quality presented in Figure 3 can be understood, following Waring et al. (2015), as a recasting of organizational scale. In other words, regional-to-local-scale environmental actors can manage water-quality problems relatively effectively, but they cannot manage climate change, so they may attempt to redefine the problem in more local terms.

Taken collectively, our results related to motivational and localism barriers indicate that organizations develop governance norms that focus on specific serviceshed spatial scales. They will seek out ways to engage in ecosystem services-based decision making that align with the serviceshed scale that matches the institutional knowledge base and areas of expertise. Further work investigating how actors navigate the relationships of servicesheds to the literature on polycentric and nested governance structures is merited.

Place matters

How are coastal conservation organizations conceiving of stakeholders in blue-carbon ecosystem services? One of the more surprising emergent results from our work was the degree to which the oft-cited challenge of scale misalignment manifested through strong articulation of attachment to attributes of place. Place attachment is associated not only with land conservation, but also with the preservation of a broader social-ecological landscape (Walker and Ryan 2008), in addition to the values and benefits the landscape confers to a homogenous community (Chapin and Knapp 2015). Having a place connection can positively influence landscape-conservation actions as well as other pro-environmental actions (Brehm et al. 2013, Hausmann et al. 2016). Notably, the actions that individuals take tend to reflect the scale of place connection that an individual exhibits (Ardoin 2014, Niemiec et al. 2017).

The connections that characterize an individual's sense of place, regardless of scale, are multidimensional, and include aspects of the biophysical, psychological, sociocultural, and political-economic (Ardoin et al. 2012, 2019). In our semi-structured interviews, respondents described connections to the places they were working to conserve across all of these varied dimensions. Our data suggest that conservationists working in local, coastal conservation organizations value those rooted, place-based connections more than larger scale climate mitigation-related ecosystem services, which may seem more removed and thus feel esoteric. This disconnection occurred despite the high potential for emphasizing the multiple co-benefits of multiple ecosystem services generated from combined conservation and restoration actions. The managers and conservation professionals in our sample did not regard carbon sequestration services as adequately supporting the dimensions of place, as described; responses suggested that organizations and individuals see ecosystem service valuation and operationalization as occurring on larger social, political, and governance scales, which do not carry the attributes of place that motivate conservation (Stedman 2002).

Often, local conservation organizations do indeed have missions that focus on taking action to create, deliver, and preserve ecosystem services that benefit local communities through place-conserving actions. Our interviews highlighted that the ecosystem services that local conservation organizations value (without using the term "ecosystem services") included healthy populations of key resource species; recreational opportunities and amenities; positive affective feelings related to place attachments; and connection to local natural history. Notably, all of those cultural services relate to relatively localized servicesheds.

Public interactions reveal ecosystem services as conflicted frame

A second key tension we observed was the unapproachability and opacity of the concept: we find an overall lack of fundamental knowledge related to ecosystem services as well as an absence of knowledge brokers. Numerous conservation professionals in our sample also reported that they regarded ecosystem services as an inadequate and ineffective framework with which to approach advocacy to the general public. Although this reflects the desire to constrain elements of activities to more localized servicesheds in which stakeholders interact, it also suggests that respondents may view the entire ecosystem services concept in a conflicted frame, misaligned with a pro-environmental, pro-conservation vision of sustainability. The implications of this perception of ecosystem services as anti-sustainability are profound.

Chapin and Knapp (2015) highlight that a sense of place can be understood as an organizing concept for negotiating contested spaces of sustainability; we see evidence of that among coastal conservation organizations. Resistance to ecosystem services is not a resistance to sustainability practices, writ large, but rather to conflicting notions of sustainability. Although Chapin and Knapp (2015) highlight opportunities for local-to-global sustainability actions through expanding senses of place, we do not yet see this kind of thinking being salient for the communities in which our sampled organizations work.

