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The concept of stewardship in sustainability science and conservation biology

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A B S T R A C T

This paper focuses on the development and meaning of the stewardship concept in the current environmental science, ecology and biodiversity conservation literature. Stewardship broadly refers to a form of collaborative planning and responsible management of the environment through sustainable natural resource management practices that respect ecosystem functions. The objective of this paper is to discuss the various meanings of stewardship in the fields of environmental science and biodiversity conservation. Our main interest is to explore how different political ideologies and ethical values of stewardship shape the conceptualisation of conservation actions and policies, and why do these matter for conservation policy in the context of the new conservation debate. To address this objective we adapted the political science framework developed by Dryzek (2013) and applied it to existing stewardship approaches in use. Based on two dimensions (reformist vs radical and imaginative vs prosaic) we identified 4 main types of stewardship: reformist, adaptive, sustainability and trans- formative stewardship. The key distinctions between stewardship types are (i) the role of science, (ii) the ex- ploration and integration of the plurality of values, and (iii) the capacity to modify values, rules and decision- making system. We conclude with a discussion on the consequences of these results and present future directions for both research and conservation policy.

1. Introduction

Stewardship is about caring for what we value (Berry, 2006; Palmer, 2006). In conservation policy, stewardship is often used as a simple rewording for wise resource use or sustainable management of wildlife or ecosystems. However, the attention given to the concept of stewardship is growing in the contemporary environmental sciences and conservation literature, especially in the natural resource use (Rawat, 2017), the agri-environmental (Hejnowicz et al., 2016) and protected areas-related literature (Wells and McShane, 2004; Mathevet et al., 2016; Jepson et al., 2017). About 75% of the citations and 62% of publications on stewardship as a key concept or a pathway for action in conservation and environmental science have appeared within the last five years (Fig. 1).

In the 1990s and early 2000s, stewardship was broadly used to describe a land ethic of care (Callicott, 2013). The stewardship concept has its roots in cultural traditions and religions worldwide (Beavis, 1994; Berry, 2006). People are the stewards of nature, they are responsible for the future of God's creation and are encouraged to actively maintain or preserve its richness and fertility (Passmore, 1974; Attfield, 2001; Callicott, 2013). In other words, people must make good use of, and take care of nature (Mathevet and Bousquet, 2014). In the first half of the 20th Century, the North American thinker Aldo Leopold developed a stewardship approach based on a "land ethic" integrating human relationships with their environments as animals and plants that inhabit them (Leopold, 1949). This stewardship approach aims to improve care for farmed fields and forests but also nature as a whole. During the 1980s, constructed as "citizen environmental practice" the Judeo-Christian tradition of stewardship environmental ethic (i.e. in contrast with a despotic reading of Genesis developed by White, 1967) had become more and more institutionalized in the United States throughout land stewardship projects involving farmers and focusing on education and dialogue (Worrell and Appleby, 2000; Wunderlich, 2004). Aiming to prevent farmland from being converted into urban areas with the growth and sprawl of cities, and to promote agro-ecology principles in farming practices, land stewardship projects are effective,

