



*Insight*

## Understanding leadership in the environmental sciences

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**ABSTRACT.** Leadership is often assumed, intuitively, to be an important driver of sustainable development. To understand how leadership is conceptualized and analyzed in the environmental sciences and to discover what this research says about leadership outcomes, we conducted a review of environmental leadership research over the last 10 years. We found that much of the environmental leadership literature focuses on a few key individuals and desirable leadership competencies. The literature also reports that leadership is one of the most important of a number of factors contributing to effective environmental governance. Only a subset of the literature highlights interacting sources of leadership, disaggregates leadership outcomes, or evaluates leadership processes in detail. We argue that the literature on environmental leadership is highly normative. Leadership is typically depicted as an unequivocal good, and its importance is often asserted rather than tested. We trace how leadership studies in the management sciences are evolving and argue that, taking into account the state of the art in environmental leadership research, more critical approaches to leadership research in environmental science can be developed.

**Key Words:** *conservation; entrepreneurship; environmental governance; fisheries; forestry; water*

### INTRODUCTION

Many widespread and repeated patterns of human behavior cause social and environmental problems (Rockström et al. 2009). Leadership is intuitively recognized as important for motivating a change in human behavior toward more sustainable practice. Engaging political leaders is considered imperative for the success of global and regional sustainable development (e.g., Walker et al. 2009). At more localized scales, interactions between contemporary and traditional leadership structures are recognized as important (e.g., Johannes 2002). As environmental problems escalate, the impetus for understanding where and how effective leadership can be found and fostered has increased.

Leadership studies is a multidisciplinary field, closely aligned with management science and organizational studies, that has emerged over the last 60 years. Traditionally underpinned by psychology and positivist social science methodologies, the field attempted to predict corporate outcomes by identifying the attributes and behaviors of individual leaders (Stodgill 1948, 1974, Tannenbaum and Schmidt 1958, Likert 1961, Fiedler 1967, Hersey and Blanchard 1988). Variations of such research persist to this day in mainstream studies of leadership. Nevertheless, alternative perspectives on leadership are emerging; these go beyond the notion of the individual, heroic leader that underpins conventional concepts of leadership (see Hosking 1988, 1999, Gemmill and Oakley 1992, Maccoby 2000, Banerjee and Linstead 2001, 2004, Jones 2005, 2006, Warner and Grint 2006, Carroll et al. 2008, Lemmergaard and Muhr 2013). Our purpose was to understand how leadership is conceptualized in the environmental sciences. We reference our findings against some key trends in leadership studies to identify what opportunities more critical approaches to leadership studies offer to the field of environmental sciences.

To capture the way leadership is presented in the environmental sciences, we used a broad conceptualization of leadership to include people, e.g., leaders, entrepreneurs, champions, brokers,

and organizations or groups, and associated characteristics, roles, and actions that affect environmental outcomes. In analyzing the literature, we sought to understand, first, how leadership is conceptualized and, second, what sustainability outcomes are attributed to leadership. We discuss the potential for more critical research on environmental leadership that is informed by contemporary scholarship in leadership studies.

### METHODS

We reviewed the environmental sciences literature over the last 10 years to identify how research has portrayed and investigated leaders and leadership. We began with a systematic search of published literature on ISI Web of Science between 2003 and 2013. Because we were interested in environmental outcomes, we focused our search on conservation, natural resource management, and governance of social-ecological systems (see Appendix 1 for specific search terms). Our search returned more than 850 records. A scan of titles excluded 378 papers that were not about the natural environment, e.g., “environment” referred to a context such as an information technology environment. A scan of paper abstracts excluded a further 302 papers. Papers were excluded when leaders or leadership were not the focus or finding of the research itself, for instance, (1) when leaders were referred to in setting up the paper’s argument or as research end users; (2) when leaders were sampled as part of a study on other topics; or (3) when the importance of leadership was simply asserted in a conclusive statement, but the body of the paper did not refer to or discuss leadership (see Appendix 2 for further details).

This systematic search identified 187 papers that we considered to represent leadership research in environmental sciences. All 187 abstracts were read and summarized by the lead author. We then conducted a selective review of this pool of papers. We included all the conceptual review or synthesis articles ( $n = 24$ ), meta-analyses ( $n = 2$ ), and large- $N$  studies ( $n = 6$ ). Because our intention was to get an overarching sense of the field rather than to conduct our own meta-analysis, we selected a subset of the

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empirical case studies for manageability (n = 25). Case study papers were chosen to reflect major environmental fields, i.e., conservation, fisheries, forestry, water, and climate change, and a diversity of perspectives on leadership. Case studies of leadership by regional bodies and conventions like the European Union or Convention on Biological Diversity were considered beyond the scope of this paper. We also recognized that leadership can be broadly interpreted and, therefore, that there may be research in the environmental sciences that is implicitly about leadership but that was not identified by our search terms. These papers would not have been captured in our review.

In total we reviewed 57 papers (see Appendix 3 for details of all papers reviewed). These papers were read in full. Using an open and inductive approach, information was extracted on (1) how leadership or a similar term was defined or conceptualized by the authors; (2) what factors, if any, were associated with effective leadership; (3) what governance outcomes were associated with leadership; and (4) how links between leaders, leadership, and outcomes were deduced.

## RESULTS

### Conceptualizing leadership

We found that much of the environmental leadership literature focuses on a few key individuals and desirable leadership competencies. Only a subset of the literature highlights multiple, interacting sources of leadership or evaluates leadership processes, i.e., tactics, in detail.

#### *Leadership as individual leaders*

In the literature we reviewed, the most common approach to conceptualizing environmental leadership is to identify individual leaders or leadership positions responsible for delivering specific outcomes. The large-N studies and meta-analyses primarily document the presence or absence of a single village, community, or group leader (Pagdee et al. 2006, Van Laerhoven 2010, Gutiérrez et al. 2011). The synthesis and case study papers also tend to focus on fewer than a handful of individual leaders. Some papers refer to these individuals in the abstract. For instance, Walters (2007:306) argues that “at least one single individual” can be credited for the few successful examples of adaptive fisheries governance. Other papers refer more specifically to named individuals or formal leadership positions. For example, Kates et al. (2012) and Smith et al. (2009) identify specific individuals in the United States and United Kingdom, respectively, who in their formal political positions as county executive, governor, or city mayor have catalyzed climate change adaptation planning and action.

Increasingly the environmental sciences literature, particularly research associated with social-ecological systems, complex systems, and resilience, refers to entrepreneurs rather than leaders. Social entrepreneurs recognize social problems and use entrepreneurial principles to organize, create, and manage an initiative to bring about social change (Biggs et al. 2010). Institutional entrepreneurs recognize environmental problems as institutional failures and leverage resources to create new institutions or transform existing ones to address particular problems (Rosen and Olsson 2013). Similarly, policy entrepreneurs connect environmental problems to policy processes and exchange resources for future policies they favor

(Folke et al. 2005, Huitema and Meijerink 2010). Westley et al. (2013) argue that focusing on entrepreneurship rather than leadership can encompass and recognize the agency of a more diverse set of actors. Indeed, Rosen and Olsson’s (2013) analysis of the Coral Triangle Initiative identified up to 50 institutional entrepreneurs who were involved in developing and promoting the Coral Triangle Initiative’s regional policy. Nevertheless, we found that many papers continue to emphasize the importance of individual entrepreneurs, specifically or in the abstract.

#### *Leadership interactions*

Only a subset of the environmental leadership literature we reviewed is explicit about interactions among different sources of leadership (e.g., Olsson et al. 2008, Zulu 2008, Marschke and Berkes 2005, Gupta 2010, Marín et al. 2012). Marín et al. (2012) identify both a governance network and people within the network as sources of leadership, claiming that the network “revolutionized ecosystem management” and that, in turn, the success of the network is attributable in part to key actors. Olsson et al. (2008) also suggest a nested form of leadership. In their analysis of the rezoning of the Great Barrier Reef Park, Australia, they refer to leadership by the Great Barrier Reef Marine Park Authority in general; the Senior Management Forum within the Authority, responsible for communicating a common vision; and the two executive directors who led the forum and navigated both internal and external politics. Rosen and Olsson (2013:201) argue that “the interactions among several types of individuals and organizations” are of great importance in institutional change.

Most studies that recognize leadership interactions portray them as mutually supportive. Olsson et al. (2008) acknowledge the involvement of senior scientists, environmental nongovernmental organizations, and lobbyists from the tourism and fishing industries in the Great Barrier Reef rezoning process, but they emphasize the success of the Authority and its senior management and did not evaluate other, potentially contested, interactions. Relatively few studies in our review document contestation or conflict among leaders (Carruthers and Rodriguez 2009, Fleischman et al. 2010, Huitema and Meijerink 2010, Hu 2011, Ernstson 2013). An insightful exception is a series of studies on fisheries comanagement in Malawi (Russell and Dobson 2009, Njaya et al. 2012). Njaya et al. (2012:663) state that “the Department of Fisheries, members of the Beach Village Committees, and the traditional leaders have all been endowed some form of power, which they use to create rules, make decisions, and adjudicate in relation to fisheries management.” In many but not all fisheries, this has led to tensions between contemporary elected leaders and traditional, nonelected, i.e., hereditary, village heads that have undermined new comanagement processes (Russell and Dobson 2009, Njaya et al. 2012). In an empirical case examining water management, Sherval and Greenwood (2012) note tension between water management agencies and community groups over the decision to build a dam. This contested leadership played out in alternative discourses, with communities engaging more effectively with the media and essentially determining the leadership outcome. More conceptually, in summarizing policy entrepreneurship in water management, Huitema and Meijerink (2010) emphasize the potential for opposing advocacy coalitions, whereas Ernstson (2013) describes competing actor networks and processes of value articulation for urban ecosystem services.

