Narratives Can Motivate Environmental Action: The Whiskey Creek Ocean Acidification Story

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Abstract

Even when environmental data quantify the risks and benefits of delayed responses to rapid anthropogenic change, institutions rarely respond promptly. We propose that narratives complementing environmental datasets can motivate responsive environmental policy. To explore this idea, we relate a case study in which a narrative of economic loss due to regionally rapid ocean acidification—an anthropogenic change—helped connect knowledge with action. We pose three hypotheses to explain why narratives might be particularly effective in linking science to environmental policy, drawing from the literature of economics, environmental policy, and cognitive psychology. It seems that yet-untold narratives may hold similar potential for strengthening the feedback between environmental data and policy and motivating regional responses to other environmental problems.

Introduction

Human activities change natural systems and alter the ecosystem services those systems provide to society (Vitousek et al. 1997; Millennium Ecosystem Assessment 2005). As these environmental changes multiply, the need to develop and implement appropriate and effective institutional responses grows accordingly (Millennium Ecosystem Assessment 2005). Despite recognition of this need, only rarely do institutions respond in a timely way, even when environmental data indicate the need for swift action. The result is an inefficient or dysfunctional feedback loop between human societies and the larger ecological systems of which they are a part. Knowledge alone has long been acknowledged as insufficient to motivate action, creating a disconnect that is widely lamented but poorly understood, despite active research across a diverse suite of fields ranging from sociology to human geography to cognitive psychology (e.g., Lorenzoni et al. 2007; Poortinga et al. 2004; Stern 2002).

Often the source of the science-policy disconnect is a lack of credible assessment of the costs and benefits of responsive action relative to inaction. But even when data are available to estimate the probable economic impact of environmental change, they tend not to lead to consensus regarding the economic costs or benefits of altering the current course of action (Johnson and Hope 2012). Consequently, strictly economic evaluations are of limited use in shaping environmental policy (Laurans et al. 2013) and do not reduce the temporal mismatch between environmental data sufficiency and policy action. For many longstanding and emerging environmental challenges—climate change, ocean acidification, emissions of reactive sulfur and nitrogen compounds (SOx and

NOx), and point- and non-point source water pollution—knowing what changes societies must make and the costs associated with making those changes still does not result in action to implement change. In short, even fairly sophisticated knowledge does not result in action.

Here we relate a case study in which a narrative of economic loss due to environmental change made a significant political and popular impact, helping to connect knowledge with action. We propose that because narratives powerfully illustrate the tight coupling of human and natural systems, they can motivate responsive environmental policy, effectively improving social feedback to natural systems. Consequently, identifying and communicating narratives that are tightly coupled to scientific assessments of environmental change could be an especially useful tool to help overcome the barriers that hinder national- and subnational-scale responses to global-scale environmental challenges.

We define "narrative" as "communication that describes specific experiences of characters [i.e., individuals] over time," (Dahlstrom and Ho 2012) consistent with existing literature on narrative science communication. We contrast this with expository communication—such as peer-reviewed scientific literature—that rarely focuses on the experiences of individuals, and generally conveys distributional or abstracted information. The evidence suggests that narratives can contribute more than just memorable anecdotes to environmental science. These real stories, in which individuals experience some gain or loss of ecosystem services and personal well-being or livelihoods as a result of an environmental change, help bring scientific and statistical projections to life, especially for ecosystem services that are less easily valued.

The particular narrative we explore here—commonly referred to as "the Whiskey Creek story" (WC)—brought media and political attention to the problem of ocean acidification in Washington and Oregon (USA). Ocean acidification is one example of a globally driven anthropogenic change with regional consequences (Gattuso and Hansson 2011) that can be exacerbated locally by natural or anthropogenic conditions (Doney 2010). Reducing both global CO_2 emissions and local confounding conditions requires political action at regional and national scales (Kelly et al. 2011). But a barrier between knowledge and action exists: the political incentives for action at national or subnational scales are absent, despite knowledge of the global problem and awareness of possible solutions. Among scientists, ocean acidification had been recognized as a consequence of rising atmospheric CO_2 as early as the 1970s (Zimen and Altenhein 1973; Fairhall 1973; Fairhall and Erickson 1975), but not until individuals in Washington and Oregon experienced measurable economic losses did popular awareness and political will begin to grow on a subnational scale. The WC story was prominent in the political response from the Washington State Governor's office, contributing to the creation of a Blue Ribbon Panel on Ocean Acidification and to the Executive Order that followed.