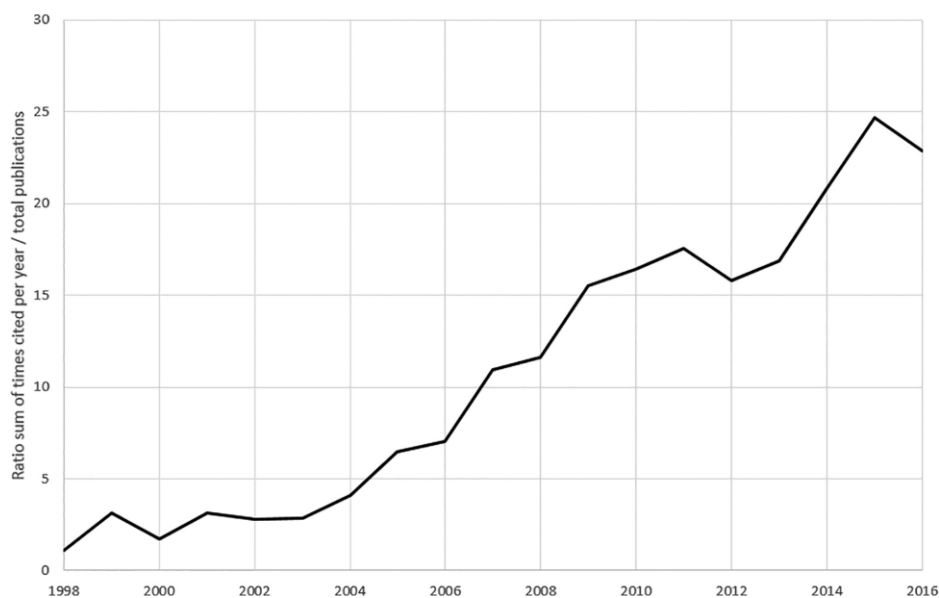


Fig. 1. The ratio of the number of citations of stewardship per year to the number of published items in each year, in publications in environmental sciences, ecology, and biodiversity conservation journals (after ISI Web of Science, accessed 10/10/2017)

practical and consistent with the leopoldian ecocentric environmental ethic (Callicott, 2013). Thus, considering that the stewardship environmental ethic is a consistent human-nature relationship from both theoretical and pragmatic perspectives, it nurtures more and more environmental attitudes, values and policies (Welchman, 2012; Ogden et al., 2013).

However, in recent years the stewardship concept has taken on a range of different meanings in the environmental management and conservation science literatures. Stewardship can be understood as an essential feature contributing to human preference for visual landscape character (Ode and Tveit, 2013). From a primary production perspective, stewardship refers to an ethic toward "the responsible use (including conservation) of natural resources in a way that takes full and balanced account of the interests of society, future generations, and other species, as well as of private needs, and accepts significant answerability to society" (Worrell and Appleby, 2000: 263). In the context of social-

ecological systems, stewardship is expressed as an approach that actively shapes trajectories of systems in order to enhance ecological resilience and support human wellbeing through the provision of ecosystem services (Chapin et al., 2009). In urban environments, urban ecological stewardship engages networks of community-based urban land management not only to clear air and provide green space (Fisher et al., 2015), but also to enhance green infrastructure, ecosystem services, and human well-being in cities (Krasny et al., 2014). Stewardship has also been used as a way to brand policies and incentive schemes that encourage sustainable farming, logging or fishing productions or protection of privately-owned land estates (Adams et al., 2012; Burivalova et al., 2017; Farmer et al., 2017; Pienaar et al., 2017). Thus there is a plurality of understandings of stewardship which are linked to distinguishing sets of landscape values and land management actions (Raymond et al., 2015).

Stewardship appears more and more as a sound alternative for fostering global change and biodiversity conservation policy as a result of recognition of the political failures of both climate change mitigation efforts (Keohane and Victor, 2016) and numerous biodiversity conservation programs (Muhumuza and Balkwill, 2013), mixed with the social demand for collaborative and bottom-up approaches (Reed et al., 2016). However, few studies have explored the political ideology and philosophical underpinnings of stewardship policy and practices (Berry, 2006; Chapin et al., 2011; Mathevet and Bousquet, 2014). The objective of this paper is to discuss the various meaning of stewardship in the fields of environmental science and biodiversity conservation. Our main interest is to explore how different political ideologies and ethical values of stewardship shape the conceptualisation of conservation actions and policies, and why do these matter for conservation policy in the context of the new conservation debate (Miller et al. 2011). To address this objective, we adapt the political science framework developed by Dryzek (2013) and apply it to existing stewardship approaches in use. After a short presentation of the classification of environmental discourses by Dryzek (2013), we present and illustrate a typology of stewardship. In the last section, we discuss these results and present future directions for both research and conservation policy.