**Table 1.** Strategies of “successful” leadership as discussed in the environmental sciences literature. References refer to the cases reviewed in this study.

Strategies	References
Early warning of crisis events: crisis recognition; communication of crisis origins and impacts	Galaz et al. 2010
Visioning and Sensemaking: strategic framing / reframing; ability to share a clear long-term vision; creating meaning; articulating value; popularizing issues	Zimmerer et al. 2004, Folke et al. 2005, Fabricius et al. 2007, Pahl-Wostl et al., 2007, Marschke and Berkes 2005, Biggs et al. 2010, Galaz et al. 2010, Meijerink and Huitema 2010; Black et al. 2011, Scholten 2010; Ernstson 2013
Knowledge building: generating understanding about environmental and social complexities	Folke et al. 2005, Bodin et al. 2006, Chuenpagdee and Jentoft 2007, Olsson et al. 2008, Wale et al. 2009, Black et al. 2011, Kenward et al. 2011
Innovating and Learning: developing new ideas, policy frames, system configurations or development pathways; encouraging learning and receptiveness to alternatives	Folke et al. 2005, Bodin et al. 2006, Olsson et al. 2008, Marschke and Berkes 2005, Galaz et al. 2010, Huitema and Meijerink 2010, Scholten 2010, Black et al. 2011, Lockwood et al. 2012, Ernstson 2013, Rosen and Olsson 2013
Securing wider political commitment and community support: communicating; overcoming bureaucratic resistance, turf battles, and risk aversion; tapping into existing priorities; building alliances with key decision-makers; outreach; recognising or creating windows of opportunity	Zimmerer et al. 2004, Olsson et al. 2008, Marschke and Berkes 2005, Smith et al. 2009, Huitema and Meijerink, 2010, Scholten 2010, Lockwood et al. 2012, Rosen and Olsson 2013
Linking actors (and discourses): identifying the right mix of actors; engaging stakeholders; initiating partnerships; coalition and/or network building (discourse coalitions, advocacy coalitions, and shadow networks); managing boundaries; foster group identity; mediation and facilitation	Folke et al. 2005, Bodin et al. 2006, Chuenpagdee and Jentoft 2007, Pahl-Wostl et al., 2007, Olsson et al. 2008, Carruthers and Rodriguez 2009, Marschke and Berkes 2005, Wale et al. 2009, Biggs et al. 2010, Huitema and Meijerink 2010, Marin et al. 2012, Rosen and Olsson 2013
Trust building: mobilizing broad support for change; ensuring transparency; balancing power; keeping in regular contact; managing uncertainty and ambiguity	Folke et al. 2005, Fabricius et al. 2007, Pahl-Wostl et al., 2007, Zulu 2008, Marschke and Berkes 2005, Fleischman et al. 2010, Gruber 2010, Rosen and Olsson 2013
Fostering social and institutional memory: contextualizing current and future change in past experience; building on previous initiatives	Folke et al. 2005, Black et al. 2011, Rosen and Olsson 2013
Conflict management: managing creative friction between actors; overcoming bargaining impediments; disperse power; avoid centralized control	Folke et al. 2005, Sudtongkong and Webb 2008, Zulu 2008, Marschke and Berkes 2005, Biggs et al. 2010, Black et al. 2011, Gutierrez et al. 2011 Lockwood et al. 2012, Njaya et al. 2012, Chuenpagdee and Jentoft 2007, Pahl-Wostl et al., 2007, Lockwood et al. 2012, Rosen and Olsson 2013
Securing resources: mobilizing financial and human resources; providing technical support; motivating and mobilising energy	Zimmerer et al. 2004
Provide legal frameworks	Zimmerer et al. 2004, Van Laerhoven 2010
Enhance monitoring: monitoring of environmental condition, resource-user compliance, or social outcomes	
Enhance resource-user compliance	Sudtongkong and Webb 2008, Gutierrez et al. 2011
Ability to switch thinking between 'big' picture and detail	Black et al. 2011
Orientation towards 'hands-on' management: installing high performance teams	Black et al. 2011
Exploiting multiple venues (as distinct from momentary windows of opportunity): 'venue shopping'; identifying most appropriate venue, manipulating the composition of venues, and creating new venues	Huitema and Meijerink 2010

### Leadership competencies

In the literature we reviewed, it was common for papers to focus on desirable leadership competencies. Competencies refer broadly to personality traits or attributes leaders possess, e.g., intelligence; leadership functions or strategies, e.g., meaning-making; and styles of leadership, e.g., visionary leadership (Carroll et al. 2008).

The desirable personality traits of leaders identified in the environmental sciences literature include charisma, strength, commitment/perseverance, and reputation. The synthesis papers tend to emphasize more transformational qualities such as vision and charisma. For example, Scheffer et al. (2003) discuss, at an abstract level, charismatic opinion leaders with high social capital. The meta-analyses, large-N studies, and other empirical case studies refer more often to strong, committed, and/or motivated leaders (Pagdee et al. 2006, Gutiérrez et al. 2011; but see also Huitema and Meikerink's 2010 review of policy entrepreneurs).

In his analysis of natural resource management policy, Biggs (2008) notes that individuals or organizations responsible for change were effective at the policy level, well respected professionally, and known for their long-term commitment to issues of social justice. Similarly, Walters (2007:306) observes that individual leaders “made a very large personal investment of time and energy to make sure the programme actually succeeded.” In this case, the author emphasizes that these individuals were middle managers and would not be called inspiring or charismatic. Attributes associated with negative outcomes include domineering, corrupt, weak or insecure, and inactive or absentee leaders (Zulu 2008).

Our review identified numerous strategies or functions that leaders do, or should, perform (Table 1). For instance, alongside visioning and sense-making, Folke et al. (2005) identify six other functions that leaders perform. Many studies agree on the key

**Table 2.** Leadership styles discussed and defined within the environmental sciences literature. The definitions emulate how these styles are expressed in the literature. References refer to the cases reviewed in this study that mention a particular leadership style, not to the original source or definition of the particular style.

Styles	Definition	Reference
Adaptive	Focused on learning how to address social problems as adaptive rather than purely technical problems	Manolis et al. 2009, Gruber 2010
Collaborative or Distributive	Encourages linking of different actors	Pahl-Wostl et al., 2007; Gupta et al. 2010
Complexity	Leadership in and of complex adaptive systems	Lockwood et al. 2012
Democratic	All parties contribute and take ownership of key decisions	Biggs et al. 2010
Entrepreneurial	Provide direction, lead by example and stimulate action... uses negotiating skills to influence the manner in which issues are presented and to fashion mutually acceptable deals	Gupta et al. 2010
Intellectual	Relies on the power of ideas to shape understanding of the issues at stake	Gupta et al. 2010
Knowledge	A measure of the frequency with which a higher authority was consulted for the purposes of building knowledge	Kenward et al. 2011
Political	Leadership by a 'Chief Executive' or top-level bureaucrat	Smith et al. 2009; Galaz et al. 2010
Process-oriented	Create conditions to get the most out of diverse perspectives, competencies and resources; Champion participatory processes by mobilising knowledge and institutional engagement by a broad range of stakeholders	Pahl-Wostl et al., 2007; Wale et al. 2009
Servant	All parties contribute and take ownership of key decisions <sup>†</sup>	Biggs et al. 2010
Systems-thinking	Focuses on continuous learning to improve the capability of a programme. Is integrated, co-operative, and self-motivated rather than output oriented, contractual, and based on reward/punishment.	Black et al. 2011
Tipping-point	Not defined	Scheffer et al. 2003 in Folke et al. 2005
Transformational	Recognises opportunities, identify and transform constraints and barriers. Inspires and enables others to transcend their own interests, is crucial to innovation that maintains fit between institutional and management arrangements and conservation needs Make daring (i.e., innovative, and somewhat controversial or risky) decisions needed to create and progress innovative policy	Folke et al 2005 Lockwood et al. 2012
Visionary	Fabricate new and vital meanings Encourage long-term visions and have reformist leanings	Scholten 2010 Folke et al. 2005 Gupta et al. 2010

<sup>†</sup> In the leadership studies literature this definition relates more closely to 'distributed leadership' but the authors refer to this form of leadership as 'servant'.

strategies or functions of successful environmental leadership, as indicated by the number of references supporting each one. The literature also emphasizes overarching leadership styles (Table 2). Some styles are common to management and organizational sciences, including democratic, transformational, and visionary leadership. Other styles arguably reflect general principles and concepts developed within environmental sciences, including adaptive, complexity, systems-thinking, and tipping-point leadership.

There is a tendency within the environmental sciences literature we reviewed for authors to advocate rather than critically analyze or test leadership competencies. For example, Black et al. (2011:335) provide a list of “recommended characteristics, qualities and actions that a systems thinking leader should apply in a conservation setting.” There is also evidence of scholars projecting positive qualities onto leaders. Pagdee et al. (2006) and Gutiérrez et al. (2011) infer that the presence of a leader suggests

strong leadership that is committed to community forestry or fisheries comanagement, respectively. Relatively few studies investigate how key strategies such as sense-making or conflict resolution are achieved in practice. The exceptions are highly insightful. For example, Rosen and Olsson (2013) elaborate in detail the tactics used by institutional entrepreneurs to “secure wider political support” and “mobilise resources” for the Coral Triangle Initiative, such as packaging the initiative in terms of the priorities of the Nations they were trying to bring on board. In a study focused explicitly on leadership for innovation, Scholten (2010) suggests that individual leaders need to use and bend the rules to achieve the innovative policy change they seek. Importantly, Meijerink and Huitema (2010) suggest that policy entrepreneurs resisting change use strategies similar to those of the ones who promote it.

