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# Pathways of adaptation to external stressors in coastal natural-resource-dependent communities: Implications for climate change

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## ABSTRACT

Adaptation to climate change is one of the greatest challenges facing coastal communities today. Coastal communities are subject to a wide range of stressors related to climate change, including biological resource decline and natural hazards. Small historically natural-resource-dependent communities are particularly vulnerable because of their close reliance on ecosystem goods and services that are likely to be affected by climate change (e.g., fisheries, forests) and their limited access to outside technical and financial resources needed for adaptation. Exogenous adaptation policies, while helpful for fostering new behavioral adjustments to address resource decline and natural hazards, can in some cases exacerbate socioeconomic disruption, further burdening communities already struggling to adapt. This paper presents an investigation of how six historically natural-resource-dependent coastal communities in Oregon, USA, have experienced and responded to external stressors and how adaptation in these communities has been shaped by interactions between past and present practices, processes, and vulnerabilities. Despite climate-related impacts identified by the scientific community, climate change was not salient in the community members' reports of stressors and impacts, and thus was not a trigger of adaptation. Rather, communities were responding to stressors associated with decades of declines in natural resource industries, an economic recession, restrictive natural resource management and land use policies, demographic change, and natural hazards. These findings confirm other research findings that chronic everyday problems, including those related to the maintenance of livelihoods, or consequences of inadequate livelihoods, often eclipse potentially disastrous threats in the minds of rural community members, thereby influencing adaptation strategies. In some cases communities do not prioritize such threats because people have come to accept living with them, or they feel powerless and unable to change the circumstances of daily life. The findings improve understanding of adaptation in natural-resource-based coastal communities in the USA and support the need for policy makers and planners to integrate climate change adaptation into livelihood improvement strategies.

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## 1. Introduction

Adaptation to climate change is one of the greatest challenges facing coastal communities (Adger et al., 2007). Coastal communities are subject to a wide range of stressors related to climate change, including change in ocean temperature, loss of habitat, and natural hazards such as storms and sea level rise (Dolan & Walker, 2006; McGranahan, Balk, & Anderson, 2007; Moser, Williams, & Boesch, 2012). Nonurban coastal communities are particularly vulnerable because of their relatively high exposure and sensitivity: these communities are often in direct proximity to climate-related hazards—in many cases the entire community lies within a hazard zone—and they often lack well-developed critical

and essential care services and diversified economies that enable them to tap alternative streams of revenue if one stream is adversely impacted (Cross, 2001; Lal, Alavalapati, & Mercer, 2011; Porfiriev, 2009). Moreover, because these communities are often isolated and economically stressed, they may have limited access to technical and financial resources needed for adaptation (Cross, 2001; Trainor et al., 2009).

Historically natural-resource-dependent communities, i.e., those in which a large proportion of employment or employment income is generated through resource activities such as forestry, fisheries, mining, and energy (Humphrey, 1993), may be especially sensitive because of their reliance on industries and ecosystem goods and services that may be affected by climate change (Coles & Scott, 2009; Davidson, Williamson, & Parkins, 2003; Donohue & Sturtevant, 2007; Flint & Luloff, 2005; Karl, Melillo, & Peterson,

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2009; Lal et al., 2011; Magis, 2010; Trainor et al., 2009; Lynn & Donoghue, 2011). In addition, the compromised health and lack of mobility of very young and elderly people, who comprise the majority of the population in many rural communities, increases risk of thermal stress, diseases, allergies, and other adverse effects of extreme weather (Krawchenko, Keefe, Manuel, & Rapaport, 2016; Lal et al., 2011). Communities in areas with disproportionately large amounts of public lands and waters, as in much of the rural western United States, may be especially sensitive to changing ecological conditions because of their lack of opportunity for pursuing alternative economic activities on lands around them (Geisler, 1995; Peluso, Humphrey, & Fortmann, 1994; Walker, 2003; West, 1994). Low per-capita income, high unemployment, persistent poverty, and dependence on public services and government transfers have rendered such rural populations lacking in resources to draw on for adaptation (Cross, 2001; Lal et al., 2011).

A substantial body of empirical research has investigated exposure and sensitivity to climate change among coastal communities in the US and other developed countries (Clark et al., 1998; Cross, 2001; Emrich & Cutter, 2011; Wood, Burton, & Cutter, 2010; Wu, Yarnal, & Fisher, 2002), as well as factors that explain risk mitigation and adaptation to climate change-related natural hazards at the level of individuals (Elrick-Barr, Thomsen, Preston, & Smith, 2017; Koerth, Vafeidis, Hinkel, & Sterr, 2013). However, capacity for adaptation to climate change at the community-level is less well documented, potentially due to the challenges of studying this phenomenon. Climate change impacts people through multiple interacting stressors that reveal themselves at different spatial and temporal scales, making it difficult to attribute behavioral adjustments to changes in climate and evaluate how behavioral adjustments contribute to welfare over the long term. Moreover, climate change is a contested concept in the conservative rural US, which challenges data collection.