2. Values, discourse and conservation/environmental politics

Many scientific disciplines are relevant to biodiversity conservation, from ecology and evolutionary biology or geology and climatology to geography, sociology and economy (Soulé, 1985; Meine et al., 2006). But conservation is not a matter of science alone, it is also a range of practices mixing various activities, techniques and technologies (Bennett et al., 2017). It is also underpinned by ethics and philosophy where different schools of thought are competing, and it engages with policy on how we have to decide and govern both ourselves and our interactions with non-humans (Robinson, 2011; Norton, 2005; Callicott et al., 1999). This specific set of relationships between conservation science, practice, philosophy and policy occurs within a changing social-ecological context (Young et al., 2014; Rozzi et al., 2015). The complexity of the social and ecological challenges and of their consequences in time and space requires that ecology, political ideology and ethics be in of both current ecological threats and implementation of contemporary conservation policy (Norton, 2005; Ogden et al., 2013). Thus it seems essential to clarify here the general philosophical and political underpinnings behind each stewardship approach. As the world is changing rapidly and at multi-scales, the previous set of values and assumptions that underpinned ecology are changing close and constant inquiry to prevent the worst effects (Minter and Miller 2011; Steffen et al., 2011). The need for interdisciplinary synthesis and theory development are widespread and crosscutting themes. What is distributing/dividing the conservationists today is the idea of a human-managed Anthropocene (Couix and Hazard, 2013; Corlett, 2015). Some conservationists claim there is a need to preserve slightly modified natural ecosystems to value “pristine” nature, others accept the idea to enable natural processes wherever possible to value “naturalness” and “wildness” arguing that nowhere on Earth is pristine anymore; others believe in technoscience and its advancement to solve ecological problems and to manage nature (Terborgh, 1999, 2000, Sanderson et al., 2002, Miller et al. 2011; Schwartz et al., 2016). Thus the stewardship ethic falls into the “new conservation” debate that mobilised the same previous and old debates in conservation science and policy (Brandon et al., 1998; Brockington, 2002; Adams and Hutton, 2007; Dowie, 2009; Minter and Miller 2011): wise use vs preservation (i.e. sustainable development vs biodiversity should be protected for its intrinsic value), parks vs people (i.e. people-free protected areas vs extractive reserves, social justice and poverty alleviation), radical anthropocentrism (i.e. view where only people matter) vs radical biocentrism (i.e. view where humans are just another species). The different stewardship approaches described in the natural resource management, agri-environment and protected area literature are not fundamentally differing in terms of environmental ethic and philosophy (Robinson, 2011). Most of them are based on a more or less enlightened anthropocentric ethic or an ecocentric ethic (Norton, 2005). They differ primarily from a political-economy theory perspective. The political economic critique of the stewardship analytical framework may focus on three areas: (1) the emphasis placed on ecological factors rather than the root social-structural causes of biodiversity loss (Wood et al., 2000); (2) the emphasis placed on individual choices and behaviours rather than their economic and neoliberal political origins (Castree, 2000; Clayton, 2012); (3) the emphasis placed on technocratic actions as mere palliatives or simple delaying actions that did not address their social-political structural causes (Robbins 2004). This political ideology shapes discourse and environmental policies at different intensities.

According to Dryzek (2013) a discourse is “a shared way of apprehending the world”. Discourses have environmental and social effects as they contribute to make sense, to define the values and beliefs we hold about nature, and to legitimate knowledge (Redclift and Woodgate, 2010). Discourses shape actions of people and embody political practices and power (Foucault, 1980); they also determine perceptions (what exists), opinions (what is good) and capabilities (what is possible). Some interests are highlighted and gain dominance and are seen as authoritative, while others are shadowed, discredited or erased, resulting in some social groups or corporations being made submissive and more governable (Foucault, 1980; Deleuze, 1992).

In an attempt to make sense of the Earth's politics, Dryzek (2013) suggested a basic classification of the main environmental discourses.

Table 1. A classification of environmental discourses (Dryzek 2013).

	Reformist	Radical
Prosaic	Environmental problem solving	Limits/planetary boundaries and survival
Imaginative	Sustainability	Green radicalism

Considering that the environmental discourse begins in industrial society (i.e. a society characterized by the material wellbeing that economic growth brings), Dryzek stated that the environmental discourse is a departure from industrialism, and this departure can be *reformist* (i.e. the degree of change can be small and based on the existing regime) or *radical* (i.e. changes are large and fundamental). This primary distinction is the first dimension for categorizing environmental discourses. The second dimension underlines that departures from industrialism can be *prosaic* (i.e. the actions are defined by and in industrialism without aiming to produce a new kind of society) or *imaginative* (i.e. environmental problems are seen as opportunities to redefine the society). Combining these two dimensions defines four basic categories of environmental discourse (Table 1).