Links between different competencies such as particular leadership styles and strategies are not evident in either the

conceptual or empirical studies we reviewed. Indeed, the empirical case studies, which more closely reflect the messiness of governance in practice, tend not to assign particular leadership strategies or styles to different sources of leadership, e.g., traditional and contemporary leaders. This reflects the difficulty of categorizing or generalizing which forms of leadership work in particular contexts for particular governance outcomes.

### **The importance of leadership**

The literature reports on the importance of leadership in maintaining existing governance processes, e.g., monitoring, enforcement, and sanctioning, and more commonly, in driving change and innovation, e.g., formulating and implementing new approaches to environmental management. We considered these types of outcome together. The environmental leadership literature we reviewed commonly reports that leadership is one of the most important factors for effective or successful management. Only a subset of literature critically analyzes how leaders or leadership affect different social outcomes, e.g., livelihoods, and environmental outcomes, e.g., water quality.

#### *Leadership is key to success*

Across the papers we analyzed, leadership is considered to be one of the key requirements for emergence and effective implementation of environmental governance and climate change policy (e.g., Folke et al. 2005, Walters 2007, Biggs 2008, Christie et al. 2009, Smith et al. 2009, Biggs et al. 2010, Gupta 2010, Black et al. 2011, Kates et al. 2012, Lockwood et al. 2012). Leaders are associated with the emergence of ecosystem-based water management (Biggs et al. 2010), they are “directly related (at statistically significant levels)” to successful implementation of large-scale marine management (Christie et al. 2009:381), and they are critical for successful scaling up of natural resource management in policy (Biggs 2008). The importance of leadership is supported by the large-N studies and meta-analyses, which find that the presence of a leader has a high (Pagdee et al. 2006, Van Laerhoven 2010, Gutiérrez et al. 2011) to moderate or mixed (Ruttan 2006, Cinner et al. 2012) positive influence on environmental governance outcomes. Leadership is often identified as one of a range of important factors and is frequently found to be one of the most important factors.

An absence of leadership is also connected to ineffective management outcomes. Fabricius et al. (2007:1) suggest that communities who cope with disturbance events but do not adapt to them “lack the capacity for governance because of a lack of leadership, of vision, and of motivation.” In a review of 30 cases of fisheries management, Walters (2007:306) found that most initiatives failed and that “of the three main causes of implementation failure, easily the most important has been lack of leadership.” More broadly, Scheffer et al. (2003) conclude that a lack of strong leadership can lead to inertia in addressing new problems in social-ecological systems. These studies contrast with a few examples showing that the absence or failure of leadership can instead lead to positive outcomes through emergent leadership at other scales, also expressed through ideas of shadow networks that form in response to an undesirable status quo. Pesqué-Cela and colleagues’ (2009) large-N study of 115 villages in China shows that distrust of township leaders is associated with increased participation in self-governing community organizations. Gupta’s (2010) review of climate change policy also shows that a

lack of real statesmanship has, in particularly stark cases, led to the emergence of subnational leadership of initiatives that diverge from national rhetoric in Australia and the United States of America.

#### *Leadership is not a panacea*

We found that a minority of studies we reviewed report on the contested or negative outcomes of leadership. The quantitative studies that find leadership to be one of the most important factors of success mostly consider a single management outcome or aggregate environmental outcomes (Pagdee et al. 2006, Gutiérrez et al. 2011, Kenward et al. 2011). For instance, Zimmerer et al. (2004) quantify the global spatial coverage of protected areas, Van Laerhoven (2010) uses community monitoring as a proxy for effective management, and Gutiérrez et al. (2011) calculate an index that combines eight outcome variables ranging from community empowerment to increased abundance of fish. In only a few cases are outcomes disaggregated (e.g., Ruttan 2006, Cinner et al. 2012). Importantly these latter cases report more nuanced, mixed findings about the importance of leadership. For example, Cinner et al. (2012) find that trust in leadership is not significantly correlated with benefits to livelihoods but is somewhat important for reported compliance to fisheries management rules. Ruttan (2006) finds that the presence of political entrepreneurs is correlated positively with water abundance but negatively with water quality in irrigation systems, and is not correlated with any successful outcomes in fisheries systems.

Empirical studies in the United States, Ethiopia, and Malawi show that leadership used as a tool to co-opt power or resources can result in weakened institutions, loss of trust, overharvesting, degradation, and overall management failure (Zulu 2008, Fleischman et al. 2010, Mohammed and Inoue 2012, Njaya et al. 2012). Wale et al. (2009:12) suggest that in a participatory process an overly dominant leader can cause “an atmosphere of disengagement.” This position is corroborated by Pahl-Wostl and colleagues (2007), who argue that although strong, centralized leadership may be useful at critical or strategic points in a process, dependence on strong individual leaders is not generally desirable or realistic in collaborative, multiactor processes of decision making. Pérez-Cirera and Lovett (2006) highlight that powerful leaders may enhance the creation and enforcement of resource regulations but in doing so are able to impose higher costs on the less powerful, leading to inequitable distribution of income. Further, Galaz et al. (2011) argue that under the intense social and political pressure that characterizes ecological crises, leaders may often be forced to make “tragic choices” in situations where no option is preferred (see also Adams et al. 2003 on contested problem definition).

As demonstrated by the disaggregated large-N studies, outcomes may often be mixed. In one of the most critically informed synthesis papers, Meijerink and Huitema (2010) highlight that in many of their 16 cases of water policy transition, new policies were rarely implemented fully. Instead, new and old policies often overlapped, with policy entrepreneurs attempting to integrate or balance the two.

#### *Leadership in context*

Although leadership is identified as one of the most important factors associated with beneficial governance outcomes, it is not

the only factor explaining success (Pagdee et al. 2006, Chuenpagdee and Jentoft 2007, Van Laerhoven 2010, Kenward et al. 2011). As Gutiérrez and coauthors argue (2011:386), “fisheries were most successful when at least eight co-management attributes were present.” The range of factors that reportedly work in combination with leadership is too varied to note here, but they include social capital, defined rights, participatory processes, and regulatory tools. In particular, the roles of institutions (Chuenpagdee and Jentoft 2007, Huitema and Meijerink 2010, Gupta et al. 2010), social networks (Folke et al. 2005, Biggs 2008, Bodin and Crona 2008), and links to political leadership (Olsson et al. 2008, Banks and Skilleter 2010, Rosen and Olsson 2013; but see Carruthers and Rodriguez 2009 for an example of negative interference by political leaders) are noted as important. As Biggs (2008:54) observes:

*There was no single “champion” that led these changes. In the case of the bamboo tubewells, the District Commissioner was important, but without the artisans and farmers who created the bamboo technology in the first place, and continued to change it, and those who changed market institutions, he would not have had a context (or alliance members) in which to be innovative.*

Biggs (2008:54) concludes that giving “privileged attention to one or two people overlooks the importance of other actors on the playing field (who may or may not be seen) at the time.” Understanding leadership in context is important and reflects more contemporary research in leadership studies. Nevertheless, the specifics of this wider context are typically not explored in detail in the environmental leadership literature we reviewed, which remains relatively silent on the perceptions, motivations, and actions of followers, the types of institutions that foster desired leadership traits and outcomes, or how leaders shape and are shaped by their context.

In sum, the majority of the environmental sciences literature that investigates leadership finds it to be important in explaining positive governance outcomes. Relatively little analysis differentiates outcomes or explores the negative impacts of leadership. Even with some studies differentiating outcomes, there are no explicit studies systematically linking different leadership competencies with particular empirical outcomes. Further, how environmental leadership emerges from, responds to, and reflects different institutional and political contexts is not well researched in the field.

## DISCUSSION AND CONCLUSION

Our investigation of leadership in the environmental sciences reveals a number of important insights into how leadership concepts are perceived and used within this scientific field to date. We see opportunities for more critical perspectives in future. By this we mean adopting a critical research perspective that challenges taken-for-granted assumptions and normative positions, and is more sensitive to different perspectives on the processes and outcomes of leadership.

### Trends in leadership studies

Scholars trace the origins of modern concepts of leadership to the “great man” thesis of Carlyle in the early 1900s (Case et al. 2011, Haslam et al. 2011). This discourse underpins romanticized notions of the heroic leader still prevalent in lay and professional

analyses of corporate and political leadership today (Case et al. 2011). Leaders are thus seen as different, superior, and rare. Individualistic frameworks support a focus on leadership competencies pursued through positivist psychological methods such as personality tests (Bolden and Gosling 2006, Carroll et al. 2008). This framing of leadership is considered incomplete: it is unable to systematically predict who will become a leader and how effective they will be, and it neglects to consider followers and their motivations (Haslam et al. 2011).