This paper uses a pathways framework (Haasnoot, Kwakkeld, Walker, & ter Maat, 2013; Wilson, 2014; Wise et al., 2014) to explain how six natural-resource-dependent coastal communities in Oregon, USA responded to change within a broader context of interactions between socio-economic and environmental external stressors and vulnerabilities. The research question was: what factors explain how rural historically natural-resource-dependent coastal communities adapt to change? Theories of adaptation to natural hazards, climate-related changes, and other stressors are drawn upon to interpret the findings about community responses to past stressors for future climate change. The findings increase understanding of processes of adaptation in rural natural-resource-based coastal communities in the USA and other developed countries and present considerations for investigations of future climate change adaptation. After a review of the literature, including theories of adaptation and the pathways framework, the methods are presented, followed by a discussion of the results, and a discussion of implications for climate change adaptation.

## 2. Literature review

“Adaptation” in social systems refers to the process of change in human behavior, in response to change in the physical or social environment, to better allow the system to cope, manage, or adjust (Denevan, 1983; Nelson, Adger, & Brown, 2007; Smit, Burton, Klein, & Street, 1999). Increased fitness, or suitability to the environment, is often considered an indicator of adaptation in the strict sense (Sober, 1993). Adaptation can be distinguished from maladaptation, which refers to an effort to adapt that has the unintended result of increasing vulnerability of other groups and sectors (Barnett & O’Neill, 2010). Adaptation—generally considered a long-term shift in behavior—is also sometimes distinguished from

coping, which involves temporary adjustment in response to change or to mitigate shocks and stresses (Blaikie, Cannon, Davis, & Wisner, 1994; Opiyo, Wasonga, Nyangito, Schilling, & Munang, 2015), and manipulation, which refers to short-term change in an external system to make self-regulation unnecessary (Thomsen, Smith, & Keys, 2012).

Adaptation is differentiated on the basis of (a) who is engaging in the behavioral adjustment, (b) to what is the actor adjusting, and (c) how is the actor adjusting (Smit, Burton, Klein, & Wandel, 2000). The actor can be an individual or group (Smit et al., 2000). The actor can adjust to long-term changes, mid-term shifts, or sudden events (Smit et al., 2000). Adaptation can be reactive or anticipatory, spontaneous or planned (Fankhauser, Smith, & Tol, 1999; Smit et al., 2000; Smithers & Smit, 1997). Adaptation can span a range of behaviors from recognition to intention to action. Adaptation can involve raising awareness of climate-related changes; developing plans to mitigate risks by adjusting human behaviors, institutions, technologies, policies, programs, and built environments; and implementing these plans (Berrang-Ford, Ford, & Paterson, 2011; Biagini, Bierbaum, Stults, Dobardzic, & McNeeley, 2014; Lesnikowski et al., 2013). Reactive adaptation may focus on avoiding, retreating, coping, accommodating, adjusting, spreading risk, and securing resources, whereas proactive adaptation may focus on planning, monitoring, increasing awareness, building partnerships, and enhancing learning or research (Berrang-Ford et al., 2011; Fazey et al., 2010).

Although adaptation to climate change occurs at the scale of individuals and groups, it is shaped by a broader context of vulnerability, specifically conditions of exposure, sensitivity, and adaptive capacity. Exposure refers to the potential magnitude, frequency, duration, and extent of climate-related changes or disturbances by virtue of a community’s geographic location (Adger, 2006). Sensitivity refers to the degree to which communities may be affected or harmed by climate-related changes because of their economic or cultural reliance on or interdependence with ecosystem goods and services that could be altered by climate change, and general susceptibility to stress and access to resources (Andrey & Jones, 2008; Cutter, 1996; Cutter, Boruff, & Shirley, 2003; Finan, West, Austin, & McGuire, 2002; Lynn & Donoghue, 2011; Smit & Wandel, 2006; Tierney, Lindell, & Perry, 2001; Vásquez-León et al., 2003; West and Vásquez-León, 2008).

Adaptive capacity refers to the ability to modify social norms, behaviors, and policies in order to anticipate or reduce risk, take advantage of opportunities, adjust to change, mitigate potential damages, or cope with consequences (McCarthy, Canziani, Leary, Dokken, & White, 2001). At the level of individuals adaptive capacity is predicated on knowledge, skills, and physical capacity; access to information and resources; perceptions and attitudes toward risks, capacities and opportunities (Elrick-Barr et al., 2017; Koerth et al., 2013). At the level of communities and social groups, broader structures and processes are also at work (Magis, 2010; Norris, Stevens, Pfefferbaum, Wyche, & Pfefferbaum, 2008). At this level, effective governance enables people and organizations to adjust to changes by modifying social norms, behaviors, and policies, and to implement adaptation decisions (Adger, 2003; Nelson et al., 2007). Culture is also important. Place attachment and continuity of place and livelihood practices is an important part of cultural identity; relocation and restricting relationships with a resource-base can cause financial and emotional stress and weaken social networks (Adger, Barnett, Brown, Marshall, & O’Brien, 2013; Brown & Westaway, 2011; Buikstra et al., 2010). Exogenous policy interventions can also be important. For example, financial and technical assistance can build capacity for adaptation, rules and regulations can enforce baseline planning and risk mitigation, and incentives can encourage innovation and investment. However, exogenous policy interventions can also, in some cases,

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