Environmental problem solving is deemed to require that the dominant political-economy needs some adaptations to deal with environmental problems, especially via public policy, institutionalization of environmental concerns, contract-based approach or market-type incentive mechanisms. *Limits/planetary boundaries and survival* is based on the awareness that unrestricted economic development and population growth will ultimately exceed the natural resources renewability and also the capacity of its ecosystems to support human activity and to accommodate changes. This discourse is radical because it looks for a redistribution of power within the industrial political economy and an extensive reorientation away from everlasting economic growth Dryzek (2013). It is prosaic since it seeks solutions in terms of options fixed by industrialism, especially, better control of existing systems by bureaucrats, scientists, and other elites. *Sustainability* is defined by imaginative endeavours to end the conflicts between environmental and economic tenets that motivate the discourse of problem solving and limits by seeing economic growth and biodiversity conservation as complementary. *Green radicalism* is both radical and imaginative. It advocates rejection of the industrial society and the way the environment is viewed and managed therein in favour of a diversity of other interpretations of people, their society and their place in the world (Dryzek, 2013). For the purposes of this paper and to illustrate our typology, we selected a set of papers and books from four different subfields of conservation sciences: agri-environmental and natural resource management, social-ecological system approach, sustainability sciences, biological conservation. Our review of this literature is centred on those articles or chapters in which the world “stewardship” is a key concept of the workpiece.

3. A stewardship typology

Based on the two dimensions and environmental discourses developed in Section 2 and our literature review, we identified four basic types of stewardship in general terms (Table 1). For the literature review we selected a set of reference papers that we have considered as representing archetypical perspectives on stewardship (those cited in the text below and in Table 2). We conducted a content analysis (Holsti, 1969; Patton, 2002; Weber, 1990) looking at who is the steward, and what are the models of change through the identification of the objective and actions of the steward. We can note that some authors embraced a large spectrum of ideas but their focus changed over time such as the work of F. Stuart Chapin III. Our typology is based on the text contents and not on the authors per se so the same author might contribute to define different types of stewardship approach.

Reformist stewardship is characterized by the reformist category of discourses. This stewardship is based on a mix of problem-solving and ecosystem approaches and is generally prosaic as it changes only small portions of the dominant industrial political economy. The adjustment process is often a list of possible measures or adaptations that do not discuss decision making process and power relationships issues. Sustainability stewardship is the local implementation of the main principles of sustainable development. The modernization features relate to the system-based approach to issues, circular economy and a focus on public-private partnerships and public policies based on incentive to business. Adaptive stewardship is growing today and is based on a general statement: both economic and population growth will hit limits set by the capacity of the biosphere to provide natural resources, and to support human activity. It challenges perpetual economic growth and power relations at the global scale. This stewardship is prosaic as its proposed solutions are based within the constraints of the capitalist and industrialism model, expecting more science-based decision-making approaches with top-level decision-makers. The last category is both imaginative and radical. Transformative stewardship promotes different ways of understanding the environment and human-nature relationships and rejects the basic structure of the industrialism. It looks to reconnect people to the biosphere and change human behaviours at the individual level but also promoting collective actions. This stewardship emphasizes the diversity of values and responsibilities but also

the need for fundamental social change in order to ensure that the way humans act is compatible with a “genuinely human life on earth” (i.e. we should act so that the effects of our action do not destroy the future potential of human life, Jonas, 1985) and avoids conservation efforts that would exacerbate social, democratic and ecological vulnerabilities.

Table 2. Synthesis of the different stewardship sub-categories.

Analytic dimensions (adapted from Dryzek, 2013)	Prosaic & radical	Prosaic & reformist			Imaginative & reformist	Imaginative & radical
Stewardship types	Adaptive stewardship	Reformist stewardship			Sustainability stewardship	Transformative stewardship
		Administrative rationalism	Democratic rationalism	Economic rationalism		
Stewardship sub-category examples	Planetary/Earth stewardship	Environmental Stewardship UK	Land stewardship USA	Forest or Marine Stewardship Councils	Biosphere stewardship; ecosystem stewardship	Transition towns Land stewardship FR Civic Ecology
Basic entities (adapted from Dryzek, 2013)	Finite stocks of resources Carrying capacity of ecosystems Planetary boundaries	Liberal capitalism Administrative state Experts Managers	Liberal capitalism citizens	<i>Homo economicus</i> Markets Prices Property governments	Complex, nested and networked social and ecological systems, Capitalist economy, State	Social & ecological systems Nature as complex ecosystems Human with broad capacities Social, economic and political structures
Vision of human/nature interactions	Nature as forces to be regulated by social sphere				Environmental problem = governance issues	Environmental problem = plurality of values and governance issues
Agents and their motives	Elites Scientists and policy or decision-makers, public interest defined by them	Experts and managers Motivated by public interest defined by them	Different agents but citizen is central Motivation: a mix of self-interest and multiple conceptions of public interest	<i>Homo economicus</i> Self-interested Elites	Many agents at different levels, transnational and local as well as the state motivated by the public good	Human subjects more ecologically aware than others, many collective actors, multidimensional motivation
Facilitators Governance	Scientists Public policy and	NR managers and scientists Adaptive management with consultation of key stakeholders			Conservationists and managers Mix of adaptive co-management and public policy	Citizen, managers and scientists Adaptive co-management Community-based management
Dominant knowledge	Driven by science and expert knowledge				Mix of experts, science and lay knowledge	Driven by pragmatic and lay knowledge
Guiding references	Rockström et al., 2009	Burton and Schwarz, 2013	Chapin et al., 2009 Fisher et al., 2015	Christian et al., 2013	Folke et al., 2011; Plieninger et al., 2015	Barry and Smith, 2008; Chapin et al., 2010; Hopkins, 2014; Krasny and Tidball, 2015