In response to these criticisms, alternative perspectives consider the relationship between leaders and followers. These perspectives are informed by political science, sociology, and social psychology. Haslam and colleagues (2011) provide a full review of these approaches. Contingency approaches describe hybrid models that consider the fit between leaders’ competencies and the situational or problem context. Transactional approaches emphasize exchanges of resources, favor, or power between leaders and followers. Transformational approaches view competencies as attributes conferred on leaders by followers, and aim to deduce core leadership strategies that lead followers to want to follow even when the leader is absent. Each approach appears to emerge in response to shortcomings in other models. For instance, transformational approaches aim to redress the loss of leader agency in contingency models and the implicit suggestion in transactional approaches that followers need to be incentivized or coerced. However, transformational models have a legacy of motivating leaders to undertake significant structural change as a measure of success. Some argue that this framing is still underpinned by the notion of the heroic individual, albeit one in which s/he is motivated to mobilize others to pursue collective goals and in which relational dynamics are factored into leadership processes (Conger 1999, as cited in Haslam et al. 2011).

The more recent critical turn in leadership studies sees leadership as more radically relational than earlier framings. It focuses on group processes and is sensitive to context and perspective (Alvesson and Svenningsson 2003a, b, Ladkin 2010, Alvesson 2011). Leadership is understood as something that is practiced rather than possessed (Hosking 1988, Gemmill and Oakley 1992, Wood 2005). As argued by Carroll and colleagues (2008), the emphasis on competencies, i.e., on attributes, strategies, and styles of leadership, is more about the what and why than the how of leadership. The result is little clarity on what leaders and followers actually do in pursuit of desired outcomes like social learning, conflict resolution, and sustainable collective action. Practice theories of leadership aim to understand leadership as an everyday process or set of routines (Carroll et al. 2008). In doing so, they are relational as opposed to individualistic, and take into account both emotional aspects (Bolden and Gosling 2006) and structural aspects (Reckwitz 2002) of leadership. Other aspects of the critical turn in leadership studies emphasize the importance of perspective: how different people view the legitimacy of leaders and the success of leadership outcomes (Turnbull et al. 2012). Many leadership scholars have argued for wider anthropological (Jones 2005, 2006), postcolonial (Banerjee 2004, Banerjee and Linstead 2001, 2004), and non-Western (Chia 2003, Jullien 2004, Warner and Grint 2006) perspectives on the phenomenon. Others have highlighted that leaders and leadership can often be dysfunctional, emotionally charged, and toxic (Maccoby 2000, Furnham 2010, Lemmergaard and Muhr 2013). We suggest that

seeing leadership as a value-neutral process that can be good, bad, or both, depending on perspective and context, offers a new, more critically informed dimension to environmental leadership research.

### **Assuming leadership**

In the environmental science literature we reviewed, leadership is too often deployed as a signifier whose meaning is simply assumed. That “we all know what leadership is” appears to be taken for granted, which reduces it to a term of lay convenience rather than one of robust social scientific validity. As such, environmental leadership research is normative and relatively lacking in critical analysis. This is demonstrated in three ways. First, authors promote rather than test desirable leadership competencies or project desirable but assumed qualities onto leaders. A clear example of this is the statement by Gutiérrez et al. (2011:387-388) that “the presence of at least one singular individual with entrepreneurial skills, highly motivated, respected as a local leader and making a personal commitment to the co-management implementation process was essential.” This study captured the presence or absence of a community leader through a binary code and did not assess the skill levels, motivation, or commitment of leaders, yet projected these positive attributes onto leaders present across their global cases.

Second, the presence of leadership is typically associated with successful outcomes, variously defined, and the absence of leadership with failures or stalemates. Indeed, in his meta-analysis of biodiversity conservation cases, Gruber (2010) finds that leadership is identified as important almost twice as often by scientists (74% of papers) as by practitioners (38% of papers), suggesting that the published scientific literature reveals a positive bias toward the importance of leadership.

Third, we argue that the language surrounding environmental leadership portrays it largely as an unequivocal good. In many cases we reviewed, those who “conform” or buy into the environmental governance process are referred to as leaders, whereas those who oppose it are not, regardless of whether or not they garner a following. This suggests the presence of unacknowledged ideological assumptions within the leadership discourse. Folke et al. (2005:54) discuss a set of “characters” that emerge in workshops on adaptive management, distinguishing those who take on leadership roles from those who oppose and criticize. In defining the multiple functions of visionaries and champions, Fabricius et al. (2007:8) refer to those who do not necessarily align with the environmental governance goals as “devious champions.” In contrast, in their review of water policy transitions across 16 cases, Meijerink and Huitema (2010) refer to those who foster or block policy change as entrepreneurs, and they found that policy entrepreneurs use similar strategies whether they advocate for change or the status quo. We noted relatively few studies in environmental leadership that recognized the potential for negative leadership outcomes. We would add, moreover, that leaders do not succeed or fail overall. Whether or not a leader or leadership is seen to be good, effective, supportive, and so on depends very much on the perspective of the observer or those being led, so leadership can be successful for some and fail for others. We believe it is important to redress the normative bias in environmental leadership research.

### **The creative edge of environmental leadership research**

A subset of the environmental leadership scholarship represents the state of the art. This includes research that (1) considers leadership as a value-neutral variable, so does not assume a priori that it is either good or bad but treats this as an empirical question; (2) queries followers’ perceptions of leaders and disaggregates outcomes; and (3) conceptualizes leadership as a process and empirically investigates leadership tactics. Conceptually, Huitema and Meijerink (2010) note the possibility of advocacy coalitions, which are well recognized in the political science literature (e.g., Sabatier and Weible 2007, Fidelman et al. 2014) and which block or contest the direction of policy change. They suggest that opposing coalitions are particularly effective during implementation stages, when shadow networks and formal policy networks interact. Empirically, some key studies consider interactions between sources of leadership and positive, negative, or mixed governance outcomes (e.g., Chuenpagdee and Jentoft 2007, Carruthers and Rodriguez 2009, Fleischman et al. 2010, Hu 2011, Njaya et al. 2012, Sherval and Greenwood 2012, Ernstson 2013).

More contemporary leadership studies explicitly consider the perceptions and motivations of followers to help explain leadership outcomes. This approach is not typically the focus of research in environmental leadership, despite its use in explaining and, perhaps, predicting outcomes. The only exceptions are the few studies that explore (dis)trust in leaders (Pesqué-Cela et al. 2009, Cinner et al. 2012). The bulk of research on leadership competencies in the environmental sciences assumes that trust, legitimacy, and affirmation of leaders result automatically from the application of the right normative approach.

Finally, Westley and colleagues (2013) recently argued that expanded concepts of entrepreneurship in environmental sciences should replace leadership as the focus of analysis because entrepreneurship can encompass more diverse, more numerous, and more institutionally or contextually embedded change agents. Meijerink and Huitema (2010) refer to this as “collective entrepreneurship.” The concept of entrepreneurship emerges from literature that investigates the role of agents within broader policy and problem domains or interorganizational contexts and so is particularly appropriate for research on environmental leadership. As such, the research emphasis shifts to the practices of a number of actors at different stages of the process and at different scales in the system. Parallel work on brokers in network theory emphasizes the linking function of leaders or change agents and in doing so recognizes the embeddedness of such actors in social and institutional structures (Bodin et al. 2006, Bodin and Crona 2008, Ernstson 2013). These conceptual developments are important and need the support of more empirical research. Westley and colleagues (2013) recognize that more work is needed to identify who these entrepreneurs are and how they practice their craft or “mobilise the central skills” to sense-make, build partnerships, resolve conflicts, leverage resources, and so on (see also Huitema and Meijerink 2010). We would add that, in particular, understanding the synergistic and antagonistic relationships among entrepreneurs is key to explaining governance outcomes.

To summarize, the creative edge in environmental leadership research is beginning to critically analyze (1) multiple, interacting leaders, (2) leadership practices and processes, (3) leadership in

different contexts, and (4) leadership outcomes from different perspectives. These efforts should be the focus of future environmental leadership research. Furthermore, we suggest that when studies acknowledge synergistic or contested interactions between leaders and the potential for both positive and negative leadership outcomes, they rarely have considered the views, motivations, and behaviors of followers. Giving followers a voice is essential for understanding environmental leadership outcomes from different perspectives. Treating leadership interactions, processes, and outcomes as analytical rather than normative concepts will significantly improve the scientific robustness of environmental leadership research. We can only hint at the rich insight to be gained from contemporary leadership studies. We suggest that environmental leadership research would benefit from closer engagement with disciplines including sociology, social and political psychology, and geography, each of which possesses well-established traditions of critical thinking.

*Responses to this article can be read online at:*  
<http://www.ecologyandsociety.org/issues/responses.php/7268>

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#### LITERATURE CITED

Adams, W. M., D. Brockington, J. Dyson, and B. Vira. 2003. Managing tragedies: understanding conflict over common pool resources. *Science* 302(5652):1915-1916. <http://dx.doi.org/10.1126/science.1087771>

Alvesson, M. 2011. *Studying leadership—taking meaning, relationality and ideology seriously*. Department of Business Administration working paper. Lund University, Lund, Sweden.

Alvesson, M., and S. Sveningsson. 2003a. Good visions, bad micro-management and ugly ambiguity: contradictions of (non-) leadership in a knowledge intensive company. *Organization Studies* 24(6):961-988. <http://dx.doi.org/10.1177/0170840603024006007>

Alvesson, M., and S. Sveningsson. 2003b. Managers doing leadership: the extra-ordinization of the mundane. *Human Relations* 56(12):1435-1459. <http://dx.doi.org/10.1177/00187267035612001>

Banerjee, S. B. 2004. Reinventing colonialism: exploring the myth of sustainable development. *Situation Analysis* 4(Autumn):95-110.