After recounting this story, we identify key aspects of the narrative that seemed to accelerate political response and that might be applicable to other environmental issues in other locations and at different times. We suggest the narrative form of information disproportionately influenced the policy response in this case, and we pose three hypotheses to explain why such narratives might be particularly effective in linking science to environmental policy, drawing from the literature of economics, environmental policy, and cognitive psychology, respectively. Our purpose in this brief piece is not to present an exhaustive treatment of these ideas or fully test these hypotheses, but instead to highlight opportunities for analysis that might clarify how this linkage between social and ecological systems operates in environmental science. Our goal is to encourage future substantive interaction between research in the natural and physical sciences and research in the policy and social science spheres, with the goal of making environmental policy more responsive to observed changes in the biophysical world.

Case study: The Whiskey Creek Story in Three Parts

1) The narrative

Sue Cudd and her husband Mark Weigardt own and run the Whiskey Creek shellfish hatchery (WC) in Netarts Bay, Oregon providing about 75% of the juvenile oyster spat used in the commercial aquaculture of Pacific oysters along the west coast of the U.S. (Dewey and Warren 2011). In providing oyster spat to the shellfish aquaculture industry, WC occupies a position between the marine environment (which influences conditions in the hatchery) and the socio-economic system in which the shellfish industry is embedded. Hence, WC links ecological and social systems (sensu Liu et al. 2007). Shellfish growers directly and indirectly employ about 3,200 people in the state of Washington (Washington State Blue Ribbon Panel on Ocean Acidification 2012), and the industry provides to the region an estimated total economic benefit of $278M (Barton et al. 2012). In 2006, the hatchery's cultured larvae experienced up to 80% mortality. Mortalities of around 75% persisted beyond 2006 (Figure 1), and by 2008, it was clear that larval mortality events coincided with periods of strong coastal upwelling that transported CO_2-rich water from depth to the surface. WC staff collaborated with Oregon State University scientists and others to initiate a water monitoring program in the hatchery. The hatchery since has installed sophisticated monitoring equipment to avoid drawing acidified water into the hatchery during spawning events, thereby reducing the vulnerability of the larvae. As a consequence, larval production has increased from 25% of historical levels in 2008 to 60% or 70% in 2012 (Tobias 2012). Throughout this process, hatchery operators openly discussed the larval mortality problem, the research and monitoring they had performed in response, and the practices they had devised to reduce their vulnerability to upwelling events. Their story has been repeated numerous times in outlets ranging from the popular media to professional and academic societies and now is widely known among those working on problems of ocean acidification (Branch et al. 2013; Flato 2013; Satran 2012; Grossman 2011; Leonard 2012; Bonfils 2010; Kaufman 2012)(Figure 1).

2) The Scientific Data

As WC operators were addressing larval mortality in the hatchery, the general scientific understanding of ocean acidification was growing exponentially (e.g., Chapter 1 in Gattuso and Hansson 2011). Oceanographers previously had determined that about 33%-50% of the CO_2 that has been emitted from the burning of fossil fuels has been absorbed by the ocean (Sabine et al. 2004; Khatiwala et al. 2012; Gattuso and Hansson 2011)). The reaction of carbon dioxide with water molecules to form carbonic acid already was known to cause seawater pH and carbonate ion concentrations to decline. New analyses determined that the rate of decline in ocean pH since the start of the Industrial Revolution has been faster than at any time in the past 300 million years or more (Hönisch et al. 2012).