From these basic categories we defined six sub-categories (Table 1) from the following elements adapted from Dryzek (2013) and Mathevet and Bousquet (2014): (i) the basic entities whose existence is recognized or constructed within the different stewardship frameworks; (ii) the dominant vision about human/nature interactions; (iii) the involved agents and their motives; (iv) the facilitators of the process; (v) the governance of the process; and (vi) the dominant type of knowledge. Hereafter we present these subcategories and then illustrate them using examples.

Reformist stewardship focuses on sustaining ecosystems to maintain their long-term capacity to provide services to support human well-being (Chapin et al., 2009; Jepson et al., 2017). This stewardship promotes collaboration between researchers and managers. Natural resource managers are seen as facilitators who engage stakeholder groups to pilot the social-ecological change and to nurture resilience (Chapin et al., 2010). We can distinguish three sub-types of stewardships within this category: *ADMINISTRATIVE RATIONALISM*, *DEMOCRATIC RATIONALISM* and *ECONOMIC RATIONALISM*. The distinction between the three sub-types rests on the agent that should be in control of the stewardship process (i.e. either state services with scientists, stakeholders or entrepreneurs with scientists). Reformist stewardship in the UK is commonly referred to in terms of administrative rationalism. Since the end of the 1980s, agri-environmental measures, varying in names such as environmental stewardship and countryside stewardship, have provided grants to help landowners to improve water quality or conditions for farmland wildlife, to reduce soil erosion, to maintain or increase landscape character, to protect historic environment and archaeological places (Hejnowicz et al., 2016; Natural England, 2016; Leventon et al., 2017).

A second subcategory of reformist stewardship is based on democratic rationalism. For instance, in the USA, what is called “land stewardship” is mostly based on the leopoldian land ethic and since the 1980s several organizations such as farmers and ranchers' associations,

conservation NGOs, the US federal land management agencies, cattlemen associations and agro-sciences corporations have implemented different “land stewardship” programs and awards, promoting sustainable agriculture and developing healthy communities (LSL, 2016; Farr et al., 2017). Since 2003 biodiversity stewardship has been implemented in South Africa by establishing agreements with private and communal landowners to protect and manage land in biodiversity priority areas, led by conservation authorities (Pienaar et al., 2017). Provincial biodiversity programs have secured about 400,000 ha in multiuse landscapes with the creation of 71 protected areas (SANBI 2014) and is expected to double the total surface area in the forthcoming years (SANBI 2014).

The third and last reformist stewardship sub-category relates to the dominant economic rationalism (Table 1). For example, for Christian et al. (2013): “Market-based efforts are designed to make consumers more aware of marine species depletion and other issues and, thereby, to shift consumer demand from unsustainable toward sustainable sea-food and to improve management”. In the forest sector, the Forest Stewardship Council (established in the 1990s) is an international multi-stakeholder organization that promotes an environmentally and socially responsible management of the forests at global scale. Based on specific standards on forest products and an eco-friendly certification system this stewardship encourages an economically viable management of the world's forests (Terborgh, 2000; Jaun et al., 2016).