Banerjee, S. B., and S. Linstead. 2001. Globalization, multiculturalism and other fictions: colonialism for the new millennium? *Organization* 8(4):711-750. <http://dx.doi.org/10.1177/135050840184006>

Banerjee, S. B., and S. Linstead. 2004. Masking subversion: neo-colonial embeddedness in anthropological accounts of indigenous management. *Human Relations* 57(2):221-258. <http://dx.doi.org/10.1177/0018726704042928>

Banks, S., A., and G. A. Skilleter. 2010. Implementing marine reserve networks: a comparison of approaches in New South Wales (Australia) and New Zealand. *Marine Policy* 34(2):197-207. <http://dx.doi.org/10.1016/j.marpol.2009.06.006>

Biggs, S. 2008. Learning from the positive to reduce rural poverty and increase social justice: institutional innovations in agricultural and natural resources research and development. *Experimental Agriculture* 44(1):37-60. <http://dx.doi.org/10.1017/S0014479707005959>

Biggs, R., F. R. Westley, and S. R. Carpenter. 2010. Navigating the back loop: fostering social innovation and transformation in ecosystem management. *Ecology and Society* 15(2): 9. [online] URL: <http://www.ecologyandsociety.org/vol15/iss2/art9/>

Black, S. A., J. J. Groombridge, and C. G. Jones. 2011. Leadership and conservation effectiveness: finding a better way to lead. *Conservation Letters* 4(5):329-339. <http://dx.doi.org/10.1111/j.1755-263X.2011.00184.x>

Bodin, Ö., and B. I. Crona. 2008. Management of natural resources at the community level: exploring the role of social capital and leadership in a rural fishing community. *World Development* 36(12):2763-2779. <http://dx.doi.org/10.1016/j.worlddev.2007.12.002>

Bodin, Ö., B. Crona, and H. Ernstson. 2006. Social networks in natural resource management: What is there to learn from a structural perspective? *Ecology and Society* 11(2): r2. [online] URL: <http://www.ecologyandsociety.org/vol11/iss2/resp2/>

Bolden, R., and J. Gosling. 2006. Leadership competencies: time to change the tune? *Leadership* 2(2):147-163. <http://dx.doi.org/10.1177/1742715006062932>

Carroll, B., L. Levy, and D. Richmond. 2008. Leadership as practice: challenging the competency paradigm. *Leadership* 4(4):363-379. <http://dx.doi.org/10.1177/1742715008095186>

Case, P., R. French, and P. Simpson. 2011. The philosophy of leadership. Pages 242-254 in A. Bryman, D. Collinson, K. Grint, B. Jackson, and M. Uhl-Bien, editors. *Sage handbook of leadership*. Sage, London, UK.

Carruthers, D., and P. Rodriguez. 2009. Mapuche protest, environmental conflict and social movement linkage in Chile. *Third World Quarterly* 30(4):743-760. <http://dx.doi.org/10.1080/01436590902867193>

Chia, R. 2003. From knowledge-creation to perfecting action: Tao, Basha and pure experience as the ultimate ground of performance. *Human Relations* 56(8):953-981. <http://dx.doi.org/10.1177/00187267030568003>

Christie, P., R. B. Pollnac, D. L. Fluharty, M. A. Hixon, G. K. Lowry, R. Mahon, D. Pietri, B. N. Tissot, A. T. White, N. Armada, and R.-L. Eisma-Osorio. 2009. Tropical marine EBM feasibility: a synthesis of case studies and comparative analyzes. *Coastal Management* 37(3-4):374-385. <http://dx.doi.org/10.1080/089207-50902937994>



- Chuenpagdee, R., and S. Jentoft. 2007. Step zero for fisheries co-management: what precedes implementation. *Marine Policy* 31 (6):657-668. <http://dx.doi.org/10.1016/j.marpol.2007.03.013>
- Cinner, J. E., T. R. McClanahan, M. A. MacNeil, N. A. J. Graham, T. M. Daw, A. Mukminin, D. A. Feary, A. L. Rabearisoa, A. Wamukota, N. Jiddawi, S. J. Campbell, A. F. Baird, F. A. Januchowski-Hartley, S. Hamed, R. Lahari, T. Morove, and J. Kuange. 2012. Co-management of coral reef social-ecological systems. *Proceedings of the National Academy of Science of the United States of America* 109(14):5219-5222. <http://dx.doi.org/10.1073/pnas.1121215109>
- Ernstson, H. 2013. The social production of ecosystem services: a framework for studying environmental justice and ecological complexity in urbanised landscapes. *Landscape and Urban Planning* 109(1):7-17. <http://dx.doi.org/10.1016/j.landurbplan.2012.10.005>
- Evans, L. S. 2009. Understanding divergent perspectives in marine governance in Kenya. *Marine Policy* 33(5):784-793. <http://dx.doi.org/10.1016/j.marpol.2009.02.013>
- Fabricius, C., C. Folke, G. Cundill, and S. Lisen. 2007. Powerless spectators, coping actors, and adaptive co-managers: a synthesis of the role of communities in ecosystem management. *Ecology and Society* 12(1): 29. [online] URL: <http://www.ecologyandsociety.org/vol12/iss1/art29/>
- Fidelman, P., L. S. Evans, S. Foale, C. Weible, F. von Heland, and D. Elgin. 2014. Coalition cohesion for regional marine governance: a stakeholder analysis of the Coral Triangle Initiative. *Ocean & Coastal Management* 95:117-128. <http://dx.doi.org/10.1016/j.ocecoaman.2014.04.001>
- Fiedler, F. E. 1967. *A theory of leadership effectiveness*. McGraw-Hill, New York, New York, USA.
- Fleischman, F. D., K. Boenning, G. A. Garcia-Lopez, S. Mincey, M. Schmitt-Harsh, K. Daedlow, M. C. Lopez, X. Basurto, B. Fischer, and E. Ostrom. 2010. Disturbance, response, and persistence in self-organized forested communities: analysis of robustness and resilience in five communities in Southern Indiana. *Ecology and Society* 15(4). 9. [online] URL: <http://www.ecologyandsociety.org/vol15/iss4/art9/>
- Folke, C., T. Hahn, P. Olsson, J. Norberg. 2005. Adaptive governance of social-ecological systems. *Annual Review of Environment and Resources* 30:441-473. <http://dx.doi.org/10.1146/annurev.energy.30.050504.144511>
- Furnham, A. 2010. *The elephant in the boardroom: the causes of leadership derailment*. Palgrave Macmillan, London, UK. <http://dx.doi.org/10.1057/9780230281226>
- Galaz, V., F. Moberg, E.-K. Olsson, E. Paglia, and C. Parker. 2010. Institutional and political leadership dimensions of cascading ecological crises. *Public Administration* 89(2):361-380. <http://dx.doi.org/10.1111/j.1467-9299.2010.01883.x>
- Gemmill, G., and J. Oakley. 1992. Leadership: an alienating social myth. *Human Relations* 45(2): 13-29. <http://dx.doi.org/10.1177/001872679204500201>
- Gruber, J. S. 2010. Key principles of community-based natural resource management: a synthesis and interpretation of identified effective approaches for managing the commons. *Environmental Management* 45(1):52-66. <http://dx.doi.org/10.1007/s00267-008-9235-y>
- Gutiérrez, N. L., R. Hilborn, and O. Defeo. 2011. Leadership, social capital and incentives promote successful fisheries. *Nature* 470:386-389. <http://dx.doi.org/10.1038/nature09689>
- Gupta, J. 2010. A history of international climate change policy. *Wiley Interdisciplinary Review: Climate Change* 1(5):636-653. <http://dx.doi.org/10.1002/wcc.67>
- Gupta, J., C. Termeer, J. Klostermann, S. Meijerink, M. van den Brink, P. Jong, S. Nooteboom, and E. Bergsma. 2010. The Adaptive Capacity Wheel: a method to assess the inherent characteristics of institutions to enable the adaptive capacity of society. *Environmental Science & Policy* 31(6):459-471. <http://dx.doi.org/10.1016/j.envsci.2010.05.006>
- Haslam, S. A., S. D. Reicher, and M. J. Platow. 2011. *The new psychology of leadership: identity, influence and power*. Psychology Press, Taylor & Francis Group, New York, New York, USA.
- Hersey, P., and K. H. Blanchard. 1988. *Management and organizational behavior: utilizing human resources*. Prentice-Hall, Englewood Cliffs, New Jersey, USA.
- Hosking, D. M. 1988. Organizing, leadership and skilful process. *Journal of Management Studies* 25(2):147-66. <http://dx.doi.org/10.1111/j.1467-6486.1988.tb00029.x>
- Hosking, D. M. 1999. Social construction as process: some new possibilities for research and development. *Concepts and Transformation* 4(2):117-132. <http://dx.doi.org/10.1075/cat.4.2.02hos>
- Hu, Z. 2011. The travails of the Ninth Dragon God: the struggle for water, worship, and the politics of getting by in a North China village. *Human Ecology* 39(1):81-91. <http://dx.doi.org/10.1007/s10745-011-9378-y>
- Huitema, D., and S. Meijerink. 2010. Realizing water transitions: the role of policy entrepreneurs in water policy change. *Ecology and Society* 15(2): 26. [online] URL: <http://www.ecologyandsociety.org/vol15/iss2/art26/>
- Johannes, R. E. 2002. The renaissance of community-based marine resource management in Oceania. *Annual Review of Ecology and Systematics* 33:317-340. <http://dx.doi.org/10.1146/annurev.ecolsys.33.010802.150524>
- Jones, A. 2006. Developing what? An anthropological look at the leadership development process across cultures. *Leadership* 2 (4):481-498. <http://dx.doi.org/10.1177/1742715006068935>
- Jones, A. M. 2005. The anthropology of leadership: culture and corporate leadership in the American south. *Leadership* 1 (3):259-78. <http://dx.doi.org/10.1177/1742715005054437>
- Jullien, F. 2004. *A treatise on efficacy*. University of Hawaii Press, Honolulu, Hawaii.
- Kates, R. W., W. R. Travis, and T. J. Wilbanks. 2012. Transformational adaptation when incremental adaptations to climate change are insufficient. *Proceedings of the National Academy of Science of the United States of America* 109 (19):7156-7161. <http://dx.doi.org/10.1073/pnas.1115521109>
- Kenward, R. E., M. J. Whittingham, S. Arampatzis, B. D. Manos, T. Hahn, A. Terry, R. Simoncini, J. Alcorn, O. Bastian, M. Donlan, K. Elowe, F. Franzén, Z. Karacsonyi, M. Larsson, D. Manou, I. Navodaru, O. Papadopoulou, J. Paphanasiou, A. von Raggamby, R. J. A. Sharp, T. Söderqvist, Å. Soutukorva, L.