Furthermore, since about the year 2000, biologists repeatedly have demonstrated that this fundamental alteration of seawater chemistry has negative consequences for calcification, reproduction, survival, and growth of numerous marine organisms, particularly bivalve molluscs and reef-building corals (reviewed in Kroeker et al. 2010; Kroeker et al. 2013). In 2008, a landmark paper described in quantitative terms the advance of ocean acidification on the continental shelf of the Pacific Northwest (Feely et al. 2008), exactly where the multi-million dollar Pacific oyster industry is located. This paper provided vital new scientific information and has been widely cited by scientists. However, a comprehensive search of newspaper articles shows that in the Pacific Northwest, the Whiskey Creek story gained attention in the popular press more quickly over a short time than did the work of Feely (Figure 2). The much more rapid spread of the Whiskey

Creek story coincided with with—and, we argue, contributed to—the adoption of new policy in Washington State, while the spread of other regionally important data on the effects of ocean acidification—such as work pertaining to pteropod dissolution—was comparatively slower (Figure 2). No other such story emerged with respect to the effects of ocean acidification on the west coast, nor did any such stories emerge elsewhere in the U.S. The singularity and salience of the WC story is indicated by its repetition throughout the country (Schleifstein 2013). Hence we view the Whiskey Creek story as being more salient in influencing public opinion than much of the other important scientific work that arose at the same time, work which is generally presented in a expository, non-narrative format lacking the human focus of the WC narrative.

3) The Role of Narrative and Scientific Data in Shaping Political Action in Washington

The recognition of ocean acidification as a major environmental concern coincided with publicity of the larval failures at WC. The narrative developed around the WC story accorded well with the new scientific data delivered by oceanographers. The WC narrative quickly became a "sticky" story of the emerging phenomenon of OA, the effects of which are otherwise subtle and mostly unobservable to those outside the field. We observed that additional factors, some idiosyncratic, contributed to the success of the narrative in garnering attention: 1) the shellfish aquaculture industry is well-established in Washington state, where shellfish have substantial economic and cultural value; 2) larval mortalities in the hatchery were of concern to a multi-state commercial shellfish industry because spat produced by the hatchery constitute the beginning of the oyster aquaculture supply chain; 3) coastal native tribes were engaged via their interest in protecting shellfish resources to which they retain reserved rights; 4) the economic recession focused attention on saving jobs and local economies; and 5) Washington state's Governor Gregoire was willing to recognize and address the problem.

The WC narrative in combination with the supporting scientific data was essential in motivating subsequent actions in Washington State. We base this assertion on our first-hand observations of the process in Washington state, and on the fact that although comparable scientific data are (and were) available for other regions in the U.S.—such as Maine (Salisbury et al. 2008; Green et al. 2009), the Chesapeake Bay region (Waldbusser et al. 2011), and Alaska (Fabry et al. 2009)—in no other region has political action been taken commensurate with that in Washington. Simply put, in other regions, the existence of scientific data was not sufficient to compel action. In Washington, ocean acidification threatened to undermine Governor Gregoire's larger goals with respect to sustaining and improving shellfish aquaculture and restoration, water quality, and recreational opportunities in Washington state as established in the Washington Shellfish Initiative (2011; aligned with NOAA's National Shellfish Initiative established the same year), and the WC story offered a compelling example of the threat. Among the pivotal responses that followed were public presentations on causes and consequences of ocean acidification made by representatives of industry, science, and government; formation, by the Governor, of a Blue Ribbon Panel on Ocean Acidification, established under the Washington Shellfish Initiative and commended by NOAA Administrator Lubchenco; strategic composition of the Panel to include representatives from industry, NGOs, state and federal agencies, elected officials, and scientists; intensely collaborative work by Panel members to establish the scientific basis for action in Washington state and appropriate remedies that could be applied; and consensus recommendations made by the Panel to the Governor that resulted in Executive Order 12-07 "Washington's Response to Ocean Acidification", specifying several concrete actions to be taken by the state. Every one of the relevant public documents—including the Blue Ribbon Panel's charter, the Panel's final Report, the scientific and policy reports written in support of the Panel's work, and the Executive Order—referenced the failure of the larval oyster supply from Whiskey Creek.

What attributes of the WC narrative transformed it from a simple story of stress in a local, family-owned business to a case that motivated action at the level of regional government? How did the WC story avoid dismissal as an unfortunate alignment of biophysical and social factors? We suggest that this story gained critical traction because it featured identifiable and sympathetic characters—real people—with both the capacity and the willingness to share their story outside the boundaries of their community, and because their story was consistent with the effects predicted by a growing body of biophysical data. WC personified the economic impacts of one specific form of environmental change—ocean acidification—and did so in a credible and accessible way. The narrative arc thus constructed was perceived to clearly link a specific environmental change to effects on real people, the small but important local industry that they support, and the provision of food from the sea.