Reformist stewardship can be based on a conjunction of administrative and economic stewardship. For instance Burton and Schwarz (2013) have worked on agri-environmental policies and compare action-oriented policies and result-oriented policies. They argue that despite some researchers suggesting that action-oriented schemes should promote long-term attitudinal and cultural change, there is little evidence that they are doing so (Mathevet et al., 2014; Pe'er et al., 2014). By making knowledge of how to improve conservation on farms important, result-oriented schemes create common goals between farmers and conservationists, leading to cooperation between two conflicting groups (Young et al., 2014). To some extent this represents the increasing ideological intrusion of neoliberalism into European Union policy with politicians contending that competitive market mechanisms are the best way of delivering outcomes from strained European budgets (Burton and Schwarz, 2013).

Sustainability stewardship refers to responsible use and protection of the environment through managing, recycling, conserving, regenerating and restoring and taking responsibility for each individual choice (Barrett and Grizzle, 1999; Di Paola, 2015). “Stewardship is not just a matter of following the right rules and procedures, but of cultivating a certain culturally evolved stance in the face of the unexpected and the unknown—of developing attitudes and practices of coping with rather than solving human–land interactions” (Barry and Smith, 2008). In Europe, an EU-funded project promoted “land stewardship” principles (LandLife 2011–2014) and developed practical tools to help people to implement this kind of approach in natural areas and farmlands (Sabaté et al., 2013). Since the end of the 1990s, conservationists have encouraged landowners and citizens to become more involved in nature conservation and to take care of the European natural and cultural heritages. In this framework, land owners and users that voluntarily take action to manage and protect landscape, nature or ecosystem functions are engaged in a collective action facilitated by conservation NGOs and local governments with the political and technical supports of public agencies and various government levels (Folke et al., 2011; Plieninger et al., 2015). All these examples show that there is little difference between theories or concepts of land stewardship and landscape stewardship in practice. Both stewardship approaches are understood as collaborative efforts toward landscape sustainability (Ode and Tveit, 2013). Usually the landscape stewardship approach addresses the concept of multifunctionality and takes into account elements of all rationality (Raymond et al., 2016).

As the emphasis is on attitudes and practices to cope with events rather than transforming the context, the political dimension of sustainable stewardship is often weak. “(...) landscape research is not a panacea, and some important research priorities of the ecosystem change and society agenda remain unaddressed. For example, questions of power relations and environmental justice have not been exhaustively considered in European landscape research, and stronger consideration of, for example, social stratification, control of labor, and access to land remains a desideratum” (Plieninger et al., 2015).

Adaptive stewardship is a stewardship which is defined as new science that facilitates a more sustainable trajectory for the relationship between society and the biosphere. As an example, the Earth stewardship initiative has been promoted by the Ecological Society of America since 2011. It aims to provide the scientific basis for “actively shaping trajectories of social-ecological change to enhance ecosystem resilience and human well-being” (Chapin et al., 2011). This multi-scale and multi-issues approach is based on interdisciplinary science, mixing natural and social scientists with practitioners and also the civil society within a participatory action-research methodology. It focuses on the development of policy and incentives for encouraging individual stewardship behaviour and reinforcing peoples' connections to culturally-valued places; and using demographic transitions, such as the shift to cities, as new opportunities for stewardship. *PLANETARY STEWARDSHIP* is derived from adaptive stewardship and attempts to delineate a “safe operating space” for humanity by analysing the dynamics of the Earth System and identifying tipping points or critical levels relating to key global-scale processes beyond which humanity should not go (Rockström et al., 2009). Science is expected to play a key role in such a stewardship. “Furthermore, if organized appropriately international knowledge institutions can play a fundamental role in facilitating a transparent, participatory and legitimate global dialogue on the need for reconnecting global policies with the biosphere. (...) Science has responsibility to provide a better understanding of the challenges facing humanity, and to explore pathways toward a sustainable world. Global and regional scale integrated assessments, inclusive, transparent, and founded on an understanding of social–ecological interactions play a central role in building momentum for Planetary Stewardship” (Folke et al., 2011). For Barry and Smith (2008), notions of ‘planetary citizenship’ seem to be far too abstract and thin to be considered politically or meaningful on their own, unconnected to the types of human social, ecological

and economic connections articulated in claims about interdependency and vulnerability.