- Vavrova, N. J. Aebischer, N. Leader-Williams, and C. Rutz. 2011. Identifying governance strategies that effectively support ecosystem services, resource sustainability, and biodiversity. *Proceedings of the National Academy of Science of the United States of America* 108(13):5308-5312. <http://dx.doi.org/10.1073/pnas.1007933108>
- Ladkin, D. 2010. *Rethinking leadership: a new look at old leadership questions*. Edward Elgar, Cheltenham, UK. <http://dx.doi.org/10.4337/9781849805346>
- Lemmergaard, J., and S. L. Muhr, editors. 2013. *Critical perspectives on leadership: emotion, toxicity, and dysfunction*. Edward Elgar, Cheltenham, UK. <http://dx.doi.org/10.4337/978-0857931139>
- Likert, R. 1961. *New patterns of management*. McGraw-Hill, New York, New York.
- Lockwood, M., J. Davidson, M. Hockings, M. Haward, and L. Kriwoken. 2012. Marine biodiversity conservation governance and management: regime requirements for global environmental change. *Ocean & Coastal Management* 69:160-172. <http://dx.doi.org/10.1016/j.ocecoaman.2012.07.015>
- Maccoby, M. 2000. Narcissistic leaders: the incredible pros, the inevitable cons. *Harvard Business Review* 82(1):92-101.
- Manolis, J. C., K. M. Chan, M. E. Finkelstein, S. Stephens, C. R. Nelson, J. B. Grant, and M. P. Dombek. 2009. Leadership: a new frontier in conservation science. *Conservation Biology* 23(4):879-886. <http://dx.doi.org/10.1111/j.1523-1739.2008.01150.x>
- Marín, A., S. Gelcich, J. C. Castilla, and F. Berkes. 2012. Exploring social capital in Chile's coastal benthic comanagement system using a network approach. *Ecology and Society* 17(1): 13. <http://dx.doi.org/10.5751/ES-04562-170113>
- Marschke, M., and F. Berkes. 2005. Local level sustainability planning for livelihoods: a Cambodian experience. *International Journal of Sustainable Development & World Ecology* 12(1):21-33. <http://dx.doi.org/10.1080/13504500509469615>
- Meijerink, S., and D. Huitema. 2010. Policy entrepreneurs and change strategies: lessons from sixteen case studies of water transitions around the globe. *Ecology and Society* 15(2): 21. [online] URL: <http://www.ecologyandsociety.org/vol15/iss2/art21/>
- Mohammed, A. J., and M. Inoue. 2012. Drawbacks of decentralized natural resource management: experience from Chilimo Participatory Forest Management project, Ethiopia. *Journal of Forest Research* 17(1):30-36. <http://dx.doi.org/10.1007/s10310-011-0270-9>
- Njaya, F., S. Donda, and C. Béné. 2012. Analysis of power in fisheries co-management: experiences from Malawi. *Society & Natural Resources* 25(7):652-666. <http://dx.doi.org/10.1080/089-41920.2011.627912>
- Njaya, F. J. 2009. Governance of Lake Chilwa common pool resources: evolution and conflicts. *Development Southern Africa* 26(4):663-676. <http://dx.doi.org/10.1080/03768350903181431>
- Olsson, P., L. H. Gunderson, S. R. Carpenter, P. Ryan, L. Lebel, C. Folke, and C. S. Holling. 2006. Shooting the rapids: navigating transitions to adaptive governance of social-ecological systems. *Ecology and Society* 11(1): 18. [online] URL: <http://www.ecologyandsociety.org/vol11/iss1/art18/>
- Olsson, P., C. Folke, and T. P. Hughes. 2008. Navigating the transition to ecosystem-based management of the Great Barrier Reef, Australia. *Proceedings of the National Academy of Science of the United States of America* 105(28):9489-9494. <http://dx.doi.org/10.1073/pnas.0706905105>
- Pagdee, A., Y. Kim, and P. J. Daugherty. 2006. What makes community forest management successful: a meta-study from community forests throughout the world. *Society & Natural Resources* 19(1):33-52. <http://dx.doi.org/10.1080/08941920500323260>
- Pahl-Wostl, C., M. Craps, A. Dewulf, E. Mostert, D. Tabara, and T. Taillieu. 2007. Social learning and water resources management. *Ecology and Society* 12(2): 5. [online] URL: <http://www.ecologyandsociety.org/vol12/iss2/art5/>
- Pérez-Cirera, V., and J. C. Lovett. 2006. Power distribution, the external environment and common property forest governance: a local user groups model. *Ecological Economics* 59(3):341-352. <http://dx.doi.org/10.1016/j.ecolecon.2005.11.002>
- Pesqué-cela, V., R. Tao, Y. Liu, and L. Sun. 2009. Challenging, complementing or assuming 'the Mandate of Heaven'? Political distrust and the rise of self-governing social organizations in rural China. *Journal of Comparative Economic* 37(1):151-168. <http://dx.doi.org/10.1016/j.jce.2008.08.004>
- Reckwitz, A. 2002. Toward a theory of social practices: a development in cultural theorizing. *European Journal of Social Theory* 5(2):243-263.
- Rockström, J., W. Steffen, K. Noone, Å. Persson, F. S. Chapin, III, E. F. Lambin, T. M. Lenton, M. Scheffer, C. Folke, H. J. Schellnhuber, et al. 2009. A safe operating space for humanity. *Nature* 461(7263):472-475. <http://dx.doi.org/10.1038/461472a>
- Rosen, F., and P. Olsson. 2013. Institutional entrepreneurs, global networks, and the emergence of international institutions for ecosystem-based management: The Coral Triangle Initiative. *Marine Policy* 38:195-204. <http://dx.doi.org/10.1016/j.marpol.2012.05.036>
- Russell, A. J. M., and T. Dobson. 2011. Chiefs as critical partners for decentralized governance of fisheries: an analysis of co-management case studies in Malawi. *Society & Natural Resources* 24(7):734-750. <http://dx.doi.org/10.1080/08941920.2010.501432>
- Ruttan, L. M. 2006. Sociocultural heterogeneity and the commons. *Current Anthropology* 47(5):843-853. <http://dx.doi.org/10.1086/507185>
- Sabatier, P., and C. Weible. 2007. The advocacy coalition framework: innovations and clarifications. Pages 189-220 in P. Sabatier, editor. *Theories of the policy process*. Westview, Boulder, Colorado, USA.
- Scheffer, M., F. Westley, and W. Brock. 2003. Slow response of societies to new problems: causes and costs. *Ecosystems* 6(5):493-502. <http://dx.doi.org/10.1007/s10021-002-0146-0>
- Scholten, P. 2010. Leadership in policy innovation: a conceptual map. *Nature and Culture* 5(1):31-48. <http://dx.doi.org/10.3167/nc.2010.050103>