Identifying General Lessons from the Whiskey Creek Story

The WC story emerged as a powerful means of translating environmental science into action. Below, we pose three hypotheses—adapted from the literature in disciplines outside of those familiar to many environmental scientists—that could explain the story's effect, and that could help identify aspects of the narrative form that may be more broadly useful in linking environmental knowledge to action. The importance of discount rates and of salience and accessibility of data are established in the literatures of economics, environmental policy, and cognitive psychology, respectively. We use these ideas to develop three hypotheses that can be used to test mechanisms that promote the effectiveness of narratives in environmental policy. This is not an exhaustive set of hypotheses, but instead represents a sampling of plausible ideas derived from the literature that can be used to promote deeper analysis of the interactions between scientific data and policy action, particularly by the natural and physical scientists who often generate the primary data upon which policy may turn.

1) Narratives lower the discount applied to harms avoided.

In economic terms, we suggest that narratives lower the discount rate applied to the analysis of costs and benefits of policy action to ameliorate the probable impacts of environmental change, moving the policy discourse from the theoretical distant future to the here-and-now. Narratives clarify the benefits of harm-alleviation and harm-avoidance by reducing uncertainty about whether or when, or to whom, environmental harm will occur (Frederick et al. 2002; Perrings 1991). Reducing uncertainty, in turn, reduces the discount rate applied, and raises the net present value of the future benefits expected from remedial environmental action today (Pindyck 2007), making present-day action more attractive in cases where longer-term benefit would result. In effect, narratives may have the power to raise and personalize the perceived costs of inaction. Where narratives accurately ground theoretical harms that communities will experience from environmental change or degradation in a real-world scenario, they could improve the cost-benefit analyses (explicit or implicit) that accompany any policy discussion.

2) Narratives increase the salience of aggregate, statistical data for policymakers, improving the probability of translating knowledge into action.

Narratives appear to improve the usefulness of scientific knowledge by increasing the legitimacy, credibility, and salience of information for decision-making (Clark et al. 2006; McNie 2007). This insight comes from investigation of the types of information most likely to lead to policy change by focusing on the attributes of useful knowledge (Clark et al. 2011; Mitchell et al. 2006). When social, economic, or scientific information is simultaneously credible, legitimate, and salient, that information is most likely to inform policy (Mitchell et al. 2006). Furthermore, "localizing" such information—i.e., by moving science from the realm of large-scale trends towards particularized, on-the-ground impacts—is likely to increase all three attributes of useful knowledge simultaneously (Clark et al. 2006; Mitchell et al. 2006). In the WC case, we suggest that the narrative was effective because it localized information about the global phenomenon of ocean acidification, effectively inserting the science of ocean acidification into the feedback loop between human and natural influences on the marine environment. This localization effect is consistent with the observation that those with personal experience of flooding are more likely to be concerned about climate change (Spence et al. 2011), and with the related idea that decreased "psychological distance" between an audience and the subject being communicated (in this example, climate change) leads to greater audience concern (Spence et al. 2012).

The analysis of narratives is a core tool in the social sciences, particularly for testing ideas about the relationship between individuals and societies (Maynes et al. 2008). In political discourse ranging from campaign speeches to presidential addresses, personal stories are featured as a means of humanizing and personifying a theory or a challenge. These narratives are an attempt to catalyze action by making the hypothetical real. Even in the context of environmental policy, narratives have been shown to shape decisions about resource use, development, and conservation in powerful ways—towards both productive and unproductive ends (Hoben 1995).

3) Narratives are the most directly digestible form of environmental data for policymakers and other relevant audiences.