Transformative stewardship. The challenge of this stewardship style relies on knowledge of ecological and social interdependencies organized in networks of interactions. Beyond relationships between people and nature, this approach emphasizes relationships between people about nature, including their emotional and cultural dimensions. Based on works initiated during the 1960s–1970s within the hippie communities, and various alternative social groups at the margin of the society, this approach questions the capacity of people to “live together” within a community enlarged to non-humans: a socio-ecological community. Based on adaptive co-management principles, this socio-ecological stewardship considers that we can increase the resilience of a system by using science and social learning. This form of stewardship may consider the power relationships among different groups: “This approach explicitly focuses on human norms, values, and well-being and must therefore continually be debated and reassessed by stakeholders (...). Despite inevitable power imbalances, transformational processes should be as transparent and open to all stakeholders as possible to counter attempts by particular groups to co-opt the outcome” (Chapin et al., 2010). This stewardship is based on a form of ecological solidarity that overcomes the basic cause-and-effect relationships and values socio-ecological interdependencies (Mathevet et al., 2016). This approach allows for a plurality of perspectives. It considers biodiversity as commons, promotes solidarity and deliberative processes and reinforces place attachment by revisiting landownership laws, land use rights and the environmental history of landscape. It also facilitates the identification of transformations necessary to ensure the resilience of the desired state and functioning of an ecosystem, exemplified by land stewardship promoted in southern France, especially among wine growers and livestock breeders (CEN LR, 2014), or civic ecology around the world to rebuild and restore local environments impacted by crisis, war or disaster (Krasny and Tidball, 2015). Crisis is considered as a potential key context for transformation. Crises can lead to opportunities in at least three ways: “active initiation of change, thus managing crisis and consequences; local system collapse, which raises broader awareness of the need for change; and learning from crises occurring at other times or places” (Chapin et al., 2010).

4. Discussion and future directions

Stewardship is a highly-loaded term that generates controversies (Mathevet and Bousquet, 2014). Some authors have argued that the notion of steward in its very etymological essence implies a gift or a possession (Beavis, 1994; Plumwood, 1999; Palmer, 2006). Thus they have underlined that this concept is not suitable for biodiversity conservation because being stewards of ecosystems instead of being integral members could lead to the commodification of nature. However, in this paper, as it is a concept in use and growing dissemination, we have advocated for a critical but constructive approach. We acknowledged that numerous conservation policy-makers, practitioners or NGOs largely altered and expanded the concept in new ways by progressively promoting a man-in-nature perspective where humans are expected to take care of non-humans and to be responsible for and not necessarily managing nature or encouraging increased human-use of biodiversity (Palmer, 2006; Mathevet and Bousquet, 2014). We recognized also that our framework doesn't include the view pleading for using another view that is not based on stewardship and management vocabulary. Thus, stewardship might be seen as an unconvincing concept for some conservationists because they may consider that it undermines several processes beyond our will and capacity to predict and shape all natural processes. However sustainability or transformative stewardships could certainly include those that do not just reject the idea of stewardship for its human-dominating dimension while advocating the recognition of spontaneous and natural trajectories of some ecosystems as a stimulating possibility. The care ethic promoted by any stewardship approach could be incompatible with wilderness or spontaneous nature as caring for nature seems to appear when wilderness is threatened (Larrère and Larrère 2015). When spontaneous nature, nature that is not directly or indirectly dependent on human actions, is disappearing we move from a non-interventionist ethic based on the respect for nature (Evans 2005), an acknowledgment of exteriority, to a human-modified nature, an interventionist ethic based on alterity, solicitude, goodness and solidarity (Plumwood, 1993; Merchant, 1996).

Acare ethic, supervision and management are necessary for conservation and/or environmental management and these domains of policy and action could co-exist without the stewardship concept. However, considering stewardship based on an adaptation of Dryzek's (2013) criteria, enables us to understand how stewardship operates at different spatial levels (landscape vs earth level) and uses different forms of knowledge (scientific or lay knowledge). The four types of stewardship can be distinguished based on: (i) the place of science (science driven process vs science support); (ii) the exploration and integration of the plurality of values; and (iii) the capacity of the approaches to modify rules, values, and the governance system. Although most of the authors ignore or weaken the importance of the political process these three distinctions enable another way to explore the power relationships among various types of stakeholders involved in a process of regulation (coping with) or transformational process, and how environmental policy can engage with the different ideologies of stewardship held by them. Drawing from our typology we identified five key points that are likely to improve future stewardship policies, practices and programs.