- Sherval, M., and A. Greenwood. 2012. 'Drought-proofing' regional Australia and the rhetoric surrounding Tillegra Dam, NSW. *Australian Geographer* 43:(3)253-271.
- Smith, J. B., J. M. Vogel, and J. E. Cromwell, III. 2009. An architecture for government action on adaptation to climate change. An editorial comment. *Climatic Change* 95:53-61. <http://dx.doi.org/10.1007/s10584-009-9623-1>
- Stogdill, R. M. 1948. Personal factors associated with leadership: a survey of the literature. *Journal of Psychology* 25(1):35-71. <http://dx.doi.org/10.1080/00223980.1948.9917362>
- Stogdill, R. M. 1974. *Handbook of leadership: a survey of theory and research*. Free Press, New York, New York, USA.
- Sudtongkong, C., and E. L. Webb. 2008. Outcomes of state- vs. community-based mangrove management in southern Thailand. *Ecology and Society* 13(2): 27. [online] URL: <http://www.ecologyandsociety.org/vol13/iss2/art27/>
- Tannenbaum, R., and W. H. Schmidt. 1958. How to choose a leadership pattern: should a manager be democratic or autocratic—or something in between? *Harvard Business Review* 37(March-April):95-102.
- Turnbull, S., P. Case, G. Edwards, D. Schedlitzki, and P. Simpson, editors. 2012. *Worldly leadership: alternative wisdoms for a complex world*. Palgrave Macmillan, London, UK.
- Van Laerhoven, F. 2010. Governing community forests and the challenge of solving two-level collective action dilemmas—a large-*N* perspective. *Global Environmental Change* 20(3):539-546. <http://dx.doi.org/10.1016/j.gloenvcha.2010.04.005>
- Wale, E., N. Chishakwe, and R. Lewis-Lettington. 2009. Cultivating participatory policy processes for genetic resources policy: lessons from the Genetic Resources Policy Initiative (GRPI) project. *Biodiversity Conservation* 18(1):1-18. <http://dx.doi.org/10.1007/s10531-008-9444-y>
- Walker, B., S. Barrett, S. Polasky, V. Galaz, C. Folke, G. Engstrom, F. Ackerman, K. Arrow, S. Carpenter, and K. Chopra, et al. 2009. Looming global-scale failures and missing institutions. *Science* 325(5946):1345-1346. <http://dx.doi.org/10.1126/science.1175325>
- Walters, C. J. 2007. Is adaptive management helping to solve fisheries problems? *Ambio* 36(4):304-307. [http://dx.doi.org/10.1579/0044-7447\(2007\)36\[304:IAMHTS\]2.0.CO;2](http://dx.doi.org/10.1579/0044-7447(2007)36[304:IAMHTS]2.0.CO;2)
- Warner, L. S., and K. Grint. 2006. American Indian ways of leading and knowing. *Leadership* 2(2):225-244. <http://dx.doi.org/10.1177/1742715006062936>
- Westley, F. R., O. Tjornbo, L. Schultz, P. Olsson, C. Folke, B. Crona, and Ö. Bodin. 2013. A theory of transformative agency in linked social-ecological systems. *Ecology and Society* 18(3): 27. <http://dx.doi.org/10.5751/ES-05072-180327>
- Wood, M. 2005. The fallacy of misplaced leadership. *Journal of Management Studies* 42(6):1101-1121. <http://dx.doi.org/10.1111/j.1467-6486.2005.00535.x>
- Zimmerer, K. S., R. E. Galt, and M. V. Buck. 2004. Globalization and multi-spatial trends in the coverage of protected-area conservation (1980-2000). *Ambio* 33(8):520-529. <http://dx.doi.org/10.1579/0044-7447-33.8.520>
- Zulu, L. C. 2008. Community forest management in southern Malawi: solution or part of the problem? *Society & Natural Resources* 21(8):687-703. <http://dx.doi.org/10.1080/08941920802039242>

**Appendix 1.** Literature search terms.

We used the following search terms: Topic=(ecosystem\* OR natural resource OR conservation OR fisher\* OR forest\* OR catchment OR water\* OR protected area OR social-ecological) AND Topic=(leader\* OR entrepreneur\* OR champ\*) NOT Topic=(Business OR company OR corporate) NOT Topic=(Agriculture OR energy OR education OR transport OR building OR health\* OR waste OR tourism OR consumption OR gene\* OR traffic) AND Year Published=(2003-2013).

**Appendix 2.** Number of articles excluded from the review according to different criteria.

<b>Criteria for exclusion of papers based on the abstract</b>	<b>Number</b>
Refers to economic entrepreneurs	55
Leaders used to set up the research argument. E.g., Leaders advocate, Canada is a leader in X	51
Not about NRM (E.g., statistics, experimental models, conflict, nano-technology, resource curse)	48
Leaders or entrepreneurs are sampled but are not the subject of study	39
Announcements (e.g., leadership awards, training, biographies)	31
Research on internal organizational change and not necessarily to NRM outcomes	19
Refers to scientific leadership	18
Refers to a plant, animal, or technological 'leaders'	12
Assert need to build leadership capacity at the end of the abstract/paper	11
Leaders or entrepreneurs as research end-users	9
Abstract and paper cannot be located or are incomprehensible	6
Leadership as outcome of the research process	3
	<b>302</b>

**Appendix 3.** Papers included in the review of leadership in the environmental sciences.

<b>Environmental sector / field</b>	<b>Approach</b>	<b>Reference</b>
Biodiversity Conservation	General review	Manolis JC, Chan KM, Finkelstein ME, Stephens S, Nelson CR, Grant JB and Domboeck MP. (2008) Leadership: a new frontier in conservation science. <i>Conservation Biology</i> 23 (4): 879-886
Biodiversity Conservation	Review of two case-studies	Black SA, Groombridge JJ and Jones CG. (2011) Leadership and conservation effectiveness: finding a better way to lead. <i>Conservation Letters</i> 4 (5): 329-339
Biodiversity Conservation	General review and expert elicitation	Lockwood M, Davidson J, Hockings M, Haward M and Kriwoken L. (2012) Marine biodiversity conservation governance and management: Regime requirements for global environmental change. <i>Ocean and Coastal Management</i> 69:160-172
Climate change policy	General review	Gupta J. (2010) A history of international climate change policy. <i>Wiley Interdisciplinary Review – Climate Change</i> 1 (5): 636-653; Gupta J, Termeer C, Klostermann J, Meijerink S, van den Brink M, Jong P, Nooteboom S and Bergsma E. (2010). The Adaptive Capacity Wheel: a method to assess the inherent characteristics of institutions to enable the adaptive capacity of society. <i>Environmental Science and Policy</i> 31(6): 459-471
Climate change policy	General review	Burch S. (2011) Sustainable development paths: Investigating the roots of local policy responses to climate change. <i>Sustainable Development</i> 19 (3): 176-188
Climate change adaptation	General review	Kates RW, Travis WR and Wilbanks TJ. (2012) Transformational adaptation when incremental adaptations to climate change are insufficient. <i>Proceedings of the National Academy of Science USA</i> 109 (19): 7156-7161
Common-pool resources	General review	Adams WM, Brockington D, Dyson J and Vira B. (2003) Managing tragedies: understanding conflict over common pool resources. <i>Science</i> 302 (5652): 1915-1916
Fisheries management	Review of 30 case-studies	Walters CJ. (2007) Is adaptive management helping to solve fisheries problems? <i>Ambio</i> 36 (4): 304-307
Marine ecosystem management	Review of eight case studies across four countries	Christie P, Pollnac RB, Fluharty DL, Hixon MA, Lowry GK, Mahon R, Pietri D, Tissot BN, White AT, Armada N and Eisma-Osorio R-L. (2009) Tropical Marine EBM Feasibility: A Synthesis of Case Studies and Comparative Analyses. <i>Coastal Management</i> 37 (3-4): 374-385
Natural resource management	Review of 47 case-studies	Gruber J. (2010) Key principles of community-based natural resource management: a synthesis and interpretation of identified effective approaches for managing the

Natural resource management	General review of positions in network structures	commons. <i>Environmental Management</i> 45 (1): 52-66 Bodin O, Beatrice C and Henrik E. (2006). Social networks in natural resource management: What is there to learn from a structural perspective? <i>Ecology and Society</i> 11 (2)
Natural resource management	Review of three case-studies	Biggs S. (2008) Learning from the positive to reduce rural poverty and increase social justice: Institutional innovations in agricultural and natural resources research and development. <i>Experimental Agriculture</i> 44 (1): 37-60
Social-ecological systems	Conceptual review	Scheffer M, Westley F and Brock W. (2003) Slow response of societies to new problems: causes and costs. <i>Ecosystems</i> 6 (5): 493-502
Social-ecological systems	Conceptual review	Folke C, Hahn T, Olsson P and Norberg J. (2005) Adaptive governance of social-ecological systems. <i>Annual Review of Environment and Resources</i> 30: 441-473
Social-ecological systems	Review of seven case-studies	Fabricius C, Folke C, Cundill G and Lisen S. (2007). Powerless spectators, coping actors, and adaptive comanagers: a synthesis of the role of communities in ecosystem management. <i>Ecology and Society</i> 12 (1)
Social-ecological systems	Review of five case-studies	Olsson P, Gunderson LH, Carpenter SR, Ryan P, Lebel L, Folke C, and Holling CS. (2006). Shooting the rapids: navigating transitions to adaptive governance of social-ecological systems. <i>Ecology and Society</i> 11(1)
Social-ecological systems	General review	Galaz V, Moberg F, Olsson E-K, Paglia E and Parker C. (2010). Institutional and political leadership dimensions of cascading ecological crises. <i>Public Administration</i> 89 (2): 361-380
Societal collapse	Historical review of 5 and 12 case-studies, respectively	Butzer KW. (2012) Collapse, environment, and society. <i>Proceedings of the National Academy of Sciences of the USA</i> 109 (10): 3632-3639; Butzer KW and Endfield GH. (2012) Critical perspectives on historical collapse. <i>Proceedings of the National Academy of Sciences of the USA</i> 109 (10): 3628-3631
Water management	Review of three case-studies	Biggs R, Westley FR and Carpenter SR (2010) Navigating the back loop: fostering social innovation and transformation in ecosystem management. <i>Ecology and Society</i> 15 (2)
Water management	Review of 16 case-studies	Huitema D and Meijerink S. (2010) Realizing water transitions: the role of policy entrepreneurs in water policy change. <i>Ecology and Society</i> 15(2); Meijerink S and Huitema D. (2010) Policy entrepreneurs and change strategies: lessons from sixteen case studies of water transitions around the globe. <i>Ecology and Society</i> 15(2)
Water management	Review of 10 case-studies	Pahl-Wostl C, Craps M, Dewulf A, Mostert E, Tabara D and Taillieu T. (2007). Social learning and water resources management. <i>Ecology and Society</i> 12(2)