Narratives may be especially effective in linking knowledge to action for a third, more fundamental reason. Information presented to an audience in narrative (rather than expository) format is recalled approximately twice as well and absorbed about twice as quickly (Graesser et al. 2002, discussing earlier work), and narrative information may ease the alteration of existing ideas (Oatley et al. 2002). Psychologists differ regarding the mechanism governing this cognitive preference for narrative learning, but it seems likely that narratives derive their power from their use of important units of cognition ("schemas") consisting of hierarchically-organized set pieces in the mind (Mandler 1984). Complementary theories hold that narratives trigger existing knowledge in the listener's mind, reiterating consistent connections among events and objects (Schank and Berman

2002), or else that the listener more easily identifies with a narrated story and is thereby more affected by it (Dal Cin et al. 2004; Green and Brock 2002).

Regardless of the precise mechanism, it seems "people are 'wired' to be especially sensitive to information in narrative format" (Green and Brock 2002). This result applies broadly, from jury decisionmaking in criminal cases (Pennington and Hastie 1993) to adult education (Clark and Rossiter 2008). If learning is the process of assimilating new facts and existing experience into a coherent whole, narratives are pre-processed bits of learning, already coherent and thereby quickly digestible. Moreover, first-person narratives are more easily remembered than third person narratives (Graesser et al. 2002); for the WC story, the first-person narratives told by hatchery owners and operators were important to the power of the story. The role of narrative—such as the WC story—may therefore be especially relevant to the research and practice of environmental decisionmaking, being an effective means of simultaneously educating about and exemplifying an ongoing problem.

Conclusion

The Whiskey Creek story—which came to prominence in 2009 and which is still consistently cited in popular press reports on ocean acidification—served to "localize" the much more comprehensive ocean acidification datasets then becoming available. In particular, the story illustrated the real effects of increasingly corrosive coastal upwelling due to ocean acidification as described for much of the west coast by Feely and colleagues (Feely et al. 2008). Our personal observations suggest that this narrative of loss and economic vulnerability at least in part animated and accelerated Washington State's response to acidification and sparked discussion about local-scale responses that can be pursued independently of international agreements on CO_2 emissions reductions. Thus, the Whiskey Creek story provided the narrative for acidification in the Pacific Northwest, while the work of scientists provided much of the data and scientific context, and the Blue Ribbon Panel process provided the political outcome. We suggest that other, as yet untold, narratives hold similar potential for strengthening the feedback between environmental data and policy as they pertain to other environmental problems, and we hypothesize that such narratives are a prerequisite for local or regional action to curb environmental degradation. At the same time, we caution that, in the context of environmental problem-solving, narrative is powerful only when thoroughly grounded in the necessary biophysical data; otherwise, it is simply storytelling. Moreover, precisely because of the power of narrative, it is especially important that those claiming to be honest brokers of scientific information consider the ethical implications of narrative vs. expository communication (Dahlstrom and Ho 2012).

The specific combination of narrative plus credible scientific data forges a tool that can be useful---even essential--- in addressing the human impacts of environmental degradation through policy intervention. We are optimistic that future research and collaboration that crosses disciplinary lines will strengthen the feedback loop between environmental data and policy, in part by clarifying the mechanisms by which narrative information influences political decisions.

Figure 1: Environmental and science events (above timeline) and policy events (below timeline) associated with the WC story. "Corrosive" water observations documented in Feely et al. (2008); OA linked to larval oyster failure in Barton et al. (2012). "BRP" refers to the Blue Ribbon Panel.

Figure 2: Cumulative number of stories in Washington and Oregon publications with the terms "ocean acidification" and "pteropods," "oysters," "Richard Feely." Mentions of the Whiskey Creek story have sharply increased since mid-2009 to approximately equal the number of mentions of Feely or pteropods, two keywords that have increased in frequency more slowly over a longer period of time. Data from Westlaw comprehensive database of Oregon and Washington newspapers.