First, environmental managers need to ask themselves a set of pertinent questions prior to engaging with multiple stakeholders in environmental management. These questions include: what is my ideology of stewardship and how does it shape the research and/or policy design? What other ideologies of stewardship exist with respect to the conservation problem and what are these individuals or groups stewarding? What should be the place of policy and science in engaging with different ideologies of stewardship?

Second, engaging with diverse ideologies of stewardship requires environmental managers to be open to issues of power and social justice, and also needs to be matched by governance arrangements and participatory processes (Prager, 2015), and at different scales of management (Cumming et al., 2015). Knowledge brokers are crucial in supporting the development of shared understandings and visions for conservation policies (Reed et al., 2014) across the different categories of stewardship.

Third, environmental managers need to be sensitive to how the spatial scale of environmental management affects the type of stewardship being considered by different stakeholders. One could promote a reformist stewardship for a local issue such as coupling purple heron (*Ardea purpurea*) or Eurasian bittern (*Botaurus stellaris*) breeding with Mediterranean reedbed harvesting (Barbraud and Mathevet, 2000) while encouraging a transformative stewardship at a larger scale based on an incentive policy developed by both the European Union through its common agricultural policy and the regional nature park authority with the support of conservation NGOs (Mathevet et al., 2016). The existence of multiple stewardship agencies interacting and overlapping because they require different temporal and spatial scales for efficient cooperation and conservation function, could be encouraged (Ostrom 1990). Policy engagement with different ideologies of stewardship should be considered as a long-term process across institutional levels (Ostrom, 2009). In some cases, different ideologies of stewardship may need to be challenged and changed through the use of policy instruments.

Fourth, to enable conservation policies to be tailored to different ideologies of stewardship, we encourage future research to develop a self-reporting instrument which distinguishes between the four types of stewardship found here. After developing and validating this instrument, researchers could then examine the responsiveness of different types of stewards to conservation policy instruments. Also, research could compare these self-reported assessments to ecological assessments of stewardship, which may assist in the formation of stewardship pathways (policies, programs and communications) which are both socially acceptable and scientifically defensible.

The relative emphases placed on environmental or social criteria may influence the way in which stewardship is conceived. In other studies political ecologists (e.g., Robbins 2004, Zimmerer and Bassett, 2003) showed that policy makers have a preference for technocratic solutions based on aspects of the biophysical environment as opposed to the social impacts. By naturalizing changes and their consequences, powerful actors may hide the politics of land access, of land control and land management (Blaikie and Brookfield, 1987; Peet and Watts, 2004; Peluso and Watts, 2001). A way to move forward is to reframe stewardship as socio-ecological or biocultural pathways, recognizing stewardship as a dynamic and transitional process. Gavin et al. (2015) provide principles that could guide such an assessment, importantly including a recognition that conservation can have multiple objectives and stakeholders, tailoring interventions to the socio-ecological context and prioritising the importance of partnership and relationship building, and respect and incorporate different worldviews and knowledge.

5. Conclusion

We presented a typology of stewardship based on different political ideologies and environmental discourses. Conservation research and policies that promote a stewardship approach need stronger considerations of power and social issues related to the differing goals of conservation and land management across scientists, policy makers and citizens. Different stewardship pathways (i.e., strategies for managing the biosphere and their outcomes) will be needed to critically address each stewardship ideology we presented. For conservation scientists working in the realm of conservation–development policies, exploring and tracing a way toward an efficient stewardship is an important research agenda.

Conservation scientists or practitioners should care about this typology and analysis mostly because this work should help them to identify barriers to transformative actions or how to fill the value-action gap (Daily et al., 2000; Norton, 2005; Bieling and Plieninger, 2017). In conservation and/or development project there is often an information and dialogue deficit that leads to uncertainty, and distrust between stakeholders (Pretty, 1995; Young et al., 2016). Moreover the lack of systemic (multi-scales) and regional approaches of environmental change (Eastwood et al., 2017) can lead to technocratic interventions as mitigation actions that do not address the social-political structural causes of vulnerability nor their transfers to other areas, social groups or biodiversity. According to our arguments the most promising research areas for treating stewardship as social-ecological stewardship are: (i) Improving social learning on vulnerability transfers and systemic understanding of social-ecological dynamics; (ii) Exploring how policies and politics tackle the key issue of individual/collective responsibility for conservation and development actions and their consequences.

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