Biodiversity conservation	Large-N study of 34 biodiversity projects	Kenward RE, Whittingham MJ, Arampatzis S, Manos BD, Hahn T, et al. (2011) Identifying governance strategies that effectively support ecosystem services, resource sustainability, and biodiversity. <i>Proceedings of the National Academy of Science USA</i> 108 (13): 5308-5312
Biodiversity conservation	Global study of protected area designation	Zimmerer KS, Galt RE and Buck MV. (2004). Globalization and multi-spatial trends in the coverage of protected-area conservation (1980-2000). <i>Ambio</i> 33(8): 520-529.
Fisheries management	Large-N study of 42 co-managed fisheries	Cinner JE, McClanahan TR, MacNeil MA, Graham NAJ, Daw TM, Mukminin A, Feary DA, Rabearisoa AL, Wamukota A, Jiddawi N, Campbell SJ, Baird AF, Januchowski-Hartley FA, Hamed S, Lahari R, Morove T and Kuange J. (2012) Co-management of coral reef social-ecological systems. <i>Proceedings of the National Academy of Science USA</i> 109 (14): 5219-5222
Fisheries management	Meta-analysis of 130 cases of fisheries co-management	Gutierrez NL, Hilborn R and Defeo O. (2011) Leadership, social capital and incentives promote successful fisheries. <i>Nature</i> 470: 386–389
Forest management	Meta-analysis of 69 cases of community forestry management	Pagdee A, Kim YS and Daugherty PJ. (2006) What makes community forest management successful: A meta-study from community forests throughout the world. <i>Society &amp; Natural Resources</i> 19 (1): 33-52
Forest management	Large-N study of 240 community forests	Van Laerhoven F. (2010) Governing community forests and the challenge of solving two-level collective action dilemmas-A large-N perspective. <i>Global Environmental Change – Human and Policy Dimensions</i> 20 (3) SI: 539-546
Fisheries and water management	Large-N study of 40 fisheries and 54 irrigation studies	Ruttan LM. (2006) Sociocultural heterogeneity and the commons. <i>Current Anthropology</i> 47 (5): 843-853.
Natural resource management	Large-N study of 115 villages in China	Pesqué-cela V, Tao R, Liu YD and Sun LX. (2009) Challenging, complementing or assuming 'the Mandate of Heaven'? Political distrust and the rise of self-governing social organizations in rural China. <i>Journal of Comparative Economics</i> 37 (1): 151-168
Biodiversity conservation	Qualitative investigation of participatory policy processes of the Genetic Resources Policy Initiative	Wale E, Chishakwe N and Lewis-Lettington R. (2009) Cultivating participatory policy processes for genetic resources policy: lessons from the Genetic Resources Policy Initiative (GRPI) project. <i>Biodiversity Conservation</i> 18: 1–18
Climate Change	A social constructivist take on leaders as representations / positions	Lansing DM. (2012) Performing carbon's materiality: the production of carbon offsets and the framing of exchange. <i>Environment and Planning A</i> 44(1): 204-220
Fisheries management	Qualitative and quantitative investigation of social capital and leadership (as individuals who mediate agency) in	Bodin O, and Crona B. (2008). Management of Natural Resources at the Community Level: Exploring the role of social capital and leadership in a rural fishing community. <i>World</i>



	resource management in Kenya.	<i>Development</i> 36 (12): 2763-2779
Fisheries management	Qualitative and quantitative investigation of social capital in fisheries co-management in Chile	Marín A, Gelcich S, Castilla JC and Berkes F (2012) Exploring social capital in Chile's coastal benthic comanagement system using a network approach. <i>Ecology and Society</i> 17(1)
Fisheries management	Qualitative investigation of co-management arrangements in Malawi	Njaya F. (2009). Governance of Lake Chilwa common pool resources: evolution and conflicts. <i>Development Southern Africa</i> 26 (4): 663-676; Njaya F, Donda S and Béné C. (2012) Analysis of power in fisheries co-management: experiences from Malawi. <i>Society &amp; Natural Resources</i> 25 (7): 652-666
Fisheries management	Qualitative investigation of co-management arrangements in Malawi across 10 fisheries	Russell AJM and Dobson T. (2011). Chiefs as critical partners for decentralized governance of fisheries: An analysis of co-management case studies in Malawi. <i>Society and Natural Resources</i> 24 (7): 734-750
Forestry	Qualitative and quantitative investigation of the factors influencing 5 communities' adaptive responses to disturbances in USA.	Fleischman FD, Boenning K, Garcia-Lopez GA, Mincey S, Schmitt-Harsh M, Daedlow K, Lopez MC, Basurto X, Fischer B and Ostrom E. (2010) Disturbance, response, and persistence in self-organized forested communities: analysis of robustness and resilience in five communities in southern Indiana. <i>Ecology and Society</i> 15 (4)
Forestry	Qualitative and quantitative investigation of decentralised natural resource management in two communities in Ethiopia.	Mohammed AJ and Inoue M. (2008) Drawbacks of decentralized natural resource management: experience from Chilimo Participatory Forest Management project, Ethiopia. <i>Journal of Forest Research</i> 17 (1): 30-36
Forestry	Quantitative examination of power distribution in local common property forest governance in Mexico	Perez-Cirera V and Lovett JC. (2006) Power distribution, the external environment and common property forest governance: a local user groups model. <i>Ecological Economics</i> 59: 34 – 352
Forestry	Quantitative investigation of the performance of committee led natural resource management in 58 villages in Malawi.	Zulu LC. (2008) Community forest management in southern Malawi: Solution or part of the problem? <i>Society and Natural Resources</i> 21 (8): 687-703
Mangroves	Qualitative examination of mangrove forest management in Thailand	Sudtongkong C and Webb EL. (2008). Outcomes of state- vs. community-based mangrove management in southern Thailand. <i>Ecology and Society</i> 13(2)
Marine ecosystems	Qualitative investigation of pre-conditions for fisheries co-management in seven countries	Chuenpagdee R, and Jentoft S. (2007) Step zero for fisheries co-management: What precedes implementation. <i>Marine Policy</i> 31 (6): 657-668
Marine ecosystems	Qualitative investigation of re-zoning of the Great Barrier Reef Marine Park	Olsson P, Folke C and Hughes TP. (2008) Navigating the transition to ecosystem-based management of the Great Barrier Reef, Australia. <i>Proceedings of the National Academy of Science USA</i> 105 (28): 9489-9494
Marine ecosystems	Qualitative investigation of institutional entrepreneurship	Rosen F and Olsson P. (2013) Institutional entrepreneurs, global networks, and the

	in emergence of the Coral Triangle Initiative	emergence of international institutions for ecosystem-based management: The Coral Triangle Initiative. <i>Marine Policy</i> 38: 195-204. Banks SA, and Skilleter GA. (2010). Implementing marine reserve networks: A comparison of approaches in New South Wales (Australia) and New Zealand. <i>Marine Policy</i> 34: 197-207
Marine protected areas	Qualitative analysis of two marine protected area networks	Carruthers D and Rodriguez P. (2009). Mapuche protest, environmental conflict and social movement linkage in Chile. <i>Third World Quarterly</i> 30(4): 743-760
Natural resource management	Review of environmental conflict and activism in Chile	Marschke M and Berkes F. (2005) Local level sustainability planning for livelihoods: A Cambodian experience. <i>International Journal of Sustainable Development and World Ecology</i> 12 (1): 21-33
Natural resource management	Qualitative and quantitative investigation of the roles and responsibilities of two natural resource management committees in Cambodia.	McKeever M. (2008). Regional institutions and social development in Southern Africa. <i>Annual Review of Sociology</i> 34: 453-473
Natural resource management	Review of regional co-operation in Southern Africa	Hahn T. (2011) Self-Organized Governance Networks for Ecosystem Management: Who Is Accountable? <i>Ecology and Society</i> 16 (2)
Social-ecological systems	Qualitative study of governance networks for ecosystem management	Morgan CR. (2007) Property of spirits: Hereditary and global value of sea turtles in Fiji. <i>Human Organisation</i> 66 (1): 60-68
Turtles	Qualitative investigation of turtles in political and cultural identity in Fiji	Ernstson H. (2013). The social production of ecosystem services: a framework for studying environmental justice and ecological complexity in urbanised landscapes. <i>Landscape and Urban Planning</i> 209: 7-17
Urban ecosystem services	Actor-network analysis of urban land-use in Cape Town and Stockholm	Agyenim JB and Gupta J (2012) IWRM and developing countries: Implementation challenges in Ghana. <i>Physics and Chemistry of the Earth</i> 47-48: 46-57
Water management	Qualitative investigation of the failure of an IWRM concept in a new area (Ghana) and the influence of cultural and political fit.	Hu Z (2011) The travails of the ninth dragon god: the struggle for water, worship, and the politics of getting by in a North China village. <i>Human Ecology</i> 39 (1): 81-91
Water management	Qualitative investigation of the influence of politics on religious beliefs and its role in water management in China	Scholten P. (2010). Leadership in Policy Innovation: A conceptual map. <i>Nature and Culture</i> 5(1): 31-48
Climate change or water management	A grounded theory empirical investigation of the relationship of “daring decision making/makers” in Dutch municipalities to theoretical leadership types	