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Figure 1

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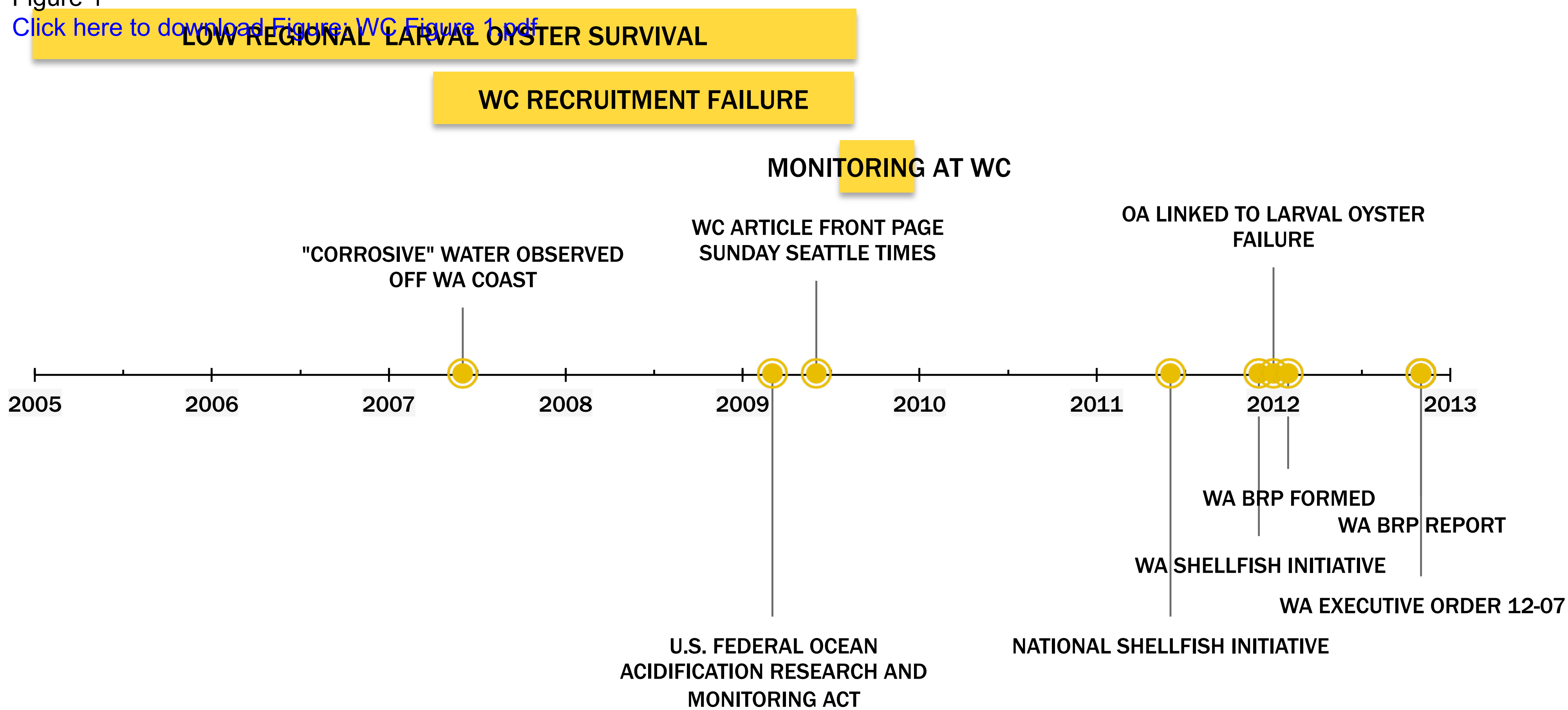
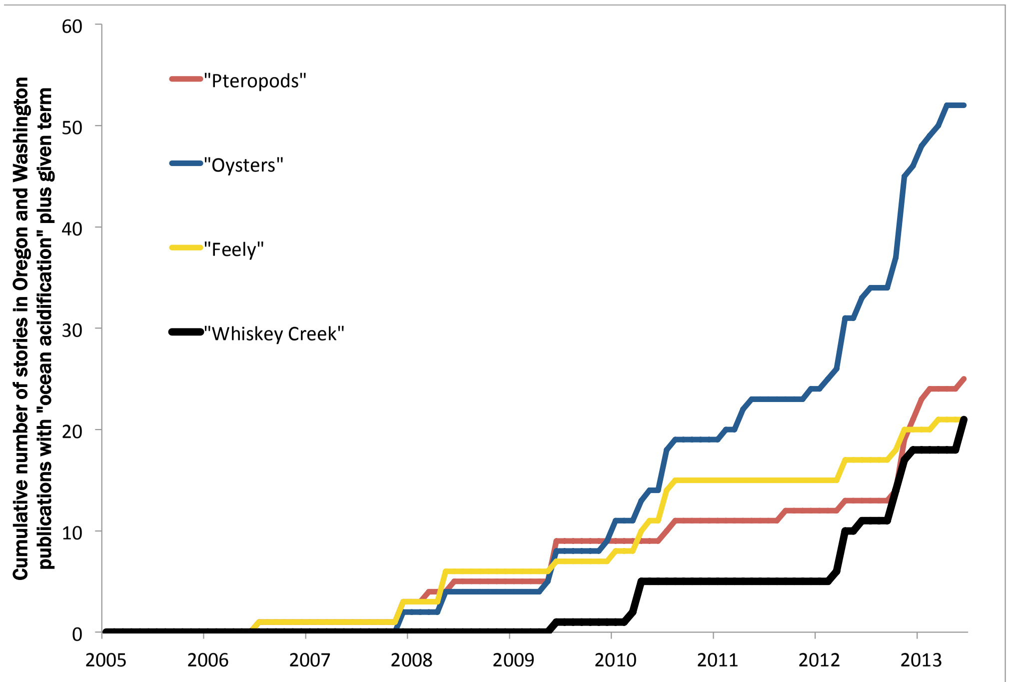
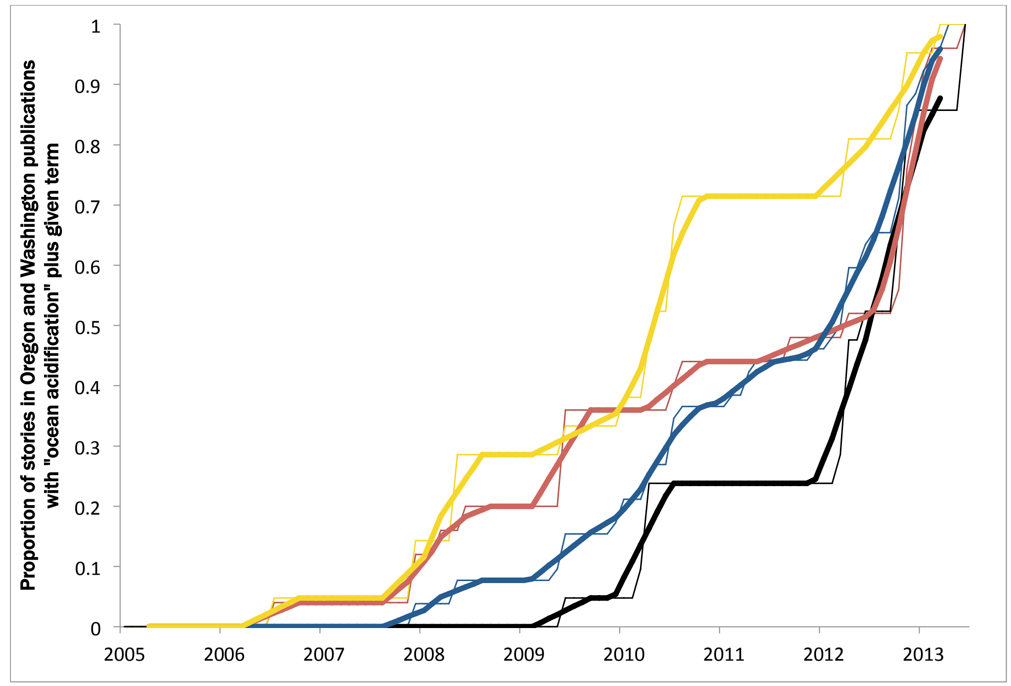



Cumulative number of stories in Oregon and Washington publications with "ocean acidification" plus given term
0
10
20
30
40
50
60
2005
2006
2007
2008
2009
2010
2011
2012
2013
"Pteropods"
"Oysters"
"Feely"
"Whiskey Creek"


Proportion of stories in Oregon and Washington publications with "ocean acidification" plus given term
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2005
2006
2007
2008
2009
2010
2011
2012
2013