No interviewees reported speaking specifically about ecosystem services when communicating with their supporters or the public overall. More pointedly, they noted actively avoiding the phrase. When prompted, interviewees indicated they believed they could more appropriately and compellingly frame the value of a coastal ecosystem in terms of the resource values that people find familiar. Interviewees suggested that a compelling frame would more likely focus on easily quantified resource values, such as coastal property values or the contributions of commercial shellfisheries to the local economy. Another compelling frame might be structured in terms of individually relevant aspects, such as those impacting human health. One organizational director highlighted these points by commenting,

> *Linking measurements of contaminants in the water to measurements in oysters is the best way to move forward on ecosystem services. The health concept linking the medical community and human health impacts to ecosystem impacts would really let the "ecosystem services" framework take off and grow. It may help connect the framework to specific communities uninterested in traditional environmental conservation.*

Facilitators: expanding beyond the top-down frame

In addition to highlighting the unapproachability of the blue-carbon concept, our data reveal a lack of knowledge about ecosystem services in general, and carbon sequestration in particular, among coastal conservation organizations without access to knowledge brokers (Fazey et al. 2013). Numerous interviewees indicated that they were unfamiliar with the concept prior to the interview or that employees or volunteers within their organization had limited access to information or knowledge about carbon sequestration.

Yet, as previously noted, some organizations reported taking blue carbon-related action. In each of these cases, the common factors were that, first, the organizations reported having connections with research laboratories and, second, they knew about the activities of RAE. For our sample population of U.S. coastal conservation groups, awareness of RAE's activities appears to be a necessary condition for blue-carbon action. Our findings thus highlight the essential nature of linking with an information-rich, networked structure of national and international nonprofits as well as being connected to academic scientists; these networks facilitate developing a blue carbon-related agenda and advancing related activities.

Why is this the case? Unlike for natural resources linked directly to livelihoods, where local knowledge can be cultivated and shared through networks of users and passed down through generations, the generation and use of blue carbon services function as qualitatively different resources. Access to knowledge and information about blue carbon appears to be facilitated through interacting with key nodes in the ecosystem services knowledge system. In particular, although research universities may provide access to expertise to overcome identified barriers, our data suggest that RAE functions as a knowledge broker for blue carbon work by nonprofit conservation organizations in the United States.

Essentially, our findings both confirm and expand upon the observation that the design and operationalization of the ecosystem services framework is primarily top-down. Numerous practitioners and scholars have repeatedly and increasingly emphasized the importance of polycentric, stakeholder-driven, and adaptive approaches to ecosystem management at local scales (Berkes 2009, 2010, Schultz et al. 2015, Grygoruk and Rannow 2017).

CONCLUSION

Our work makes clear that local, place-based conservation organizations in the U.S. coastal context have not yet mainstreamed the concept of ecosystem services, certainly in the case of blue carbon. Although we purposefully limited the scope of our work to the case of blue carbon, and therefore cannot assess whether the same conclusions would hold for terrestrial carbon sequestration services or other ecosystem services more broadly, we expect elements of our work should help inform those activities. As the ecosystem services concept continues to rise in prominence in the environmental decision-making realm (Olander et al. 2018, Ellis et al. 2019), careful attention to its reception, dissemination, and evolution at local scales is essential. Examples of the successful incorporation of the ecosystem services frame into decision making (Arkema et al. 2015, Ruckelshaus et al. 2015) and addressing and overcoming the barriers to its incorporation in local-scale conservation practice should be a focus of future scholarly and practitioner attention.

If the ecosystem services framework is to continue to occupy a central place in ecosystem management paradigms, our data suggest that organizations interested in advancing the concept work to build cross-scalar, networked connections. Place-based conservation organizations represent significant stakeholders in conservation activities: they own and conserve coastal land, engage the public, and build local capacity. As larger scale nonprofit organizations as well as federal and state agencies develop institutional and educational architectures around ecosystem services, our findings suggest that those actors should attend to building networked connections that cross scales and capacity that engages the ecosystem services concept with place-based, local concerns.

Responses to this article can be read online at:
https://www.ecologyandsociety.org/issues/responses.php/12741

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Data Availability:

The qualitative data (interview transcripts) that support the findings of this study are available on request from the corresponding author, ALS. The data are not publicly available because of their containing information that could compromise the privacy of research participants.

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